The Cross Section

Published monthly by High Plains Underground Water Conservation District No. 1, 2930 Avenue Q, Lubbock, Texas 79405—Ph. 762-0181

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Southern Counties Vote

Voters in eight High Plains Water District counties will go to the polls on January 21 this year for the annual election of a slate of District Directors and County Committeemen. The ballots will list three Board members for re-election, and positions for twenty-four county committeemen.

Elections will be held only in those counties or portions of counties comprising District Director Precincts One, Two and Five. These include eight southern counties on the High Plains. Precinct One includes Crosby, Lubbock and Lynn counties. Precinct Two includes Cochran, Hockley and Lamb counties, while Precinct Five encompasses Floyd and Hale counties.

New positions to be filled include places for fourteen county committeemen whose places are vacant because these men have completed two consecutive four-year terms of service and are not eligible for re-election under the District's by-laws. Ten other committeemen now serving are eligible to serve another term.

District Directors James Mitchell of Wolfforth, Mack Hicks of Levelland, and Gilbert Fawver of Floydada, will seek re-election. James is seeking his fifth term of office. Mack will seek his third term and Gilbert his second two-year term. Directors may serve an unrestricted number of two-year terms, while committeemen are elected for four years and may not serve more than two consecutive terms.

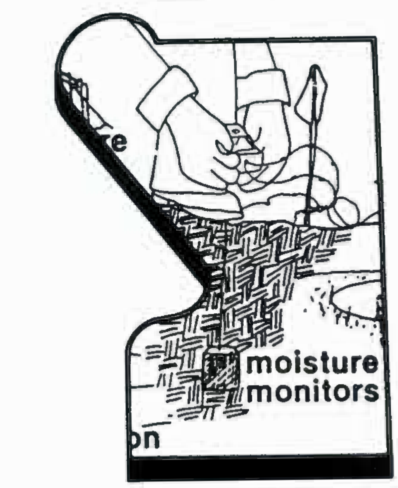
Cliff Leaving

The *coach* is retiring. After 38 years of sports officiating, Clifford Thompson is trading in his whistle for a set of golf clubs. And after 18 years with the High Plains Water District he is turning over his duties as head of the District's water well permit section.

Clifford has taken charge of issuing and processing water well permits for the District since he first joined the staff in 1966. He has held many titles in his long tenure, from secretary to section chief to acting manager. His jobs have expanded to meet the District's growing program needs, whether it was water depletion map distribution, auditing the county committees' books or running the annual elections. Clifford is a jack of all trades and absolute master of some.

He is fondly known among the staff as the guy who'll do anything, anytime

continued pg. 2, col. 3 . . . THOMPSON



THE AMAZING DIFFERENCE visible in this grain sorghum is due to Spralite. However, weeks after the photo was taken the control rows (left) got one less watering, disqualifying the field as a research site.

Chemical Slows Plant Water Use

A new kind of chemical on the market may be the best thing for plants since fertilizer. It is a kind of plant deodorant. It acts to reduce the amount of water a plant transpires into the atmosphere through its stomata (pores found on the underside of its leaves).

Plants must transpire to live and grow. Through its stomata a plant takes in CO-2, essential for photosynthesis and growth, and puts out oxygen and water to keep itself cool. The rate of exchange is governed by the temperature of the air. Because plants cannot precisely control their own thermostats, scientists believe that plants waste a significant amount of the water they transpire.

Dan Krieg, professor of crop physiology at Texas Tech University, is also a researcher at the Lubbock Agricultural Experiment Station. He believes that plants can ultimately be taught to self regulate their water loss and maximize the use of CO-2 per unit of water lost.

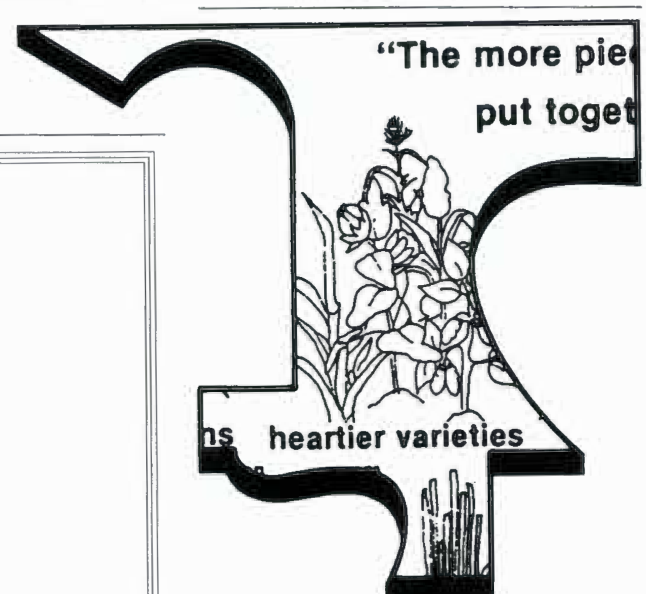
"Right now there is as much as a twenty percent inefficiency in the system," says Krieg. "Depending on the temperatures, on a hot, 100 degree day, cotton probably wastes ten to fifteen percent of its moisture. On a cooler, 90 degree day, it may waste twenty-five to thirty percent of its water."

Krieg believes those transpiration rates can be slowed, chemically in the short run and, over the long term, by genetic modification. However, if the stomata are closed down too tightly the plant will burn up.

This summer the Water District discovered a few irrigators using a chemical product claimed to slow a plant's transpiration rate. It is called Spralite. Its inventor, Frank Moore, says Spralite is neither a plant growth regulator nor a hormone.

"Properly applied," he says, "it can reduce a plant's water requirements, increase its efficiency, make the plant

continued pg. 2, col. 3 . . . SPRALITE



The Board of Directors and Staff
of the
High Plains Water District
cordially invite you to a reception
in honor of
Clifford E. Thompson
on the occasion of his retirement

1:00 p.m. until 4:00 p.m.
Friday, January 20th

2930 Avenue Q
Lubbock, Texas

What's Up . . .

CALENDAR OF EVENTS

January 9 Baily County Electric Coop Association Fourth Annual Irrigation Conference, at the Bailey County Coliseum, Muleshoe. Registration at 8:30 - 3:30.

January 11 Surge Flow Irrigation Conference, sponsored by the Texas Agricultural Extension Service, at the Holiday Inn, 4300 W. Highway 80, Midland. Registration at 8:30 - 4:30—$15.

January 12 High Plains Irrigation Conference, sponsored by the Texas A&M Research and Extension Center, Panhandle Economic Program, 6500 Amarillo Bldg., West, Amarillo. Registration at 8:45 - 4.

January 20 Retirement Open House for Clifford Thompson, permit section, High Plains Underground Water District offices, Lubbock. 1 - 4 p.m.

January 21 ELECTION of 3 Directors and 24 County Committeemen to the High Plains Underground Water Conservation District in Crosby, Lubbock, Lynn, Cochran, Hockley, Lamb, Floyd and Hale Counties.

February 11-12 Water, Inc. Annual meeting in Amarillo.

February 22-24 Texas Water Conservation Association, Annual meeting in Dallas at the Registry Hotel.

March 7-8 Conservation Tillage Conference sponsored by Soil Conservation Society of America, New Mexico Chapter and Texas Golden Spread Chapter, the Curry County, N.M. Soil and Water Conservation District Board, and the local SCS; in Clovis, half day.

April 3-4 Water for the 21st Century: Will It Be There? An Interdisciplinary Conference on meeting the water needs of the Southwest. Southern Methodist University, Dallas.

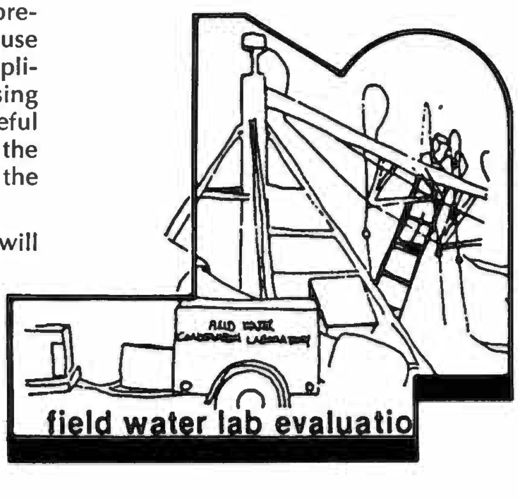
June 4-7 Ogallala Aquifer Symposium II, sponsors to date: Texas Tech University's Water Resources Center, International Center for Arid and Semi-Arid Land Studies, College of Ag Sciences, College of Arts and Sciences, College of Engineering, Vice President of Research and Graduate Studies, Vice President of Academic Affairs, Division of Continuing Education; High Plains Underground Water Conservation District, Lubbock Chamber of Commerce; Oklahoma State University; University of Nebraska Water Resources Center; New Mexico Institute of Mining and Technology, and State Engineer, New Mexico. At Lubbock Memorial Civic Center, Lubbock, Texas.

USDA Flyover

Can a microwave beam accurately sense soil moisture changes and determine soil moisture conditions in cropping areas? The U.S. Department of Agriculture is proposing to find out by evaluating its multibeam microwave system in a series of flights over the Texas High Plains to track soil moisture changes using temporal changes of the microwave brightness temperature.

They are attempting to track preplant soil moisture conditions because they say this is the very type of application that microwave remote sensing of surface soil moisture may be useful for. However, the depth to which the microwave sensors will penetrate the soil is limited.

In early February USDA planes will fly over part of the HPWD's service area and attempt to measure soil moisture conditions. They will later compare the microwave data to data from neutron access tube readings taken by the Water District and Soil Conservation Service for their annual pre-plant soil moisture deficit survey map. If the flyover can supply accurate soil moisture data to a depth necessary to benefit landowners/operators, it will be very beneficial to area irrigators and could ultimately result in a much faster and less expensive way to monitor soil moisture throughout the area.



SPRALITE . . .

(continued from page 1)

stronger and healthier, and less attractive to insects."

Frank says Spralite has been in field use since 1973 on soybeans, cotton, wheat, corn, milo and sunflowers. It is best applied by airplane to the plant in order to ensure covering the stomata on the underside of the leaf. Farm crops require only a single application during early bloom stage at the beginning of the plant's maximum water use period. Once applied and allowed to dry, Spralite won't wash off during an irrigation or rainfall. Application costs have run under ten dollars an acre.

Water District staff made several trips to observe Spralite treated crops. The chemical has been applied to more than half of each field, leaving only a small number of control acres untreated at the edge of each field. As the season heated up to drought stress conditions, the difference in the treated and untreated crop rows became more visible, dramatically in some fields. However, there was no conclusive evidence based on yield comparisons to verify that Spralite had ultimately benefitted the growers.

The District located several cooperators who agreed to apply the chemical on their crops as a field test and to harvest the treated and untreated plots separately. Several weeks after application, the District collected leaf pressure measurements in the treated and control plots with a 'pressure bomb.' The instrument indicates the amount of tension or suction the plant exerts to hold water in its leaves. The more stress the plant is in, the higher its tension reading. Leaf samples measured showed a significant difference between treated and untreated plots. While there were varying responses within different varieties of the same crop, generally, the difference ranged from as high as five bars more pressure in the untreated plots to no difference at all in a few fields. The average difference was two bars, a significant spread.

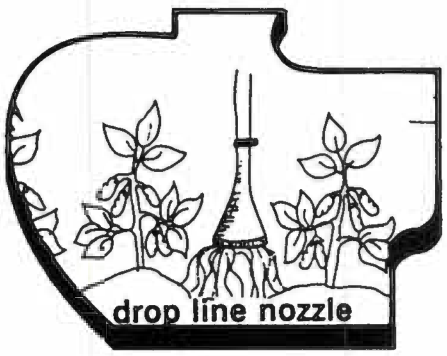
Bob Hawkins of Kress, the pilot who applied Spralite for several irrigators who first tried it, says he has been putting it out for the last three years. "We applied about a hundred acres the first year, 150 the second, and about 400 this year. Most of it has been east of Kress."

"I can see the difference where I've sprayed," says Bob. "The plants are greener and stand up better. In a few patches, I couldn't believe the difference. But the guy who farms it swears up and down he watered it the same."

Kelly Durham tried Spralite on his crops for several years. He says he could tell, to the row, the 30 rows of corn where he left off the chemical. "Those 30 corn rows were dry two to three days before the rest of the field. I estimate there was probably 500 pounds difference in yield. It made a believer out of me."

Kelly also put Spralite on about 60 acres of seed milo and he says it was just like the corn — it held moisture longer. "I believe it helped a little in the yield."

Like other growers who first tried Spralite, Kelly did not harvest the treated and untreated plots separately for yield comparisons. So, until the District can get some figures on yield differences in the test fields of its cooperators, the proof will not be concrete.



THOMPSON RETIRES . . .

(continued from page 1)

for anybody. Clifford has been directly responsible for overseeing the regular business of the county committeemen and secretaries for many years. His management has been characterized by meticulous attention to details, records and deadlines. And he does it by the book.

Cliff says he's learned from years of officiating baseball, basketball and football, "you've got to play by the rules, but you can be too technical to the point of ruining the game. It also takes common sense."

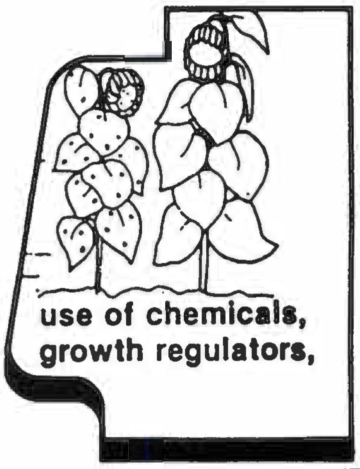
He says he loves to get along with people, a trait he may have acquired during the 16 years of selling experience Cliff brought with him to the job. "Handling tailwater waste complaints is really where you get your patience tried," says Cliff. "I'm firm but not hardboiled."

Clifford recently received some very special honors from his fellow referees and 'umps.' He was recognized by the South Plains Chapter of the Southwest Football Officials Association for his 38 years of service. He was also distinguished for his many years of dedication with a very high honor as only the second official to receive the coveted Curtis Barrett Award for the Association's most deserving individual.

Cliff recalls he and Curtis go back a long way together. "The two of us organized Little League and Pony League in Lubbock back in 1953." Clifford is a past president and member of the Board of Directors of SFOA.

Cliff plans to keep from getting soft by staying active in golf, exercising, and traveling with Ruth, his bride of 44 years.

The Board and Staff of the High Plains Underground Water Conservation District reluctantly let him retire. We wish him lots of good fortune and health, and express our deep appreciation for his many years of loving labors for the people of the High Plains.



Surge Flow

by Joe Henggeler,
Extension Irrigation Specialist,
Fort Stockton

FORT STOCKTON—Interest in surge flow is rapidly spreading among farmers in Texas. Surge flow is a new, yet old, method of irrigation that cuts water loss, in some cases as much as 50 percent. It differs very little from regular furrow irrigation, save that the water is cut on and off with a special valve (on the average about every 20-30 minutes) which allows the irrigation water in the furrow to move out faster.

The Texas A&M Agricultural Extension Service is sponsoring with the High Plains Underground Water Conservation District, a Surge Flow Irrigation Conference to be held at Midland on January 11, at the Holiday Inn. The meeting will continue from 9 through 5, and all interested farmers and furrow irrigators are invited to attend.

"Farmers have always had to waste large amounts of water" said Texas A&M Irrigation Extension Specialist, Joe Henggeler, "just to get water to the ends of their fields." Soil expert Dr. Ed Colburn, from College Station agrees and adds "that sometimes an average of ten inches have to be applied to get the water out. Since soils might only need three or four, a good amount of water is lost."

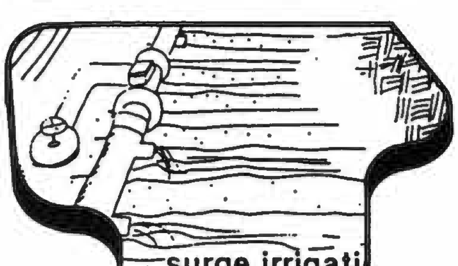
History

The ironic thing about surge flow is that farmers have known about its affects for years, but only recently have agricultural universities begun to study it. When researchers at Utah State University, where the first studies of surge flow began in the late '70s, showed the results to farmers, the agrarians reported that the early pioneers were aware of it, too, and practiced it under the term of "bumping." Farmers who used to practice it, however, were actually surging one time (i.e., there was an on-, and off-, and then a last on period). Its purpose was to have the water reach the end of the field when advance had stopped.

Today, there are probably more surge units in operation in Texas than in any other state. While Utah, and perhaps Colorado, still lead the way in research, Texas is the place where most of the on-farm work with surge flow is happening.

Dr. Wynn Walker, of Utah, the country's leading expert in surge flow, found that the low-energy surge systems were more efficient than side roll systems and in some cases, than center pivots. Walker reports a minimum of 50 percent in energy savings would occur when surge was implemented over the higher energy-using systems.

Since surge flow is so new (for example, even researchers have only two years' worth of data in Texas) many questions still need to be answered and information gotten to farmers. Right now each farmer spends thousands of dollars for the energy required to irrigate, and help is needed in this area. The state-wide Surge Flow Symposium in Midland will gather Texas' experts and farmers together to present findings to date and trade ideas. Dr. Walker will present the keynote address.



Grazing Knotgrass Pays

EDITOR'S NOTE: Clinton Robinson, agricultural economics major at Texas Tech University's College of Agricultural Sciences, recently completed a study of the economic potential for knotgrass established in playa lake basins on the High Plains of Texas. The following are excerpts from that study.

KNOTGRASS

Knotgrass is a forage believed by many to be well suited to playa basins in the High Plains of Texas. Knotgrass (Paspalum Distichum) is a perennial grass with creeping stems above and below ground. It is native to the southern United States and grows well in moist bottom lands that are periodically flooded. High Plains agriculturalists who either have knotgrass presently on their playas or have observed the grass, have indicated that it can provide substantial grazing even after being covered with water for an extended period of time. Once established, the grass can provide grazing indefinitely and under varying extremes in moisture conditions. The grass has also shown to be quite palatable and often preferred by livestock over wheat pasture.

Nutritional Quality

A series of four knotgrass samples were taken from Mr. Ray Kitten's playa located near Slaton, Texas. These samples were analyzed by Dr. Arthur G. Matches, a plant science professor from Texas Tech University, to determine the nutritional quality of the grass. The results of his analysis are as follows:

10%	Crude Protein
57% - 65%	Digestibility
60% - 65%	Total Digestible Nutrients
85% - 90%	Dry Matter

Gain Rate and Stocking Rate for Knotgrass Grazing

Mr. Kirby Huffman, of the Texas A&M Experiment Station, has estimated that grasses similar to knotgrass will produce approximately 3,500 pounds of forage per acre on an average year. The amount of dry matter (DM) per acre for knotgrass was estimated using an 87.5% dry matter for the knotgrass samples. Total pounds of forage production per acre was multiplied by the dry matter percent for the samples in order to estimate the pounds of dry matter produced per acre.

3,500 lbs. x .875 DM = 3,062.5 lbs. DM/ac

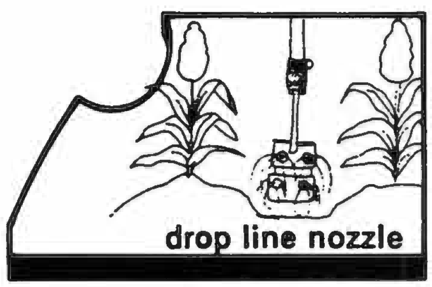
Dr. Robbi Pritchard, Animal Science professor from Texas Tech, estimated the pound per day gain for knotgrass using the nutritional data supplied from the samples analysis. With each animal eating 15 pounds of dry matter per day, the gain rate was estimated to be 1.5 pounds per day for 500 pound steers. The total pounds of dry matter consumed per head for the 130 day grazing period was estimated to be 1,950 pounds (15 lbs. DM/Day x 130 days).

The optimum stocking rate for knotgrass grazing was estimated by dividing total pounds of dry matter produced per acre by the pounds of dry matter consumed per head for the 130 day grazing period. This was estimated to be 1.57 head per acre.

3.0625 lbs. DM/AC ÷ 1,950 lbs. DM/hd. = 1.57 hd/ac.

Potential

A stocker calf budget for a knotgrass established playa can be estimated to produce 195 pounds of beef per animal in a 130 day grazing program. Total carrying capacity for a 30 acre lake would be 47 head resulting in estimated beef production potential of 9,165 pounds. Establishing knotgrass in playa lake basins can provide a means for increasing net farm income on land that previously provided little or no economic benefit to the farmer. Once established, knotgrass playas can provide grazing for an indefinite time at a low cost. Knotgrass will survive in dry periods as well as during times of prolonged flooding which makes it a natural for playa basins.

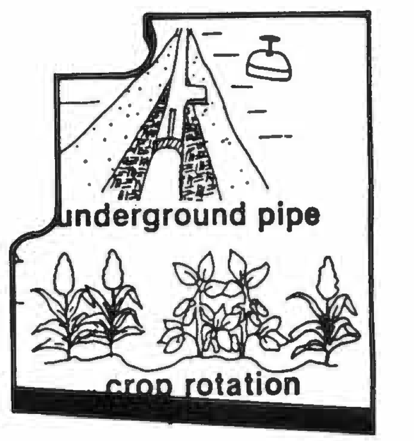


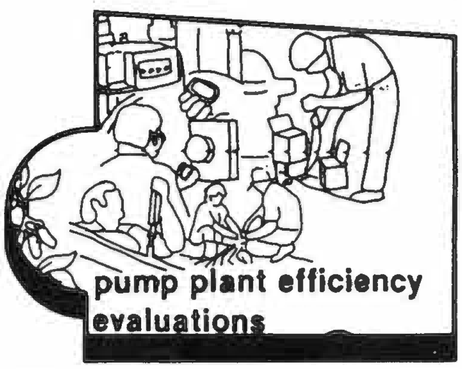
Wells Measured

Annual water level observation well measurements begin in January. District staff are heading to their respective counties to make depth-to-water measurements in a select group of wells in the District's service area. These measurements will determine the annual change in the ground water supply which occurred during the past year. The District will measure water levels in a network of approximately 900 wells this year.

These wells are carefully chosen to reflect the variation in the thickness of the aquifer throughout the area. While new wells are continually being added to the network to upgrade and maintain good coverage of the District, most of the wells have been measured annually for many years. This allows for a comparison of current water levels with levels of past years.

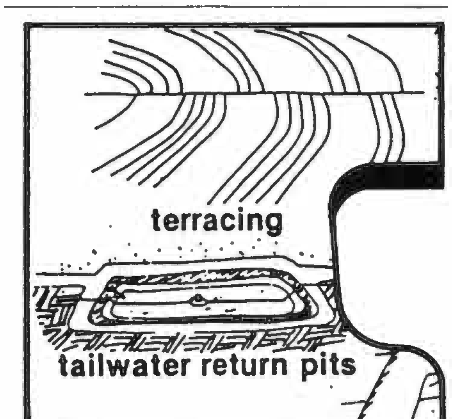
Actual measurements are taken by lowering steel tapes coated with blue carpenter's chalk into the well to a predetermined depth, usually about five feet below last year's water level. When the tape contacts the water, that portion of the chalk turns a darker blue. By subtracting the amount of wet area on the tape from the total length lowered into the well, current depths-to-water are determined. The measurement is then written on a vinyl tag and attached to the well for the landowner's-operator's information, and is recorded by the staff.

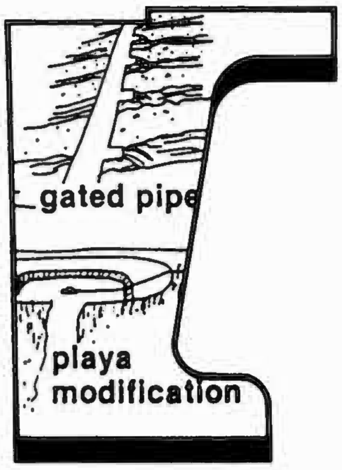




Congratulations to Bob Arhelger for being awarded a Certificate of Merit by the United States Department of Agriculture "in recognition of outstanding performance in directing operations of the Lubbock Field Office resulting in the office achieving a commendable record in the planning and application of a high quality conservation program."

Bob was recently promoted by the Soil Conservation Service to Area Conservationist for the Big Spring, Texas area.





IRRIGATION CONFERENCE

AMARILLO—New ideas for improving irrigation efficiency while reducing costs and conserving water will highlight the annual High Plains Irrigation Conference here Jan. 12.

Participants will get a special look at the potential for surge irrigation and the newest developments in low energy precision application (LEPA) center pivot systems. State Sen. Bill Sarpalius of Canyon will report on current and future water legislation.

The annual conference will be held at the Texas A&M University Agricultural Research and Extension Center, 6500 Amarillo Blvd., West. Registration and display of equipment will begin at 8:45 a.m. The program will conclude at 3 p.m. It is sponsored by the Texas Agricultural Extension Service and the Panhandle Economic Program.

"A popular feature of this conference each year is the discussion by a panel of growers, and this is an outstanding segment of the program again this year," said Leon New, Extension agricultural engineer and irrigation specialist who is conference coordinator.

Addressing the topic of "How I manage irrigation on my farm" will be Phil Johnson of Friona, Willie Wieck of Etter, Q. D. Bevill of Gruver and Norman Hinchliffe of Earth.

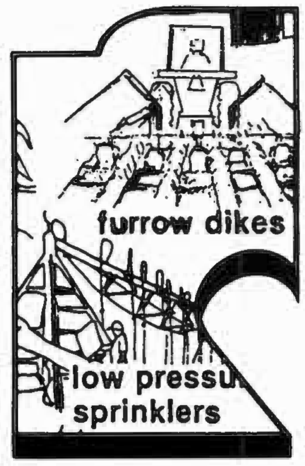
Irrigation management can usually be improved by accurate knowledge of soil moisture, New said. Olan Moore of Dimmitt, owner and manager of High Plains Consultants, will discuss his use of soil sensors to monitor moisture changes and the rate at which crops extract that moisture.

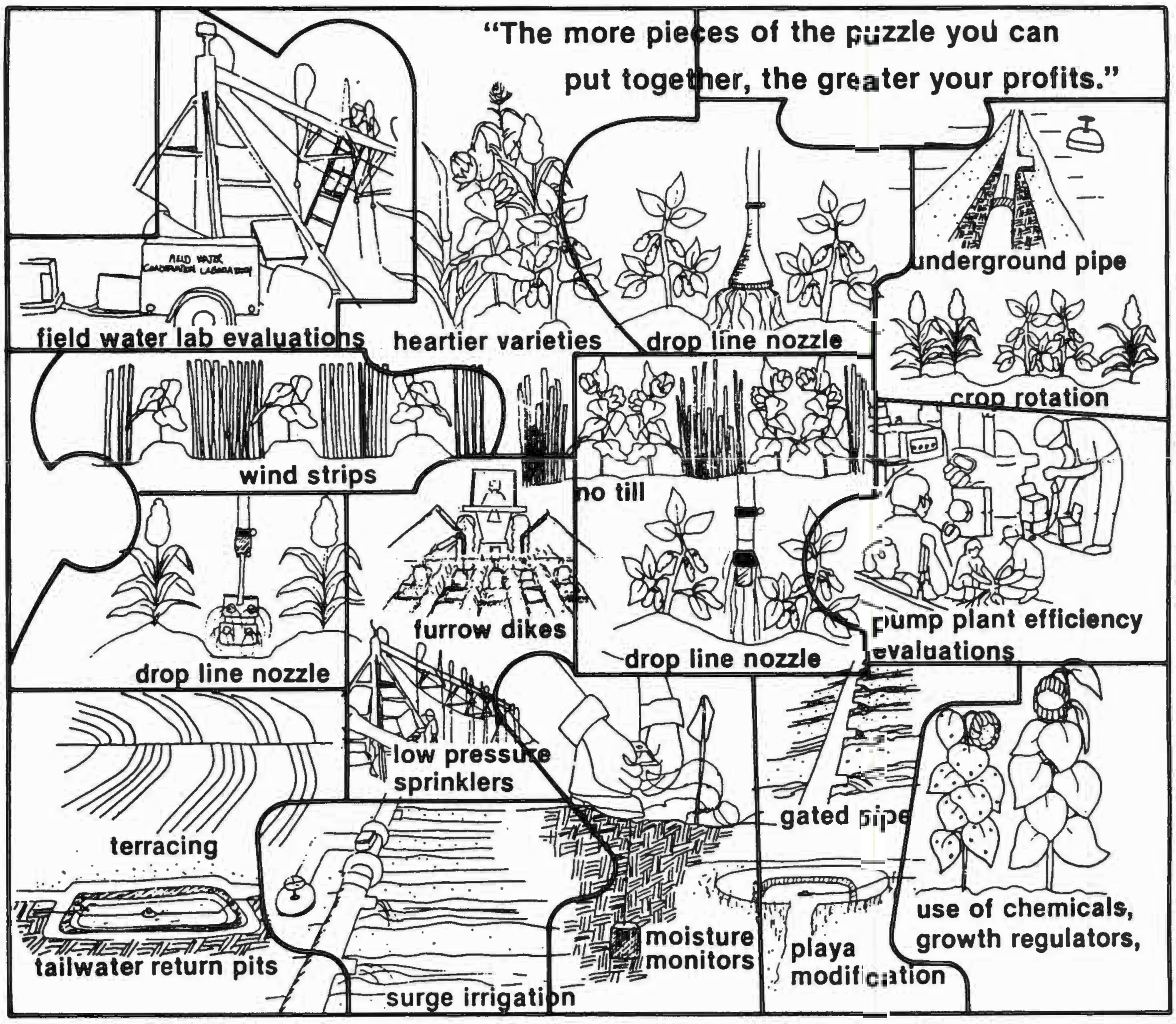
Surge irrigation shows promise of improving furrow irrigation efficiency and the equipment is available at a nominal price to the producer, New said. Jerry Walker, agricultural engineer with the Soil Conservation Service at Amarillo, will describe results of field tests conducted on the High Plains.

LEPA systems, which reduce center pivot fuel use and curtail water loss by applying water close to the ground, will be discussed by Dr. William Lyle, research agricultural engineer with the Texas Agricultural Experiment Station. Lyle developed the LEPA system and will report on his research and field tests on growers' farms.

Potential legislation and its impact upon farming practices in the fertile High Plains will be addressed by Sarpalius.

Exhibits at the conference will include components that convert standard center pivot systems into LEPA systems, surge irrigation valves and control units, and improved and modified irrigation pumping engines.





SECOND CLASS PERMIT

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT NO. 1
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Sen. Sarpalius Asks Growers To Get Involved

EDITOR'S NOTE: *Senator Bill Sarpalius recently offered some candid insights into the working and thinking of the State Legislature, regarding agriculture on the High Plains of Texas. His remarks were delivered to over 100 producers at the High Plains Irrigation Conference sponsored by the Texas A&M Research and Extension Center, with Leon New, in Amarillo.*

"It really concerns me when you hear them talking about storing nuclear waste down below the Ogallala Aquifer. My colleagues in the Senate and Legislature are not that concerned about what we've got up here in the Panhandle. We've had to constantly fight and try to convince the members of the legislature that the Texas Panhandle is just as important to the State of Texas as Houston or Dallas or any other place.

"In my senatorial district, which is the top 29 counties, we produce over one-third of the total agriculture produced in the state. That's ten percent of the national production of agriculture. The number one income in the state is oil and gas; number two is agriculture.

"There were a lot of bills filed this past session to help with agriculture, and a lot of them dealt with water. Unfortunately, a lot of them didn't pass . . . We filed a bill to regulate the rate for natural gas to farmers. All the natural gas in the state is regulated except agricultural gas. Farmers were complaining to me that their bills were jumping up without warning and they had no notice or recourse. So we filed a bill. It finally died on the floor for lack of votes; but it was ironic that from the time the bill was filed through the time it was voted on, all the gas rates to agriculture dropped. We guestimated that it probably saved the farmers around 50 dollars a month per well during the time that legislation was being discussed . . .

"The Legislature has tried to look at incentives for irrigation systems that would save as much water as possible. One bill you probably heard lots about dealt with low interest loans for using watering systems that can help conserve water, like surge, dikes and low pressure sprinklers. The bill ran into trouble and there are still lots of problems with it. For instance, in the case of a farmer who has gone dryland

down the road from a farmer who still irrigates his crops; the dryland farmer is technically conserving water. So why couldn't he get a low interest loan for new equipment to help on the cost of converting to dryland farming?

"Another problem. Banks are very reluctant to make these type loans with only the new equipment or pipeline as collateral. Bankers want more than

continued pg. 2, col. 1 . . . LOANS

Area Needs Moisture

In spite of the heavy fall rains, the southern High Plains does not have as much moisture in the soil as most producers anticipate.

For the third year in a row, the abundantly wet fall weather has fallen short in wetting the total soil root zone profile. This year the annual soil moisture deficit survey team found conditions generally running 60 to 80 percent of field capacity. Approximately 50 percent of field capacity is wilting point for the soils in our area. The total plant available water therefore ranges from as low as 20 percent of a particular soil's potential in the drier areas to as much as 60 percent in wetter areas. The moisture is evenly distributed throughout the soil profile.

Last year's winter snows blanketed the area and contributed to more uniformly wet soil down to the two foot level with a drier profile below. This year the moisture deficits vary widely across the entire southern High Plains with the areas of greater need for water generally corresponding to those counties which have received the smallest amount of rainfall since September. For example, the extreme western areas of Parmer, Bailey and Cochran counties are dry, including a stretch sweeping across Deaf Smith County into Castro County. To the east, soils are holding more moisture than last year at this time.

The rainfall distribution table for the southern High Plains counties shows the average range of precipitation received between September 1 and January 15. It suggests a correlation with the soil moisture deficits. However, there are many more areas without adequate preplant moisture than the table indicates.

RAINFALL DISTRIBUTION SEPT. 1 - JAN. 15, 1984

	(inches)
ARMSTRONG	7.5 - 9.5
BAILEY	4 - 6
CASTRO	2.5 - 7
COCHRAN	6 - 8
CROSBY	9 (one site)
DEAF SMITH	3 - 5
FLOYD	9 - 12+
HOCKLEY	5 - 12+
LAMB	4 - 12
LUBBOCK	9 - 16
LYNN	11 - 20
PARMER	2 - 6
POTTER	no data
RANDALL	1 - 9

Those fall rains came hard and fast with high intensity storms that generally created heavy runoff. As a result, most areas picked up very little deep moisture and lost even more potential deep soil water to hard pans which are so prevalent and increasingly severe this year (see story on hard pans, page 4).

The number of survey sites with serious compaction layers has increased since last year. But Mike Risinger, Lubbock SCS soil scientist, also commented he is seeing more breaking plows and deep chiseling in operation this year than ever before.

The team measured soil moisture deficits in 190 neutron tube sites over the 15 counties, with cooperation of local landowners. Site selection was based on soil type and variations in the saturated thickness of the Ogallala aquifer.

The soil moisture deficit map is published as a tool to give producers a better picture of soil moisture reserves over the entire area. It can help them

continued pg. 3, col. 1 . . . DEFICITS

In Eight Southern Counties

WATER LEADERS ELECTED

James Mitchell of Wolfforth, Gilbert Fawver of Floydada, and Mack Hicks of Levelland were each re-elected to the Board of Directors of the High Plains Water District on January 21. The official canvas of the votes and swearing-in ceremonies for the board were conducted during their regular business meeting in February.

Also elected in January were 24 county committeemen in eight southern counties within the Water District's service area. The District has a grass roots network of 75 committeemen serving throughout the 15 counties.

James Mitchell, an outstanding conservation farmer, was re-elected by voters in Lubbock, Lynn and Crosby Counties to represent them in District Director's Precinct One. James will serve his fifth two-year term.

Elected to serve with Mitchell as committeemen were nine farmers. Most were seeking their first four year term.

In Crosby County, Ronald Smith, Marvin Schoepf and Loyd Gregory were elected for their first terms.

In Lubbock County, Billy Walker, Richard Bednarz and Daniel Stanton were elected for their first terms.

In Lynn County, David Weid and Leland Zant were re-elected for a second term, and Willie Nieman was elected to his first term.

District Director's Precinct Two voters in Cochran, Hockley and Lamb Counties elected Mack Hicks to his third term on the Board of Directors. Hicks is manager of Whiteface Farms. Nine committeemen were elected in the three counties to serve with him.

Cochran County farmer Douglas Zuber will serve his first four year term as a committeeman. Donnie Simpson and Richard Greer were re-elected to their second terms.

In Hockley County, W. C. McKee won re-election. Randy Smith and R. H. Reaves were elected to their first terms.

The Water District's first committeewoman was elected in Lamb County. Mrs. Belinda Fudge will serve her first term along with J. D. Barden and Arlen Simpson.

Gilbert Fawver, a Floydada producer, was elected by voters in Floyd and Hale Counties to serve his second term on the Board of Directors representing District Director's Precinct Five. Elected to serve with him were six local county committeemen in the two counties.

In Floyd County, Cecil Jackson and D. R. Sanders were re-elected to their second four year terms. John Lee Carthel won his first term.

In Hale County, Harold Newton, Jim Byrd and Ray Porter were each re-elected to their second terms.

From Dallas

WEST TEXAS GIVEN CREDIT

Ag Research:
HERE'S A LAUGHER

A deodorant for plants? Scientists in West Texas are trying to reduce the perspiration of plants. That's right.

Plants must transpire to live. They absorb carbon dioxide and put out oxygen and water to keep cool. The problem is that plants don't precisely control the amount of water excreted. Air temperature controls the amount of water put out. A researcher at Texas Tech University says that on 100-degree days, cotton may waste 10-15 percent of its water; on a cooler, 90-degree day, the waste may be as much as 25-30 percent.

Tests using a special chemical to retard transpiration have been inconclusive. But they will continue.

We will leave the chuckles to those not affected by the dry West Texas climate. The effort to curb the water loss is a good example of scientific innovation that could pay dividends. Every drop of water in West Texas and the High Plains is valuable today and will become more so in the future. This kind of work, seeking to get the most from every drop, will help to head off the state's "water shock" of the 1990s.

Dallas Morning News Editorial, January 13, 1984.

A PANEL OF GROWERS who used surge flow watering last season shared their experience with producers at the Midland Surge Flow Conference in January. James Mitchell (l), Philip Bates, Steve Jones and Phil Johnson fielded questions.

LOANS . . . continued from page 1

that. But you engaged in farming know that you've already got just about everything you own up for collateral.

"To be honest, at this time we don't see that bill for low interest loans for farmers who want to save water gaining much support until we iron out some of those problems . . .

"In the past four years we have been able to create three new water districts in the Panhadle. And we're going to continue to create districts anywhere we can put water. We've got to get the funds for the dams and start conserving the water.

"I don't see a water importation bill coming about for quite some time. We've got to conserve the water we've got . . . The Corps of Engineers looked at possible routes for moving water from the Arkansas River to the Panhandle as part of the Six State Ogallala Study funded by Congress. Now every new governor in Arkansas talks about how they want to keep their water. The time to talk to Arkansas about their water is when they're flooded.

"The idea was to take the water at the time the River is flooding and fill up all those lakes along the way. That's why I feel that creating water districts and finding places to conserve that water is so valuable. If you do ever import water, you've got to have a place to put it. And the more water districts we can create the more places we will have to store enough water.

"When you talk about water importation in the Legislature, you have a lot of members who feel like you're just blowing wind. I think it is a question we have to face in this state. We must look at more laws dealing with the storage of water and continue to fight for those laws that protect the rights of the person who owns the land to the use of underground water.

"When we start talking about soil and water conservation we've got to have the support of the farmers and ranchers. I can't help but say that your involvement means an awful lot. It's really depressing (and I think Foster will agree on this) when you're sitting there fighting for a bill dealing with agriculture and you've only got three or four farmers to speak for all the farmers in your district, and the other side has a lot of money and a lot of testimony and a lot more going for them, it's hard to get the legislation passed.

"What I'm saying is that you have to become more involved in what's going on in Austin and Washington. Become active. Write letters, make phone calls. Take part and be concerned about the future of our area."

Bruno Resigns

This issue of the Cross Section brings our readers to an end and to a new beginning. Patricia Bruno has resigned from the staff of the High Plains Water District and respectfully entrusted her office as editor of the Cross Section and Chief of the Information and Education Division to Kathy Redeker.

Patricia served district readers for five years writing, editing, photographing, designing layout and overseeing the printing of the last 58 issues of the Cross Section. She has kept in touch with the press and media, in contact with teachers and service organizations, and promoted water conservation education throughout the High Plains.

She was probably best recognized in the field by the camera slung around her neck and her long, dirty tennis shoes. She says she most enjoyed working with producers, the Soil Conservation Service, local Extension agents, and the many great researchers whom she often pestered to "explain what they meant."

We will miss her "cocky" spirit and wish her every success in her new business venture.

COTTON . . . continued from page 3

crucial in the future, if predictions for the 1985 farm bill are correct. The outlook of one Atlanta conference speaker was to expect 1985 to be a fine tuned version of the 1981 farm bill. With no target price, a definite move to a free market, price supports substantially below world market prices, no production controls and no farmer owned reserves. In short, very simple to almost no program at all.

While the target price is sure to be heavily debated, the trend is to freer markets. And the inflationary value of the dollar in relation to currency exchange could leave us without either an export or a domestic market.

THE CROSS SECTION

THE CROSS SECTION (USPS 564-920)

A MONTHLY PUBLICATION OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
2930 Avenue Q, Lubbock, Texas 79405
Telephone (806) 762-0181

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District Office at Lubbock

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Don Smith ... Geologist
Don McReynolds ... Geologist
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Becca Williams ... Permits
Kenneth Carver ... Agriculturist
Obbie Goolsby ... Engineer Technician
Dan Seale ... Engineer Technician
Eldon Lancaster ... Engineer Technician
Jerry Funck ... Agricultural Engineer
Richard Howard ... Draftsman
Kay Hughes ... Bookkeeper
Kathy Redeker ... Executive Secretary
Carole Rosiak ... Secretary-Librarian

NOTICE: Information regarding times and places of the monthly County Committee meeting can be secured from the respective County Secretaries.
Applications for well permits can be secured at the address shown below the respective County Secretary's name, except for Potter County; in this county contact Sam Line.

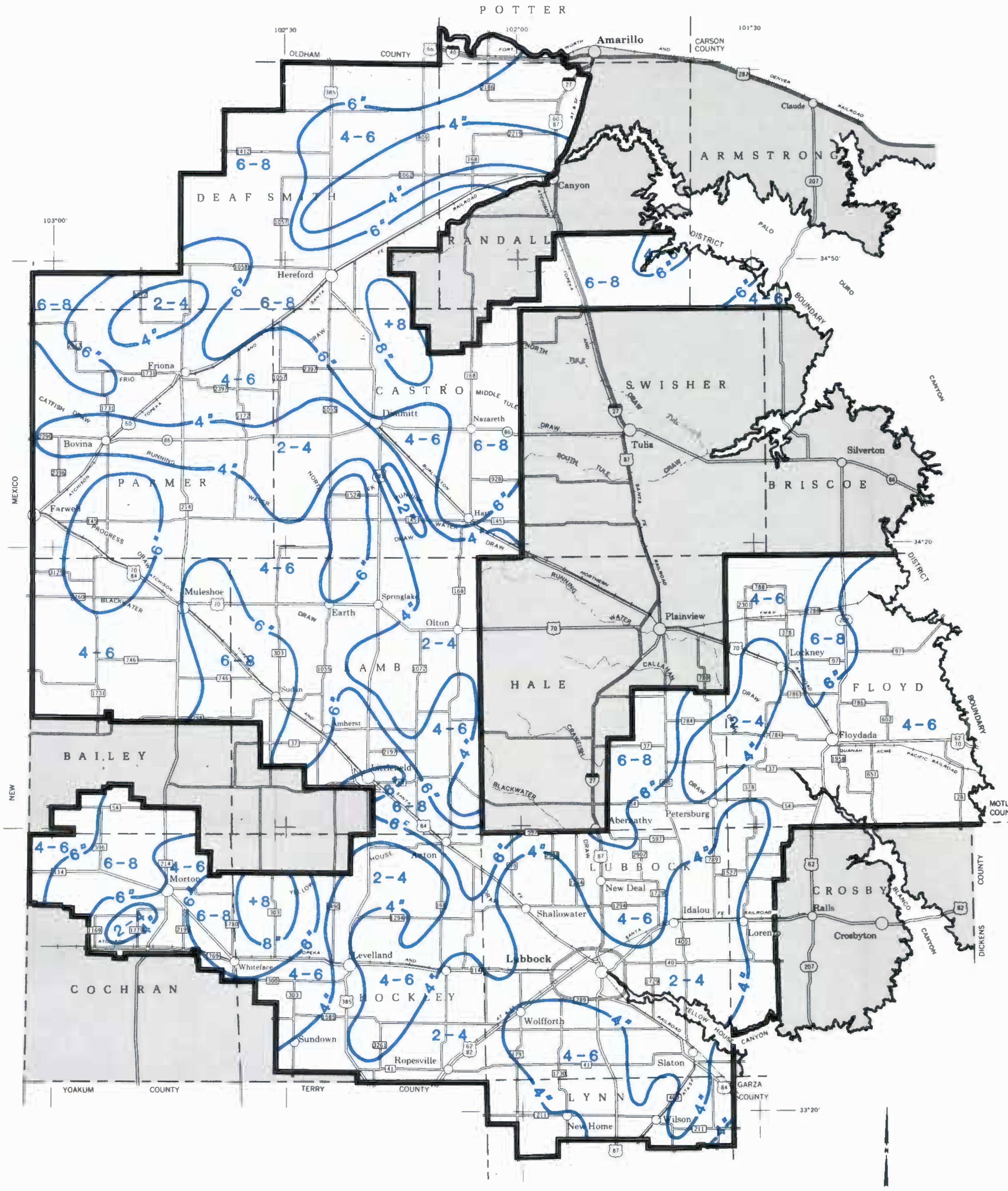
DEFICITS MAPPED . . .

(continued from page 1)

to make more informed irrigation decisions and help them avoid both over or under irrigating in the spring. It can also give an indication of potential production.

The map's soil moisture deficit readings are a measure of how much water is still neded to wet the soil in the crop root zone to field capacity. The sample indicates general trends over the area, but does not predict exact soil moisture conditions on any given farm. Each landowner needs to check his individual farm soil moisture to determine its water needs.

The survey is a cooperative effort by the Soil Conservation Service and the High Plains Water District.



INCHES OF WATER NEEDED TO WET THE TOP FIVE FEET OF SOIL TO FIELD CAPACITY

SURVEY CONDUCTED DEC.1,1983–JAN.16,1984

APPROXIMATE SCALE - MILES

Domestic Cotton Markets Need High Plains

High Plains cotton growers could be selling to a strong demand domestic market at high returns if they were willing to customize their production and marketing strategies. The message from spinners at this year's annual Beltwide Cotton Production Research Conference in Atlanta, Georgia was to make the choice. One: continue to grow any and every variety with little attention to quality and strength, be dependent on export sales and loan support prices; or two: set a goal of supplying long staple, high strength varieties to a healthy domestic market. Concentrate on quality, sample test before harvest and organize before going to the gin into module groups of equivalent quality and strength cotton to be sold in blocks directly to the mills.

Mack Hicks, Water District Board Director and manager of Whiteface Farms, heard several speakers characterise the High Plains producer's current operation as "growing just to grow cotton at the government support price." Spinners, meanwhile, are importing high quality cotton (one and 1/32 inch staple length with strength of 25 or more) to meet their needs.

The Burlington Cotton Company says it imported 25 percent of its cotton in 1975. In 1982 imports increased to 30 percent; and it says if the trend continues, by 1992 it will be importing 60 percent of its cotton if domestic growers do not upgrade quality to meet their needs. The Dixie Milling Company said it needs a constant supply of one and 1/32 inch or greater length with a strength of 25 or more, and would definitely pay a good price for this quality of cotton from the High Plains. Other mills repeated the call for High Plains cotton producers to supply quality, long staple and high strength cotton, free of moisture, trash, dust, oil or grease.

Fiber length is critical in today's open ended spinning configuration of five thousand looms running at one time. Fiber breaks stop all five thousand looms while the thread is tied. Quality is hurt because the tie creates neps or little white specks visible in the cloth. Neps are unacceptable in fine materials.

Fiber strength affects the cloth's ability to accept dyes, and dying cotton yarn or cloth is affected by dust, trash, oil or grease in the fiber. Spinners emphasize the need for clean cotton which is easy to dye, because the demand today is for color. Dirty or greasy fibers require two or more trips through the dying process.

"The domestic market for quality cotton is there," says Hicks, "but for the High Plains producer to capitalize on it he will have to take care of business. Many of us will have to change some of our operations to sell in this market, but we can," says Hicks. "I'd rather sell 400 pounds of 65 cent cotton than 500 pounds of loan price cotton at 42 cents. If we don't adjust and go after these markets, we'll be gambling at the denim and export market and the loan price, while the spinners will be locking in contracts with other countries who are willing to grow what they want."

"We're not that far off now," says Hicks. "I've looked at cotton grades and quality since I've been back that were grown in this area, this year, that fit the quality they want. This summer we had enough hot, dry days to create enough heat units to develop the maturity and strength. Our lack of moisture in August prevented the cotton from setting late bolls that would not fully mature and which would have weakened grades.

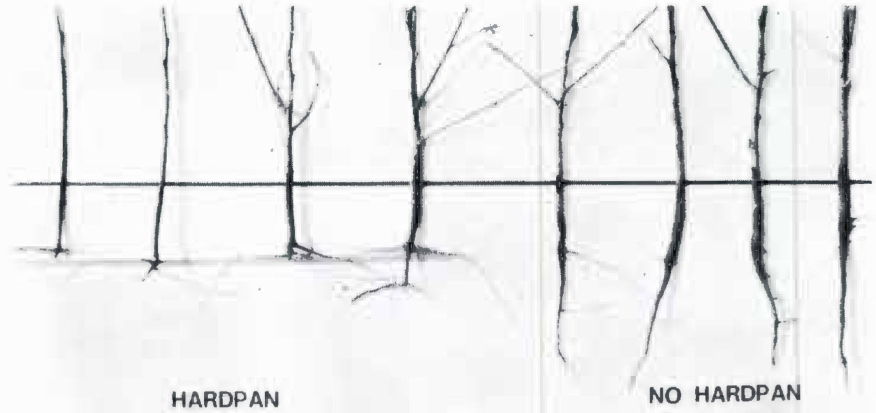
"Weather is an important factor. We need in excess of 150 days of high temperatures to get the maturity and strength spinners want. We can't control the weather, but there are some things we can control.

"Producers can grow the best varieties for their local soils, available moisture and other climatic conditions. We can use chemical plant growth regulators, control insects, fertilize early, and water for maximum strength instead of for maximum yield. We can avoid watering in late August which sets late bolls that won't mature.

If the gins can begin to handle local production in blocks according to quality, it could strengthen the High Plains market position. That could be

continued pg. 2, col. 1 . . . COTTON

Hard Pans Hurt Yields



The tap root of a cotton plant is its lifeline. Pinch it off, squeeze it down or block its growth path through the soil and plant yields will suffer. Hard pans, dense compacted soil layers under the soil surface, are probably affecting yields over as much as 40 percent of the land farmed on the High Plains in 1983, and if not broken up will again reduce yields in 1984. These pans are so dense that it is difficult for plant roots to penetrate through to deeper moisture and nutrients. In most cases, hard pans also slow moisture from moving deeper into the soil, which increases runoff.

High Plains Water District staff, measuring field moisture over the High Plains, are finding moderate to severe compaction is widespread. It not only affected cotton tap roots, but every other crop grown on the High Plains, forcing the plants to squeeze back their root systems into smaller, less efficient laterals across the top and through cracks in the hard pans.

Mike Risinger, Lubbock Soil Conservation Service soil scientist, explained that when a plant root grows through the loose, cultivated layer and hits a soil hard pan, it will be diverted horizontally. It may grow into the compacted layer a short distance, but then slow down dramatically, or even quit growing altogether. "The rate of root growth is proportional to the resistance it meets," Risinger said. "The harder the layer the slower the growth and the more yield is affected."

"Hard pans severely restrict infiltration of rainfall and increase erosion. We're finding that soil moisture readings taken this winter are significantly lower in soils with severe pans."

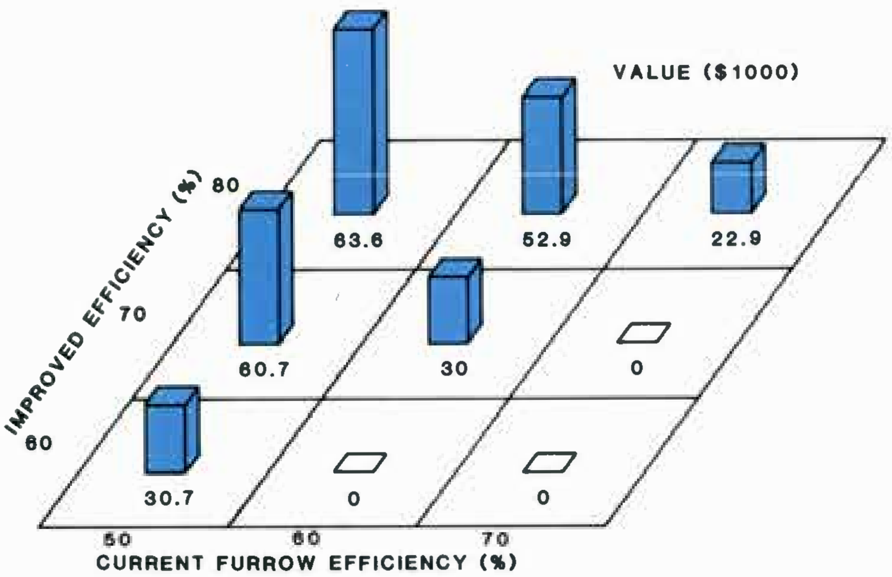
"Random soil moisture samples at 139 sites measured by the District in December indicated dense compact soil layers over 75 percent of the area. About 24 percent had none to light pans, but of the 8 percent with no pan readings, virtually every field had been chiseled or deep broken since harvest. Pans were severe in 25 percent of the sites. Compaction was moderate in 37 percent of the samples and moderate to severe in 13 percent of the samples."

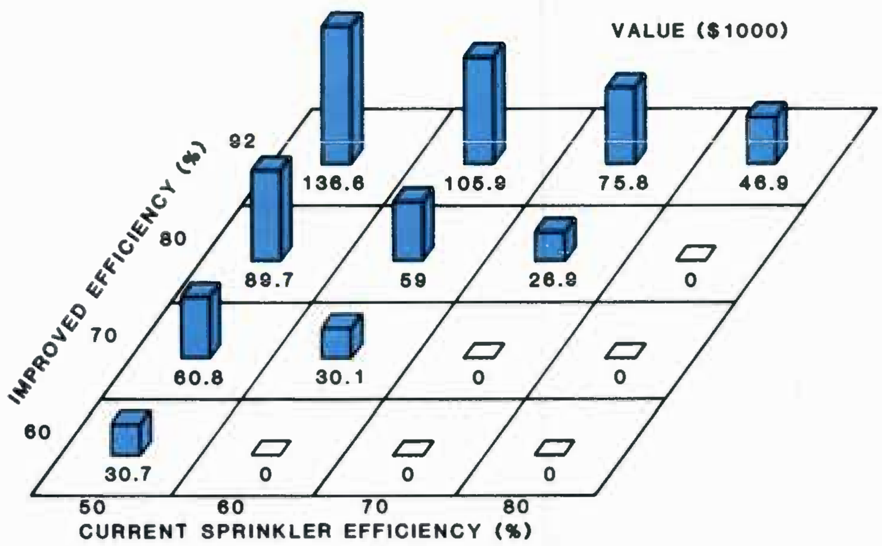
"There are probably more pans this year, and they are especially dense now," said Risinger. "It's worse than typical because last year's abnormally wet spring drove producers into the field with sand fighters, some as many as nine times, usually the first day the field was dry enough to get into. The conditions were optimal for soil compaction. The same conditions occurred this fall as farmers rushed back into wet fields to harvest after unseasonable rains."

Even when the ground appears dry near the surface, severe compaction will result when heavy equipment rolls through a field where the soil is moist.

The most evident symptom of a compact soil layer is a shallow root system, growing horizontally. It is especially noticeable in tap root crops such as cotton. The best way to determine the effects of a hard pan is to dig a hole at least three feet deep and look for crop roots in the subsoil. If the roots have penetrated that deep, chances are you do not have a serious hard pan problem. Another check is to push a sharp, steel small diameter rod into the soil at a slow uniform rate. The force required should be constant for a depth of eight to ten inches unless a plowpan is present.

"Once a pan develops on the High Plains, it won't cure itself," said Risinger. To prevent a dense compacted layer, he recommends confining equipment tracks to the same row every year. Run a chisel behind the tractor tires every year, deep chisel at an angle across the field every other year, and consider deep breaking the field every third to fifth year, depending on moisture conditions.





This graphic illustrates the value of upgrading irrigation distribution efficiencies. If your furrow irrigation efficiency is currently 60 percent (middle block on bottom row) and you upgraded it to 80 percent (middle row at top) over a twenty year period it should increase your net income by $52,900.

This equation assumes initial 139 ft. of saturation thickness, 281 feet of lift, a six percent discount rate over a 20 year planning horizon, and average crop prices. The values listed are the maximum that could be expected from improved irrigation efficiency at today's prices.

The next graphic illustrates the increase in net return that could be expected by upgrading irrigation sprinkler distribution efficiencies. If your sprinkler is currently operating at 60 percent efficiency (second row at bottom left) and you upgraded it to a dropline and obtained a 92 percent efficiency (second row at top left), your increase in net income should be $105,900 over the next 20 years.

This calculation assumes initial 139 feet of saturation thickness, a 281 foot lift, a six percent discount rate over a 20 year planning horizon, and average crop prices. The values listed are the maximum that could be expected from irrigation efficiency at today's prices.

Excerpted from an ongoing study by Ron Lacewell, Ph.D. Department of Agricultural Economics, Texas A&M University, College Station, Texas.

SECOND CLASS PERMIT

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THE Cross SECTION

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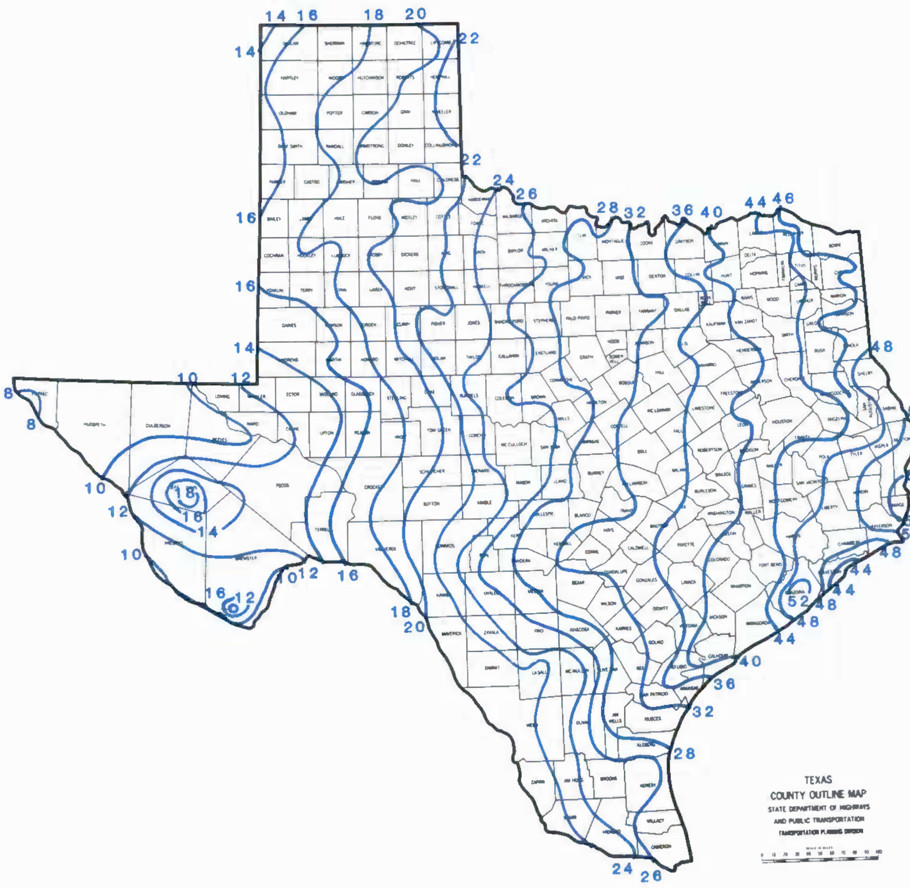


AVERAGE ANNUAL PRECIPITATION IN INCHES, 1951-1980

Dikers Proven Cost Effective

Researchers have proven that the installation of furrow dikes is the single most cost effective conservation practice High Plains producers can implement to increase yields and thereby increase profits. Installed in conjunction with routine farming operations, furrow dikes will normally pay for themselves within one growing season.

By incorporating furrow dikes into normal farming operations, it has been shown that approximately three additional inches of precipitation water can be made available for use by plants. This is achieved by the furrow dikes holding precipitation in place until it has time to infiltrate the soil and be stored in the plant root zone area for future use by growing crops.

Costs associated with the purchase of furrow dikers is minimal when the pay-back time is taken into consideration. Dikers can be purchased for approximately $175 per row. With the addition of 14 percent interest for one year, a furrow diker would cost $199.50 per row. If eight row equipment is utilized in the farming operation, total investment for the purchase of furrow dikers would then equal $1,596.00. Eight row diking equipment would be adequate to install dikes on a farm of 640 or more acres.

Maps on page 3 of this issue of the Cross Section show "Average Monthly Precipitation in Inches From 1951 to 1980." These maps can be used as a guide to which months the furrow dikes have the most potential for harvesting precipitation. Naturally, there are no assurances that this quantity of rain will be received; however, there is a reasonably high probability of similar rainfall occurring.

Under limited water situations, if through the use of furrow dikes just one additional inch of water could be made available for crop use, increased yields of 30 to 50 pounds of lint cotton, 300 to 400 pounds of grain sorghum and 400 to 500 pounds of corn per acre should be attained. Cotton grown in the High Plains of Texas in 1983 sold for approximately 60 cents per pound. Grain sorghum brought $5.10 per

DIKERS . . . continued on page 2

SUBCOMMITTEE ENCOURAGES RESEARCH

The Groundwater Subcommittee of the Texas House of Representatives' Natural Resources Committee recently met to accept testimony regarding the investigation into secondary recovery of ground water from the Ogallala Formation. Members of the subcommittee: Representative Gerald Geistweidt, Chairman from Mason; Representative J. W. Buchanan from Dumas; and Representative Chip Staniswalis of Amarillo, heard the Water District's research team report on the results thus far attained in this research and development project.

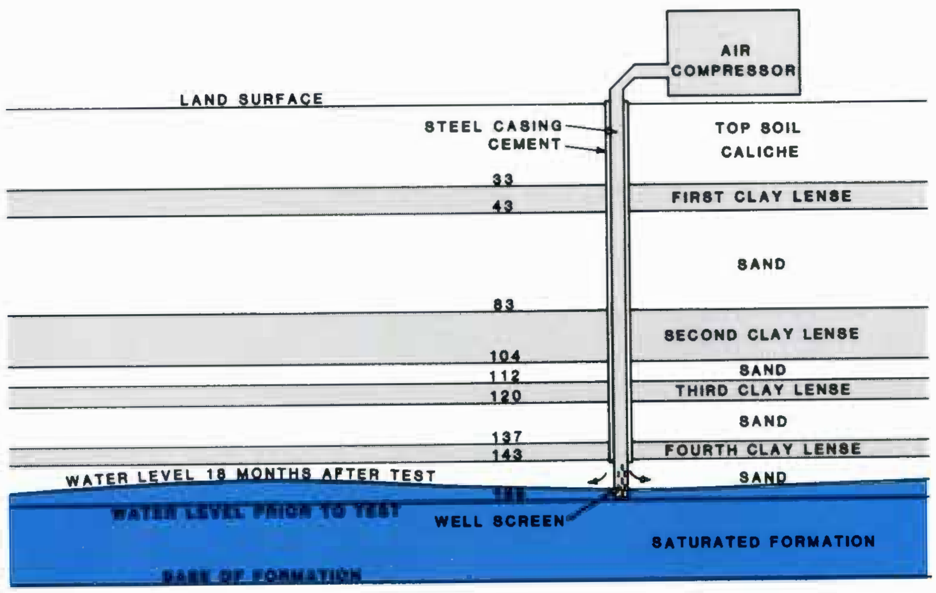
In 1980, the 67th Texas Legislature appropriated $250,000 to the Texas Department of Water Resources to investigate the feasibility of the release of water from the wet sands of the Ogallala Formation in the High Plains of Texas for future recovery by wells. The 68th Texas Legislature in 1982 appropriated funds in the amount of $100,000 to continue this research effort. This investigation has been conducted by the High Plains Underground Water Conservation District through contract with the Texas Department of Water Resources and in cooperation with Texas Tech University's Water Resources Center, Texas A&M University, and the Texas A&M University System Texas Agricultural Experiment Station.

A. Wayne Wyatt, Manager of the Water District began testimony with a slide presentation. He presented the committee with an overview of the project to date. Wyatt explained that in the initial phases of the project, five objectives were set: 1) to determine the amount of water in capillary storage; 2) to identify available or emerging technologies for recovery of capillary water; 3) to evaluate capillary water recovery techniques, 4) to develop plans to field test a recovery technique, and 5) to field test a secondary recovery technique.

In order to accomplish these five objectives, Wyatt reported that the Department of Water Resources drilled core holes at seven locations to collect formation core samples. Analyses were then performed on these samples to determine the percent moisture by volume in each core sample. In conjunction with these analyses, District staff set out to determine the amount of wet formation material between the root zone (ten feet below land surface) and the 1980 water table. It was determined from the thickness map made for the area that there were 3.36 billion acre feet of wet formation material in the Ogallala Formation in the High Plains of Texas. Using the results of the core analyses which showed an average moisture content of 25 percent by volume of the wet formation material, it was estimated that there were 840 million acre feet of water in capillary storage.

Meanwhile, an exhaustive review of literature was being conducted to find reports of previous research projects of this nature. No articles pertaining directly to the secondary recovery of

RESEARCH . . . continued on page 2



This cross-section of the secondary recovery site at Idalou illustrates approximate rises in water levels 18 months after the air injection test ended. Rises of 4 to 9 feet still remain even though 295 acre feet of water have been pumped for irrigation since the test ended.

DIKERS . . . continued from page 1
hundred weight; and corn sold for $6.30 per hundred weight.

Assuming furrow dikes had been installed and only one inch of additional water had been made available to crops, production should have been increased by an average of 40 pounds of lint cotton, 350 pounds of grain sorghum, and 450 pounds of corn per acre. Producers could then have increased their profits by $24.00 per acre of cotton, $17.85 per acre of grain sorghum, and $28.35 per acre of corn.

Applying these per acre yield increases for only one additional inch of water to an example farm of 640 acres of which one-half or 320 acres was planted to one of these crops in 1983 the increased gross profits could have been $7,680 for cotton, or $5,712 for grain sorghum, or $9,072 for corn. The potential addition of three inches of water which could possibly have been made available through the use of furrow dikes would then increase the gross profit potential by a multiple of three.

Additionally, the estimated three inches of precipitation harvested by the use of furrow dikes, or 960 acre inches on the 320 cropped acres, could be viewed as reduced ground - water pumpage thereby water saved for future use. Also saved would be the estimated $4.00 per acre inch fuel cost to pump the 960 acre inches of water for a total fuel cost savings of $3,840.

Harvesting precipitation prior to the irrigation season is very important in improving pre-plant soil moisture conditions and making more water available to young crops. However, furrow dikes have also proven very effective when used during the growing season in irrigated crops. They are particularly effective when used in connection with sprinkler systems and in alternate row irrigation watering patterns. Benefits are derived in irrigated situations in the same manner as with precipitation in that water is held in place until it infiltrates the root zone soil profile.

Some irrigators choose to install their dikes in all rows except their wheel rows until the crop is established. These rows are left open to run sand fighters or in the event replanting becomes necessary. No matter when or how furrow dikes are installed, in order to capture the most rainfall for storage in the soil moisture profile and have it available for later utilization by growing plants, dikes should be in place throughout the entire year and removed only when necessary to accommodate farming operations.

Although yield increases attributable to furrow dikes are highly variable due to related factors such as weather conditions, commodity prices and etc., the facts still seem to indicate that furrow dikes would be a highly profitable, inexpensive addition to any farming operation.

James P. Mitchell of Wolfforth, President of the Board of Directors, raises his right hand to receive the oath of office from Judge J. Q. Warnick, Jr., Lubbock County Court At Law No. 2 (top).

Judge Warnick also swears in Mack Hicks of Levelland (middle) and Gilbert Fawver of Floydada (bottom) as re-elected members of the Water District's Board.

RESEARCH . . . continued from page 1
water were found; however, five potential recovery techniques were identified. The identified techniques were air drive, surfactant/foam, thermal, vibration and electro-osmosis. Through laboratory analyses of these techniques, it was determined that air drive showed the most promise with the other four being currently economically infeasible due to energy intensiveness.

Wyatt reported that on the basis of the quantities of capillary water in storage and the selection of air drive as a potential recovery technique, three field tests were then conducted from December of 1981 to June of 1982. Two of the field tests were performed on Mr. Ronald Schilling's farm west of Slaton in Lubbock County, Texas and the third test was conducted on a farm south of Idalou in Lubbock County, Texas on land owned by Mr. Clifford Hilbers. The results of these tests indicated that approximately 25 percent of the water in capillary storage was released for future recovery by wells. Calculations of the cost of the field tests as applied to the initial amount of water made available for future use showed an approximate cost per acre foot of water released of $50.00.

Wyatt concluded his overview of the project by discussing the current field experiment which is being installed at the City of Wolfforth in Lubbock County. Wyatt explained that through cooperative agreement with the City of Wolfforth, the Water District staff was currently installing a field test site which will be used to determine if lower volumes of air (250 cfm), under lower pressures (15 psi), injected over a longer period of time (30+ days) will produce similar results at reduced costs. If this test proves successful, the technique of secondary recovery of water could become more cost effective for area landowners.

In supportive testimony, Bill J. Claborn, PhD, Department of Civil Engineering at Texas Tech University, reviewed his current efforts to develop a computer model for utilization by local landowners in determining the volume of air to inject, the optimun injection pressure and the length of time air would need to be injected for maximum results with the least cost per acre foot of water released. The computer model's recommendation would be based on the feet of wet sand at the landowner's site plus other data known for the area.

Efforts to design and construct a physical model and determine optimum air flow rates through wet sand formations to obtain maximum water release at economically acceptable costs was then discussed by Don Reddell, PhD, Department of Agricultural Engineering at Texas A&M University in College Station. Dr. Reddell reported that through construction of this physical model and determination of air flow rates, he could supply the necessary input data for the mathematical model being developed by Dr. Claborn.

Additionally, Robert Sweazy, PhD, Director of the Water Resources Center at Texas Tech University, discussed the center's involvement. Dr. Sweazy outlined the work efforts to date and research needs to be addressed in the future to perfect the secondary recovery technique. Don Smith, Water District Geologist, described the Wolfforth project and outlined changes in the testing procedures being used as a result of experience gained in the two previous tests.

The subcommittee members then heard from Tommy Knowles, PhD, Director of Data and Engineering Services for the Texas Department of Water Resources, and Herbert Grubb, PhD, Chief Planning Officer for the Department. Dr. Knowles explained that the Department's staff had taken a critical reviewer's posture in the project and concluded that from work done to date, even though all the answers to all the questions had not been determined, the research methods used were scientifically sound and the test had showed positive results. Chairman Geistweidt questioned Dr. Knowles as to the Department's enthusiasm for the project. Dr. Knowles responded that the Department's staff was at this point cautiously optimistic. Dr. Knowles then went on to say that from the information developed thus far, the project appeared to have tremendous potential.

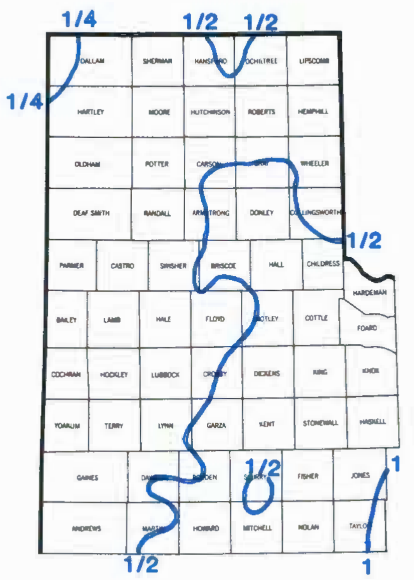
Dr. Grubb's remarks related to the possible extension of the life of the ground-water supplies and the possible economic benefits which might be derived from this effort in the foreseeable future. In summary, Dr. Grubb referred to previous testimony indicating a potential of 1.46 billion acre feet of water in capillary storage. This figure includes that area above the present water table (840 million acre feet) and the capillary storage capacity of the currently saturated formational materials (620 million acre feet). Dr. Grubb explained that with a potential recovery rate of 25 percent as reported from the field tests, a possible 365 million acre feet of water could be made available for future use. He noted for the subcommittee members that this quantity of water was very near the estimated quantity of gravity water currently believed to be available for pumping by wells in the area.

In conclusion of the hearing, Chairman Geistweidt asked the research team if it was their opinion that given time and funding, the potential quantity of recoverable water might be increased and the recovery costs decreased. The research team responded that they believed this could be accomplished. The Chairman also relayed his hesitation at the onset of the project noting that he was concerned as to whether the project had technical merit. He added, however, that the potential benefits of the project far outweighed the expenditures. The hearing concluded when Chairman Geistweidt expressed his pleasure that the research effort to date had provided positive results and he further encouraged the Water District's research team to "keep up the good work.'

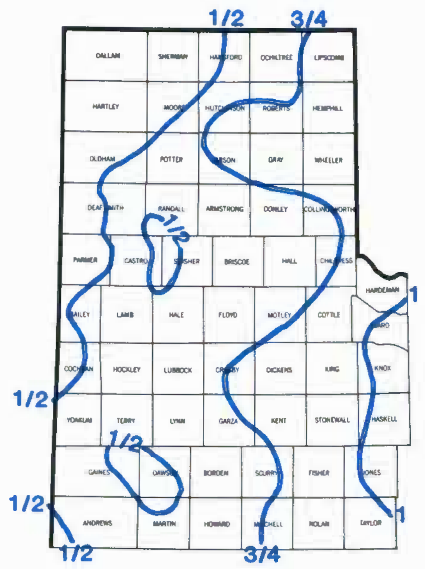
Average Monthly Precipitation In Inches–1951-1980

High Plains Of Texas

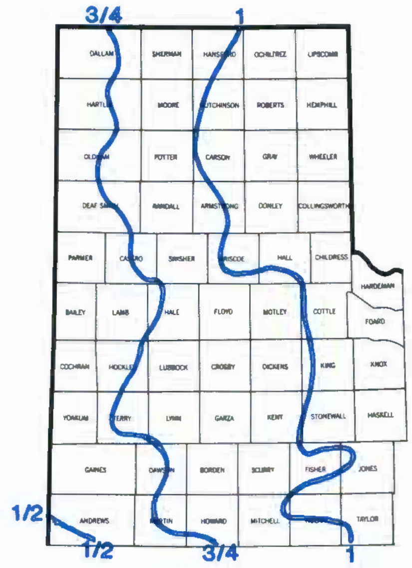
JANUARY



FEBRUARY



MARCH



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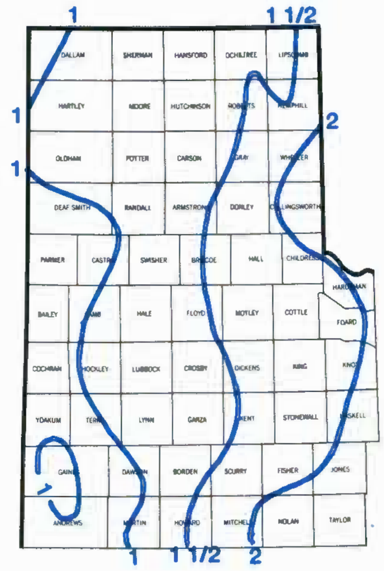

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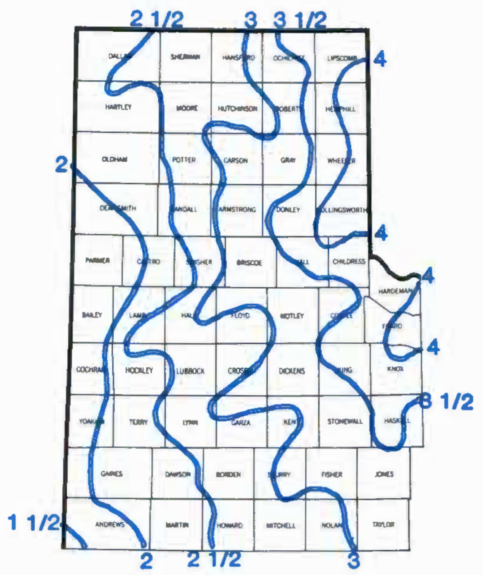

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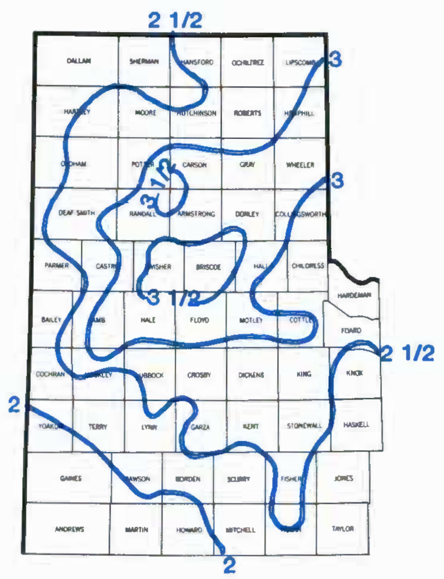

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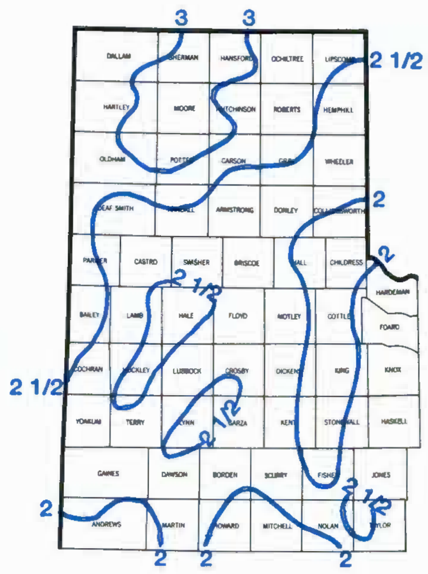

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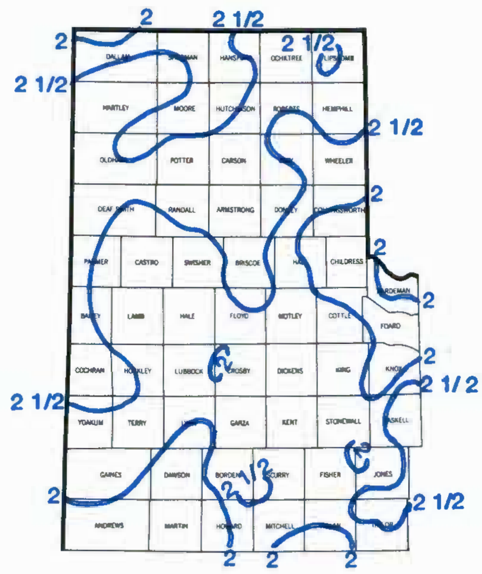

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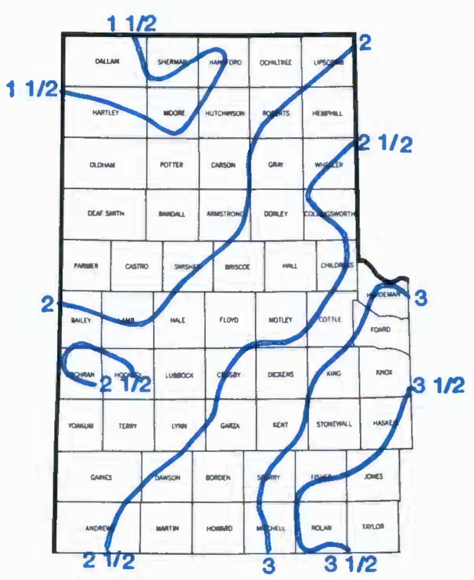

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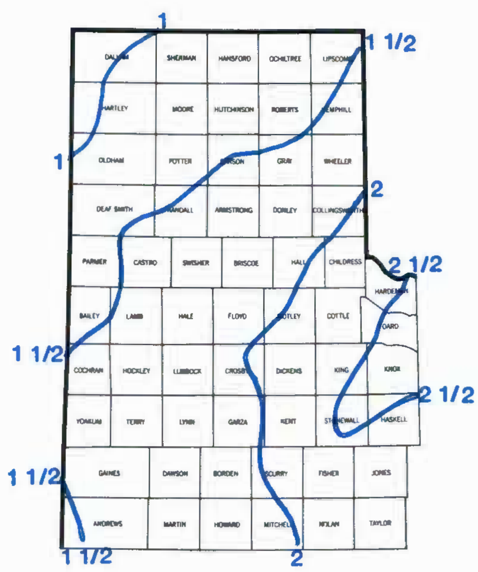

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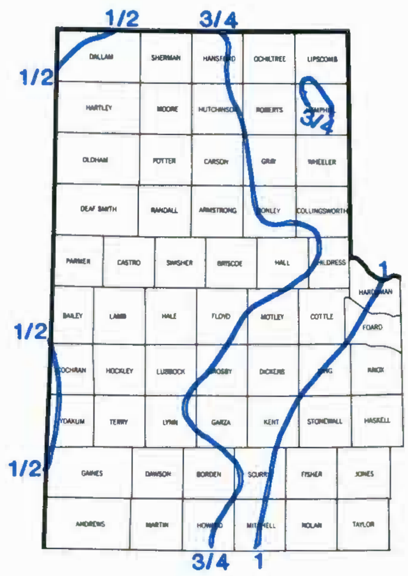

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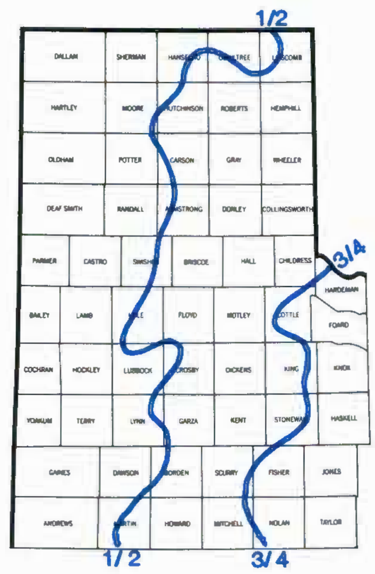


Precipitation maps taken from "Climatic Atlas of Texas," LP-192, Texas Department of Water Resources, December 1983.

District Honored With First GMDA Award

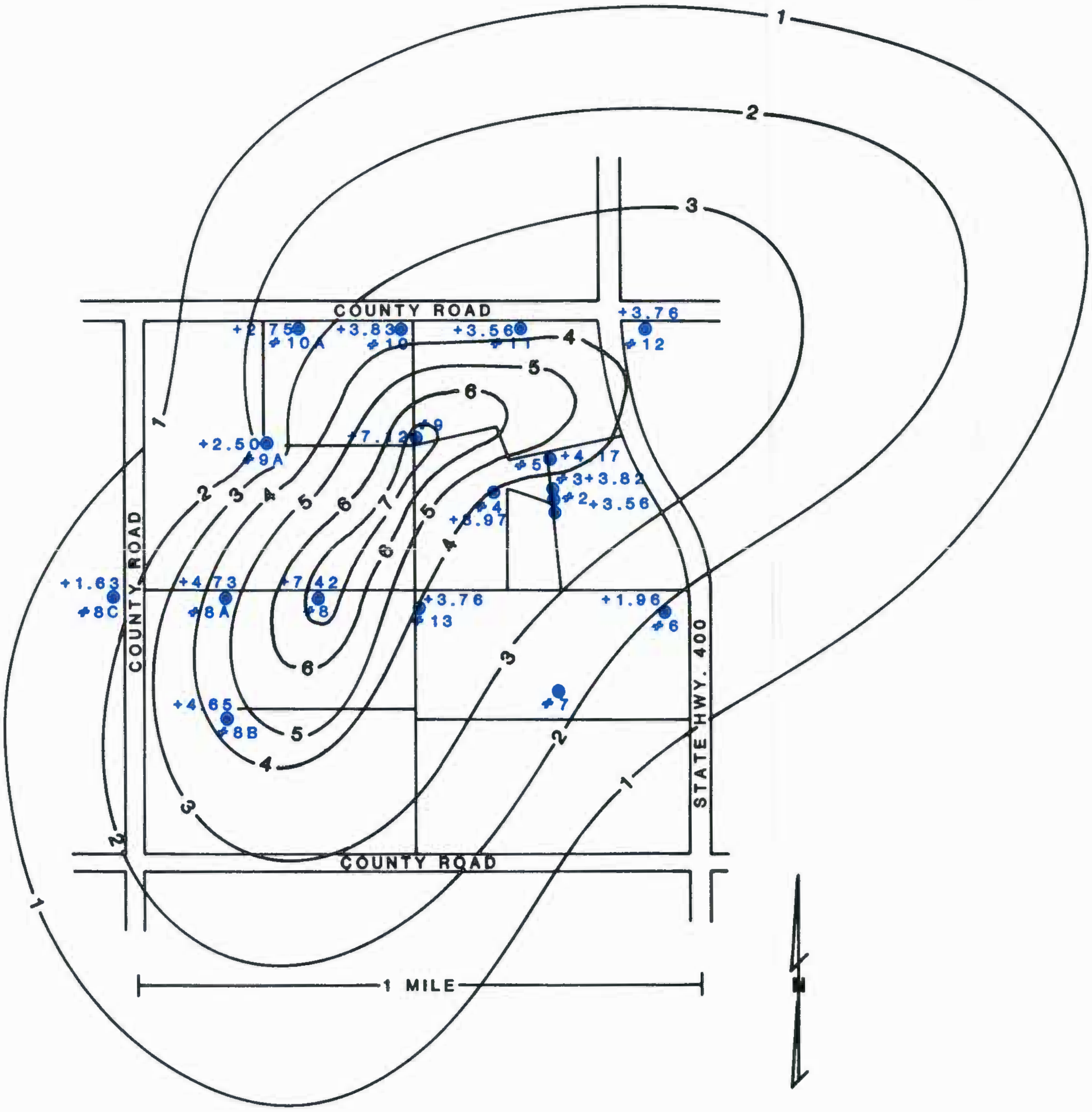
In the first award of its kind, the Groundwater Management Districts Association recently honored the High Plains Underground Water Conservation District as the 1983 "Outstanding Water Resource Person of the Year." Don Smith, Water District Division Director, accepted the award at the 11th Annual GMDA Conference held in Tulsa, Oklahoma.

In presenting the award, GMDA President Tom Bell honored the Water District for exceptional service and contributions toward the protection, conservation and management of water as a valuable resource. Mr. Bell stated, "We take great honor in presenting this award to the High Plains Underground Water Conservation District No. 1. It would be difficult to think of any individual or organization who has had such a tremendous impact upon the way all of us think about conservation."

The Groundwater Management Districts Association is a national non-profit organization comprised of ground-water management districts, ground-water developers, users, owners and other individuals and organizations concerned with conservation and protection of ground water. The Association was formed in 1975 to provide the opportunity for water resource interests from different areas of the country to exchange ideas, develop or influence programs for the development, utilization, conservation, protection and management and control of ground water.

The awards program was established by the Association in 1982. The award goes to any person, firm, organization, district, agency or other organized entity, panel, authority or board whom the GMDA Board of Directors feels has exhibited outstanding contributions or services in the management of water resources.

APPROXIMATE RISES IN WATER LEVELS AT IDALOU SITE FROM JUNE 16, 1982 TO DECEMBER 30, 1983



Ag Yearbook Available

Using the natural resources of the United States wisely is a major challenge of the 1980's, Secretary of Agriculture John R. Block said in the 1983 Yearbook of Agriculture, published recently. He said the new yearbook gives an idea of what is involved in that challenge and how the nation can meet it.

"Our vast natural resources are a priceless heritage," Block said in the foreword. "Using them wisely is everyone's responsibility."

The 612-page hardback is titled "Using Our Natural Resources." It has 60 chapters, 32 pages of color photos and many other illustrations. The book has more than 185 black and white photos, a glossary and an index. Each yearbook of agriculture is on a different subject. Select chapter titles include: "A Billion Acres of Rangeland: Our Nation's Multiple Use Lands," "Irrigating Better With Less Water: Small Watershed Success Story," and "Managing Soils for Your Garden and Homesite."

The High Plains Underground Water Conservation District was honored by being invited to contribute to the 1983 yearbook. A chapter titled, "Ground Water Conservation on the Texas High Plains" describes work accomplished by the Water District, the Soil Conservation Service, the Texas Agricultural Experiment Station, Texas Tech University and others on the Texas High Plains.

Copies of the 1983 yearbook are available for seven dollars each from the Superintendent of Documents, Washington, D.C. 20402. Copies will also be for sale at government bookstores in many cities.

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
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THE Cross SECTION

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CONSERVATION EFFORTS REDUCE DECLINES BY 54 PERCENT

The rate of depletion of the Ogallala aquifer in the 5,216,600 acre, 15-county area served by the High Plains Underground Water Conservation District No. 1 has been cut more than half during the past five years (1979 to 1984) as compared to the previous five years (1974 to 1979). Depth-to-water level measurements made annually in a network of 948 wells in this 15-county area were used to make this observation.

The average annual change in water levels in the area served by the Water District for the past ten years (1974 to 1984) has been a decline of 1.40 feet per well. In the first five years (1974 to 1979) of this ten-year period the average annual change in water levels was a decline of 1.90 feet per well. During the past five years (1979 to 1984) the average annual change has been a decline of 0.88 of a foot per well which is 46 percent of the prior five-year average rate of decline. This indicates a reduction of 54 percent in the depletion rate. In 1983, the average change in water levels throughout the Water District's service area was a decline of 0.56 of a foot which is 40 percent of the ten-year average.

In the southern part of the Water District (Bailey, Lamb, Hale, Floyd, Crosby, Cochran, Hockley, Lubbock and Lynn Counties) the average annual change in water levels during the five-year period 1974 to 1979 was a decline of 1.52 feet per year. The average annual change during the period 1979 to 1984 has been a decline of 0.45 of a foot per year which is approximately 30 percent of the prior five-year average rate of decline.

In the northern part of the Water District (Potter, Randall, Armstrong, Deaf Smith, Parmer and Castro Counties) the average annual change in water levels for the five-year period 1974 to 1979 was a decline of 2.67 feet and during the period 1979 to 1984 the average change has been a decline of 1.69 feet per year which is 63 percent of the prior five-year average rate of decline.

The following are examples of the conservation techniques that area farmers have utilized which have resulted in the reduced rate of depletion of the aquifer. Irrigators report that through the installation of furrow dikes to capture and hold precipitation in place until it has time to soak into the soil they can annually save an average of three inches of irrigation water per acre. Pumping rainfall runoff water which collects in the playa basins instead of pumping ground water has resulted not only in ground water saved for future use but has also reduced fuel costs by 50 percent or more.

Replacing open irrigation ditches with surface or underground pipeline has resulted in reduced water losses of 10 to 20 percent per 1,000 feet of replaced open ditch. Through modification of existing irrigation systems utilizing technical assistance provided

continued page 2 . . . DECLINES

Average Annual Change In Feet For All Water Level Observation Wells Measured In The Following Counties For Time Period Indicated

County	*Number of Wells in County**	*Avg. Change 1983-1984 in Water Levels*	*Avg. Change 1974-1979 in Water Levels*	*Avg. Change 1979-1984 in Water Levels*	*Avg. Change 1974-1984 in Water Levels*
Armstrong	9	+0.08	—1.00	—0.72	—0.82
Bailey	71	—1.08	—1.79	—1.28	—1.50
Castro	89	—2.27	—3.06	—2.41	—2.63
Cochran	53	+0.06	—0.38	+0.20	—0.08
Crosby	23	+0.11	—2.81	—0.67	—1.48
Deaf Smith	88	—1.23	—2.54	—1.29	—1.83
Floyd	97	—0.23	—2.45	—1.08	—1.76
Hale	27	—0.98	—1.58	—1.05	—1.39
Hockley	90	+0.25	—0.68	+0.23	—0.19
Lamb	92	—1.35	—2.84	—1.87	—2.30
Lubbock	118	+0.45	—1.05	+0.35	—0.35
Lynn	37	+2.20	—0.47	+0.97	+0.33
Parmer	97	—1.23	—3.30	—2.18	—2.61
Potter	6	—1.08	—1.04	—0.62	—0.88
Randall	51	—0.51	—0.97	—0.34	—0.59
Dist. Total	948				

** Only those wells with water level records for the period considered were used.*

DISTRICT HONORED with "National Water and Energy Conservation Award" by the Irrigation Association. Executive Vice-President Wally Anderson (center) presents James Mitchell, Water District Board President (right) and A. Wayne Wyatt, District Manager (left), with this award for excellence in promoting water conservation.

District Receives Top Honors

This year's "National Water and Energy Conservation Award" from the Irrigation Association has been awarded to the High Plains Underground Water Conservation District No. 1. The award recognizes the Water District's varied and continuing efforts to promote water conservation in its 15-county service area in the High Plains of Texas.

Ongoing programs and services offered to irrigators which formed the basis for the award were the District's development of mobile field water conservation labs to conduct efficiency tests on irrigation systems; pump plant efficiency evaluations; soil moisture monitoring; and the pre-plant soil moisture survey that is conducted annually.

In addition to its agricultural work, the award committee noted that the District works closely with cities and towns in its area to assess their existing ground-water reserves and to evaluate the adequacy of those supplies to satisfy future needs. Urban water conservation awareness is also a priority of the District which is being addressed in every grade level in the public school system.

The award was established by the Irrigation Association three years ago to recognize significant achievements in the conservation of water and its related energy usage; to bring national recognition to individuals, firms or agencies working to conserve our natural resources; and to challenge those responsible for irrigation usage in agriculture or in landscape to reach

continued on page 4 . . . DISTRICT

Improved Efficiencies Attainable

According to a report recently published by the Texas Department of Water Resources, improvements of about ten percent can be made in irrigation application efficiencies. Since 1978 the irrigation application efficiencies of over 400 High Plains irrigators' irrigation systems have been tested in a cooperative program between the U.S. Department of Agriculture-Soil Conservation Service and the High Plains Underground Water Conservation District No. 1. The results of many of these efficiency evaluations have been documented in a report entitled, "Irrigation System and Pump Plant Efficiency Evaluations, 1978-1981," LP-191.

Irrigation application efficiency is the relationship between the amount of water pumped from the well and the amount of water that enters the ground and is stored in the plant root zone soil profile. Efficiency of application is hampered by losses incurred during the application of water such as: evaporation, irrigation tailwater and pipeline leakage.

In evaluations of 278 center pivot

continued on page 2 . . . EFFICIENCIES

MITCHELL DEEMED CONSERVATION PIONEER

"Water Conservationist of the Year" honors were recently bestowed upon James Mitchell, President of the High Plains Water District Board of Directors, by the Texas Water Conservation Association at their annual meeting in Dallas, Texas.

In presenting the award, Sam Collins, TWCA President, said, "He could be called a modern day pioneer in soil and water conservation. He is a true conservationist who has exceptional foresight and is not afraid of change. He considers his basic resources of soil and water as a trust and never forgets his responsibilities to the land. His influence on the conservation movement is so far-reaching it cannot be measured. Conservationists from arid regions across the nation and the world have been to his one-half section farm to observe his innovations in farming, and his ideas are being applied across the United States and in foreign countries."

Mr. Collins noted, "that with his limited water supply, he practically spoon-feeds each plant. He cannot afford to waste a drop. He uses gypsum blocks and tensiometers to check his soil moisture, insuring irrigation water applied in proper amounts and only when needed."

The Texas Water Conservation Association praised James Mitchell as a conservation leader, a civic leader and a leader in preserving agriculture on the High Plains for future generations.

TRUE CONSERVATIONIST honored as Sam Collins, TWCA President, presents James Mitchell with the TWCA "Water Conservationist of the Year Award."

DECLINES . . . (continued from page 1)

by the Soil Conservation Service (SCS) and the mobile field water labs provided by the Water District, 10 to 20 percent improvements in water use efficiency have been attained. This in turn has also reduced pumpage from the aquifer. Utilizing soil moisture information provided by the Water District and the SCS to determine preplant soil moisture needs and using soil moisture monitoring devices during the growing season to determine the quantities of water which need to be applied to the plant soil root zone has resulted in reduced over irrigation thus saving water for future use.

Selection of crop varieties which require less water as well as switching to crops such as grain sorghum instead of corn has also helped. Grain sorghum requires approximately 30 percent less water than corn. Maximum utilization of irrigation tailwater collection systems has resulted in a 20 percent or more savings of ground water by some irrigators.

Most farmers are currently utilizing one or more of these techniques and many are planning to incorporate more water saving practices into their farming operation as their economic conditions permit. Ultimately this will even further reduce the rate of depletion of the aquifer.

ALWAYS SMILING . . .

She's always smiling as you come in the front door and is more than happy to help you in any way she can. Carole Rosiak has been the "official greeter" for the Water District's Lubbock office for the past two years, but she does much more than that.

Carole began her service with the Water District in July of 1981 and has performed the duties of Secretary/Receptionist since that time. She processes all of the District's water depletion claims and assists the landowners and their accountants in getting the proper information for use in claiming their cost-in-water depletion deduction on their federal income tax returns. Carole also handles all of the associated record keeping for this program, which is no easy task, and assists all other staff personnel with their secretarial needs. She expertly handles the telephone calls coming into the office and makes everyone feel at home and welcome.

WARM AND WELCOME greetings are always extended to those who enter the District's Lubbock office as Carole Rosiak makes visitors feel at home.

A native of California, Carole and her husband, Jim, and son, David, now call Lubbock their home. The family moved here in 1978 and have "chosen to stay." Carole says, "the only part of California I miss is my mom and sister" who both still reside on the West Coast.

Carole says she loves her job and the people she works with at the District. She is now looking forward to a more involved and challenging role as Executive Secretary to the District's Manager. Being a talented and creative lady, we all know she'll do an excellent job.

EFFICIENCIES . . . (continued from page 1)

sprinkler systems an average application efficiency of 83 percent was shown. Thirty-three side roll sprinkler systems showed an average application efficiency of 74 percent and 98 furrow irrigation systems had an average application efficiency of 81 percent.

The combination of the 409 systems evaluated including furrow, center pivot sprinkler and side roll sprinkler systems had an average application efficiency of 82 percent. Upon completion of the recommended improvements, some of these systems were re-evaluated and it was found that the average application efficiency had been improved to an average of 88 percent.

Furrow irrigators changed their irrigation procedures to upgrade efficiencies by shortening the length of the irrigation run, installation of additional pipeline, utilization of surge irrigation systems, and modifications in the time duration of furrow waterings. Testing procedures have been implemented by the sprinkler irrigation industry to assist sprinkler irrigators in upgrading existing system efficiencies. In designing new systems, manufacturers are now making sure that they have proper data on well yields, line pressures and nozzle sizes.

Uniformity of water distribution in the plant root zone throughout the field was also evaluated. Some center pivot sprinkler systems showed inefficient distribution of water in the soil profile resulting from uneven applications due to worn sprinkler nozzles, reduced line pressures and lower well yields than the systems were originally designed to handle. This type of uneven distribution was also found for some side roll systems and in most instances was more severe due to the aging of these type systems.

Unevenness of distribution occurred in some furrow systems in the upper and lower ends of the field as a result of water penetrating below the root zone area. In addition, irrigation tailwater losses at the low end of the field reduced efficiency. Irrigation tailwater losses in furrow irrigation systems were generally recaptured and reused through irrigation tailwater return systems. The efficiency evaluations did not, however, credit the systems with the water which was returned to the field for use. In the middle of the field, the entire root zone area was not evenly wet as compared to the rest of the field in furrow irrigation.

Copies of the report, "Irrigation System and Pump Plant Efficiency Evaluations, 1978-1981," LP-191 can be obtained free of charge from the Texas Department of Water Resources at P.O. Box 13087, Capitol Station in Austin, Texas 78711, or from the High Plains Water District in Lubbock.

"Rain Saver" Added Dimension

High Plains irrigators try their best to conserve the waters of the Ogallala aquifer by adopting the latest technologies available, controlling their tailwater losses, and determining their soil moisture so they will know when and how much irrigation water they need to apply. They are also constantly coming up with new ways of harvesting that moisture which is supplied at infrequent times and in some cases in limited amounts by Mother Nature. Farmers are very rapidly adopting the use of furrow dikers to build small dams in their furrows to hold precipitation in place on their land and thereby make the most beneficial use of one of the least expensive watering methods available to them. But, cost effective and efficient as furrow dikers are, one West Texas farmer was not just satisfied with that. He continues to seek additional ways to be even more efficient.

Mr. Don Bell, Mayor of the City of Wolfforth, past Lubbock County Committeeman for the High Plains Water District, and an irrigation farmer in Lubbock and Hockley Counties has added an extra dimension to his furrow diking operation which enhances the capture and beneficial use of rainfall in the early spring prior to planting. Don affectionately calls the device "a rain saver."

The "rain saver" is a metal shoe which attaches to a cultivator footpiece on his furrow diking equipment. It rides along the top of the bed and cuts a miniature valley right in the top of the bed. Don states, "if it rains, it holds water right where the seed will be planted and gives this water time to soak into the soil." He adds, "This is the third year we've run them. Of course, last year we didn't get any rain before planting. The year before last, down at our place by Posey where we have a real flat farm, it got so wet we almost never got in to plant. That year my neighbors had all planted and their crops were coming up before it got dry enough for me to plant. But at harvest time, my yields were up and I felt like it was at least partially due to the additional moisture I had at planting time."

Don indicates that it is hard to judge just how much water the "rain saver" will hold, but he feels that any water it holds will help get the water into the soil root zone area and may just give him the edge he needs to get his crop established.

The "rain saver" may not be suitable for all types of soils and slopes. It appears to be most effective on flat farms with heavier loam-type soils. It might not prove advantageous on

continued on page 4 . . . "RAIN SAVER"

"RAIN SAVER" cuts miniature valleys in the top of the beds to harvest additional rainfall.

"How To" Guide To Operating Surge Irrigation Systems

By RICK SCHLEGEL

EDITOR'S NOTE: *Rick Schlegel is the Irrigation Engineer for the Soil Conservation Service office located in Pampa, Texas. The information presented below pertains primarily to the heavier Pullman-type soils found in the northern parts of the Water District's service area. The May edition of the Cross Section will provide similar information developed by Greg Sokora, Area Engineer for the Lubbock Soil Conservation Service office for the sandier-type soils found in the southern part of the Water District's service area.*

Surge irrigation is the intermittent application of water to land with the flow being in the form of surges. In furrow irrigation, this is most commonly practiced by using two independent irrigation "sets" that are interconnected with an automated surge controller and two "sets" of surface pipes.

The purpose of the automated surge controller is to switch the flow of irrigation water from one set to the other set at predetermined times (referred to as half-cycle times). A definition of half-cycle time is the time the water is allowed to flow on one side of the surge controller before it is switched to the other side of the surge controller. Surging back and forth from one set to the other set at these predetermined times will increase the rate that water advances down the furrows as compared to continuous flow irrigation. This increased rate of advance is due to a lowering of the soil intake rate of the furrow and also to an additional advance of water down a set after water has been switched to the other side. With an increased rate of advance, water is distributed more evenly down the set of furrows.

The primary purpose of this guide is to provide irrigators with practical alternative methods of field operation of surge irrigation systems that will result in desired water savings. Three basic methods will be presented. The half-cycle times that are needed to provide proper management will be determined by using the field methods as described.

Alternative No. 1
Variable Time-Constant Distance Method

This method appears to be the most efficient and effective method of surge irrigation based on area Soil Conservation Service field experience and research done at Colorado State University. This is especially true on run lengths in excess of one-quarter mile. Not all equipment available today has the capability of automatically utilizing several different surge half-cycle times needed for practical use of this method. This method will probably be used more frequently when more surge controllers have been developed with this capability.

1. Set up two irrigation sets with a surge controller interconnecting the two sets. This should be done preferably at the edge of the field to be watered that has the easiest access down the length of the field. Use the same size sets you normally use.
2. Measure off and flag points down the length of the set at 100 foot intervals, beginning at the upstream end of the furrows and ending at the downstream end.
3. Begin surge irrigation.
4. Allow water to advance down furrows on one set until approximately 75 percent of the furrows have advanced 300 feet, then switch water to the other set and follow the same process. The time that is required to do this will be the initial half-cycle time that will be used on the rest of the field.
5. During the second surge, allow water to advance down the previously wetted furrows and then allow it to wet up an additional 300 to 500 feet of dry portion of the furrows. The time that is required to do this will be the second half-cycle time that will be programmed into the controller to be used on the remainder of the field.
6. Continue this process of determining consecutive half-cycle times by wetting up a constant amount (300-500 feet) of dry furrows with each surge until the water has advanced to the end of the field. (Manual adjusting of various furrow flow rates will usually be needed to keep all rows advancing at the same rate.)

SURGE CONTROLLER box switches the water from one set to the other set on predetermined half-cycle times.

7. After the water has reached the end of the field, a reduced half-cycle time should be programmed into the controller. This half-cycle time will be set such that water will advance down the wetted furrows to a point approximately three-fourths of the distance down the field. At this time, the water should be switched to the other set. This will be the final half-cycle time. Ideally, the remaining water in the furrow after switching will continue to advance to the end of the rows. If it fails to do this, the final half-cycle time should be increased until it does. This final half-cycle time will allow you to add additional layers of water to the furrow at a very even distribution rate while greatly reducing tailwater.
8. Use these established half-cycle times on the remainder of the field if row conditions and lengths are similar.

Alternative No. 2
Constant Time-Variable Distance Method

This method is most efficiently used on lengths of runs of one-quarter mile or less or when the surge controller does not have the capability of automatically utilizing several surge times.

1. Set up two irrigation sets with a surge controller interconnecting the two sets. This should be done preferably at the edge of the field to be watered that has the easiest access down the length of the field. Use the same size sets you normally use.
2. Measure off and flag points down the length of the set at 100 foot intervals, beginning at the upstream end of the furrows and ending at the downstream end.
3. Begin surge irrigation.
4. Allow water to advance down furrows to approximately one-fourth the length of the total run length. Use this time for your trial single half-cycle time.
5. Using a single constant cycle time will result in a lessening amount of dry furrow being wetted with each surge. The amount of dry furrow wetted up with each surge should be approximately 75 percent of the amount of dry furrow that was wetted up on the previous surge. Keep up with this and if about 75 percent of the previous wetting of dry furrow is not accomplished on the current surge, increase the single half-cycle time by one-half hour intervals until this is accomplished.
6. There is one big disadvantage with using a single half-cycle time. Once the rows are out, the single half-cycle time that was required to get the water out will result in excessive amounts of tailwater being pumped. Ideally, one should go back after the rows are out and manually reduce the half-cycle time to the time required to travel a distance of approximately 75 percent of the row length as described in Item Number 7 of the previous method. The system should then be allowed to surge until the desired amount of water has been supplied.
7. Use the established single half-cycle time and the final half-cycle time on the remainder of the field if row conditions and lengths are similar.

Alternative No. 3
Automated Cutback Method

This method will utilize a portion of either Alternative No. 1 or Alternative No. 2 to accomplish rate of water advance down the rows. The difference in this method is that the number of rows per set will be altered.

1. Set up two irrigation sets with a surge controller interconnecting the two sets. This should be done preferably at the edge of the field to be watered that has the easiest access down the length of the field.
2. The big difference between this method and the first two methods is that the number of rows set on each side will be only one-half to three-fourths the number of rows normally used. The purpose of this is to increase the flow rate of each individual furrow thereby giving an even faster rate of advance. One must be careful, however, to maintain a non-erosive furrow stream. This method, as indicated by field experience, works best on higher intake soils or on extremely long lengths of runs and may not be an asset on normal run lengths for low intake soils.

ONE HALF-CYCLE time completed, the surge controller switches the water to the other side and wets another set of furrows before switching back to the original set of furrows.

3. Begin surge irrigation.
4. Follow either Alternative Method No. 1 or Alternative Method No. 2 as described previously until the rows are out. Using the increased furrow stream, however, requires a very short half-cycle time on the final surge after the rows are out to prevent excessive tailwater. Normally, the final half-cycle time would be set to switch when the water reached approximately three-fourth of the total row length. Alternately, after the initial surges, get the rows out (when cross slope will allow for uniform furrow streams), open both surge vales and irrigate through both sides of the surge equipment for the remainder of the set
5. Use this method with established half-cycle times on the remainder of the field.

When using any of these methods, it is extremely important that one realizes that in most cases, the surge sets will need to be allowed to run a longer length of time than what normally has been done with continuous irrigation after the rows reach the end of the field. This is necessary in order to make the water application that will meet the needs of the crop. This is true unless only a light application is desired. This is especially the case when low intake rate soils, such as Pullman soils, are being irrigated. If the proper amount of water is not applied, even though one may have watered to the end of the rows, crop yields will suffer.

Irrigators really need a full understanding of their soil moisture needs to effectively use surge irrigation. An excellent and field practical method of monitoring and understanding soil moisture needs and conditions is through the use of gypsum blocks in water management programs.

Any questions or further assistance needed can be obtained by contacting your local Soil Conservation Service Field Office.

Whose Obligation Is Soil And Water Conservation?

By DR. A. W. YOUNG *(Retired), Department Chairman*
Plant and Soil Sciences, Texas Tech

It has been said that "charity begins at home." It can also be said that the solution of many of our problems begins at home.

Not long ago a report indicated that thirteen public hearings, 182 personal interviews, and more than 100 written responses in the form of public input to amend the Texas Water Plan were recorded. Numerous articles appear in local and national magazines on the erosion of our lands. In most cases the solution to our soil and water conservation problems involve some form of funding by state or national money sources. Too many people want to live as they please and if a crisis of special need arises they call for help.

This spirit of helplessness was not one of the motivating forces of our forefathers as they settled and developed our agricultural lands. They had to set their priorities on the assumption that the individual had to meet and solve the crisis by himself or at best with the help of his neighbors. With this situation the operator of the farmland recognized that proper care be taken to prevent a crisis.

In more recent years, following the World War II demand for increased production of food and fiber, short cuts in good land use and water conservation practices were taken to increase production. After the war, the size of farms continued to increase with many operators paying less attention to good management and soil and water conservation.

The farm operators and land owners have an obligation to apply good land use and water conservation practices on every acre of land under their control. Adequate technical assistance from the Soil Conservation Service and the Water Conservation District offices and other agencies is available to the land owners and operators to allow them to plan adequate protective programs for their particular farms. Such plans should be reviewed frequently for every acre of cultivated and range land. Following a good land use and conservation program could tend to eliminate some of the crises which arise when the land is literally mined or exploited without due consideration for conservation.

When one visits the successful farmers in the area who own their farms and have operated them for periods of years in the majority of cases these farmers have both good soil and water conservation programs and considerable crop diversification. Too often the one crop system of farming does not lend itself to an adequate program of soil and water conservation.

The common operation of large acreage production, in many cases the terraces and contours have been destroyed to accommodate the fast moving large scale machinery. Thus, in order to cut the man-hour cost for tillage, the soil and water conservation practices are largely neglected giving rise to more loss of rainfall by runoff which carries with it the top soil. This leads to sheet, rill and gully erosion with the more severe rains. Also the loss of the rainfall by runoff reduces the crop producing potential below the potential when the water is held on the soil until it penetrates the root zone of the plants. Each soil loss by sheet erosion removes soil nutrients and leaves the soil less productive. If our country expects to maintain the crop producing capacity of our land each farm operator must use suitable land use practices to prevent soil and water erosion losses. These practices are available and can be maintained on the land largely within the day to day operations.

Perhaps it is time to seriously re-examine the philosophy and operational management of the successful farmers who have continued to operate and live on the land with less dependence on state and national assistance in times of unfavorable crop production conditions.

It is recognized that many allied problems are involved in solving the soil and water conservation problems. Not the least of these problems is the fact that much of the land is operated by non-landowners who tend to "mine" the soil in order to produce the largest returns with the least expenditure of money.

RANDY UNDERWOOD

"RAIN SAVER" . . . continued from page 2

sandy soils where the extra plow could cause the break up of clods and increase wind erosion problems. Additionally, on slopping soils the "rain saver" might provide a runoff channel for water, whereas without them this water could be captured in the furrow dikes.

The "rain saver" is, however, an additional invention of the West Texas farmer which has the potential to provide better soil moisture for his crops for a limited investment. The cost of the units is fairly minimal, about $25 per row. The equipment is made to fit on a standard sweep foot-piece that is attached to the draw bar used to mount the furrow diking equipment.

The inventiveness of the West Texas farmer is truly amazing, but it all comes back to the fickleness of Mother Nature. As an added dimension to his farming operation, Don states, "If it rains, it's real good. If it doesn't rain, it's just like all of our other efforts—wasted."

Underwood Takes Reins

Taking the reins as the new District Conservationist for the Lubbock County Soil Conservation Service is Randy Underwood. Randy is an agronomist with more than ten years service with the Soil Conservation Service.

Starting out in 1974 with the Hereford SCS, Randy moved from there to Iowa Park in 1975. He then transferred to Spur as District Conservationist in 1978 and from there took a new assignment in Amarillo as a member of the newly created Irrigation Water Management Team. With the other members of the water management team, Randy served over 30 counties in the High Plains of Texas helping irrigators with their irrigation application and water management decisions.

Randy states, "The basics of soil and water conservation are the same, you just have to fine tune them to fit the area" and that is exactly what he anticipates doing in the Lubbock area. With his extensive background in the High Plains area, Randy should do a fine job.

DISTRICT . . . continued from page 1

for and achieve a higher level of excellence.

Mr. Wally Anderson, Executive Vice-President of the Irrigation Association presented the award to Mr. James Mitchell, President of the Water District's Board of Directors. In presenting the award Mr. Anderson noted, "The District's whole program is so strong and comprehensive," and the District has done "a very excellent job" of employing and teaching water conservation methods.

RAIN SAVERS have been used on the field at right as can be seen by the indention in the top of the bed. This compares to the field at the left showing standard beds. This small indention in the top of the bed will hold precipitation until it soaks into the soil.

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
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THE Cross SECTION

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LISTENING CAREFULLY, Senator Bill Sarpalius (center), Rep. J. W. Buchanan (left) and Rep. Chip Staniswalis (right) accept testimony from local residents regarding soil and water conservation as well as predatory animal control.

GYPSUM BLOCKS REVEAL "WHAT'S HAPPENING"

As producers wind up their pre-plant irrigations, they begin to look forward to planting and getting their crops established. Their thoughts turn to the amount of stored soil moisture which is available for their crops during that crucial germination period and throughout the growing season. There are numerous tools available which can help producers make informed irrigation decisions based on soil moisture conditions and the rate at which moisture is being depleted from the root zone by crop use and evaporation. One tool is the gypsum block used with a conductance meter.

"One year's experience taught me how to read them," indicates Wendell Morrow, a Lynn County farmer and former member of the High Plains Water District's Lynn County Committee. Morrow has used soil moisture gypsum blocks and conductance meters for the past three years and plans to install them on his land in northwestern Lynn County again this year. Morrow states, "I should have listened to them a lot better last year. Most of my land had been watered after the tenth or so of August and it was getting close to shut off time. The blocks kept reading dry indicating to me that I needed to irrigate, but I kept insisting it was going to rain so I didn't water. I found out later that I should have irrigated. A few days with a little bit of moisture makes a big difference. I did crank back up on one field about the 20th of August and it made quite a bit of difference in yield."

Alvin Morrison, a Crosby County farmer and previous member of the Crosby County Committee for the Water District explains, "They give me a picture of what is happening from planting to harvest. We put them in at one, two, three and four foot levels.

BLOCKS . . . continued on page 2

Local "Hands-On" Demonstrations

There are many methods used to educate the public to new ideas and new technologies. Printed news articles, television, your local radio station and specialized publications are all excellent sources of information on new concepts. However, nothing beats actual hands-on testing to learn how to use new tools and determine whether or not such new technology could be of value under a specific set of circumstances.

In an effort to provide irrigators with hands-on water conservation information and introduce producers to the new tools which are available to help with farm management decisions, the USDA-Soil Conservation Service and the High Plains Underground Water Conservation District No. 1 are conducting community field days. During these days out in the field, SCS and Water District personnel demonstrate state - of - the - art water conservation techniques and equipment. Basically, the idea is to display the best water conservation techniques and equipment on a producer's farm in a local community and invite local landowners and/or operators to come by and see these techniques and the equipment

HANDS-ON . . . continued on page 4

Legislative Committees Receive Local Input

In efforts to receive local citizen input and provide an opportunity for residents of the High Plains to identify problems and needs, Agricultural Subcommittees of the Texas Senate and House met in the High Plains during April 1984. The Agriculture Subcommittee of the Senate met in Amarillo on April 10 to receive testimony on soil and water conservation and the control of predatory animals. The House Subcommittee met on April 16 in Lubbock to hear comments related to the economic feasibility of the utilization of water efficient crops and the conversion of irrigated land to dryland farming.

Senator Bill Sarpalius, Chairman of the Senate Agriculture Subcommittee was assisted in receiving testimony during the Amarillo hearing by Representative Chip Staniswalis and Representative J. W. Buchanan. Senator Sarpalius noted that the purpose of the hearing was to gather information and learn more about local problems. He further explained that the testimony presented during the hearing would be compiled into a report and provided to the Legislature prior to the next regular session to assist the Legislature in dealing with area problems.

Extensive testimony was heard by the Subcommittee on the activities and accomplishments of the Texas Soil and Water Conservation Districts. Sunset review of the Texas Soil and Water Conservation Districts is being conducted this year by the Legislature. Harvey Davis, Executive Director for the State Soil and Water Conservation Districts, testified that soil and water conservation districts are unique and have been very successful in achieving soil and water conservation throughout the state through local cooperation and direction.

Testimony dealing with research and development programs being conducted in the High Plains area which are designed to extend the life of current water supplies and increase the supply of available water were also heard by the Subcommittee. Jim Conkwright, member of the Board of Directors of the High Plains Water District testified to the Subcommittee regarding several of the programs being carried out by the Water District in cooperation with other agencies and universities. Secondary recovery of ground water, playa lake recharge, irrigation application efficiency testing and development of new irrigation technology were items which Mr. Conkwright detailed.

Members of W.I.F.E. (Women in Farm Economics) discussed individual cases of the effects of the depletion of the Ogallala aquifer on their farms and encouraged the Subcommittee to do whatever possible to assist irrigators in conserving and extending the areas' water resources. Jack Shelton, President of the Texas and Southwestern Cattle Raisers Association presented testimony regarding the private rights of landowners and stressed to the Subcommittee that retention of these rights must be preserved.

In Lubbock, the House Subcommittee which was chaired by Representative Steven Carriker heard testimony from landowners which dealt with the economic effects of conversion from irrigated to dryland farming as well as methods of maintaining or increasing production from current dryland farm-

LEGISLATIVE . . . continued on page 4

DISTINGUISHED PANEL chaired by Rep. Steven Carriker (center) receives input from farmers, farm experts and state and local agency officials as to the economic squeeze being placed on farmers by rising energy costs and low commodity prices.

BLOCKS REVEAL . . . (continued from page 1

I had one set of blocks on cotton and one set on peanuts last year. Throughout the year, moisture was being taken from all depths in my cotton. Peanuts on the other hand, have shallow roots, 18 inches to two feet, and the plants need water in the root zone all during the fruiting season. We could not allow our moisture level to drop in the top station to five (the meters read from zero to ten). Stress showed on the peanuts if it did drop to five or below.

"Blocks are an educational tool. I would like to put blocks on every field this year. With farming the way it is, we need all the information we can get; everything including moisture, entomology, fertilizers, improved efficiency in our pumps . . . The more information we can get the better job we'll do."

Soil moisture gypsum blocks, which are inch-long porous cylinders imbedded with lead wires, are installed after emergence of the crop. They are buried in the soil root zone at one-foot intervals to a depth of four feet. Readings taken with a conductance meter which measures electrical resistivity, will indicate to the producer the amount of moisture currently available in his soil profile. Electrical resistance varies with the amount of moisture in the soil. Readings taken over a period of time will show the producer how rapidly his crop is using the moisture.

CUT AWAY version of gypsum block reveals the lead wires which are imbedded in the block. Lead wires are extended to land surface to attach to the conductance meter.

Once information on current moisture levels and the rate of use by the plant are known, decisions as to when to irrigate and the amount of water which needs to be applied can be made.

Readings taken on a weekly basis are recommended until the crop is established. For example, in cotton the blocks need to be read once a week until first bloom. After the first bloom, readings should be increased to two times per week. For grain sorghum and corn, the blocks should be read on a weekly basis until the crop is about knee high, then the frequency of readings should be increased.

Ken Carver, Division Director for the Water District indicates, "The key to use of the blocks is making enough readings to know what happens to your soil moisture as your crop developes. We recommend that an irrigator make readings before irrigation and a few days after he finishes irrigating. These readings will indicate to him how much soil moisture was added. Later readings will give him an indication of how much water the crop is extracting on a daily basis. The irrigator then will have a good idea as to how long the soil moisture in the root zone will supply the plants' water needs."

"The first year we used blocks," relates Morrison, "the Water District put out the blocks for us and kept the records. Last year I kept the records and read the blocks. We planted cotton and after planting, readings showed full moisture profiles at all stations, but I felt the cotton needed water to get it established. It really needed a good rain to get it off to a start and get the roots down to where they could draw the moisture we had. We irrigated to replenish the top level but we didn't get 100 percent effective irrigation.

"After our first irrigation, the moisture level in the top station was pulled down to zero, the second station to zero, the third station was pulled down to four and the bottom station still showed ten before we watered again. I was really surprised by what the blocks showed on cotton and the picture of my soil moisture profile that developed through the year. Final readings were: zero at the top station, zero at the second station, 2.5 at the third station and 7.5 at the bottom station when the early season freeze came last year. After the freeze I abandoned my blocks. Then the rains in October came.

"After the first rain, our top station went to 10, the second, third, and fourth stations stayed the same as they were before the rain. The next rain brought the readings to 10 in the first and second stations and the other two stayed the same. We finally got all four stations to ten again as the rains continued. That was the picture I got." Wendell Morrow relays similar circumstances noting, "After a rain, moisture levels came up, but the blocks did not show to be as wet as we thought it should be."

Ken Carver notes, "First time moisture block users need to watch their readings for a time or two and then they will see a pattern developing of how long it takes to dry out the root zone profile. Additionally, irrigators will be able to monitor the effects of rainfall on their soil moisture such as that related by Mr. Morrison and Mr. Morrow.

"One of the biggest decisions made by most irrigators is to decide whether or not to apply one more irrigation before they shut down their wells in late summer. If they have used blocks and recorded the data, then they will have the information necessary to base this last decision upon."

It is recommended that the blocks be experimented with for one year, then used again the next year before deciding whether or not they fit a particular farming operation. There is a great deal of experience gained during the first year's use which will show patterns and trends which may be used to more effectively irrigate the next year. The moisture blocks help the irrigator to determine what is actually happening in his root zone soil moisture profile and to see from what depth his crop is extracting moisture as well as how much they are extracting.

CONDUCTANCE METERS read electrical resistivity. The electrical resistivity indicates the percent moisture in the soil. The higher the meter reading, the greater the soil moisture.

Gypsum Blocks Available Locally

The High Plains Underground Water Conservation District and the local Soil and Water Conservation Boards have joined to provide a local source for purchase of the soil moisture gypsum blocks and meters necessary to read the blocks for landowners and/or operators in the High Plains Water District's service area. Heretofore, the only retail outlet for purchase of the blocks that the District staff was aware of officed in New Jersey. Orders through this agency had an approximate three week turn-around time from order to receipt of delivery.

The Board of Directors of the High Plains Water District discussed this turn-around time and the pace at which the meters and blocks are being tried and incorporated into farming practices in this area. The Board Members decided that a local supplier for the blocks and meters would encourage irrigators to try them. Contact was made with the Texas Soil and Water Conservation District Board and a cooperative program was established.

Producers who have previously used the gypsum blocks and meters have reported reduced water pumpage and reduced fuel bills. The blocks are a tool by which a landowner or operator may get a picture of his soil moisture profile, the rate at which his moisture is being used by the crop and then schedule his irrigations accordingly.

Anyone interested in purchasing and using the moisture blocks and meters should contact your local High Plains Underground Water Conservation District office or your local Soil and Water Conservation District Board. The Soil and Water Conservation Districts usually office at the USDA Soil Conservation Service field office. If these local offices do not currently have the equipment, please contact the Water District's Lubbock office at 2930 Avenue Q in Lubbock, Texas 79405, or telephone (806) 762-0181.

Tensiometers Gauge Soil Moisture

by Dale McCary,
Soil Conservationist,
SCS Muleshoe

Clarence Kube and his son Weldon saved one watering during the 1983 growing season by using tensiometers. That meant a five to seven hundred dollar savings. These producers jointly operate about six hundred and fifty acres northwest of Muleshoe.

Their meters were made available by the Muleshoe office of the Soil Conservation Service. The SCS, in cooperation with the High Plains Underground Water Conservation District, is making a limited number of meters available for loan to irrigators throughout the area who will install the tensiometers. The Water District requests those who use the moisture monitors to keep accurate records for future studies.

A tensiometer works the same way a plant root does; the dryer the soil around the meter tip, the higher the gauge reading. By reading the gauge, the farmer can graph the amount of water available to his crop. He can then determine the time and amount of water to apply.

"With the use of the tensiometers," explained Weldon, "I was able to water every other row instead of each one."

"Using the meters requires very little time," Clarence Kube stated. "I spent about ten minutes every day driving to the field and taking the readings. Usually I wrote the readings on a slip of paper then graphed them when I had time."

Tensiometers are more effective if used in groups of two or three. They should be placed above and below the average root zone. In this manner, a producer can tell how much water is in these areas.

TENSIOMETERS . . . continued on page 4

Management Required For Surge Use

By GREG SOKORA

EDITOR'S NOTE: *Greg Sokora is the Area Engineer for the Soil Conservation Service area office located in Lubbock, Texas. As promised in the April, 1984 edition of the Cross Section, information on the operation of surge irrigation systems in the southern part of the Water District's service area and on sandier soil types is presented below.*

The recent publicity relating the advantages of surge irrigation over conventional continuous-flow furrow irrigation has lead to the purchase of surge time control valves by many area irrigators. Field trials conducted by Soil Conservation Service and High Plains Underground Water Conservation District No. 1 personnel last year show that surge irrigation will improve the distribution of the water down the furrow in most cases, and will allow the irrigator to control the amount of water he wishes to apply even in small applications. An increased level of both sides of the valve are needed for use in the calculations to accurately compute gross application.

Selecting the proper furrow stream will greatly affect the distribution of water down the furrow. To get an even distribution, the water must reach the far end of the field as quickly as possible. This will provide each point along the furrow with approximately the same opportunity time. Opportunity time is the total amount of time water stands on the soil surface and thereby infiltrates into the soil. To obtain this rapid advancement, an adequate furrow stream must be provided. As a minimum, the furrow stream should be twice the length of the field divided by 100 feet. A quarter-mile row would need a minimum of $\frac{2 \times 1320 \text{ feet}}{100} = 26$ gallons per minute. This flow rate works on reasonably smooth furrows such as those on which a "bullet" has been run. If

ANOTHER PERSPECTIVE of the surge valve shows the conclusion of one half-cycle time to the left as the second half-cycle time begins on the right.

irrigation water management will be required, however, for an irrigator to reap all of these benefits. There are several steps involved in increased water management.

The first step is knowing the amount of water to be applied with each irrigation. The irrigator needs a full understanding of his soil moisture conditions to effectively use surge irrigation. There are several methods for monitoring soil moisture including: gypsum blocks, tensiometers, the feel method, the volumetric method, neutron moisture monitoring probes and private consulting.

The next step is a knowledge of how to adjust irrigation times and sets to apply the needed amounts of water. An irrigation stream of 450 gallons per minute will apply one inch of water on one acre in one hour. If an irrigation well is producing 600 gallons per minute, and this amount of water is applied to 40 one-quarter mile rows for 12 hours, this would apply a four inch gross application. The calculation of gross application is:

$\frac{600 \text{ gpm} \times 12 \text{ hrs.}}{450} = 16$ acre inches;

$\frac{40 \text{ rows} \times 40 \text{ inches} \times 1320 \text{ ft}}{12 \text{ in/ft} \times 43560} = 40$ acres;

$\frac{16 \text{ acre inches}}{40 \text{ acres}} = 4.0$ inches.

When using surge, the total area watered on both sides of the surge valve and the total time allowed on the furrow is cloddy, trashy or cracked, the furrow stream will need to be increased.

A good starting point for selecting a surge half-cycle time would be one hour. This one hour half-cycle time seems to work well on quarter-mile rows which are reasonably level. If the rows are shorter or longer than one-quarter of a mile, then the surge half-cycle time will need to be adjusted proportionately. A longer half-cycle time might be required due to deep breaking or deep chiseling. The proper half-cycle time will advance the water approximately one-third to one-half the length of the entire furrow with the first surge.

Once the rows are watered out to the end of the field, the surge time generally needs to be adjusted. Continuing use of the same half-cycle time as used to get the rows out to the end of the field generally will result in excessive tailwater runoff. Ideally, the second half-cycle setting time used after the rows are wet out to the end of the field would be the time required for the water to travel from one end of the field to the other. This is generally about one-half of the beginning time control setting. This adjustment can be made automatically with some of the newer types of surge equipment. Some of these units have a controller that can be set for different half-cycle times for a variable number of surges

MANAGEMENT . . . continued on page 4

INTERNAL WORKINGS of a surge time control box shown close-up. Surge count shows the number of surges completed, time set is the length of each surge in hours and minutes and remaining time indicated is the time before the current surge is completed. These all help the irrigator manage his uniformity of application.

Surge – "A New Wrinkle"

"I used to use siphon tubes out of my ditch and water about eight rows for 12 hours," recalls Wendall Morrow a farmer in northwestern Lynn County and former member of the Lynn County Committee of the High Plains Water District. "Now with the surge system I use one and a half hour half-cycle times, watering seven rows on each side of the surge valve or 14 rows in the field. It still takes about 12 hours to complete the watering, but I cover twice the rows I used to.

"My neighbor, Ronald Wyatt, and I were visiting about surge one day and I had figured that to put in a surge valve I would need to buy a lot of gated pipe. Ronald said he was going to try running a surge unit using his ditch and just cutting out the ditch on the rows he wanted to water. I decided to try it.

"I run my flow line for approximately half the distance of the ditch I am covering, then tie in with the surge valve. I work one line of the surge into the lower end of the ditch. I use the other side of the surge unit to move the water to the top end of the field and into the ditch. I control the evenness of the flow in my furrows by either removing more of the ditch at the top end of the furrow or packing some dirt back into the ditch to slow down the flow. To move up my field with my water, I just put in ditch stops.

"I like the open ditch because it reduces the amount of labor required. With pipe there is a lot of changing; moving pipe that you don't have to with a ditch. My ditch losses are probably about ten percent. The ditch seals off just like the furrows do. After a surge or two, it takes less time to fill the ditch than at the start. It is as easy to cut out the rows as it is to move gated pipe or use siphon tubes."

Surge irrigation out of an unlined irrigation ditch may not be as efficient as using underground line and gated pipe and Morrow would be the first to admit it. But it does help him extend his limited water supply and reduce his fuel costs by doubling the number of rows he can water in his 12 hour sets.

WRINKLE . . . continued on page 4

DIGGING OUT HIS DITCHES, Wendell Morrow adapts the use of a surge valve to his open ditch irrigation system.

ONE VALVE of the surge system moves water to the low end of the field, while the other valve moves water to the top end. The ditch stop in the upper right hand corner divides the ditch into halves.

LEGISLATIVE . . . continued from page 1

ing operations. Examples cited included residue management and conservation tillage. James Mitchell, Water District Board President, shared his experiences in adjusting to a declining water supply. Mitchell noted, "The process of converting from full irrigation to limited irrigation is a multi-stage process." Rex Caldwell, a Swisher County dryland farmer, noted that he and his father had a successful program of conservation tillage and residue management that provided wind and water erosion control.

Technical representatives from various agencies and universities discussed the importance of the High Plains region of the state in agricultural production and the value of this production to consumers of the state and nation. Dr. Herb Grubb, Principle Planner for the Texas Department of Water Resources in Austin, testified, "In 1981 there were 8.2 million irrigated acres in the 12 major areas of the state of Texas in which irrigation is concentrated. Water use for irrigation accounts for $1.7 billion of food and fiber production over and above what could have been derived from dryland farming operations on the same acres. Irrigated agriculture's impact on the non-farm sector is 2.1 times the value of products from the farm, thus amounting to about $3.7 billion of indirect value of production in other industries for 1981. The economy-wide business effect of marketing and processing agricultural commodities is an additional $2.50 to $3.00 per dollar of agricultural commodity."

Testimony was also given regarding the research and development currently in progress to identify and promote water efficient crops. Some crops were identified that are water use efficient;

TESTIFYING before the Senate Agriculture Committee, Jim Conkwright describes Water District research activities.

however, most have a limited market which is a deterrent to production. The Subcommittee was encouraged to do whatever possible to stabilize and expand both domestic and export markets for High Plains commodities.

Additionally, the Subcommittee heard testimony regarding the lack of financial incentives to irrigators to purchase and install the newest, most efficient water management equipment available. Mack Hicks, Water District Vice-President, testified, "We are making all the conservation improvements that are economically feasible. The key to that statement, however, is economically feasible."

During the course of the afternoon, more than 40 farmers, farm experts, research scientists, and state and local agency officials testified that of the 12.8 million acres of farm land in the High Plains, more than half had always been farmed dryland. Testimony attempted to impress upon the Subcommittee the extent of the economic squeeze being placed on dryland farmers as well as irrigators due to rising production costs and low commodity prices.

MANAGEMENT . . . continued from page 3

then automatically change to a new half-cycle time.

While surge irrigation will usually allow the irrigator to water more rows in the same amount of time, it is important to realize how much water is being applied. Normally, the rows will be out to the end of the field sooner, but to apply the appropriate amounts of water, several more surges may be needed to refill the soil profile to the point desired by the irrigator in his management scheme. An irrigator might need to experiment with several different surge times and furrow streams to achieve the results he is hoping for from surge irrigation.

TENSIOMETERS . . . continued from pg. 2

"In August my milo looked stressed and normally I would apply water at that growth stage. But the one foot meter showed plenty of water and the two foot meter was stable so I was able to delay my watering for five days," Clarence commented. "Also when my corn reached the dent stage, I would have applied water but the two foot tensiometer saved me that irrigation."

If you are interested in more information about using tensiometers or other moisture monitors, contact your local SCS or Water District office.

HANDS-ON DEMONSTRATIONS . . . (continued from page 1)

in operation. Soil Conservation Service and Water District personnel are on hand during the entire day of the demonstration to explain the advantages of improved irrigation technologies and answer producers questions about the use of these new technologies.

The latest and best in water conservation techniques and equipment are on display for local landowners' inspection and hands-on testing. The mobile field water conservation mini-labs which are used to test irrigation application efficiencies are available and SCS personnel are there to explain the use of all the equipment in these mobile labs. Additionally, soil moisture monitoring equipment including gypsum blocks and conductance meters, tensiometers, and neutron moisture probes are available for inspection and use. The Water District personnel have on hand a pump plant efficiency testing unit and perform an actual efficiency test on the landowners well. The results of the pump plant energy use efficiency test are right there on the site for interested parties to look at and discuss with Water District personnel.

Thus far, water conservation information days have been performed at the Hockley County Gin farm near Levelland, the Gilbert Fawver farm located just outside of Floydada; and at the Funk Seed Farm located north of Idalou. The SCS and Water District plan to continue these local community field days throughout the growing season. If there has not been a water conservation field day in your area thus far, watch your newspaper or listen to your local radio station for details of the field demonstration day to be held in your area.

UNDERSTANDING HOW IT WORKS—Greg Sokora, SCS Area Engineer and Tim Dybala, SCS Area Irrigation Specialist explain surge irrigation to a Hockley County farmer.

DRAWING MOISTURE from the surrounding soil, tensiometers show pressure gauge readings to help the irrigator determine his soil moisture.

WRINKLE . . . continued from page 3

"I also use soil moisture gypsum blocks on this farm and plan to install furrow dikes after I finish my pre-watering," relates Morrow.

Like many other High Plains irrigators, Wendall Morrow is adapting his farming operation to compensate for his declining water supplies and maintain liveable yields. "We've got to adjust to the situation," says Morrow. "We're doing what we can."

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Ground Water Loan Approved

In precedent setting action, the Texas Water Development Board recently approved a request from the City of Wolfforth for a state guaranteed loan to purchase ground-water rights. Water Development Board Members Louis A. Beecherl, Jr., Chairman; George W. McCleskey, Vice Chairman; Glen E. Roney; W. O. Bankston; Lonnie A. "Bo" Pilgrim; and Louie Welch, voted unanimously to approve the city's request which will effectively more than double its current water resources.

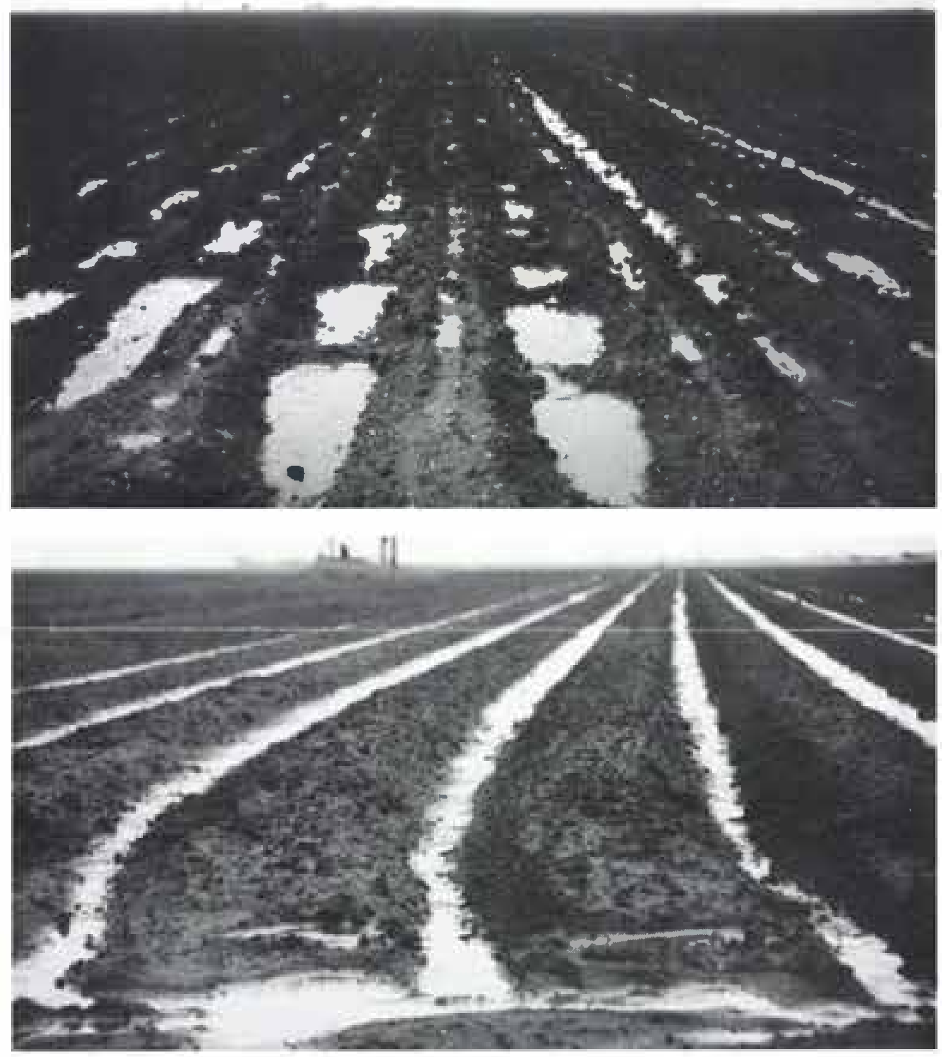
Not only will this water supply loan provide additional water resources to meet the city's long-term needs, but city officials in seeking this type of loan have effectively saved their residents thousands of dollars in interest over the term of the loan. The interest rate of the Texas Water Development Board loan will be approximately 8.2 percent while on the open market the city would probably have had to pay 11.2 percent interest. Over the 17 year period of the loan, the interest rate of the Water Development Board loan will save city residents approximately 310,000 dollars.

In 1978 Wolfforth city officials recognized the importance of an adequate water supply. To determine the status of their current resources versus demand, city officials contacted the High Plains Water District with a request for a water assessment study for the city. At the time of this first study, the Water District staff evaluated the city's ground-water resources and estimated that with continued population growth and city expansion, the available water resources would have an effective life of ten years thereby supplying the city's needs until approximately 1988. As a result of this assessment study, the Water District staff recommended that the city actively seek additional water supply sources to augment its reserves.

Wolfforth city officials realized that long-term water resources adequate to meet residential and municipal demands were essential to the future of the city. In 1983 the city extended its boundaries to incorporate developed areas which added to its available water resources. Additionally, through a cooperative effort between the city and the Frenship Independent School District, the city obtained water rights under a 59 acre tract of land north of the city. Water supply wells will eventually be drilled on this tract of land to supply water to city residents.

Following the acquisition of the additional water supplies, Wolfforth city officials again came to the Water District and requested a water assessment study. The Water District re-

continued on page 4 . . . LOAN



FURROW DIKES AND "RAIN SAVERS" hold water even after the briefest showers while conventional furrows allow valuable precipitation to escape from the field. Above are the results of a one-inch rain. (What's a rain saver? see the April 1984 Cross Section.)

Targeted Funds Program Impressive

Secretary of Agriculture John R. Block and Peter C. Myers, Chief of the USDA-Soil Conservation Service, authorized $175,000 in 1983 and $565,000 in 1984 of specially targeted funds to assist irrigators in improving their irrigation water use efficiency in 27 counties on the High Plains of Texas. The irrigation efficiency assistance program was conducted in the High Plains of Texas from October 1, 1982 through March 31, 1984, by the USDA-Soil Conservation Service using mobile field water conservation laboratories provided by local water conservation districts, the Texas Department of Water Resources, and in some instances by County Commissioners' Courts. The accomplishments of this program are quite impressive.

Assistance has been provided on 268,011 acres with 126,866 acres having improved efficiencies which average 11.4 percent. The improvement in efficiencies indicates 77,148 acre feet of water was conserved or saved for future use. Savings in fuel costs alone of $3.00 per acre inch would result in an immediate savings to the irrigators of $2,777,328. The estimated value of the water saved when used for future production would be $7,714,800 at a value of $100 per acre foot. The long-term benefits of this program are tremendous. As an example, the above estimates do not include the water saved for future use or pumping cost saved in the year(s) following the year the improvements were made. Undoubtedly future savings of water and pumping costs has and will continue to occur as a result of the improved efficiencies.

The specially targeted funds irrigation efficiency assistance program is scheduled to continue through October 1, 1985. Irrigators interested in participating in this program should contact their local USDA-Soil Conservation Service office to arrange for an irrigation efficiency evaluation.

Tailwater Waste–Risky Habit

District Court injunctions, liability for public and private property damage, liability for loss of crops and even "contempt of court" citations, which carry maximum fines of $500 per occurrence and maximum sentences of six months in the county jail, are but a few of the penalties which could face the habitual tailwater waste violator if court action involving the waste of underground water is required.

As everyone becomes more and more aware that the ground-water reserves of the area are being depleted and that this depletion is affecting the entire population and economy of the area, there is little understanding or sympathy expressed for those who habitually waste water. Irrigators who allow irrigation waste to escape from their farms, though they are small in number, draw a great deal of attention to themselves and risk serious consequences.

Bankers, lawyers, businessmen, homemakers, elected officials, neighbors, bus drivers, and mail carriers are just a few of the type of conscientious residents of the area who are to be credited with responsibly reporting losses of irrigation tailwater. These residents are of the opinion that the underground water in this area is a very valuable asset which should not be wasted.

The High Plains Water District has in the past received injunctions against landowners and operators who were habitual waste violators. Receipt of a District court injunction transfers responsibility for fines and/or punishment for tailwater waste to the court. Further occurrences of waste are considered an act of "contempt of court." In addition to the fines and jail sentences which could be assessed by the courts as a result of a contempt of

continued on page 4 . . . TAILWATER

How Important Is Irrigation Pump Efficiency?

"A Talk With Manufacturers"

Field tests indicate that the vast majority of irrigation pumps in the High Plains of Texas are using almost two times the amount of energy necessary to pump a given unit of water. In essence, a properly designed and adjusted pump could reduce many irrigation fuel bills by almost one-half. In order to determine how the irrigator and the pump manufacturer can better work together to upgrade efficiency, local pump manufacturing company representatives were recently contacted and offered their comments.

"What we need more than anything else," states Mr. Don Akehurst, Sales Manager, Agricultural Products, Texas Division of Goulds Pumps, Inc., "is complete well conditions. What will the well produce in gallons per minute, the static water level, the pumping level and the drawdown. Also, the

TANK TESTS performed at both Goulds and Simmons Pump companies simulate pumping levels and other conditions to measure pump efficiency and performance.

requirements of the application equipment such as center pivot sprinkler systems, and the pressure required for operation. With this information, we can supply the correct pump for a particular well and the farmer can get maximum energy use efficiency."

Mr. Maurice Hall, Sales Manager for Simmons Pump Company, echoes these same sentiments. "Everybody is trying to provide pumps that are as efficient as possible, but many times they are using guesses given to them by the farmer after his well breaks down and it is impossible to obtain accurate information. The farmer needs to measure the capacity of his well at least once a year. He needs to watch for a drop in water production, and air or sand pumpage," as a sign that he may be losing efficiency in his water production. "Then he needs to know his installer. The installer is the man who needs the data on the pumping depth of the water, the well yield and pumping pressures. Any pump is only as good as the installer and the information he has available to use to make his decisions."

In talking about guaranteeing efficiencies Mr. Akehurst indicates, "The stand we take is that we publish a curve from zero to where the pump dies and list the efficiencies at different flow rates. We can only guarantee efficiency at one point on the curve. Generally, we rely on our curve. Our products will meet the curve efficiency under the given conditions. If there is some setting where the pump is not meeting the curves, then we will test the pump in our testing facilities. Some of our products may be used in municipal or industrial development. We have to guarantee efficiency on municipal jobs. Cities do their own tests to see that the equipment meets the specifications. But for agriculture, the dealers don't generally guarantee efficiency because the consumer doesn't require it. Within a reasonable set of boundaries, however, the dealer can give the irrigator a good understanding of what he can expect from the pump under a specific set of conditions. It all goes back to what is actually known about the well conditions; you have to be very, very specific. If the farmer guesses at his pumping level, his well yield, his operating pressure requirements and his guesses are wrong, the pump will probably not be efficient."

"Over the past few years, efficiency has become the most important thing in designing equipment," said Mr. Ivor Smith, Manager of Engineering with the Texas Division of Goulds Pumps, Inc. "Since the mid-1970's everybody is watching efficiency. We are continuously redesigning our products and checking the components as they come in the door. It does not take major modifications in design to pick up a few percentage points in efficiency. Small improvements can add up."

BREAK DOWN DARE—Goulds Pump Company performs a continuous tank test on one of their pumps to check performance and wear. This pump has been running for 700 hours.

Mr. Smith continues, "There is a certain point where the farmer cannot afford to continue to pump water at lower and lower efficiencies. I would say that once a system drops to an efficiency of 50 to 60 percent, this would be the point where the farmer would say that his equipment requires attention. But to let efficiency drop to as low as 10 to 15 percent as some testing has indicated, I am amazed that the irrigator can continue to operate. But, the user decides on the economics."

When asked what role installation and making final adjustments once the pump is set plays in efficiency, Mr. Akehurst and Mr. Smith explained, "On open impellers, you can change the efficiency a great deal. A few one-thousandths change in the setting can change the efficiency totally. On closed impellers you don't have that problem, but there are advantages to open impellers. Open impellers contribute to a more efficient pump. Comparing the two, the open impellers would pick up two to three percentage points in efficiency over the closed. Once again, efficiency all goes back to knowing the conditions of the well and knowing your dealer and installer."

Even if a producer's pump is currently producing water at an efficient level, these manufacturers advise farmers to keep a constant watch on their equipment. When the pump fails or well conditions change and efficiency drops, accurate information on well production, water levels (both static and pumping) and application pressures can be used to design a pump that is energy use efficient. Maintaining your pumps at optimum efficiency may be a vital part in determining whether or not irrigated farming remains profitable.

Tests Indicate Efficiencies Similar To 1960's—Fuel Costs Aren't

A major portion of the total cost of pumping irrigation water, which is in itself one of the largest farm budget expenses, is the energy or fuel costs. As a result of rapidly rising energy prices during the past several years, irrigators have begun to look for methods available to reduce production costs. One area where significant reductions can be attained is through improvements in pumping plant efficiencies.

In a program carried out from 1978 to 1981 to evaluate pump plant efficiencies, tests on 832 electrically powered pumping plants and 442 natural gas powered pumping plants were conducted by the USDA-Soil Conservation Service, the Texas Agricultural Extension Service, the High Plains Water District, and several rural electric cooperatives.

Pumps and Motors

The average efficiency of pumping plants today, as evidenced through this testing program, are similar to those of the 1960's. The electric rate in the 1960's was approximately 1.5 cents per killowatt hour (KWh). Today, the electric cooperatives' rates average eight cents per KWh. The cost of natural gas has risen from about 35 cents per thousand cubic feet (MCF) in the 1960's to more than $4.50 per MCF today.

A comparison of actual performance with an industry performance standard makes it possible to estimate how much energy or fuel costs could be reduced by improving the efficiency of a pumping plant.

Motors

Motor or engine efficiency standards range from 20-26 percent for automotive-type natural gas engines to 24-35 percent for industrial-type natural gas engines to 85-92 percent for electrical motors. With general maintenance routinely performed motor efficiencies remain near industry standards.

Pumps

The average pump efficiency of the electrically powered pumps evaluated in the testing program was 35.3 percent and the pump efficiency of the natural gas powered pumps evaluated averaged 56.1 percent. Standard attainable pump efficiencies range from 67 percent for submersible pumps to 75-81 percent for vertical turbine pumps.

The effect of pump efficiency on energy use and pumping costs can be seen by comparing an inefficient natural gas-fueled pump with an efficiency of 20 percent to an efficient pump with an efficiency of 80 percent. If the two pumps were producing water against the same total dynamic head, the amount of energy consumed, and the fuel cost, per unit of water would be four times greater for the inefficient pump (80 ÷ 20 = 4). Applying today's natural gas cost of $4.50 per MCF, the difference in fuel cost would be $18.00 per unit of water.

If you irrigate 2,000 hours during the growing season and your pump efficiency is 20 percent, your fuel cost will be about $16,000. Whereas, if your pump efficiency were increased to an efficiency level of 80 percent, your pumping costs on the same 2,000 hours would be only $4,000.

The pump in an irrigation well is normally where the greatest potential for energy savings is possible. It also requires the greatest capital expenditure to achieve its full potential of efficiency. However, improving pump efficiency and the resultant energy savings will in many instances pay for the repairs in a short period of time and provide a savings to the irrigator for several years.

Irrigation pump plant efficiency tests will identify where in a pumping plant, whether it be motor efficiency or pump efficiency, improvements can be made. Any irrigator who is not sure that his pumping plant efficiency is satisfactory should inquire at the local office of the Soil Conservation Service, Agricultural Extension Service, the High Plains Water District, or electric cooperative for information on evaluating the pumping plant efficiency.

Variety Selection, Management, Weather Determine Cotton Quality

By Dr. James R. Supak

EDITOR'S NOTE: *In response to numerous questions as to whether or not High Plains producers can grow the high strength cotton which is desired by spinning mills, Dr. James R. Supak, Extension Agronomist-Cotton with the Texas A&M University System, Texas A&M Agricultural Experiment Station at Lubbock, Texas, was asked to provide his comments. Although it may be too late in the planting season for area producers to use the information on variety selection, the paper contains helpful hints for cotton care during the growing season.*

The availability of High Volume Instrument (HVI) cotton classification systems along with market premiums for fiber meeting certain quality requirements is encouraging High Plains cotton farmers to upgrade the quality of the cotton they produce. The HVI system determines strength, length uniformity, leaf and color in addition to the fiber length and micronaire measurement provided by conventional classing.

Of these parameters, fiber strength has received the most attention recently. Modern high speed open-end spinning mills need strong cotton fiber to produce yarns with desired strength characteristics. Although it isn't the only fiber property contributing to yarn strength, a recent study conducted by Mr. Joel Hambree, Consultant, Natural Fiber Information Center, shows that fiber strength does account for roughly 50 percent of the explained variance in yarn strength.

In an effort to realistically assess the worth of strength in the market place, Mr. Hambree also analyzed the source of differences in value between High Plains and Far West (California) cotton. The results of his study show that strength and length (staple) account for most of the price differences.

Locally, farmers have been offered premiums for cotton meeting certain strength and length uniformity requirements over and above those offered for length, micronaire and grade. Many are considering growing cotton for the markets and are asking what, if anything, they should do differently to attain desired quality and yield levels.

Variety Selection

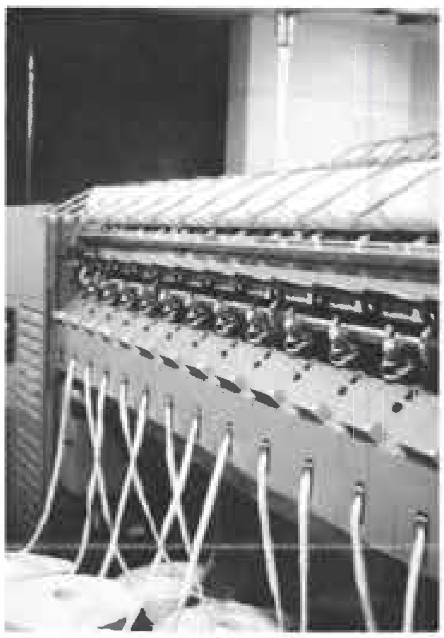
Probably the most important consideration in producing cotton with certain quality characteristics is variety selection. Most fiber characteristics—length, length uniformity, micronaire, strength, elongation — are genetically determined. Environment can alter these traits to some extent in any given growing season. For example, moisture stress during the three-week period following bloom can shorten fiber length or below normal temperatures in August and September can lower micronaire.

To some extent, the reverse is also true. Good growing conditions can improve fiber properties. For example, ample moisture and favorable temperatures might increase staple length by 1/32 inch or so. Or, as we've seen during the past two years, the right combination of environmental conditions can enhance strength by as much as two or three grams/tex.

Overall, however, if a farmer wants to produce cotton with certain fiber traits, he must start with a variety that inherently possesses those traits.

Presently, there is a great deal of interest in high strength cotton, often with little regard given to adaptability and yield potential. Generally speaking, the upland cottons that consistantly produce high quality fiber tend to be late maturing, indeterminate, open bolled and less productive in this area than many of the varieties that are currently being grown.

There are varieties currently available that are exceptions in one or more of these traits and cotton breeders (both public and private) are working diligently to expand the list of acceptable varieties. For the present, however, a producer may have to give up some yield potential, stormproofness, earliness or other desirable traits in order to grow a variety that is capable of consistantly producing high strength fiber. Somewhere along the line, the producer must decide if the potential gains will at least off-set the potential losses.



OPEN-END SPINNING machines turn processed bulk cotton into the yarn required by manufacturers.

Planting Dates

To consistantly produce a crop with well developed fiber, cotton typically needs to accumulate roughly 2200 heat units (DD-60's). Heat unit accumulation in most High Plains counties generally falls short of this desired level.

Can producers beat nature's system by planting earlier? In most years, the answer would have to be no for several reasons. First, Dr. Brad Waddle, Cotton Breeder in Arkansas, maintains that to germinate and emerge, a cotton seed must spend at least 100 hours at temperatures of 60°F or more. Once the seed is planted and imbibes water it begins to use up its stored energy reserves and continues to do so until the cotyledons (seed leaves) begin to produce sugars via photosynthesis. When germination and emergence require more than 7 to 10 days the seed must utilize too much of their reserves for survival and the resulting seedlings tend to be weak and ultimately develop into plants with limited production potential.

Is it worth the risk? Every High Plains farmer knows that adverse weather conditions are more likely to force replanting of a late April or early May planted crop than that of one planted in mid-to-late May. In addition, Dr. J. D. Bilbro, USDA agronomist stationed at Big Spring, has shown that typically, cotton planted in mid to late April produces its first bloom on about the same date as cotton planted on May 10.

Hence, there seems to be little advantage in rushing the planting date, especially if the ten-day average soil temperature at the eight-inch depth is below 60°F.

Fertilization

In producing a bale of cotton per acre, approximately 40 pounds nitrogen, 20 pounds phosphorus, 30 pounds potash, and smaller quantities of other nutrients are removed from the soil in lint, seed and burs. If the soil is not capable of meeting these demands, it becomes necessary to add the nutrients in the form of fertilizers.

Of the major plant nutrients needed by cotton, a deficiency of nitrogen is most likely to result in yield and fiber quality reduction. Nitrogen deficiencies limit plant growth, the number of bolls set and consequently, yield. High levels of nitrogen, in conjunction with ample or an over supply of soil moisture leads to excessive vegetative growth, delayed fruiting and delayed maturity. This often results in reduced yields, lower lint percent, poorly developed (low micronaire) fiber and reduced grades.

Irrigation

Normal cotton growth and development requires ample soil moisture during much of the growing season. Ideally, the crop is planted in fields wherein the soil is at or near field capacity. This permits timely planting and, if temperature is not a limiting factor, stand establishment.

Most cotton researchers generally agree that the first summer irrigation can be delayed until the early bloom stage in order to encourage root development and limit vegetative growth (and hence, water use). In practice, this is not always feasible because of limited irrigation water supplies.

Generally, the early maturing, determinate or moderately determinate varieties can be initially irrigated when the first squares are one-third to one-half grown without stimulating excessive growth or fruit shed. At this growth stage, soil moisture sensing instruments such as gypsum blocks and tensiometers typically show that roots actively extract moisture from the second foot in the soil profile.

With the medium to late maturing, more indeterminate varieties (many high strength cottons fit in this category) irrigation should be delayed until early bloom. At this stage, soil moisture sensors usually indicate that roots are already extracting water from the third foot of soil.

In either case, in furrow irrigation fields, alternate furrow and/or surge irrigation should be used to replenish the moisture in the soil profile uniformly across the field without excessive leaching. With sprinkler systems (even pivots) it is probably better to apply more water (two or three inches) per irrigation rather than apply more frequent lighter waterings. Heavier applications are likely to reduce evaporation losses and to place more water deeper in the soil profile (6 to 18 inches) where active roots are concentrated.

In years with normal rainfall, a single four to six inch summer irrigation is adequate to produce a one to one and one-fourth bale per acre crop. In dry years a second watering may be justified and should be applied 15 to 30 days after the first. It is important to get that second watering on before moisture stress (wilting by 10:00 a.m.) develops. Water stressed cotton tends to cause square shed and stimulates vegetative growth.

It takes about three weeks to overcome the "stress (cut-out) effect" and get plants back to a normal growth and fruiting mode. In most cases, the growing season limitation makes it impractical to "re-start" stressed cotton with irrigation water.

For all practical purposes, irrigation should be terminated around August 10 to 20 in the northern counties (Plainview), August 15 to 30 in the central counties (Lubbock) and August 20 to September 10 in the southern counties (Lamesa) of the Southern High Plains.

Excessive moisture late in the season tends to slow fiber and seed development, add fruit that will not mature, stimulate unneeded growth, delay harvest, likely increase ginning costs and reduce lint and seed quality.

In summary, High Plains cotton farmers should give serious consideration to the quality of fiber they produce because of the potential for greater returns and expanded markets. At the same time, individual growers must carefully consider tradeoffs involving quality versus yield potential and adaptability. Fiber properties are largely expressions of genetic traits; if the varieties are adapted to the production area their response to applied cultural practices will be essentially the same as that of "conventional varieties."

STRETCH—Testing the strength of cotton thread from open-end spinning machines determines the pounds of pressure required to break the thread.

TAILWATER WASTE . . . (continued from page 1)

COUNTY ROAD BAR DITCHES may hold tailwater waste from furrow irrigated fields, but using the ditches for this purpose is a violation of the law.

court citation, the court might also choose to direct the sheriff to padlock the well(s) to prevent any further waste of water if the violator persists in violating the court order.

Additionally, tailwater waste violators should be aware that there are other damages for which they could be held liable. If the tailwater waste occurs on a public road or roadway and an accident were to occur as a result or partially as a result of the loss of water, the producer of the water could be held liable for damages. Should damages occur to another landowner's property as a result or partially

SPRINKLER SYSTEM END GUNS spraying water onto county roads is also a violation of the law as well as being extremely dangerous for unsuspecting motorists.

as a result of the tailwater loss, the producer of the water could be held liable for property damages as well as loss of crops.

The responsibility of investigation of tailwater complaints is one of the functions of the Water District's staff. Upon receipt of a complaint, the staff proceeds to document the waste of water through photographs and written memorandums detailing the waste. Follow-up investigations are made to determine if the tailwater waste is a habitual occurrence. The landowner and operator are contacted and advised that the waste of water is a violation of the law and must be stopped. If no action is taken and the waste continues, the Water District may seek a District Court injunction. Such injunctions are sought against both the landowner and the operator.

According to state law (Chapter 52, Vernon's Annotated Civil Statutes) and Rule No. 1(h) of the High Plains Underground Water Conservation District No. 1, irrigation tailwater waste is described as "wilfully causing, suffering, or permitting underground water produced for irrigation or agricultural purposes to escape into any river, creek, or other natural watercourse, depression, or lake, reservoir, drain, or into any sewer, street, highway, road, road ditch, or upon the land of any other person than the owner of such well or upon public land."

There are many methods available to irrigators to help control and even eliminate tailwater runoff. Some methods being used are: the use of borders to hold the water on the land; the use of a tailwater return pit and tailwater return system to capture and reuse the water; the installation and use of sprinkler systems; and a new method of furrow irrigation using a surge time control valve.

Considering the options available to control waste of water, the value of the resource to the area's economy and quality of life, and the cost of pumping an excess amount of water, not to mention the risks involved for the habitual waste violator, the choice to make the most beneficial use of this area's most valuable resource would seem a simple one.

WEST TEXAS CROPS . . .

THAT'S NOT PEANUTS

EDITOR'S NOTE: *The following is a reprint of an editorial printed in The Dallas Morning News, Tuesday, March 13, 1984.*

Texas can't continue to take an out-of-sight-out-of-mind approach to West Texas' water problems. Granted, the agricultural High Plains are far removed from much of the state. But the economics of the region spin a web in which other Texans may be caught.

For example, the Trinity Improvement Association recently pointed out that the irrigated farm lands of the High Plains produced more than $1.6 billion in crops in 1982, roughly 40 percent of the state's farm crop income. Each dollar of farm products generates an additional $2.11 in supplies and services, increasing the region's impact on the state's economy to $5.1 billion. Many of the grains (and other crops) in the region are exported, helping to offset the nation's foreign trade imbalance.

Hard times face the region. The Ogallala aquifer, from which the region's water is drawn, is being depleted far faster than it's being regenerated by nature.

Industrial and municipal use also is expected to grow, although no more water will be available. And transportation of water to the plains from other regions is not cost effective.

So how can the state help these farmers? Two avenues come readily to mind. First, more funds must be invested in agricultural research to improve water recovery techniques, to develop plants that need less water and to improve irrigation systems. Second, low-interest loans should be made available to farmers to upgrade their properties. Small investments now can help avoid big problems in the future.

GROUND WATER LOAN . . . (continued from page 1)

evaluated the city's water resources and estimated that the city's new reserves would extend the life of their current reserves by four to six years beyond the original estimate.

City officials recognized that they should not stop their efforts to augment their water resources and have continued to seek ways to increase their water supplies. As a result, the city entered into a cooperative program with the High Plains Water District to perform a secondary water recovery test inside the city limits. The test, which is currently in progress, is being performed using low volumes of air injected under low pressures to cause the release of capillary water held in the sand formations above the current water table. These released waters will then move downward to the current water table and become available for production. The city is also negotiating with Texas Tech University and the Water District to perform a playa lake recharge project using the playa lake which is located on the newly acquired tract of land.

Not missing an opportunity, city officials have also recognized that conservation could play an important role in helping to extend the life of the city's water resources. To address this conservation effort, the city conducted a water conservation education program for its residents and provided in-home water conservation packets. Using these packets, city residents tested for leaks in commodes, installed shower and water faucet restrictors as well as other simple water conservation measures.

Though conservation, secondary recovery and playa lake recharge were all seen as providing excellent contributions to preservation of the city's water resources, they were not seen as answers to the city's water needs. Continuing efforts by Wolfforth city officials lead them to the Texas Water Development Board with an application for a state guaranteed loan for the purchase of ground water rights.

Approval of this loan was granted at the April 23, 1984 meeting of the Texas Water Development Board. Funds from this loan will be used by Wolfforth city officials to purchase a 320 acre tract of land and the associated water rights, drill water supply wells, install the pipeline necessary to transport the water from its location five and one-half miles southwest of the city to the water supply storage tank which will also be constructed using loan funds.

Other ground-water users throughout the state of Texas should take note of the first loan of its kind for the purchase of ground-water rights and commend Wolfforth city officials for opening the door for others to follow.

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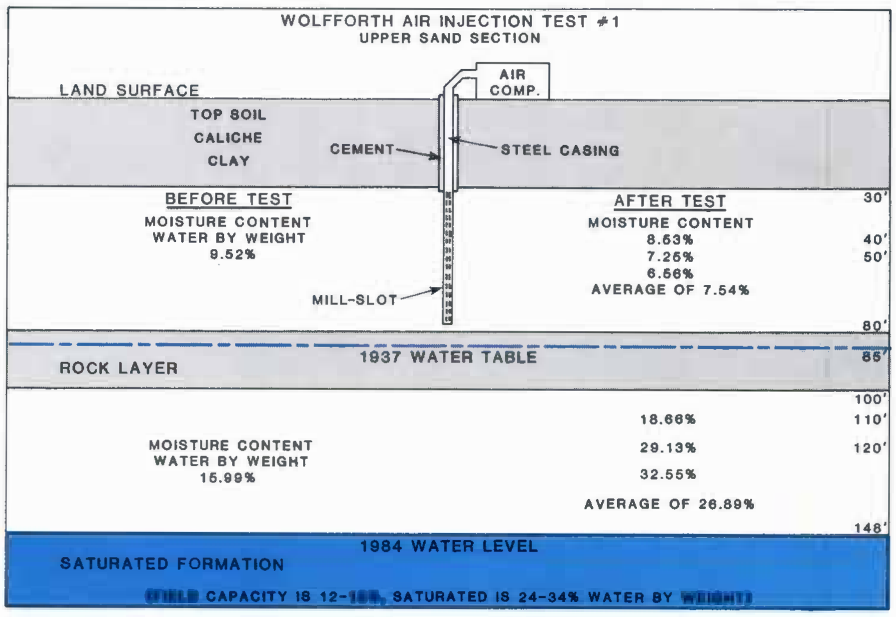


MOISTURE CONTENT in the upper injection zone was reduced as a result of the injection of air. Increased moisture content was shown in the lower zone after the first air injection test. The diagram shows the design of the air injection hole and layout of formational material at the Wolfforth secondary recovery site.

Ogallala Experts Optimistic

More than 100 water experts from around the country convened in the Lubbock Memorial Civic Center on June 4 - 7 for the second Ogallala Aquifer Symposium. The first Ogallala Aquifer Symposium was held in Lubbock in 1970.

The focus of the 1984 symposium centered on advancements and developments that have been made which were designed to provide for better management and understanding of the aquifer since the 1970 meeting. Symposium sponsors included the High Plains Water District, the Panhandle Water District, the U. S. Geological Survey, Texas Tech University, Oklahoma State University and the Lubbock Chamber of Commerce.

Presentations made by the forty speakers who participated in the technical sessions ranged from quantitative and economic projections, to legal aspects of ground-water management, to the latest research efforts aimed at extending the life of the Ogallala.

The general consensus among attendees and participants alike was that while the rate of decline of the aquifer has slowed in most of the Ogallala states, research directed toward improved conservation and augmentation practices, better management strategies and refined analytical techniques for describing and understanding the aquifer

continued on page 4 . . . EXPERTS

Irrigation Motors Need "TLC"

"Motors, or electrical motors, are fairly efficient animals," states an industry representative. Electrical motor efficiencies range from 85-92 percent. Internal combustion engine efficiency standards range from 20 to 26 percent for automotive-type natural gas engines to 24-35 percent for industrial-type natural gas engines.

Recent attention to efficiencies of irrigation pumping plants, including both motors and pumps, lead to a discussion of the efficiency of irrigation pumps in the previous issue of *The Cross Section*. This month contact was made with representatives from both the electrical motor and internal combustion engine industries who offered the following comments.

Electrical Motors

Mr. Gary Clark and Mr. Walt Clark, Technical Advisors for Brandon and Clark Electric noted, "You are going to get the most benefit out of an electrical motor by matching horsepower to pump load. The industry has been building motors that are efficient for about 20 to 30 years. Motors are in their third or fourth generation since the 1970's of enhancing efficiencies. There is still some more to get out of them, but you soon reach a point of diminishing returns. Any more input to raise the efficiency becomes cost ineffective.

continued on page 2 . . . MOTORS

LOWER AIR PRESSURES / VOLUMES RELEASE CAPILLARY WATER

The release of water from the wet sands of the Ogallala Formation, a process commonly referred to as secondary recovery, has been under study by the High Plains Underground Water Conservation District, Texas Tech University, Texas A&M University, and the Texas Department of Water Resources for the past four years. The most recent secondary recovery project is currently being conducted inside the city limits of Wolfforth, Texas on property owned by the Wolfforth Co-op Gin. The City of Wolfforth is financially supporting the study as well as providing field support as needed.

The first secondary recovery field test was conducted in 1982 on Mr. Ronald Schilling's farm located near Slaton, Texas. A second major field test of the theory of secondary recovery was conducted in 1982 on Mr. Clifford Hilbers' farm near Idalou, Texas. The largest costs associated with these tests of the release of water from the wet sands through air injection were those associated with the lease of large air compressors and the cost of fuel for the large motors used to power the compressors.

The test at the Wolfforth secondary recovery site is directed at reducing the costs of releasing capillary water by the injection of low volumes of air under low pressures using a much smaller air compressor powered with electrical energy.

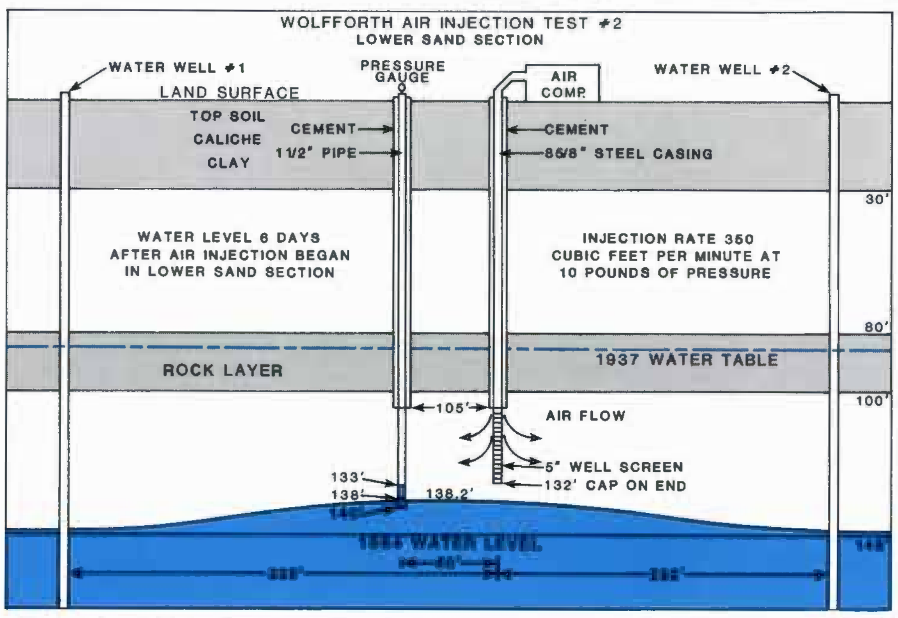
At the Slaton and Idalou test sites only the sand sections which were seen as providing the optimum results from air injection were tested. The entire potential recovery zone at the Wolfforth test site is being tested.

Initially at the Wolfforth site, a test hole was drilled from land surface to the water table which is located about 150 feet below land surface. The drill core samples and electrical impulse logs taken at this site indicated a clay lens from 20 to 30 feet below land surface. Additionally, a dense rock layer was found between 80 and 100 feet below land surface. It was, therefore, concluded that two air injection tests would be conducted at this site.

In the first test air would be injected in the sand section lying between the clay lens and the rock lens or between 30 and 80 feet below land surface. In the second test, air would be injected between the rock lens and the water table or at 100 to 150 feet below land surface. It was also decided that air would be injected at a rate of between 300 to 400 cubic feet per minute (cfm) under pressures ranging between 10 and 15 pounds per square inch (psi).

A small electrically powered air compressor was purchased for approximately $3,500 for this test. A 14-inch diameter hole was drilled from land surface to a depth of 30 feet and cased with 8⅝-inch diameter steel casing. Cement was then placed in the well between the casing and the wall of the hole. After the cement had time to cure, a drill stem was installed inside the 8⅝-inch diameter casing and a

cont'd. on page 2 . . . CAPILLARY WATER



LOWER INJECTION ZONE sees a rise in the water level of about ten feet after six days of air injection.

AIR PRESSURE READINGS at the Wolfforth secondary recovery site are taken every three hours. Here Cindy Gestes, Water District geologist, checks pressure in Air Monitor Hole No. 11 while District Board Members watch.

CAPILLARY WATER . . . (continued from page 1)

hole was drilled down to the top of the rock using air as the drilling medium. Five inch mill-slot casing was installed in the lower section of the hole opposite the wet sand section. The moisture content of the sand in this hole, as determined by push core samples taken prior to air injection averaged 9.52 percent by weight.

Five air pressure monitoring holes were drilled and equipped in the upper sand section on this site to monitor air pressure which would indicate air movement at various distances from the air injection well. Two water level observation wells were additionally drilled. These wells were equipped with automatic water level recorders to continuously monitor changes in the water level during the test.

Air was injected in the upper sand section for a 60-day period. The rate of air injection averaged about 360 cfm under an average injection pressure of 10 psi in the well bore.

Unfortunately, no precipitation was received in the area during the air injection test and it was necessary for producers to pump their wells for preplant irrigation. Two city wells located in the near vicinity of the test site were also heavily pumped during this test. Therefore, the water level under the test site actually declined almost two feet during this first phase of the test.

At the conclusion of this first phase, formation push core samples were collected between 30 to 40 feet, 40 to 50 feet, and 50 to 70 feet in core holes drilled at distances of 25 feet, 50 feet, 100 feet, 150 feet, 200 feet, and 300 feet from the air injection well. The moisture content of these samples as compared to earlier formation core samples indicates an average reduction in moisture by weight of 20 percent. The sand section between 50 and 70 feet showed the greatest reduction in moisture content of 32 percent.

Core samples were also taken in the sand section lying below the rock at depths between 100 to 110 feet, 110 to 120 feet, and below 120 feet in core holes drilled at distances of 50 feet, 150 feet, and 250 feet from the air injection hole. These samples had an average moisture content of 26.89 percent by weight. The moisture content of formation samples taken prior to air injection in this same zone had an average moisture content of 16 percent water by weight.

For the second phase of this test, a 12¾-inch diameter hole was drilled from land surface completely through the rock lens to a depth of 105 feet. As in the first air injection hole, an 8⅝-inch diameter steel casing was then installed. Cement was placed between the well bore and the casing from the bottom of the hole to land surface. After four days, a smaller hole was drilled from the bottom of the casing to a total depth of 132 feet. Well screen was installed opposite the sand section.

The injection of air into this lower sand section continues as of the time of this writing. The same small compressor is being used to inject air into this hole and air injection rates are averaging about 350 cfm at pressures of 10 psi.

Three temperature/moisture sensing devices have also been installed at various distances from the air injection hole in the lower sand section. Meter readings are being made daily which will indicate to the research team the change in formation temperature/moisture content in the sand section as water is released.

After six days of air injection, the water level 60 feet from the air injection hole has not only regained the two feet lost to earlier irrigation pumpage, but has gained an additional ten feet. In essence, the depth to water below land surface has risen from 150 feet to 138 feet.

The water level observation wells mentioned previously which are equipped with automatic recorders have also shown rises above the pretest level equalling about one-half foot each. These wells are located 292 feet and 335 feet in opposite directions from the air injection well. The research team anticipates that the injection of air into this deeper sand section will continue for about 60 days.

The formation core samples taken from this lower sand section below the rock lens indicated a moisture content in excess of field capacity. This indicates that water in excess of what the soil will normally hold against the forces of gravity is in this section. This water is moving downward to the existing water table through the natural forces of gravity. It is hoped that the injection of air into this section will enhance the release of this excess water and further release much of the water held by capillary forces in this sand section after the moisture content drops below field capacity.

IRRIGATION MOTORS . . . (continued from page 1)

"Let's take motors that are in existence right now," continues Clark. "When it is damaged, we have an opportunity to do something with efficiency, if it is done properly. In a repair technique, if you mill the iron properly and control the temperatures that the iron is subjected to, it will not destroy the silicon plates in the motor. We can then actually enhance the efficiency of that motor by some percentage point, maybe one to two percent." Clark emphasizes, "If a motor is damaged, say if a bearing goes out and the rotor rubs too deeply into the iron, that changes the air gap and you will never bring the efficiency on that motor back up to new standards because there is material removed from the motor."

When questioned about the newer designs in motors Clark indicates, "There are new motors now that are just coming to the market with higher efficiencies. They label those energy efficient motors. You can obtain as much as 96 percent efficiency out of some motors of 100 horsepower and above. In fact, in 100 horsepower motors, the industry standards are apt to be around 94 to 95 percent.

"If you have a lot of operating hours, one percentage point in efficiency makes quite a bit of difference particularly if you project the life of the motor. Payback won't be as attractive as it would be with higher operating hours, but it will represent a savings."

In order to help irrigators determine if they are a candidate for an energy efficient motor Clark notes, "If the irrigator knows the parameters that he is operating with, we can calculate what it would take to replace that motor with a premium efficiency motor. He needs to know his cost per killowatt hour, which his power company can tell him. Also, he needs the number of hours he is in operation and the horsepower of the motor. Then we can do the calculation and determine the payback period based on his parameters. We have the in-house computer capability to do that.

"In order to buy the correct motor," Clark states, "the irrigator needs to know the pump efficiency, gallons per minute, total foot of head, and then we can tell him what horsepower it's going to take. The variable is pump efficiency. Typically we end up over-sizing the motor, due to guesses of pump efficiency, so it will pump under the worst possible conditions. This in itself is counter-productive, because a motor operates normally most efficient at three-quarters to 100 percent of its load capacity. If you go into overload, you will drop efficiency or if you go below half of the motor's load capacity, you will drop efficiency.

"A motor is a go or no go type situation. It either goes or it doesn't go. There is nothing that you can really do to preserve that efficiency over the life of the motor. That efficiency is built into it. It is designed to function," concludes Clark.

Internal Combustion Engines

"Just a little tender loving care on the equipment will go a long way. Keeping it properly adjusted and maintained, finely tuned, will sure pay dividends," states Mr. Bob Carthel, Agricultural Representative for Energas in Amarillo.

"One of the things that is most important to our customers is getting their pressure at the carburetor right, thereby burning as much of the gas inside the engine as possible and not passing some unburned gasses out the exhaust pipe. Generally speaking, at night if you drive by an irrigation engine and see a blue flame coming out of the exhaust, those are unburned gases going out that should have been burned inside the engine. In other words, it is burning too rich a mixture. This condition needs to be corrected," explains Carthel. "When the mixture gets too rich you are just wasting fuel. If it gets too lean, then it may have a tendency to burn the valves prematurely. This mixture adjustment needs to be fairly close in order to get the longest life and yet conserve your fuel.

"Some other things they can do on top of the ground that won't cost them very much and will save them quite a bit in dollars and cents on energy," explains Carthel, "are checking their ignition system to see that it is in good shape, checking their timing and carburetor to see that they are set properly and checking the pressure of gas to the carburetor."

Carther concludes, "These suggestions are just rules of thumb to keep the engine tuned as close to optimum as they can. If they will do that, they can save themselves some dollars."

Mr. P. D. Cunningham, owner of Bucks Irrigation, echoes Carthel's remarks. "Basically, the most important thing you could do is keep a close check on your natural gas pressure and keep your engine tuned ultimately. Be sure to check your spark plugs and, one important thing that is often forgotten, is checking the spark plug wires. You have to transmit that spark before it is any good. I also think that exhaust headers are just nearly a necessity for peak efficiency."

Cunningham explains further about exhaust headers. "They are a tremendous benefit to the efficiency and life of an engine. They just increase the volumetric efficiency. They fix it so that the engine gets rid of the exhaust about three times faster and it alleviates the tremendous heat build up in the exhaust manifold of the engine."

Other than that, Cunningham expresses his opinion that, "If you get into reconstruction of an engine you are spending about as much money as you would save. It can make them more efficient, but the engine has to last a long time to ever return the investment. You get into a diminishing return.

"Engines could be made more efficient for natural gas fuel by putting in high compression pistons and changing cam shafts. But, there you get into something that is highly sophisticated and very complicated."

All of the persons interviewed agreed that the electrical motor and the internal combustion engine are inherently efficient by design. Additionally, they agree that with proper maintenance, a little attention to repair and using repair facilities equipped for modern technology, will keep your irrigation power unit pretty close to the efficiency it had the first day you began operation.

Furrow Dike Manufacturers Discuss Dike Advantages

Since about 1976 the Texas A&M Research Stations located at Lubbock, Halfway and Amarillo, and research personnel at the U. S. Department of Agriculture's Lubbock and Bushland Research Centers have been evaluating the water conservation benefits and increased production benefits of the utilization of furrow dikers to hold precipitation in place until it has time to infiltrate the soil.

The Texas Agricultural Extension Service has assisted farmers with on-farm demonstrations of furrow dikes and in doing so has collected data to document the effectiveness of the use of furrow dikes. Those persons interviewed are convinced that the use of furrow dikes has helped increase yields and/or reduced pumping costs. In fact, all the research, field demonstrations and opinions of area farmers indicate that on a ten-year average, two to four additional inches of precipitation can be harvested annually and stored in the soil for use by field crops through maximum utilization of furrow dikes.

Within the past two years there has been a great deal of discussion and published information regarding the benefits of using furrow dikes, but very little published information about the different types of furrow dikers which are currently being manufactured and used in the High Plains area. Recent contact with each of the furrow diker manufacturers has lead to the discussion presented below of the potential advantage of each type of diker as seen by each manufacturer.

"The Rain Saver"

Mr. John D. Gibson, developer of the three-paddle diker indicates, "We developed this one in 1979. One of the advantages to ours is it doesn't put up a real tall dike. It spaces the dikes about 30 inches apart.

"RAIN SAVER" makes smaller dikes, leaves loose soil and trouble free operation.

"Another thing that I think is unique about ours is that it doesn't leave any hard soil in between the dams. It will leave some loose soil in between the dams and when it does rain it will percolate into the loose soil.

"Down here," Mr. Gibson states, "in some of our land, the red lands, when you take the loose dirt off the top, you can create a surface hard pan. Then when it rains you can fill the dam up with water, but it will stay for three days or so. When it does stay for that long, more than likely most of it will evaporate. A lot of people in the sandier land at first didn't think this was practical. But now, they use them early in the season to help capture more rain before they plant.

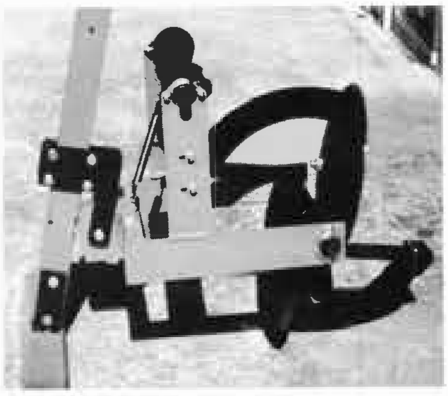
"Another thing," Mr. Gibson sees as an advantage to his brand of furrow diker is, "ours doesn't give any trouble. The old number one that I built and we're running has been across 2500 acres of land a lot of times. It's on one piece of equipment and it goes all the time. You can back up and you can do anything and you won't tear them up." Mr. Gibson explains, "You can run them at any speed you want to. In fact, we ran them at 12 miles per hour just to see if it would fly apart but we never had any trouble."

The biggest advantages Mr. Gibson sees to his particular three-paddle type furrow diker is, "So far ours has been trouble free, they can run behind anything and it just doesn't take the soil out."

For more information on Mr. Gibson's "Rain Saver" furrow diker, interested persons should contact Sam Stevens, Inc., Route B, Lamesa, Texas 79331, or telephone (806) 872-8365.

"The Row Dammer"

Mr. Gerald Bailey, Secretary-Treasurer for the Hamby Company, pointed out, "This is a brand new design. In fact we have only put one together so far. Ours is made using 16 inch concave discs and a hydraulic motor attached to the end which turns the shaft. It fits on a one-inch shank with a one-inch clamp. They have flexibility built into the shaft for side-to-side



"ROW DAMMER" doesn't disturb the dam and has flexibility built in.

movement. That way it will seek its own level when used on a circle.

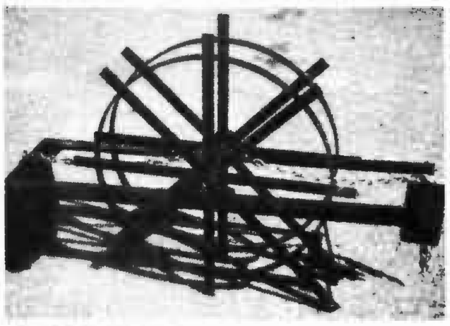
"We feel like the advantage of this type row dammer," Mr. Bailey continues, "is the concave disk. When it trips it does not disturb the dam. The distance between dams depends on the speed of the tractor. If you slow down, the dams are closer together. If you go faster, then the dams are further apart.

"Another advantage of our type of row dammer," indicates Mr. Bailey, "is the flexibility that we have built into the shaft so that it is free to seek its own level. Of course, if it rains, its worth a fortune, but if it doesn't rain . . ."

Mr. Gerald Bailey can be contacted at the Hamby Company, Route 3, Box 146A, Plainview, Texas 79072 or telephone (806) 293-5321 for more information on the "Row Dammer."

"The Texas Diker"

"The way I would describe this diker to you is that it's a machine made by man for the use of Mother Nature and for the benefit of Mother Nature. That's the best I can describe it," states Mr. W. C. Isbell, the manufacturer of the Texas Diker, a single blade, wheel-type diker.



"TEXAS DIKER" never fails to trip and compacts the dirt by dragging it.

"The advantage of this one, the old original, is positive. It never fails to trip. It just glides at seven foot and picks up. If it's got dirt fine, if there is none it still dumps." Mr. Isbell explains, "This old thing firms up the pile of dirt it's got. In other words, it sort of compacts the dirt by dragging it. It will then withstand a more severe faster rain. I've seen it take two and a half inches of rain in 30 minutes on a steep hillside and the only place it broke is where a border just above it caught full of water and then the border broke.

"This diker will run five and a half miles per hour pushing dirt ahead of it," comments Mr. Isbell. "Anything over that, then the diker begins to slide down. So, you can pick your range of speed to where you get it to slide down to the height you want. This one puts dikes seven feet apart."

Mr. Isbell likes to relay the story of how he got started building dikes after several years of just keeping some built around the shop. "Old Ken Isom bought a set of dikers and slipped out of town with them. When he got home he slipped out to the farm and in one evening got the diker all fixed up, then went out and diked across 60 acres. Just as he was making the last pass, a little cloud blew in and it rained about two inches in about an hour. He turned the whole place into one big lake." Mr. Isbell continues, "The next day Ken and his brothers, Rex and Larry, who had given Ken considerable trouble the day before over the idea of the diker, were all over at my shop and wanted to set up and market them if I would build them.

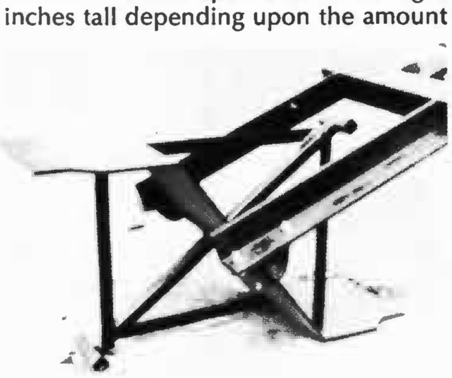
"The reason I started making the dikers was to help the territory. My dikers you can run at any speed or at any spacing on some of the other models I build" states Mr. Isbell. Believing in the benefit of the dikers as Mr. Isbell does, he comments, "I'll tell a man when he comes in here, I don't care whether he buys my diker or not. Of course, I'd prefer he did. But if he's not going to run mine, for goodness sake run somebody's."

If you are interested in more information about the "Texas Diker" contact Mr. W. C. Isbell, 1401 East First, Petersburg, Texas 79250, or telephone (806) 667-3988.

"The S & H Diker"

Mr. Oliver Shadden, co-owner of S&H Welding Manufacturing in Abernathy, Texas, sees the advantages of his two-paddle brand of diker as, "It puts up a big enough dike to hold the water and it can be run at speeds up to nine miles per hour."

Mr. Shadden also mentions, "Either using high or low speed will make the same size dikes. The dams are about four to five feet apart and six to eight inches tall depending upon the amount



"S&H DIKERS" are self-tripping and make dikes as tall as the bed or taller.

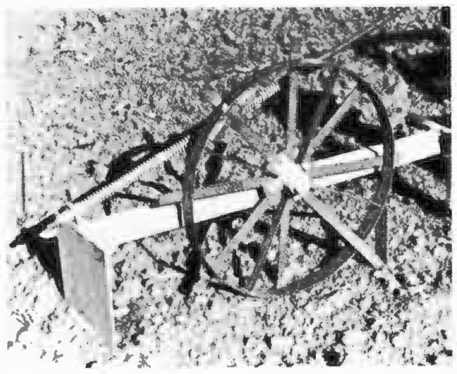
of loose dirt you have to work with.

"Our dikers are self-tripping and are built on a swivel frame to follow either straight or contour rows. We really feel that the advantages of our dikers are the speeds at which you can plow yet still come up with a big enough dike to hold the water and the fact that the dikers are self-tripping."

Further information on the two-paddle diker which is manufactured by Mr. Shadden, contact S&H Welding Manufacturing, Abernathy, Texas 79311 or telephone (806) 298-2924.

"The Roll-A-Diker"

"Durability and realiability" are the advantages Mr. Don George, Sales Manager for Roll-A-Cone in Tulia, Texas, sees in the wheel-type one blade diker which is manufactured in his plant. Mr. George states, "It operates on a simple principle and while it may not have all the features that some of



"ROLL-A-DIKER" features reliability and durability while it operates on a simple principle.

them have, it's simple and does not give the operator trouble all the time.

"Most operators will get about four to five seasons' use out of a set of dikers. Ours operate at speeds around five and a half miles per hour. They were engineered so that they would do that," indicates Mr. George. As with every other manufacturer, Mr. George states, "We like the dikers and what they do. We think they are a good idea. Our dikes are as tall or taller than the seed bed and will hold a good amount of water."

Contact Roll-A-Cone Manufacturing Company at Route 2, Box 25, Tulia, Texas 79088 or telephone Mr. Don George at (806) 688-2400 and he will

cont'd. on page 4 . . . MANUFACTURERS

Users Recommend Moisture Blocks

"I like them well enough that I don't want to try watering without them," states Mr. Jerry Smith, a Parmer County farmer. Mr. Smith recently spoke of his experiences using soil moisture gypsum blocks and resistance meters in connection with his sprinkler irrigation system.

Mr. Smith explained, "When we first got started with our sprinklers, we thought we could go over the land and get it real wet. With the blocks, I found out that it wasn't as wet as we thought it was.

MOISTURE READINGS taken with a resistance meter help the irrigator determine his soil moisture conditions at each depth. Here "Shorty" Lancaster, District Engineer Technician, checks the moisture at a site in cotton.

"Last year was the first time I had used the moisture blocks. We had planted sugar beets on one-half circle and soybeans on the other half circle. Then we followed with wheat. Our moisture was being drawn down pretty good even with the good fall snows. In fact, I was surprised at how fast wheat draws moisture when it gets to the boot stage. It is critical to have adequate moisture at that time.

"After the wheat came off, we watered real good to plant corn. We thought we had put down enough water, but when I checked the blocks, I discovered that where the soybeans had been our moisture was pretty good, but where those sugar beets had been, it was still real dry. If it hadn't been for the blocks and the readings I took, I could have been in real trouble with my corn on that half circle. We just didn't get as much water applied and our soil profile was a lot drier than we thought it was on the patch where the sugar beets had been grown."

Mr. David Wied, a farmer who has used the moisture blocks and resistance meters for about three years on two locations of irrigated cotton in Lynn County indicates, "It is surprising to see how the moisture moves in the soil profile and just how quickly your soil moisture profile can change. I've found out that the moisture is not necessarily where I thought it would be. Also, it is amazing to me to see how wet the soil surface can be and then in just a matter of a few days, how this soil moisture can be gone. For instance, after a good rain, I've checked the readings two or three times to make sure the meter was working because I didn't get the good moisture readings I thought I should be getting. Maybe just the top foot would be wet. Then in just the next day or so the moisture might move on down depending on your crop and how fast it is using the soil moisture."

Mr. Wied also feels that the blocks might be of benefit on dryland as well as irrigated land. "It would help you make some management decisions. For instance, if you have real strong underground moisture and fair moisture on top, I would be more likely to put more fertilizer on my dryland.

"I haven't watched the blocks long enough or studied the readings close enough to know the exact moisture point to begin irrigating or how low the moisture level can drop and my cotton survive," continues Mr. Wied. "I'm still learning on that. But I do know I've gotten a better indication of when I need to water as well as how much water I need to apply."

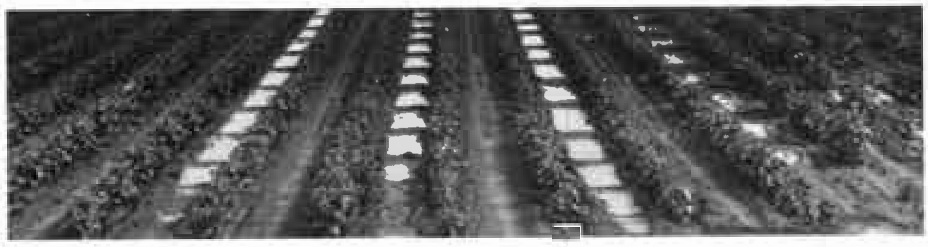
Both Mr. Smith and Mr. Wied would recommend the use of soil moisture gypsum blocks and resistance meters to their neighbors. Mr. Smith states, "I've got some neighbors who are just getting started with their sprinklers and I feel like I need to go tell them about the blocks and how they can use them."

Anyone interested in more information about soil moisture blocks should contact their local Soil Conservation Service office or the High Plains Water District. Moisture blocks and resistance meters necessary to read the blocks are currently being made available on a local basis through the local Soil and Water Conservation District offices, local High Plains Water District offices or the Water District's headquarters office in Lubbock, Texas.

MANUFACTURERS . . . cont'd. from pg. 3

be happy to answer any questions concerning their "Roll-A-Diker."

The furrow dikers mentioned above all have list prices somewhere between \$150.00 and \$275.00 and will cost the producer slightly less than list price depending upon the number of rows he purchases. Most farmers currently utilizing furrow dikes install and remove the dikes while they are performing other farming operations; therefore, there is little additional cost in their utilization. The cost of fuel to pump a quantity of water equal to that harvested by the use of furrow dikes will exceed the cost of the dikers, five years of interest paid on the money spent for the dikers plus two trips across the field to install and or remove the dikes (which may or may not be necessary). All the manufacturers agree, "Using furrow dikers and harvesting precipitation water just makes good farm management sense."



FURROW DIKERS make miniature dams to hold water in the field until it has time to infiltrate the soil. Each of the dikers mentioned above make a different size and type of dike, but when it rains, they all harvest rainfall.

EXPERTS . . . continued from page 1

fer must be increased and intensified if the aquifer is to remain economically viable far into the 21st century. Most were optimistic about maintaining irrigation at near current levels through the year 2020, but cautioned that in addition to research, essential elements to sustaining agricultural production in the High Plains will be planning, coordination and cooperation.

Approximately fifty people participated in their choice of two field trips and saw first hand either newly developed technology and equipment to apply, monitor or augment the supply of irrigation water, or several geological characteristics of the Ogallala Aquifer.

The conference proceedings are expected to be available later this summer, and copies may be obtained from the Texas Tech University Water Resources Center for \$30. Proceedings of the 1970 conference have provided a source of excellent resource materials on the Ogallala for the past 14 years. It is anticipated that this year's conference proceedings will provide equally important and informative material.

4.5 Million Cattle Fed In '83

Southwestern Public Service Company's latest annual Fed Cattle Survey shows that 4,575,821 cattle were fed in 1983 in Southwestern Public Service Company's service territory. SPS serves a 70,000 square mile area including 35 counties in the Texas Panhandle and South Plains, six counties in eastern New Mexico, three counties in the Oklahoma Panhandle and Morton County in Southwestern Kansas.

Seventy-four feedlots in Texas, eleven in New Mexico and eleven in Oklahoma combined to make the 96 feedlots which were surveyed having capacities of 5,000+ head. Fifteen other feedlots with capacities under 5,000 head were also surveyed to make a total of 111 feedlots surveyed. The total capacity of the feedlots surveyed in 1983 was 2,494,000 head. This is down slightly from total capacity in 1982 when lots could carry 2,516,000 head.

Additionally, there are 16 beef packing plants located in Southwestern Public Service Company's service area with an annual slaughter capability of 4,942,813 head. The number of fed cattle slaughtered in this service area in 1983 totaled 4,721,699 which was 713,621 head more than in 1982.

The 1984 Fed Cattle Survey individually lists feedlots with 5,000+ head capacities as well as county totals for lot capacities and number of cattle fed in 1983.

"Requests for this survey come from all across the nation," said Seth Thomason, Manager of Agricultural and Industrial Power for SPS in Amarillo. "It is an excellent way for us to tell others about our area's capabilities in the beef industry, and it helps stimulate the area economy and create new jobs."

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Texas Water: Problems And Solutions

How much water does Texas have? Is there enough for the people, the economy, and the environment? Will there be enough for future generations? Will it be safe to drink and to use in other ways? These fundamental questions exemplify the need to plan for water development, water conservation, and water quality management in Texas.

Water demands by people, industry, and agriculture, although somewhat seasonal, are continuous from hour to hour and day to day in many cases. In addition, water-using functions and enterprises cannot all be located adjacent to available water supplies. Thus, it is essential to plan, develop, operate, and maintain adequate water storage, water conveyance, water treatment, and wastewater treatment facilities for the existing people and the present economy, as well as to plan for the development of adequate facilities for the future as the population and the economy grow.

EDITOR'S NOTE: *"Section 16.051 of the Texas Water Code directs the Executive Director of the Texas Department of Water Resources to prepare and maintain a comprehensive State water plan for the orderly development and management of the State's water resources in order that sufficient water will be available at a reasonable cost to further the economic development of the entire State. In addition, the Department is directed to amend and modify the plan in response to experience and changed conditions." This issue of the Cross Section is devoted to "Water For Texas: A Comprehensive Plan for the Future" which is the amended Water Plan for the State of Texas as released by the Texas Department of Water Resources in Austin, Texas, June, 1984. This amended water plan sets forth planned actions and policies to address future water supply, water quality protection, water conservation, flood protection, and other water-related needs of the State. Presented herein are the major types of water and water-related problems in each of the eight major geographic regions of the State and planned actions and policy recommendations to address these problems.*

OVERVIEW OF WATER PROBLEMS AND WATER RESOURCES

Rapid population growth and economic development, coupled with a climate in which water resources are scarce, have imposed real and potential water supply problems in many areas within the State. In much of the State today, available storage capacity in existing surface-water reservoirs will barely be sufficient to meet water demands during critical droughts.

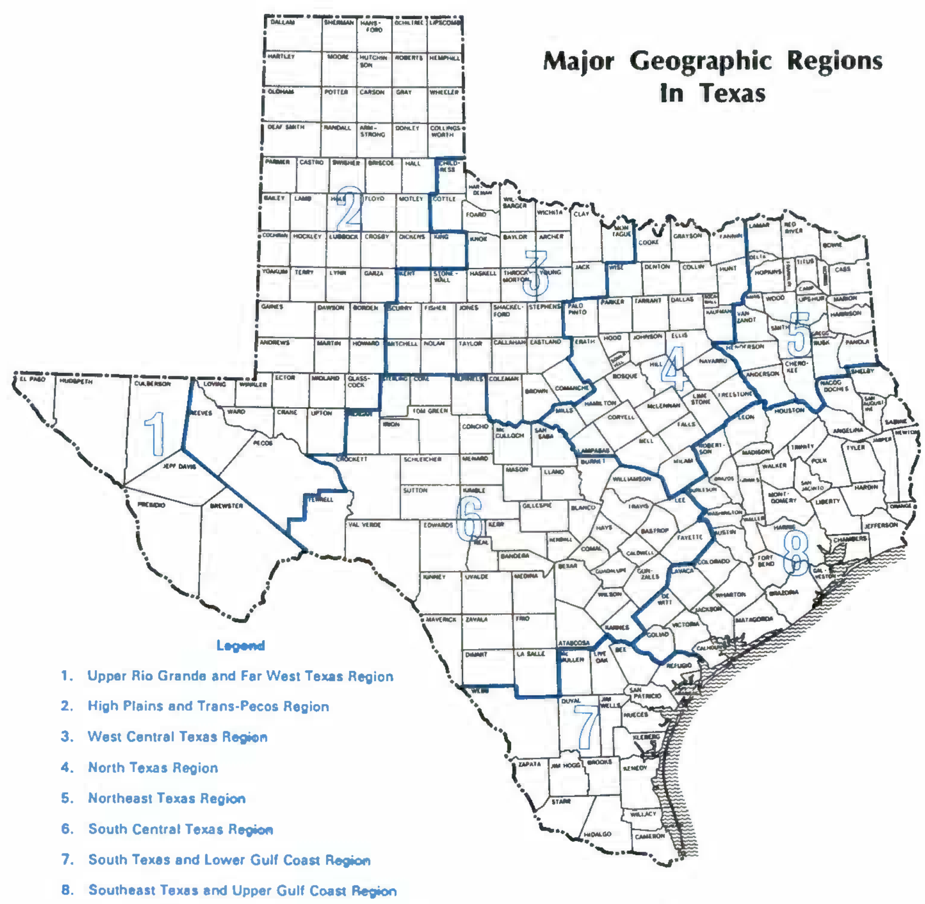
Industrialization and population increases have resulted in steadily increasing water requirements and water quality protection needs for the State. Extensive development of ground water has resulted in several problems, some local in nature, while others are more widespread.

Water quality problems, both natural and man-made affect a significant part of the State's surface-water resources. Serious flooding conditions have at one time or another struck most parts of the State. Flash flooding resulting from high-intensity rainstorms is common and not easily predicted. The potential effects of upstream water development on freshwater inflows to the bays and estuaries are of major concern to the State.

More than 50 percent of the surface area of Texas is underlain by seven major aquifers and sixteen minor aquifers. Collectively these aquifers contain about 430 million acre-feet of water in storage that is recoverable using conventional water well technology. Of this total, about 89 percent or 385 million acre-feet is located in the High Plains (Ogallala) aquifer. Of the 17.9 million acre-feet of water that Texans currently use annually, about 10.9 million acre-feet is from ground-water sources.

Texas has 15 major river basins and eight coastal basins. Long-term average annual precipitation ranges from eight inches in the El Paso area to more than 56 inches in the Beaumont area. Average annual runoff is about 49 million acre-feet. From 1940 through 1970, statewide runoff averaged 57 million acre-feet per year during the wettest period (1940-1950), and 23 million acre-feet per year during the severe drought of the early and mid-1950's.

There are currently 184 major reservoirs with 5,000 acre-feet or greater capacity in Texas with five new reservoirs presently under construction. The dependable (firm) water supply, which is the uniform yield that can be withdrawn annually from conservation storage through extended drought periods, from these major reservoirs is about 11 million acre-feet annually. We are now using seven million or 64 percent of this dependable surface water supply.



The following is a presentation of the water-related concerns of the State by geographic division.

Upper Rio Grande and Far West Texas

This region, shown as area 1 on the map on page 1, includes the major city of El Paso.

1. Water supplies are very limited. The surface-water and ground-water supplies of the Region are shared by Texas, New Mexico, and Mexico. During the past 30 years, the Rio Grande delivered only 65 percent of the water needed for the El Paso irrigation area.
2. High salinity in surface-water supplies due to frequent low flows, and increased salinity of municipal and agricultural return flows is detrimental to crops and cropland.
3. Ground water from the Hueco Bolson deposits is the primary source of municipal and industrial supply. The Bolson is being "mined" and saline water from adjacent saline water-bearing sands is encroaching upon the Bolson.
4. Fresh ground water is projected to meet El Paso's needs through 2010, but at higher costs for pumping and a poorer quality water.
5. Water supply for smaller cities is a problem now.
6. Flash flooding is a major problem.

High Plains and Trans-Pecos

This area includes the major cities of Odessa, Midland, Lubbock and Amarillo (area 2 on the map on page 1).

1. Surface-water supplies are very scarce, with practically all such supplies already developed and dedicated.
2. The High Plains (Ogallala) Aquifer—the major source of municipal and irrigation water is being mined. At the present time, the Ogallala supplies irrigation water to 4.6 million acres in the Southern High Plains (south of Canadian River) and 1.3 million acres in the Northern High Plains. By the year 2000, it is projected that the Ogallala can supply

irrigation water to 7.5 million acres if an effective water conservation program is implemented and 6.0 million acres if effective conservation is not practiced throughout the area. By the year 2030, it is projected that the Ogallala can supply water to irrigate only 2.7 million acres in the Southern and Northern High Plains, if an effective water conservation program is not implemented.

3. Municipal and industrial water supplies are becoming more difficult to obtain and more expensive as the water table declines. Some major cities of the area will need additional supplies by 1990. Ground water in many areas is higher in fluoride and nitrate concentrations than the U.S. Environmental Protection Agency and the State allow for public consumption under the Federal Safe Drinking Water Act.
4. Localized flooding is a problem throughout the Region.

West Central Texas

The cities of Abilene and Wichita Falls are included in this region of the State (see area 3 on the map on page 1).

1. Surface-water and ground-water supplies are very scarce.
2. Natural salt pollution in the upper reaches of the Red and Brazos River Basins precludes full utilization of the water resources of these basins. Also, leaking oil, gas, and salt water disposal wells and improper disposal of salt water incidental to oil and gas exploration and production have resulted in local contamination of fresh ground- and surface-water supplies.
3. High nitrate concentrations occur in the ground water in some areas due to natural phenomena, locally intensified by septic tanks, cesspools, feedlots, agricultural fertilizers, and cultivation practices. Locally, ground water is higher in fluoride than existing State standards for public consumption under the Federal Safe Drinking Water Act.
4. Major cities will need additional supplies within the next 25 to 30 years. Some smaller cities have experienced water shortages during droughts since 1980, and as a rule have poor quality water (relatively high chloride, fluoride, dissolved solids, and nitrate concentration).
5. Brush infestation of rangeland and growth of woody species that obtain water directly from the water table or from the soils just above it (phreatophytes) compete with more useful plants for fresh water.
6. Agricultural land practices in some dryland farming areas cause increased infiltration of water directly from rainfall and from surface runoff. This has contributed to soils becoming water logged, highly mineralized, and completely unproductive.
7. Localized flooding is a problem throughout the Region.

North Texas

The concerns of this area affect major cities such as Dallas, Fort Worth, Waco, Arlington, Denison, Garland, Killeen, Temple, Sherman, Denton, Plano, Richardson, and Irving (see area 4 on the map on page 1).

1. Surface-water development is near the maximum potential for the Upper Trinity River Basin. Water is being imported from neighboring basins to the east. Potential future surface-water projects to serve the region are located in neighboring basins to the east and the north.
2. Major cities have adequate supplies to meet projected needs until about 2000 to 2010. Cities served by the North Texas Municipal Water District are near critical water supply conditions.
3. Ground-water levels (Trinity Group Aquifer) have been lowered severely; thus, pumping costs are burdensome and will increase.
4. Quality of ground water is deteriorating as water levels decline. Fluoride concentrations of ground water are high. Surface-water quality suffers from high urban use pressures (dissolved oxygen, suspended solids, phosphates, fecal coliform, algal blooms, and aquatic plants).
5. Smaller cities throughout the area do not have adequate supplies to meet growth needs. Many are barely meeting current needs.
6. Major flooding problems exist in the Region.
7. High chloride concentrations in Lake Texoma in the Red River Basin and reservoirs in the middle Brazos River Basin preclude full utilization of the water resources of these basins.

Northeast Texas

This area includes the cities of Tyler, Longview, Texarkana and Marshall (note region 5 on the map on page 1).

1. Surface-water and ground-water resources are potentially available to meet projected needs, if projects are planned and developed on schedule.
2. Rapid growth due to development and use of lignite reserves is expected.
3. Water and air quality protection and land reclamation from strip mining are potential problems for this area.
4. In many areas, shallow ground water has high concentrations of iron and is acidic, which makes the water undersirable for municipal use and many manufacturing processes. These problems generally can be solved by completing wells in deeper water-bearing sands or by expensive treatment of water from shallow wells.
5. Presently, water supplies for many smaller cities are inadequate in both quality and quantity.
6. Flooding problems are present in local areas.
7. Periodically, dissolved oxygen content in streams is low due to low stream flow and low natural reaeration rates.

South Central Texas

Austin, San Angelo and San Antonio are the major cities affected in this region of the State (illustrated as region 6 on the map on page 1).

1. Rapid growth of cities and suburban areas is straining existing water supply and waste disposal facilities and subjecting many citizens to threat of flooding.
2. Development of surface-water projects is needed to firm up municipal supplies and reduce reliance on the Edwards (Balcones Fault Zone) aquifer in critical drought periods. Increased use of surface water would also assist in maintaining the ecosystems and recreational opportunities of Leona, San Pedro, San Antonio, Hueco, Comal, and San Marcos Springs, and the base flow of streams to the south of the aquifer.
3. Continued protection of the Edwards (Balcones Fault Zone) aquifer from pollution is essential.
4. Pumping from the Carrizo aquifer in the Winter Garden area has lowered water levels more than 400 feet since 1930. Poor quality water is encroaching into the aquifer in this area. Pumping costs may soon render this aquifer an uneconomic source of irrigation water.
5. The Guadalupe, San Antonio, and lower Colorado River Basins have potential surface-water projects that can be developed.
6. The upper Colorado River Basin has serious water quality problems due to inflow of saline ground water.
7. The Region has other local salinity problems and flooding problems from locally intense storms.

South Texas and the Lower Gulf Coast

This area of the state includes the major cities of Brownsville, Kingsville, Laredo, McAllen, Harlingen and Corpus Christi (see area 7 on the map on page 1).

1. The Region has insufficient quantities of surface water and ground water to meet growth needs for all water-using purposes. Surface-water supplies are practically all developed and committed. During extended drought periods, some of the current requirements cannot be met.
2. Soil salinity and drainage problems are present locally.
3. Woody species that obtain water from the water table or from the soils just above it (phreatophytes) compete with more useful plants for water.
5. Surface-water quality in the region is generally good, but low dissolved oxygen occurs in some stream segments during summer months.
6. Navigation facilities, channel maintenance, dredge spoil disposal, and bay and estuary protection require continuing management programs.

Southeast Texas and the Upper Gulf Coast

This region of the state and its associated water-related problems affects the cities of Houston, Galveston, Beaumont, Port Arthur, Victoria, Bryan, College Station, Lufkin, Nacogdoches, Huntsville, and Orange (note the map on page 1, area 8).

1. Land surface subsidence and salt water encroachment result from over-development of ground-water supplies.
2. The Houston and Galveston areas have water supplies to meet growing needs until 1990 to 1995.
3. Smaller cities are having problems from lack of surface-water availability and insufficient treatment, conveyance, and storage facilities.
4. Storm surge flooding and drainage problems are present.
5. Salt water intrusion during periods of low flow in the Brazos, Neches, and Trinity Rivers has the potential for contaminating the freshwater supply at existing intake facilities.
6. Navigation facilities, channel maintenance, dredge spoil disposal, and bay and estuary protection require continuing management programs.
7. Water quality problems require a continuing management program.

The conditions described above are illustrative of the types of water problems present in major geographic areas of Texas. However, it is emphasized that each area has significant water resources and water resource facilities that are now being used. These problems have been identified for the purpose of developing and suggesting plans to solve as many of them as possible.

PLANNED ACTIONS AND POLICY RECOMMENDATIONS

Previously we have presented an overview of the water resources problems in Texas from a statewide perspective. This section sets forth proposed actions and recommendations to local, State and federal entities and the Legislature, which are directed toward expanding programs already in place and currently operational and also toward new programs that will direct resources and activities into new areas.

WATER CONSERVATION AND PUBLIC EDUCATION

Water conservation must be given increased emphasis in the State's water supply development and water management programs. A balanced approach is needed which gives consideration both to water conservation opportunities and to those needs that can only be satisfied through the development of additional supplies. Preceding sections of the Plan provided a general discussion of the role intended for water conservation in long-range water resource planning. Here, specific actions and activities are recommended for the water conservation and public education programs of the Texas Department of Water Resources.

Municipal and Commercial Water Conservation

In order to increase municipal and commercial water conservation, the Department of Water Resources will cooperate with local governments and State and federal agencies to disseminate water conservation information to the public, encourage water conservation by the public, encourage water conservation through the news media, and support research and development of water conservation methods through the following actions:

1. The Department will provide staff assistance for developing and implementing water conservatiion programs by cities, water supply districts, river authorities, and other entities as appropriate.

2. A clearinghouse will be established within the Department for information relative to municipal water conservation. The results of conservation and reuse activities of cities and the results of research by universities and other agencies engaged in water conservation research will be monitored and such information will be made available to the public.

Activities of the municipal and commercial water conservation program will include the following:

1. The Department will conduct one-day workshops for members of city planning staffs in each of the 24 regional planning areas of the State. In these workshops, methods for increasing municipal and commercial water conservation will be identified. Procedures for developing municipal and commercial water conservation programs appropriate for each region will then be presented.
2. Technical assistance in the development of municipal and commercial water conservation programs will be provided to approximately 100 cities and water districts and authorities that have experienced difficulties or that are projected to experience difficulties in meeting demands placed on their water supply systems.
3. Water conservation pamphlets, brochures, flyers, and other materials will be prepared for distribution to the public.

Industrial Water Conservation

Water conservation methods utilized by private industry are generally proprietary. The Department, however, needs to be informed of industry efforts aimed at reducing the quantities of water used in manufacturing processes, especially attempts to reduce use of potable water, as these reductions affect Department estimates of future water requirements for industrial purposes. Estimates of the potential to use recycled water within industrial facilities, or available treated effluent, will be defined and incorporated in the methodology used to project future industrial water needs.

Agricultural Water Conservation

In order to accomplish the objectives of an agricultural water conservation program, and to realize the water-saving potential from such a program, the Department will promote agricultural water conservation and cooperate with other public and private agencies, institutions, and establishments to expand water conservation research and public information programs through the following actions:

1. Additional data on agricultural water conservation practices will be collected and staff expertise in all phases of agricultural water conservation will be enhanced.
2. Agricultural water conservation information will be disseminated, as broadly as possible, through a public information program.
3. The Department will request appropriations from which financial assistance can be provided to local soil and water conservation districts and local underground water conservation districts in each of the 12 major irrigation areas of Texas for the acquisition of irrigation system efficiency testing equipment and technical staff support.
4. Appropriations will be requested with which to develop a program, whereby local-area irrigation technicians can be trained to perform system efficiency tests, and to prepare exhibits and conduct demonstrations of practical, on-farm uses of irrigation water conservation equipment and techniques.
5. Increased federal and State funding for research to study the effects of brush control on water yields and enhanced production of desirable vegetation in representative physical regimes in Texas will be supported.
6. The effectiveness of the existing Statewide efforts for agricultural water conservation will be increased by supporting increased funding for existing programs of other agencies (Texas State Soil and Water Conservation Board and local soil and water conservation districts, underground water conservation districts, Texas Agricultural Extension Service, Texas Agricultural Experiment Station, universities, and agencies of the United States Department of Agriculture) which have programs in research, education, extension, technical assistance, and financial assistance for agricultural water conservation.
7. Programs which need additional efforts will be evaluated and, where appropriate, funds will be expended from the Research and Planning Fund (or other funds) for these programs not funded by other agencies.

The Department's role in agricultural water conservation will be to: promote conservation; disseminate information and materials on irrigation techniques and equipment that are water efficient; provide training, assistance, and demonstrations to local-area soil and water conservation districts, underground water conservation districts, and farmers; and continue to provide cooperation and support to other federal, State, and local agencies with related responsibilities. It is in the private sector, however, that most of the actual investment, production, financing, and finally, purchase and use of irrigation water conservation equipment, must be made.

Public Education

From the recommendations of the Governor's Task Force on Water Resources Use and Conservation (September 2, 1982), the following statement generally describes the need and role for a program in public education in water resource-related and flood-protection problems in Texas:

> "Successful resolution of complex water resource problems is often dependent upon the degree of public understanding of the problem and the degree of public support for the solution. Given the importance of effective public participation in finding and implementing solutions to water resource problems, the State should actively support education and technical assistance efforts that will enhance the public's understanding of water resource problems and issues. The State, working with local and regional government, should assist in the development of and provide funding for curricula and educational materials and technical assistance in water conservation, water reuse and recycling, water quality management, water supply development, environmental management, and flood protection."

In particular, education will play a major role in water conservation and flood protection programs. Therefore, the Department will request that the Legislature appropriate funds with which to initiate and implement water conservation and public education programs.

WATER FINANCING

Water facilities financing is influenced by growth of the local population, financial conditions of the area, level of available federal funding, and age and condition of the water and wastewater systems in place. Department surveys of need and analysis of future growth in population indicate increased burdens upon local financing for water projects. Federal programs that provide funding for water supply, wastewater treatment, and flood control are being reduced, including a reduction in U.S. Environmental Protection Agency grants for construction of wastewater treatment facilities. In the future, many areas in the State will need additional assistance in financing such projects. The State currently has established programs for assistance to hardship cases, primarily small jurisdictions without the capability to sell bonds at reasonable rates of interest.

Other State programs which provide loans for water supply development and water quality enhancement, and the acquisition of storage in reservoir projects, are also in place, but are not adequately funded. Therefore, it is recommended that:

1. Legislation be enacted proposing a constitutional amendment to increase the bonding authority of the existing Water Development Fund by $600 million, $200 million of this increase to be dedicated to water quality enhancement projects and $400 million to water development projects. Of the $400 million, $200 million should be used in the storage acquisition program of the Water Development Fund.
2. Legislation be enacted proposing a constitutional amendment to create a bond insurance (guarantee) program to which the State pledges its general credit in an amount not to exceed $250 million to insure (guarantee) the payment of principal and interest on bonds or other obligations issued by cities, special governmental districts and authorities, and other political subdivisions of the State for use for water development, water conservation, or water quality enhancement. Through enabling legislation, such a guarantee can be leveraged to provide several times the $250 million in funding capability.
3. The Legislature appropriate $50 million per biennium into the existing Water Assistance Fund to accelerate acquisition of reservoir storage space by the State as a measure to permit construction of reservoirs at their optimum capacity in order to provide long-range regional needs, and to provide additional financial assistance to combinations of local entities for development of regional water supply and wastewater collection and treatment systems.
4. The Legislature appropriate $5 million per biennium into the Water Assistance Fund to fund research and flood protection planning to the extent that projects funded from this appropriation complement and extend related projects funded by other agencies—State, federal, local, as well as private entities.
5. Legislation be enacted proposing a constitutional amendment to remove the hardship condition (e.g., the inability to finance proposed projects through the sale of bonds in commercial channels at reasonable interest rates) as a requirement for financial assistance through the Water Development Fund in order to provide funding for regional water and wastewater systems.
6. Legislation be enacted which will allow water conservation studies and the costs of regional facilities planning to be eligible items for financial assistance through the Water Development Fund program.

WATER QUALITY MANAGEMENT

Significant water quality problems are present in many areas adjacent to and downstream of urban centers because municipal development and population growth have overloaded existing sewage treatment and collection facilities. In addition, poor operation and maintenance of wastewater treatment plants continue to cause localized water quality problems. In some cases, regionalization of planning, implementation, management, and operation of wastewater systems could improve water quality protection. Also, there is increasing concern over the generation, management, and disposal of hazardous wastes. Therefore, it is recommended that:

1. Legislation be enacted authorizing the Department of Water Resources to levy administrative penalties for violations of the Texas Water Code, Department rules, waste discharge permits, solid waste permits, and underground injection control permits.
2. Legislation be enacted authorizing the collection of fees and/or taxes associated with the generation and/or disposal of hazardous waste to provide funds for State management of hazardous wastes.
3. Legislation be enacted to amend the Texas Water Code to require, as a matter of State policy, that water users discharge their treated wastewaters for subsequent reuse, except where the Water Development Board adopts special "no discharge" rules or where waste discharge permits specifically provide for land application of wastewaters.

4. Legislation be enacted to amend the Texas Water Code, as appropriate, to strengthen existing statutes authorizing the Department to require the regionalization of wastewater systems, where such systems can be demonstrated to be appropriate and cost effective.

MANAGEMENT OF FRESHWATER INFLOWS TO BAYS AND ESTUARIES

Freshwater inflow is an essential factor in maintaining the biological productivity of estuarine systems, which include about 2.6 million acres of the Texas Gulf Coast. The bays and estuaries of Texas are dependent upon freshwater inflows for nutrients, sediments, and a viable salinity gradient that allows inhabiting organisms, such as the economically important fish and shellfish species, to survive, reproduce, and grow.

Although studies of Texas bays and estuaries have been carried out during the past decade, the data base available for these studies do not represent a sufficiently long period of time, nor are the related laboratory studies of sufficient breadth, to completely and reliably establish the effects of, and needs for, freshwater inflow. Estuarine science is relatively new and many ecological processes have not been completely described nor are they completely understood. Therefore, it is recommended that the Legislature enact legislation authorizing the Executive Director of the Texas Department of Water Resources to develop an estuarine management plan for each major Texas bay and estuary, and provide sufficient funding through 1991 for the Department to continue to carry out bays and estuaries research and planning.

GROUND-WATER MANAGEMENT

Extensive development and use of ground water in Texas has resulted in several types of problems, some local in nature, others more widespread. In West Texas, the rate of use of water from the High Plains (Ogallala) aquifer for agriculture and other purposes far exceeds the rate of natural recharge, and along parts of the Gulf Coast, large-scale pumpage of ground water has resulted in land surface subsidence, saline water encroachment, and fault activation. Problems of water quality, both from natural and man-made causes, affect the suitability of water that is available from portions of most of Texas' aquifers. Moreover, ground water, unlike surface water, is the property of the overlying landowner and its use is subject to very few limitations.

With proper modification of Texas law and water management practices, conjunctive use, defined as "use of water from ground and surface sources, separately or in combination, in such a manner that the availability of these sources for future supplies is maximized," has the potential for increasing available water supplies in the State. It is recommended that the Texas Water Code be amended to allow the Texas Water Commission to hold hearings for the purpose of designating additional ground-water conservation districts, where such districts are deemed appropriate to address local area problems. Upon completion of such hearings, the Texas Water Commission would be empowered to call a local election in a potential district area for the purpose of determining if a local district should be created. The Texas Water Development Board should be given the authority to set minimum standards for operation and management of local ground-water districts.

INSTREAM FLOW MANAGEMENT

Water resource planners are faced with the dilemma of providing adequate supplies of water to meet man's needs and the preservation or maintenance of sufficient stream-flows to meet identified instream flow needs. Problems associated with the instream flow needs include identification of the particular uses, quantification of the need for such uses, and designating the appropriate entity and, where appropriate, the financial responsibility for providing waters for instream flows. Few of the existing instream uses are specifically identified in the Texas Water Code. Section 11.023, list of beneficial uses of State water. Those listed have a low priority of use. Should existing and future reservoir projects be required to make releases specifically for maintenance of instream flows, the dependable yields of the projects will be reduced. Flow requirements for many of the instream flow uses relating to maintenance of fish and wildlife habitat have not been quantified for most Texas streams. If reservoir operators are required to make releases over and above the amounts normally necessary to meet contractual commitments and/or senior downstream water rights, the unit cost of water for municipal, industrial, and agricultural users will increase. Therefore, it is recommended that:

1. The Texas Water Commission continue to grant water rights permits subject to conditions that downstream water rights are protected, as appropriate.
2. The Texas Water Commission continue to issue waste discharge permits predicated upon the ability of the discharger to meet effluent standards sufficient to protect established stream quality criteria.
3. Where potential future instream flow problems can be identified, reservoir development and methods of operation be considered on a case-by-case basis and appropriate solutions implemented. If potential solutions include the pass-through of all or a portion of the baseflows of streams, or releases from reservoir storage, then the water appropriation permits for the reservoirs should specify such requirements.

FLOOD PROTECTION

Flooding is a serious problem in Texas, resulting in loss of life and millions of dollars in damages annually to urban and rural areas, industry, transportation, and public utilities. Even with flood protection programs; damages from flooding will continue to increase along floodplains and in coastal areas, if these areas are selected for residential and business locations. Commonly, however, people do not perceive or consider the risk of flooding, and flood-prone areas continue to be developed to accommodate population and economic growth. It should, therefore, be the policy of the State to assume greater responsibility for the planning and financing of structural and nonstructural flood protection programs. Therefore, it is recommended that:

1. Legislation be enacted that provides the necessary additional, but limited authority for counties, on a local option basis, to establish and enforce development and drainage design standards in unincorporated areas for flood control purposes.
2. Legislation be enacted to establish flood control assistance financing through a loan guarantee program (see "Water Financing" section of the policy recommendations).
3. Legislation be considered that provides for disclosure of floodplain status in contracts for sale of real estate.

WATER IMPORTATION

In some areas of Texas, there is unappropriated surface water which remains to be developed. In most areas of the State, however, little, if any, significant potential water supply sources remain undeveloped. Where potential supply remains to be developed, it may not be sufficient to meet future requirements of the area, even after giving full consideration to the effects of water conservation in the projections of future needs. Water supplies in other parts of the State are, to a large extent, limited to ground-water resources which are finite and exhaustible. For many municipalities, and for irrigated agriculture in the High Plains, ground water is the only source of supply and this supply is being progressively depleted. El Paso and other areas within the Rio Grande Basin also will need water from new sources, sources not available in the basin. Therefore, it is recommended that:

1. A multi-state water resources study committee be established, by legislation or by Executive Order of the Governor, to initiate and carry on discussions and coordination with neighboring states relative to multi-state development and importation of water. Staff support would be provided by the Department of Water Resources.
2. Funds be appropriated to the Department to provide support to the multi-state water resources study committee and to provide additional staff for water importation planning work within the Department's long-range planning program.

WATER RESOURCES RESEARCH AND PLANNING STUDIES

Research and development of new technology to increase the usefulness of Texas' water resources are essential to Statewide water resources planning and to the general welfare of the State. Major types of research needed include technical, legal and institutional, economics, and planning. The Department will work in concert with federal agencies, local water resource agencies, business, industry, universities, and private citizens to coordinate the research and development of technology in these areas.

The September Cross Section will complete the policy recommendations and include additional information from the revised Texas Water Plan.

Copies of the publication "Water For Texas" can be obtained from the Texas Dept. of Water Resources, P.O. Box 13087, Capitol Station, Austin, TX 78711.

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Population/Water Requirements Considered In Water Planning

EDITOR'S NOTE: *In the August, 1984 issue of the Cross Section the majority of the planned actions and policy recommendations which address the water and water-related problems of the state of Texas were presented. The following are the remainder of the policy recommendations and planned actions.*

In developing the report, "Water for Texas: A Comprehensive Plan for the Future," the Texas Department of Water Resources made an evaluation of the population and water use requirements for all cities in the state with populations in excess of 1,000. Additionally, they projected the increase in water use for each city by decade periods through the year 2030. The charts on pages 2 and 3 contain the data for each major city in the Water District's service area as well as county totals for those cities with less than 1,000 residents and rural residents.

Projected municipal water use was computed by multiplying per capita water use rates by projected population. Historical per capita water use rates for each city were used to derive average and drought condition per capita water use rates. The low case water use projections are based on average per capita water use rates and the low case population projections while the high case water use projections are based on the drought condition per capita use rates and the high case population projections. Municipal water use includes residential, commercial and institutional (i.e., schools, etc.).

PLANNED ACTIONS AND POLICY RECOMMENDATIONS

PRESERVATION OF RESERVOIR SITES

Between the time that a reservoir site is selected and construction is initiated, the value of land and improvements escalates due to market forces. Land values in Texas have increased at a rate of about 10 percent per year during the last two decades, faster than the general inflation rate. Protection of reservoir sites from commercial development and inordinate price increases will require new legal and public policy approaches. Any actions will directly impact the traditional emphasis upon protection of rights of landowners in areas outside of municipalities. Proposed actions must include proper mechanisms for reservoir site designation and preservation and ways to mitigate local tax effects of such actions, among other concerns. Therefore, it is recommended that:

1. Legislation be enacted to create a State Reservoir Site Development Easement System within the Texas Department of Water Resources, whereby limited eminent domain power would be used to restrict specified parcels of land, that are geographically and hydrologically suitable for water supply storage projects, from certain kinds of land use during the time before reservoir construction begins. Types of alternative uses of land that would be precluded would be those that involve the erection of major facilities which eventually would require purchase and relocation, or other public uses that would preclude reservoir construction. The owners would retain title and use of the lands in all other respects.
2. Legislation be enacted to create a Reservoir Site Acquisition Fund to be administered by the Texas Water Development Board for purposes of preserving future reservoir sites.
3. The Legislature appropriate $100 million in each successive biennium to the Reservoir Site Acquisition Fund to compensate landowners for easements and land options to secure lands for reservoir site preservation.

MITIGATION

Development and management of the State's water resources will inevitably result in both beneficial and adverse impacts to other natural resources. At issue is the balance point for an acceptable trade-off between the maintenance of natural habitats, meeting the needs of the people, and compensation for unavoidable losses to the natural system. Methodologies for determining the nature and degree of impact are complicated and studies often require an inordinate quantity of time and funds to complete. Current procedures utilized by the U.S. Fish and Wildlife Service consider only adverse impacts to fish and wildlife and their habitat and do not include the beneficial impacts of newly created open water habitats resulting from reservoir projects. The cost of mitigative measures may be substantial for some projects, and financial responsibilities for

WATER PLANNING . . . continued on page 4

ENKADRAIN is just one sample of the type of underdrain material which is being tested in the playa lake recharge project at Shallowater. Pictured above, the underdrain material which is a composite of the black mesh and white cloth-type material is wrapped around a three-inch perforated PVC pipe which drains the filtered water to the instrument shelter and recharge well.

Recharge Project Design Tested

After months of work to attain the materials, design the layout and install a network of underdrains in a playa lake bed, then two months of waiting, the rain finally came. The June rains in the test site area provided about three acre-feet of runoff water into the playa lake located jointly on the Owens and Woodruff farms just south of Shallowater. This runoff water was just what Dr. Bill Claborn and Dr. Lloyd Urban, associate professors of Civil Engineering at Texas Tech University, were waiting for.

The researchers had previously installed 16 different filtering lines using various fabric underdrain materials in assorted sizes and shapes, and buried at various depths in the bottom of the playa lake. The June rains were just sufficient to provide a "shake-down of the design of the field test site and monitoring equipment," states Urban.

Claborn explains, "The objectives of this test are two-fold. First, we want to verify in the field what we learned last year in the laboratory. Our laboratory tests proved that the fabric underdrain materials provided sufficient filtering of the silts in playa lake water. We need to duplicate these results in the field. Secondly, we want to determine what design works best. We need to know which filter material works best under our field conditions, at what depth the materials need to be buried, and what length of filter is needed to provide the best potential for recharge."

"In installing this field test site," notes Claborn, "a standard length of 100 feet of filter material was normally used; however, lengths of 40 and 60 feet and square pads were also used." Urban explains that to install a typical filter, "A trench was dug and then partially backfilled with sand. A filter material was then placed in the trench and covered with additional sand backfill. Finally, three inches of native clay material was placed atop the sand. The clay was used to perform a natural filtering function and then the sand was used to provide easy access of the water to the filtering materials."

"When it finally rained," states Claborn, "the filters proved successful in the field. Varying flow rates ranging from insignificant through two lines to over five gallons per minute in four lines were monitored through the return lines connecting the filtering materials to the instrument shelter."

Claborn also notes, "Naturally, one of the first things we were concerned about was the quality of the filtered water. We collected water samples from each of the return lines and a chemical analysis on each sample

RECHARGE . . . continued on page 4

POPULATION PROJECTIONS

CITY/COUNTY	*Population Total 1980 (U.S. Census)*	*Low Case Water Requirements By Decade Periods*					*High Case Water Requirements By Decade Periods*				
		1990	*2000*	*2010*	*2020*	*2030*	*1990*	*2000*	*2010*	*2020*	*2030*
ARMSTRONG COUNTY	1,994	2,050	2,135	2,233	2,340	2,452	2,067	2,181	2,312	2,452	2,615
BAILEY COUNTY											
MULESHOE	4,842	5,421	6,138	6,686	7,987	9,624	5,379	6,426	7,577	9,624	12,274
OTHER	3,326	2,503	2,318	2,600	3,015	3,634	2,483	2,426	2,861	3,634	4,634
COUNTY TOTAL	8,168	7,924	8,456	9,486	11,002	13,258	7,862	8,852	10,438	13,258	16,908
CASTRO COUNTY											
DIMMITT	5,019	6,212	7,179	7,993	9,165	10,806	6,305	7,484	8,756	10,806	13,297
HART	1,008	1,072	1,162	1,293	1,483	1,748	1,088	1,211	1,417	1,748	2,151
OTHER	4,529	3,942	3,826	4,260	4,887	5,761	4,001	3,990	4,667	5,761	7,088
COUNTY TOTAL	10,556	11,226	12,167	13,546	15,535	18,315	11,394	12,685	14,840	18,315	22,536
COCHRAN COUNTY											
MORTON	2,674	3,037	3,428	3,754	4,134	4,614	3,041	3,582	4,014	4,614	5,557
OTHER	2,151	1,811	1,777	1,945	2,142	2,392	1,813	1,856	2,080	2,391	2,880
COUNTY TOTAL	4,825	4,848	5,205	5,699	6,276	7,006	4,854	5,438	6,094	7,005	8,437
CROSBY COUNTY											
LORENZO	1,394	1,593	1,743	1,835	1,993	2,265	1,599	1,775	1,925	2,264	2,661
RALLS	2,422	2,630	2,848	2,999	3,256	3,700	2,639	2,901	3,146	3,700	4,348
OTHER	5,043	4,756	4,676	4,922	5,346	6,074	4,772	4,763	5,163	6,075	7,138
COUNTY TOTAL	8,859	8,979	9,267	9,756	10,595	12,039	9,010	9,439	10,234	12,039	14,147
DEAF SMITH COUNTY											
HEREFORD	15,853	20,320	23,555	26,204	29,988	35,635	20,917	24,620	28,578	35,634	44,496
OTHER	5,312	3,665	2,930	3,259	3,730	4,432	3,773	3,063	3,554	4,433	5,534
COUNTY TOTAL	21,165	23,985	26,485	29,463	33,718	40,067	24,690	27,683	32,132	40,067	50,030
HALE COUNTY											
ABERNATHY*	2,205	2,397	2,558	2,823	2,966	3,180	2,438	2,711	3,084	3,503	4,105
PETERSBURG	1,633	1,827	2,101	2,374	2,716	3,207	1,858	2,227	2,593	3,207	4,140
OTHER	33,754	36,149	40,452	45,751	52,611	62,449	36,772	42,869	49,981	62,126	80,614
COUNTY TOTAL	37,592	40,373	45,111	50,948	58,293	68,836	41,068	47,807	55,658	68,836	88,859
HOCKLEY COUNTY											
ANTON	1,180	1,326	1,430	1,503	1,598	1,779	1,351	1,471	1,553	1,779	2,039
LEVELLAND	13,809	17,008	19,028	20,001	21,260	23,666	17,331	19,562	20,660	23,665	27,121
SUNDOWN	1,511	1,754	1,946	2,044	2,174	2,420	1,787	2,000	2,112	2,420	2,773
OTHER	6,730	5,049	4,335	4,557	4,844	5,391	5,145	4,456	4,707	5,391	6,177
COUNTY TOTAL	23,230	25,137	26,739	28,105	29,876	33,256	25,614	27,489	29,032	33,255	38,110
LAMB COUNTY											
EARTH	1,512	1,881	2,122	2,204	2,289	2,395	1,904	2,166	2,262	2,395	2,537
LITTLEFIELD	7,409	8,534	9,254	9,612	9,978	10,443	8,637	9,445	9,863	10,443	11,062
OLTON	2,235	2,640	2,923	3,036	3,152	3,299	2,672	2,983	3,115	3,298	3,495
SUDAN	1,091	1,145	1,196	1,243	1,290	1,350	1,159	1,221	1,275	1,350	1,430
OTHER	6,422	5,409	4,986	5,179	5,377	5,627	5,474	5,090	5,314	5,628	5,961
COUNTY TOTAL	18,669	19,609	20,481	21,274	22,086	23,114	19,846	20,905	21,829	23,114	24,485
LUBBOCK COUNTY											
ABERNATHY*	699	748	815	905	1,008	1,117	772	859	978	1,111	1,301
IDALOU	2,348	3,090	3,659	4,044	4,437	4,820	3,188	3,856	4,370	4,889	5,616
LUBBOCK	173,979	203,176	227,450	251,386	275,789	299,613	209,617	239,724	271,681	303,910	349,079
REESE AFB	1,921	1,862	1,823	1,778	1,743	1,649	1,921	1,921	1,921	1,921	1,921
SHALLOWATER	1,932	2,554	3,044	3,364	3,691	4,010	2,635	3,208	3,636	4,067	4,672
SLATON	6,804	6,702	6,840	7,560	8,294	9,010	6,914	7,209	8,170	9,140	10,498
WOLFFORTH	1,701	2,501	3,086	3,411	3,741	4,065	2,580	3,252	3,686	4,123	4,736
OTHER	22,267	21,754	24,143	26,915	29,719	32,510	22,444	25,446	29,088	32,749	37,877
COUNTY TOTAL	211,651	242,387	270,860	299,363	328,422	356,794	250,071	285,475	323,530	361,910	415,700
LYNN COUNTY	8,605	8,378	8,917	9,751	10,737	12,056	8,322	9,315	10,408	12,057	13,953
PARMER COUNTY											
BOVINA	1,499	1,719	1,896	2,084	2,386	2,840	1,722	1,959	2,273	2,840	3,559
FARWELL	1,354	1,455	1,585	1,742	1,994	2,373	1,457	1,637	1,899	2,373	2,974
FRIONA	3,809	4,625	5,261	5,784	6,621	7,881	4,633	5,436	6,307	7,881	9,875
OTHER	4,376	3,312	2,972	3,269	3,741	4,453	3,318	3,071	3,564	4,453	5,579
COUNTY TOTAL	11,038	11,111	11,714	12,879	14,742	17,547	11,130	12,103	14,043	17,547	21,987
POTTER COUNTY											
AMARILLO*	93,019	103,196	109,008	113,645	119,965	132,178	105,557	111,780	122,786	137,705	155,372
OTHER	5,618	5,373	2,026	806	3,222	5,383	5,496	2,077	870	3,699	6,327
COUNTY TOTAL	98,637	108,569	111,034	114,451	123,188	137,561	111,053	113,857	123,656	141,404	161,699
RANDALL COUNTY											
AMARILLO*	56,211	56,002	58,740	65,953	74,001	81,099	63,787	67,548	74,199	83,215	93,891
CANYON	10,724	10,528	11,223	12,751	14,018	15,140	11,992	12,906	14,345	15,763	17,528
OTHER	8,127	16,529	24,152	28,223	29,533	30,727	18,827	27,774	31,752	33,211	35,574
COUNTY TOTAL	75,062	83,059	94,115	106,927	117,552	126,966	94,606	108,228	120,296	132,189	146,993
**The Cities Of Amarillo And Abernathy Are Divided Between Counties. Presented Below Are The City Totals.*											
CITY OF AMARILLO	149,230	159,198	167,748	179,598	193,966	213,277	169,344	179,328	196,985	220,920	249,263
CITY OF ABERNATHY	2,904	3,145	3,373	3,728	3,974	4,297	3,210	3,570	4,062	4,614	5,406

The Data Above Was Compiled By The Texas Department of Water Resources For Use In "Water For Texas."

MUNICIPAL WATER USE REQUIREMENTS IN ACRE FEET
(One Acre-Foot Is Equal To 325,851 Gallons)

CITY/COUNTY	*Total Water Requirement*	*Low Case Water Requirements By Decade Periods*					*High Case Water Requirements By Decade Periods*				
	1980	*1990*	*2000*	*2010*	*2020*	*2030*	*1990*	*2000*	*2010*	*2020*	*2030*
ARMSTRONG COUNTY	265	341	363	380	398	416	464	499	529	561	598
BAILEY COUNTY											
MULESHOE	1,227	1,251	1,444	1,620	1,879	2,264	1,591	1,929	2,275	2,889	3,685
OTHER	391	308	299	335	388	468	378	383	452	574	732
COUNTY TOTAL	1,618	1,559	1,743	1,955	2,267	2,732	1,969	2,312	2,727	3,463	4,417
CASTRO COUNTY											
DIMMITT	1,225	1,719	2,026	2,256	2,587	3,050	2,154	2,599	3,040	3,752	4,617
HART	186	130	143	159	183	215	202	228	267	329	405
OTHER	532	587	591	659	755	890	762	782	915	1,129	1,389
COUNTY TOTAL	1,943	2,436	2,760	3,074	3,525	4,155	3,118	3,609	4,222	5,210	6,411
COCHRAN COUNTY											
MORTON	410	575	664	727	801	894	773	927	1,039	1,194	1,438
OTHER	252	223	229	251	276	308	286	306	342	393	474
COUNTY TOTAL	662	798	893	978	1,077	1,202	1,059	1,233	1,381	1,587	1,912
CROSBY COUNTY											
LORENZO	266	257	287	302	328	373	362	408	442	520	611
RALLS	343	386	427	450	489	555	559	624	677	796	935
OTHER	771	660	676	712	773	878	934	967	1,048	1,232	1,447
COUNTY TOTAL	1,380	1,303	1,390	1,464	1,590	1,806	1,855	1,999	2,167	2,548	2,993
DEAF SMITH COUNTY											
HEREFORD	4,012	4,848	5,726	6,369	7,289	8,662	6,350	7,584	8,803	10,977	13,707
OTHER	674	502	427	469	531	621	625	537	615	755	930
COUNTY TOTAL	4,686	5,350	6,153	6,838	7,820	9,283	6,975	8,121	9,418	11,732	14,637
HALE COUNTY											
ABERNATHY*	369	427	467	515	542	581	593	671	763	867	1,016
PETERSBURG	266	303	360	407	465	550	429	526	613	758	978
OTHER	6,544	6,946	7,947	8,988	10,330	12,258	9,459	11,868	13,016	17,088	19,763
COUNTY TOTAL	7,179	7,676	8,774	9,910	11,337	13,389	10,467	12,394	14,430	17,846	23,037
HOCKLEY COUNTY											
ANTON	252	302	327	343	365	407	395	432	456	522	598
LEVELLAND	2,567	2,820	3,176	3,338	3,548	3,905	3,999	4,536	4,790	5,487	6,289
SUNDOWN	491	540	610	641	682	759	667	757	800	916	1,050
OTHER	790	622	559	587	624	695	795	719	760	869	996
COUNTY TOTAL	4,100	4,284	4,672	4,909	5,219	5,811	5,856	6,444	6,806	7,794	8,933
LAMB COUNTY											
EARTH	332	392	452	469	487	510	520	620	628	665	705
LITTLEFIELD	1,486	1,654	1,835	1,906	1,978	2,070	2,235	2,486	2,596	2,749	2,912
OLTON	427	695	783	813	844	883	877	992	1,036	1,097	1,163
SUDAN	130	139	147	153	159	166	216	230	240	254	269
OTHER	755	666	642	667	693	725	828	804	839	889	941
COUNTY TOTAL	3,130	3,546	3,859	4,008	4,161	4,354	4,676	5,114	5,339	5,654	5,990
LUBBOCK COUNTY											
ABERNATHY	116	133	149	165	184	204	188	213	242	275	322
IDALOU	405	460	557	616	676	734	682	838	950	1,062	1,220
LUBBOCK	34,679	38,690	44,331	48,996	53,753	58,396	53,535	62,298	70,603	78,978	90,716
REESE AFB	707	503	496	484	474	449	643	648	648	648	648
SHALLOWATER	365	478	580	641	703	764	664	819	929	1,039	1,193
SLATON	919	901	942	1,042	1,143	1,241	1,379	1,462	1,656	1,853	2,128
WOLFFORTH	228	314	394	436	478	519	491	627	710	794	912
OTHER	2,632	2,816	3,259	3,632	4,009	4,384	3,936	4,632	5,292	5,957	6,887
COUNTY TOTAL	40,051	44,295	50,708	56,012	61,420	66,691	61,518	71,537	81,030	90,606	104,026
LYNN COUNTY	1,204	1,109	1,220	1,334	1,469	1,645	1,643	1,884	2,105	2,437	2,817
PARMER COUNTY											
BOVINA	501	520	584	642	735	875	633	731	848	1,059	1,328
FARWELL	351	380	419	461	527	627	475	539	625	781	979
FRIONA	837	1,088	1,261	1,386	1,587	1,889	1,391	1,656	1,922	2,401	3,009
OTHER	553	447	422	460	521	612	552	534	614	757	939
COUNTY TOTAL	2,242	2,435	2,686	2,949	3,370	4,003	3,051	3,460	4,009	4,998	6,255
POTTER COUNTY											
AMARILLO*	20,631	23,003	24,666	25,714	27,144	29,907	30,387	32,555	35,760	40,105	45,250
OTHER	910	782	307	122	487	814	1,040	407	170	725	1,240
COUNTY TOTAL	21,541	23,785	24,973	25,836	27,631	30,721	31,427	32,962	35,930	40,830	46,490
RANDALL COUNTY											
AMARILLO*	12,402	12,483	13,291	14,923	16,744	18,350	18,363	19,673	21,610	24,235	27,345
CANYON	1,919	2,040	2,213	2,514	2,764	2,985	3,103	3,383	3,760	4,132	4,594
OTHER	1,079	2,179	3,262	3,791	3,961	4,117	3,203	4,853	5,530	5,779	6,181
COUNTY TOTAL	15,400	16,702	18,766	21,228	23,469	25,452	24,669	27,909	30,900	34,146	38,120
**The Cities Of Amarillo And Abernathy Are Divided Between Counties. Presented Below Are The City Totals.*											
CITY OF AMARILLO	33,033	35,486	37,957	40,637	43,888	48,257	48,750	52,228	57,370	64,340	72,595
CITY OF ABERNATHY	485	560	616	680	726	785	781	884	1,005	1,142	1,338

The Data Above Was Compiled By The Texas Department of Water Resources For Use In "Water For Texas."

WATER PLANNING . . . continued from page 1

providing such measures must be determined. In many cases, the compensatory lands recommended for mitigation will be removed from the areas' tax base, placing a greater tax burden on the local population. Therefore, it is recommended that:

1. The Department of Water Resources with assistance from the Texas Parks and Wildlife Department and other agencies, as appropriate, evaluate each nonfederal water development project with respect to the need for mitigation of potential damages or losses of fish and wildlife habitat resulting from implementation of the project. In the evaluation process, enhancements and benefits to fish and wildlife as well as adverse effects and losses would be considered. Where the Texas Water Commission determines that there will be significant net adverse impacts as a result of issuing a permit for the project, the Commission require appropriate mitigation of those net impacts as a condition of the permit.
2. The Department coordinate with public agencies having responsibility and authority for fish and wildlife management early in the planning stages.
3. Legislation be enacted to provide that the costs of mitigation be borne by the direct beneficiaries of water development projects; and where a public benefit from mitigation is identified, the State assume financial responsibility.

FUTURE AMENDMENTS OF THE TEXAS WATER PLAN

Section 16.056 of the Texas Water Code provides that "the Board shall amend or modify the plan as experience and changed conditions require. The water plan presented herein is the first official revision of the Texas Water Plan which was adopted as the official water plan for the State in 1969, over 15 years ago. During this 15 year period, there has been a tremendous influx of persons into Texas, a sizeable rearrangement of population within Texas from rural areas to urban centers, and a shift in economic activity from the traditional sources in agriculture and oil and gas production into broadly based manufacturing and microcomputer technology. At the same time, an increasing public awareness of the environment has resulted in the emergence of new issues and additional State and federal legislation, regulations, and administrative requirements which have affected the manner in which development and management of Texas' water resources has been carried on.

This amended Texas Water Plan has taken these factors into consideration. As time passes and conditions continue to change, it will again become necessary to re-evaluate goals, projections of water needs, and decisions about water supplies, water quality management, flood protection, and other water-related problems and issues. Planning must keep pace with an evolving economy, changing public attitudes, advancing water use technology, and ever-changing local, State, and federal initiatives. Therefore, it is recommended that the Texas Water Plan be officially amended at least every ten years.

Open Letter to Our Readers . . .

This issue and the previous issue of the Cross Section have been dedicated primarily to the revised Texas Water Plan, "Water for Texas: A Comprehensive Plan for the Future." We commend the Texas Department of Water Resources and the Water Development Board for their efforts in revising the water plan. We are particularly pleased and impressed with the inclusion of planned actions and policy recommendations which are included to aid Texans in better utilizing their current water resources and planning for their future water needs.

We hope that the Texas Legislature will see fit to carefully study the Water Plan and thoughtfully consider approval of the recommended funding and enabling legislation.

Sincerely,

Wayne

A. Wayne Wyatt
Manager

TAES 75th Anniversary Field Day

In celebration of its seventy-fifth anniversary of continuous service to the citizens of the High Plains of Texas, the Texas Agricultural Experiment Station has planned an extra special Annual Field Day this year. The field day is scheduled for Tuesday, September 11, 1984, at the Lubbock station.

"This year the field day is going to be as usual, featuring weed control, water use efficiency and cotton improvement," indicates Dr. Bill Ott, Resident Director of Research for the Experiment Station. "The exception to that is that this is the 75th anniversary of the station and we are continuing that celebration and carrying it over into the field day."

Dr. Ott explains, "We will be modifying the day's activities and instead of starting the field tours at 1:00 p.m. as we have in the past, we are going to start them at 10:00 a.m. There will be a break at noon for an old-timers barbeque at the center. Then the field tours will resume in the afternoon.

"Some of the out of the ordinary activities that we have planned are a slide presentation in the auditorium which will pictorially represent the happenings of the last 75 years; a static display of old publications, bulletins and historical sequences in the halls and foyer; an on-going demonstration of computers in agriculture; and a tour of the laboratory which we have not normally had before." Dr. Ott indicates, "There will be a completely separate grape tour with special trailers and anybody who wants to go to that can take off and do so, or be a part of the rest of the field day, or both.

"The other thing that we have planned is on the regular tour. We will have a series of historical plantings of old crops. These crops are no longer important to agriculture in the area, but were important in the making of the agriculture of this country."

Dr. Ott invites, "Anyone and everyone to attend the field day and participate in the station's 75th anniversary."

RECHARGE . . . continued from page 1

showed the water to be free of silt. No harmful chemicals were detected. After that had been determined, we began to recharge the filtered water into the formation through the recharge well." The reaserchers did notice a growth of slime (algae) in the pipes leading from the underdrains to the recharge well; however, it is not certain at this time if the slime will present a problem to this recharge technique.

Both researchers are enthusiastic about the field test of this playa lake recharge system. Claborn indicates, "We recharged about 20 percent of the water collected during this first rain. That means about six-tenths of one acre-foot of water was filtered and recharged before the lake dried. We believe that it is possible to recharge 80 to 90 percent of the water in the lake while utilizing as little as two acres of the lake area to install the filtering system."

Urban states, "Now that we have fixed a few plumbing problems in the instrument shelter, gotten rid of the frogs, and are ready to go again, we're just waiting for more rain." The project is scheduled to run for up to six years in order to gather sufficient data on the economic feasibility, lifespan, and design criteria of this type of playa lake recharge system.

SAVE THIS ISSUE .... IT MAY BE YOUR LAST !!

THE COMPUTER'S IN CHARGE

With this issue of The Cross Section the computer takes charge of our mailing list. If you experience any problems please let us know.

Kathy Redeker
Editor

THE CROSS SECTION (USPS 564-920)
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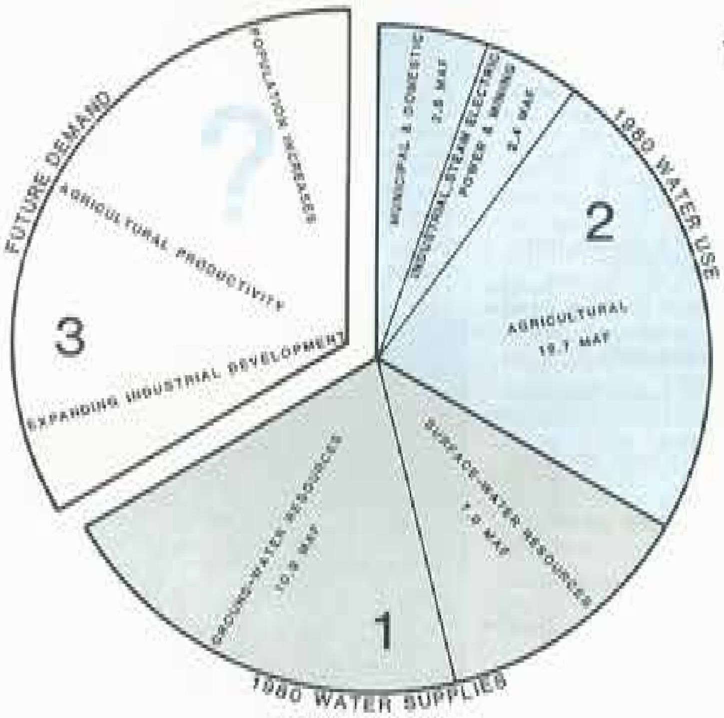

TEXAS WATER— WILL THE PIECES FIT?

MAF=Million Acre Feet

In 1980, (1) Water Supplies Equaled (2) Water Use. But, Consider (3) Future Demand. Can we make the pieces fit?

Changes Realign District Staff

There are some new faces around the Water District's office and some staff have been assigned new duties and responsibilities.

One of those who has been assigned additional responsibilities with the Water District is *Ken Carver*. Recently appointed Assistant Manager, Carver now assists A. Wayne Wyatt, District Manager, with the overall management of the District's staff, its programs and activities.

Originally employed with the Water District in 1973, Ken served as an Engineer Technician; Director of the Agricultural Division; and currently serves a dual role as Assistant Manager and as Director of the Water Use/Conservation Division. Ken directs the activities of the staff involved in all the agricultural water use and conservation programs as well as the permit section staff. Ken states, "I have enjoyed my tenure with the Water District and am looking forward to new challenges and opportunities as Assistant Manager. I look forward to seeing that the services the Water District provides are carried out to the fullest extent possible in our service area."

Ken sees the major emphasis of the Water Use/Conservation Division as "expanding the use of soil moisture monitoring equipment by the irrigators and helping the irrigator improve his water and energy use efficiency. All of these programs will help farmers hold down costs, improve profits and conserve both water and energy. I believe we have an excellent staff who can provide high quality services to the irrigators in the area served by the Water District."

Water District Geologist, *Don McReynolds*, has also been assigned new duties in the refinement of staff responsibilities. Don was recently appointed as Director of the Geohydrologic/Graphic Arts Division and now supervises the activities of personnel in the field Technical Support, Graphic Arts and Geohydrologic Sections.

With the District since 1971, Don has served primarily as a geologist providing geohydrologic mapping of various aspects of the Ogallala Formation including altitude of the base of the Ogallala Formation, altitude of the water table, saturated thickness, and change in the water table from predevelopment of extensive irrigation to

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SATISFYING OUR FUTURE WATER NEEDS

EDITOR'S NOTE: *The two previous issues of The Cross Section were dedicated to presenting information from the revised Texas Water Plan. The August, 1984 issue contained the majority of the planned actions and policy recommendations contained in the updated Water Plan. Then the September, 1984 issue completed the planned actions and policy recommendations as well as provided population and water use projections for the major cities within the Water District's service area and county-wide totals for the areas outside the major cities. This issue, October, 1984 is dedicated to identifying the sources of water which are available to meet the projected needs.*

MUNICIPAL WATER USE

In the High Plains of Texas, principally the area served by the High Plains Water District, the Ogallala Formation is the primary water source. The Ogallala Formation extends far beyond the boundaries of this Water District, encompassing approximately 35,000 square miles in 42 Texas counties and 176,940 square miles in eight Great Plains states. This Water District serves all or parts of 15 counties containing approximately 8,149 square miles.

The Ogallala aquifer in the 42 counties in the High Plains of Texas presently contains about 420 million acre feet of water. Of this 420 million acre feet, the Texas Department of Water Resources predicts that 385 million is recoverable through conventional means, i.e. wells.

This 385 million acre feet of water represents 89 percent of the total recoverable ground-water resources within the State of Texas. The volume of gravity water in the Ogallala Formation for each county served by the Water District as of January 1980 and estimated to be in storage by the year 2000 is as follows:

County	*1980*	*2000*
Armstrong	3,100,000	2,640,000
Bailey	5,990,000	4,440,000
Castro	12,300,000	8,150,000
Cochran	2,780,000	2,070,000
Crosby	5,180,000	5,080,000
Deaf Smith	9,970,000	7,140,000
Floyd	8,840,000	6,500,000
Hale	12,710,000	10,420,000
Hockley	3,360,000	2,950,000
Lamb	10,100,000	7,450,000
Lubbock	3,880,000	3,480,000
Lynn	1,900,000	1,890,000
Parmer	10,370,000	6,430,000
Potter	2,760,000	2,260,000
Randall	3,410,000	2,410,000
TOTAL	96,650,000	73,310,000

The water currently in storage in the Ogallala aquifer is and will continue to be the principal water supply source for municipal, industrial, agricultural, livestock and domestic water used in the High Plains area. Many cities and towns do not currently have adequate ground-water reserves to supply their long-term needs; therefore, it will be necessary for some to acquire additional ground-water rights some time in the future in order to fulfill their projected needs. In most instances adequate ground-water resources are expected to be available within close proximity to most towns and cities.

The Department has calculated the number of new wells which will be needed to satisfy increased water demands as a part of its planning efforts. The number of new municipal wells that will be needed in the area of the High Plains of Texas which is underlain by the Ogallala aquifer between 1980 and the year 2030 is estimated to be 2174. About one-half of this total will be needed in the Water District's service area.

Surface Water

Nineteen towns and cities on the High Plains or near the High Plains are currently obtaining all or a portion of their water supplies from three existing surface-water reservoirs. These reservoirs are: Lake Mackenzie Reservoir, White River Lake Reservoir, and Lake Meredith Reservoir. The towns served from these reservoirs are: Floydada, Lockney, Tulia and Silverton from Lake Mackenzie; Ralls, Crosbyton, Spur, and Post served from White River Lake; and Amarillo, Lubbock, Pampa, Borger, Plainview, Slaton, O'Donnell, Tahoka, Levelland, Lamesa and Brownfield served from Lake Meredith.

The Water Plan identifies four additional potential reservoir sites either on or near the High Plains which might be constructed to provide water for some of the towns and cities in the High Plains. These are: the Palo Duro Reservoir located in Hansford County, Sweetwater Creek Reservoir located in Wheeler County, and the Post and Justiceburg Reservoirs located in Garza County.

Wastewater Treatment

County	*Number of Facilities Needed, 1984-2000*
Armstrong	2
Bailey	4
Castro	4
Cochran	3
Crosby	5

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Deaf Smith	1
Floyd	6
Hale	5
Hockley	6
Lamb	8
Lubbock	12
Lynn	4
Parmer	6
Potter	3
Randall	5
TOTAL	74

Secondary Recovery

Additional quantities of fresh water may be obtained from aquifers that are only partially saturated. Such water is known as capillary water and is the water which occurs between the water table and the land surface but which cannot flow into a well under gravitational force due to capillary action. This capillary water is the subject of recent and on-going secondary recovery investigations. Preliminary secondary recovery tests, using air injection to overcome the capillary force, have proved promising. However, additional research is needed in order to determine the potential for secondary recovery of ground water and the associated costs. If proven economically feasible, secondary recovery will increase the amount of recoverable water supplies in the Texas High Plains and other areas having aquifers with water in capillary storage.

Desalinization

Below the Ogallala Formation in the Water District's service area, the Triassic Formation contains significant quantities of saline water. This saline water can, by the process of desalinization, be converted to potable water. This saline water can then be used to meet future demands for most towns and cities in the Water District's service area. Desalting is currently being utilized to a limited extent in Texas, primarily for industrial boiler feedwater and for municipal uses. The process of desalinization is expensive, but in time could prove to be an economical and feasible means to supplement municipal and industrial water supplies.

Water Importation

Importing water from outside the State for irrigated agricultural use in the High Plains of Texas was considered in the revised water plan, but the current costs of $600 to $800 per acre foot for delivery to the High Plains of Texas plus an additional $100 to $200 per acre foot for delivery to the farm, makes the concept of water importation economically infeasible at this time. The Department plans to continue to monitor needs and costs as well as possible supply sources. Should the demand for food and fiber increase to a point where there is a national shortage or the prices received for food and fiber justify the costs, a serious pursuit of importation will be made.

Weather Modification

Efforts to artificially induce or increase precipitation with the use of silver iodide, dry ice, and other means may have potential to increase water supplies in drier areas of the State. While a number of independent research projects indicate that rainfall can be increased as much as 10 to 50 percent in the western United States through weather modification activities, in the target area of a cloud-seeding project conducted in West Texas during the 1970's approximately 28 percent more rain occurred than was observed to have occurred in neighboring areas in the same years. Precipitation in both the cloud-seeding target area and neighboring areas was higher than normal during the observation period. Although promising, these techniques are not yet thoroughly proven and additional research is required to appropriately consider weather modification as a viable method of increasing water supplies. Thus, long-range planning work will encourage and promote research in the field of weather modification, and the Department will provide technical assistance to and coordination of this research as funds allow.

Agricultural Water Conservation

Declining ground-water supplies and rising costs of pumping require that irrigation water use efficiency be increased to the fullest extent feasible. The purposes of agricultural water conservation are to allow existing, but exhaustible, ground-water reserves to support present irrigated acreages for longer periods of time, to reduce the costs of production, and, to the extent possible, allow for an increase in irrigated agriculture to meet growing market demands for food and fiber in future decades.

Significant savings in water use can be accomplished with improvements in conveyance systems, the use of more efficient irrigation application systems, soil moisture monitoring, the development and use of drought-tolerant strains and varieties of crops, use of growth regulators and evaporation suppressants. Along with use of water-saving equipment and practices to reduce the quantities of irrigation water applied to crops, appropriate farming practices need to be developed and used to capture and hold rainfall in the soil profile. The capture and retention in the soil profile of rainfall, or reducing runoff from fields, applies beneficially to dryland farming operations as well as to irrigated operations. Furrow diking and conservation tillage are the leading practices currently in use to reduce rainwater runoff, along with control of weeds and brush that use water for no beneficial purpose. In order to realize these potentials, the Department will encourage agricultural water conservation and cooperate with other public and private agencies, institutions, and establishments to expand water conservation research and extension programs. Specific actions to accomplish these general objectives are included in the recommendations of the Water Plan.

The State's role in agricultural water conservation will be to promote conservation and disseminate information and materials on irrigation techniques and equipment that are water efficient. Agricultural water conservation work will be done to the extent that resources are available for programs of public information, training, assistance, and demonstrations.

The Texas Department of Water Resources has requested a substantial appropriation to support their agricultural water conservation action pro-

continued on page 3 . . . WATER NEEDS

etc.

- H.R. 71 which deals with recharge of waters into the Ogallala aquifer in the High Plains states was passed by both the U.S. House and Senate and presented to the President in September.
- Your Cross Section is now being addressed by computer. Any problems?? Let us know.

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

A MONTHLY PUBLICATION OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1

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Lindy Clark .... Receptionist-Secretary

NOTICE: Information regarding times and places of the monthly County Committee meeting can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name, except for Potter County; in this county contact Sam Line.

Conservation Tillage: A Different Way Of Life

"You just can't wake up one morning and decide you're going to do all conservation tillage. It takes a lot of nerve to sit there and know that the field has to be planted and that you haven't done anything to it," states Royce McFadden who practices conservation tillage on his land near Olton, Texas. "It's just a way of life to get out there and plow it, work it, and cultivate it to the point of planting. And it's real hard to just let it lay there. I like to compare it to some of these new women's hairdo's. You don't have to do anything to it, just leave it straggly. It's hard to do."

But, no-till technology, as McFadden has discovered, offers agricultural producers one of the best ways to maintain income and yields while cutting production costs. "Last year we grew a corn crop on less than $50 per acre. We monitored the water fairly close and pumped approximately 16 inches through our sprinkler. I'm proud of that." By comparison, McFadden says regularly tilled corn in his area requires 28 to 36 inches of water either through rainfall or irrigation.

"JUST LEAVE IT STRAGGLY" states Royce McFadden kneeling in a strip of corn where he had previously tested to see if it was harvest time. The rest of the tall corn field will be reduced to similar residue when he finishes his harvest.

Tillage Operation	*Water Use*
Regular tillage	28 to 36 inches
Minimum tillage	18 inches
Water savings	55 to 100%
Cost savings (per acre)	$25 to $45

"If I could, I'd do all my farming this way. We started three or four years ago following wheat. Then we tried it with some soybeans and then some maize. We began to wonder how it would work on other things. We also began to see the advantages of leaving the residue on the top of the ground."

McFadden questions himself, "Why did we do it? Water was the number one reason. We've just got to save water or we're not going to have any, plus we can't afford to pump it. I guess the main reason I started looking at conservation tillage was that I had too many overhead expenses. The writing was on the wall. I was going to have to quit irrigating as much. Also, when you change over to conservation tillage you cut out a lot of labor. You can do a better job of planning your work as well. You don't have interruptions like having to go out and run a sand fighter. We don't have any trouble with sand at all."

The other differences McFadden sees in conservation farming are, "When you get ready to harvest, you learn to take care of how you leave the residue. In other words, if we're cutting wheat, we'd like to cut it as high as possible. The number one goal is to try to get all the grain when we harvest the crop, yet leave the wheat stubble as tall as possible."

McFadden, like all farmers is concerned about weeds. "I've found out that any time I've stirred up the soil, I bring up a whole new generation of weeds. That's why my committment is more to no-till. It just takes a little more management to control your weeds. I used to have the idea that you would have to put up with weeds, but I think that's a misconception. You can go out and not plow a field right and have weeds. You can also go out and mess up with your herbicides and still have weeds. But, if you're particular enough and hit it right, you can have a weed free field. Now, I'm not saying my fields are all weed free, because sometimes I falter and I've got some weeds. They're not an economic loss, they just hurt your pride. I've had clean fields under regular tillage and weedy fields under regular tillage. It's going to be the same thing under minimum tillage. When you do it right and it works, you're going to be weed free. If you falter a little bit, you're going to have weeds. It won't be any different than any other time."

McFadden also sees that his soil retains moisture better as a result of his conservation tillage farming. "I really haven't had a big rain in the past two years, but I just know that water is captured a lot better. I was in Kansas one time during a rain storm and couldn't figure out why water stays on those hillsides. But, as I got to looking, the land was rough after wheat harvest and it made a natural diking effect. To me land planted flat and kept flat is much, much better. You get a much better water penetration. It's easier to work with because you don't have all those ridges to run over when you're combining your grain. Also, to me whenever you make a furrow, you are exposing the maximum amount of soil possible to the sun. Then the wind blows across those ridges and it tends to dry them out much worse than when it's flat. Plus, if you've got residue laying on flat ground, it's pretty well protected from the wind.

"The only drawback I see to conservation tillage is that it's hard to keep my government allotments together and get my rotations going like I want to. The number of acres that you have to set-aside is the problem. If you had everything exactly one third wheat, a third corn and a third cotton, and had all that proportioned with your set-aside, then you could move that all around any way you wanted. But they change the programs and then you don't have enough wheat stubble to put corn back into."

A common complaint McFadden hears from other farmers is, "How do you get a planter through all that trash?" His answer is simple, "To my knowledge, we've never had to stop because of a plug-up of straw. The no-tillage or minimum tillage tools are just built to handle it.

"A STANDARD JOHN DEERE PLANTER is what we use," states McFadden. "The only difference is that this one carries our fertilizer and has room for these coulters (at right) which cut through the residue."

"The biggest drawback is that I spent $25 to $30 per acre on chemicals when I could have done it on $6 per acre by using Atrazine. But, then I couldn't have my rotation the way I wanted it. I can plant onions, carrots, or any kind of seed and it will grow. There's no chemicals here that will hurt as far as planting anything else. The newer chemicals are just more selective. They don't work on as broad a spectrum of weeds or crops, but some of them let you do anything you want with your rotation program.

"I think wheat is a good way to get started on minimum tillage. I think you can come out of wheat into milo or into cotton or corn real well. We have followed wheat with maize then followed maize with corn, and corn with corn, and all with good success. We've had better success with maize and corn and I haven't had very good luck with soybeans. I just haven't been able to control the weeds in soybeans the way I want to."

McFadden sums it all up saying, "I started farming in 1958. I guess times were rough then, but I didn't know it. It seems like everything always clicked. Then starting in about 1979, it didn't keep clicking. I always used to look at minimum tillage and say it wouldn't ever work. But, water's the number one thing along with pumping costs. We've just got to save water. I can do that with my minimum tillage, so I've changed my mind."

Larry Hill, another conservation farmer just south of Springlake echoes McFadden's concerns, "We were shooting at cutting down the cost of pumping water as well as saving water. We changed to conservation tillage for one thing, it's cheaper. We still produce just about the same, certainly no less with our minimum tillage. You save time and you don't work the ground all the time and wear out your equipment just working the ground."

Hill feels, "It's cut my water use. I have low pressure, drop sprinklers and I think it has cut my water use almost in half." Farming nine circles and grazing 2000 head of cattle mostly by himself, Hill doesn't really see any disadvantages to conservation tillage. "It cuts down on your labor and when you've got other things to do, it makes it a lot easier. You don't have to go out there and hit the ground but maybe once or twice a year and that's all. It costs me from $5 to $6 per acre just to run a tractor across the field pulling anything. The more I can keep from running that tractor, the better I like it. It just costs too much."

Granted there are advantages and disadvantages to conservation tillage and it won't work on every field. But, in some instances, as McFadden and Hill have found, conservation tillage is worth looking into.

WATER NEEDS . . . . continued from page 2

grams as outlined in the August issue of The Cross Section.

Summary

In summary, the length of the life of the remaining supplies of gravity water available in the Ogallala aquifer will be dependent upon the conservation practices of those in the area; the irrigators, city dwellers, and industrial water users. In spite of the best efforts of everyone, the water supplies in some areas of the Water District are expected to continue to decline which will result in a reduction of the number of acres which can be irrigated for maximum potential yields. The rate of decline in acres irrigated will likely not exceed one-half to one percent per year in the Water District service area.

There is a good possibility that this trend can be reversed. This could be achieved through perfecting the secondary water recovery technology. Development of this technology could bring back into irrigated production some of the acreage previously reverted to dryland farming and further could sustain a high level of irrigated agriculture in the area for 50 or more years with no substantial decreases. Additionally, water released through secondary recovery could supply the needs of municipalities and industries in the area for almost an indefinite period of time. Studies indicate that there are 1.46 billion acre feet of capillary water in storage in the Ogallala Formation in the High Plains of Texas. If one-fourth of this can be released, it would almost double the recoverable water reserves.

Rainfall enhancement could increase agricultural production. This could also reduce ground-water pumpage and enhance water supplies through recharge which would prolong the life of irrigated agriculture in the area. Municipalities, although their water use is small as compared to that used in irrigated agriculture, can reduce their use through educational programs for their residents on how to utilize water with minimum waste. Drought tolerant crop strains, chemicals to reduce water use as well as water use efficient application all will play a role in determining the life of our current water supplies.

IT IS IN THE PRIVATE SECTOR THAT THE ACTUAL INVESTMENT, PRODUCTION, FINANCING AND FINALLY, PURCHASE AND USE OF IRRIGATION WATER CONSERVATION EQUIPMENT MUST BE MADE.

STAFF CHANGES . . . . continued from page 1

1980. Don also researches water well drillers' logs and supervises the water-level observation well monitoring program. From the annual water-level observation well measurements, Don constructs yearly change-in-water level decline maps. Information is taken from these maps to provide decline data to landowners for use in claiming a cost-in-water income tax depletion allowance. Don's other activities include geophysical logging and supervision of the District's water quality monitoring program. He also serves as radiological safety officer for the District.

Don believes, "It is extremely important to the landowners and operators in our service area that we provide reliable information on the Ogallala aquifer. The maps the District has created have been and continue to be valuable tools for the residents of the area in determining the depth to water below land surface, the depth below land surface to the base of the formation, and the volume of water in storage under their tract of land. Additionally, these maps and other data can be used to estimate potential well yields, to determine the most promising location to drill a well for the best yields, and other valuable information." Don and the staff of the Geohydrologic Section strive to provide the highest quality, most reliable data possible.

Additionally, *Kathy Redeker,* an employee of the Water District since May of 1975, was assigned editorship of The Cross Section, and the role of Water District Information and Education Director when Patricia Bruno left the District to manage P&R Surge Irrigation Systems. Kathy began her career with the Water District as the Receptionist/Secretary and has since served as Assistant to the Public Information/Education Section and Executive Secretary for the Manager for approximately the past five years before taking over her current assignments.

Kathy notes, "The District has an extensive and comprehensive public school water conservation educational program which is currently being utilized in 65 school districts located within the boundaries of the Water District. We endeavor to inform all the citizens we serve regarding the importance of their water resources. I would like to see the day when every child entering the Texas Public School system will be taught about their water resources, where their water comes from and how each child can use water wisely without waste. That way, when they become the adults of tomorrow they will be prepared to deal with the challenges the future holds in meeting their water needs."

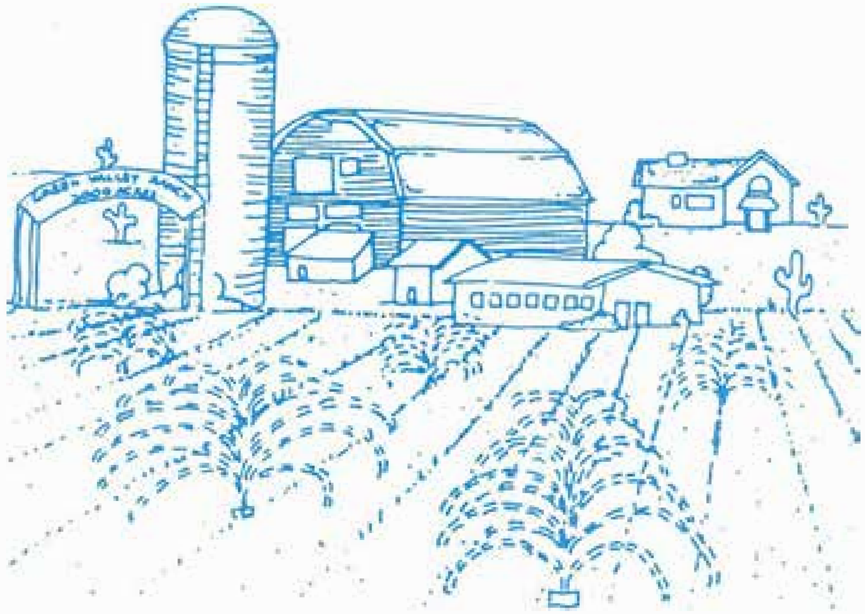
With Kathy's appointment as Director of the Information/Education Division, a vacancy was created at the Executive Secretary's desk. *Carole Rosiak,* as reported in the April, 1984 issue of The Cross Section, has had no trouble in moving over from the Receptionist/Secretary position and assuming the duties of Executive Secretary for the Manager.

Three fresh faces were added to the District's staff during the first part of 1984. With Mr. Clifford Thompson's retirement in January, the District employed *Becca Williams* to assume the duties of Chief of the Permit Section. *Lindy Clark* came to the District as Receptionist/Secretary when Carole moved up to Executive Secretary. *Cindy Gestes* was also employed this year as a Water District Geologist. Cindy had previously been employed with the District while working on her

masters degree and just happened to be in the right place at the right time with the right credentials when a position opened with Don Smith leaving the District to join the Texas Department of Water Resources' Lubbock staff.

"With all the changes in responsibilities and assignments," states Wayne Wyatt, District Manager, "I can't say that 1984 has been one of our most organized years. But, I believe we now have an excellent team of staff members in place who are ready to meet the challenges of the coming years."

Which Has Priority?



Growing demands on limited water supplies will result in the necessity of making choices. A 2000-acre farm can use as much water per day as a city of 50,000 does. If a particular water supply cannot support both, which has priority? The city of 50,000? Or the farm that feeds that city?

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Reagan Signs Legislation For Ground-Water Recharge Studies

On September 28, 1984, President Ronald Reagan signed into law the "High Plains States Groundwater Demonstration Program Act of 1983." This law authorizes and directs the Secretary of the Interior to engage in a special study of the potential for groundwater recharge in the High Plains states.

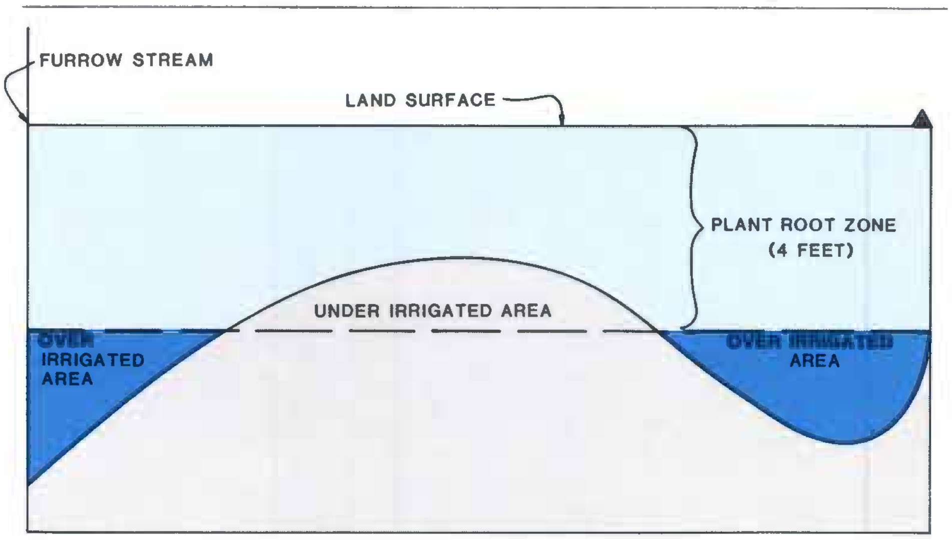
Public Law 98-434 (previously referred to as H.R. 71) authorizes a two phase investigation of and establishment of demonstration projects for ground-water recharge of aquifers in the states of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas and Wyoming (High Plains States) as well as other Reclamation Act States (Arizona, California, Idaho, Montana, Nevada, North Dakota, Oregon, Utah and Washington).

Phase I of the project directs the U. S. Bureau of Reclamation to develop a detailed plan of demonstration projects with the specific purpose of determining whether various recharge technologies may be applied to the diverse geologic and hydrologic conditions represented in the High Plains and other Reclamation Act States. Under the provisions of Phase I, the study calls for the selection of a total of not less than 21 demonstration project sites, twelve of which will be located in the High Plains States and nine of which will be in other Reclamation Act States.

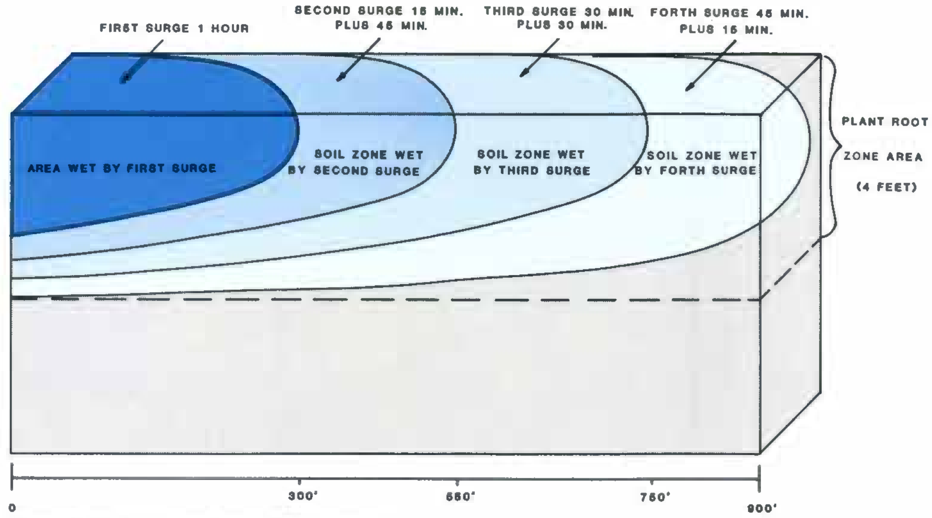
Physical criteria for demonstration project sites is confined to areas having a declining water table, an available surface water supply, and a high probability of physical, chemical and economic feasibility for recharge of the ground-water reservoir. In its section-by-section analysis of the bill, the Senate Committee on Energy and Natural Resources expressed the intent of the physical criteria for selection of demonstration project sites saying, "The committee intends an 'available surface water supply' to mean a water supply which is generally local in nature. It is not the intent of the committee that H.R. 71 imply support of, or be used for, the importation of water from great distances for the purpose of recharging aquifers. In light of the moderate level of funding authorized by H.R. 71, reality precludes massive water transfer projects for aquifer recharge under the act." The committee also noted that, "playa lakes, which are small ponds or lakes which appear temporarily after precipitation, are available surface water supplies under the act." Five hundred thousand dollars is appropriated under the law for completion of Phase I of the project.

Phase II of the law authorizes and directs the Bureau of Reclamation to design, construct, and operate demonstration projects in the High Plains and other Reclamation Act States to recharge ground-water systems as recommended in Phase I. An appropriation of $20 million is authorized by the law to carry out Phase II. The funds auth-

continued on page 2 . . . REAGAN



CONVENTIONAL FURROW FLOW irrigation commonly results in over irrigation and deep percolation at both the upper and lower ends of the field while the middle of the field does not receive sufficient water in the crop root zone area. Water losses occur when deep percolation occurs and water penetrates below the crop root zone area, thereby rendering it unuseable by the crop.



SURGE FLOW FURROW IRRIGATION in theory works as depicted above. As the watering cycle alternates on either side of the time control valve, the water is allowed to penetrate into the soil, thereby sealing the furrow surface so that the next surge will send water further down the furrow. This effectively eliminates over watering and deep percolation at both the upper and lower ends of the field which provides even water distribution through the field. Even water distribution helps improve the uniformity of the crop yield.

Surge Improves Crop Uniformity

"There's just no difference in the uniformity of my crop from one end of the field to the other and that's what is great about it," states Charles Hedges, referring to the uniformity of application he is able to obtain using his new surge irrigation valve. He explains, "The problem was, we always had trouble getting uniform distribution of our water in the plant root zone area throughout the field with a continuous flow of water down the furrows. The crop was good on the upper and lower ends and weak in the middle of the field. Since we have changed to surge irrigation, you can go anywhere in these fields and the crop is the same. I've got a field of cotton where it is just as fine on the lower end and in the middle of the field as it is at the top of the field."

Hedges bought his first six-inch surge valve late last spring to finish his pre-plant irrigation and has been experimenting with it since then. "I just bought one surge time-controlled valve and finished watering beds on the farm where I intended to plant my cotton. Then when we started irrigating the other farms, I moved that six-inch valve to see if it could be used to water the milo land. Well, it turned out that I had too much water for the six inch valve, so I had to go buy an eight inch. After I got that, we watered 15 rows on each side of the surge valve on one and a half hour surges and were getting 30 rows per set. Usually, the fourth surge got us out to the end of the field and the rows are over a quarter of a mile long. We doubled the amount of land we were watering before we had the surge valve."

In his experimenting, Hedges ran water down his smooth-packed rows where he had run his bullets. Then, just to see what it would do, he ran his water down the soft rows. "All these years we have had trouble getting water to the end of the field because of the clods. So in order to smooth out the rows so we could get our water to the end, we always ran bullets," notes Hedges. "You won't ever have to run bullets with these surge systems. If you want to water a farm, you won't have to pack and smooth the middles of your furrows if you use a surge valve. The on and off flow of a larger head of water down the furrow pretty well smooths the furrow out."

This is the first year since 1959 that Hedges has grown milo on one particular tract of land located just west of Shallowater, Texas, but he says, "We figure on making at least 6,000 pounds per acre. It was only pre-plant irrigated then watered one more time during the summer. During the pre-plant irrigation we watered every other row, and then we watered every row during the summer irrigation."

"I don't know why somebody didn't think of these surge valves before now," said Hedges as he sums up his opinions of the new furrow irrigation tool. "I've been watering these fields since 1959 and that ought to be long

continued on pg. 4 . . . CROP UNIFORMITY

Jerry – "Gentleman Aggie"

Just for "fun" on his weekends off, Jerry goes back to the area in and around Dimmitt where he spent lots of time growing up, and he works and relaxes around the farm with his relatives. Jerry grins and says, "It's just a lot of fun and my family lives there. My brother and his wife, grandparents, and aunts and uncles live around Dimmitt, and besides that, sometimes they even let me do something helpful around the farm."

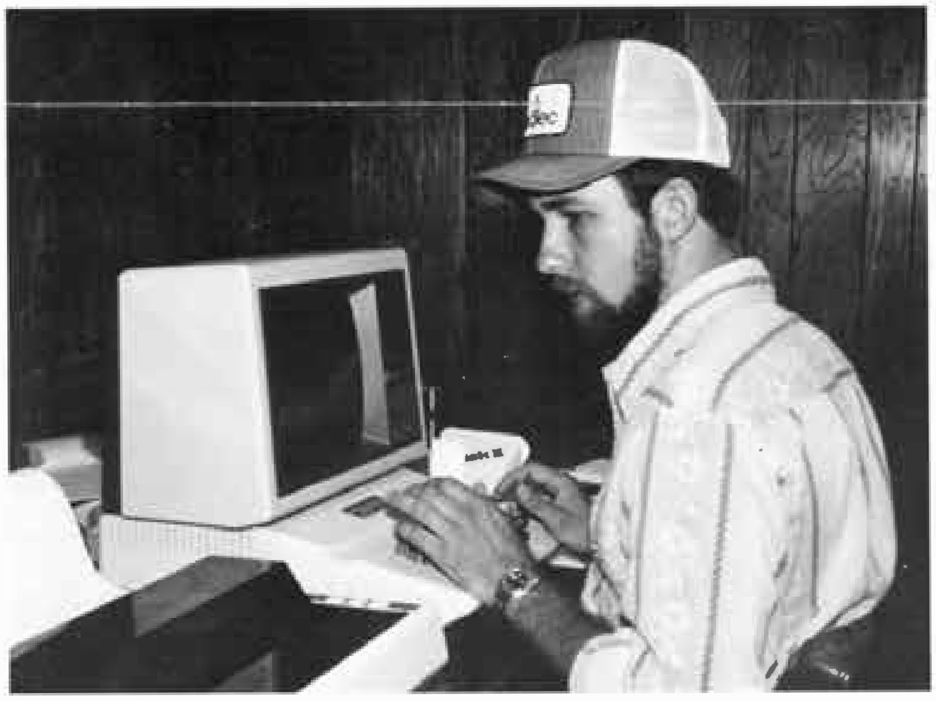
"Gentleman Aggie" describes Jerry Funck, the Water District's Agricultural Engineer, to a tee. First, he's a proud 1981 graduate of Texas A&M University with a Bachelor of Science degree in Agricultural Engineering. Secondly, as a fellow employee puts it, "Jerry's got a big heart and is conscious of other people and their needs over his own." Those qualities show up in Jerry's work as well.

Normally found either in the office or field wearing blue jeans, boots, his cap or cowboy hat and always with a can of Copenhagen in his back pocket, Jerry says he is very interested in "performing the services the Water District provides for the farmers. Hopefully I can help them in some small way."

What are Jerry's duties as Agricultural Engineer with the Water District? "Basically, he's a jack - of - all - trades when it comes to our agricultural programs," notes Ken Carver, Division Director of the Water Use/Conservation Division and Jerry's supervisor. "Jerry works in just about every agricultural program the District has including the growing season soil moisture monitoring program, the surge irrigation field demonstrations, and pump plant energy use efficiency evaluations, as well as working on our secondary recovery program and helping with water level observation well measuring. Writing computer programs for the pump plant efficiency tests, secondary recovery tests and other assorted field data programs is Jerry's speciality," states Carver.

Jerry originally came to the Water District's staff in December, 1981 just out of college. He says, "I really wanted to work in agriculture. My favorite jobs, if I have to choose, would be performing the surge and irrigation evaluations and pump plant efficiency evaluations for the farmers. If I can help just one farmer save money through a savings in fuel or water, then that makes me feel like I've earned my pay."

Jerry's mom and dad, who live in Houston, don't get to see their son in action very often, but they should be congratulated on raising a fine son who, we think, is a fine employee.



REAGAN . . . continued from page 1

orized for Phase II of the project must be shared with 20 percent of the cost being absorbed by states, their political subdivisions, or other non-Federal entities.

In background material for the report from the Senate Energy and Natural Resources Committee it notes that, "Ground - water depletion, that is pumping from underground aquifers at a rate greater than replenishment, has long been a recognized problem in many areas of the United States. Problems have been particularly acute in the arid West where large irrigated acreages, as well as several urban areas, are dependent upon groundwater resources. Particular attention has focused on the Ogallala aquifer, which encompasses 156,000 square miles and underlies portions of New Mexico, Oklahoma, Colorado, Kansas, Nebraska, and Texas.

"In Texas alone, four million to six million acre-feet of water are withdrawn from the Ogallala aquifer each year in comparison to the annual recharge from precipitation of only 200,000 acre-feet. Extensive drawdowns of the aquifer, thereby increasing pumping costs to the consumer, are widespread. In turn, it is estimated that from two million to four million acres of agricultural land in Texas will be turned back to dryland farming within 40 years."

In its conclusion, the Senate committee report notes, "Enactment of H.R. 71 would authorize a cooperative Federal/non-Federal program of study and actual testing of artificial recharge methods. Noteworthy is the potential application of the results of the investigation and demonstration programs to

continued on page 4 . . . REAGAN

Q. How Many Gallons Are In One Acre-Foot Of Water?

A. There Are 325,851 Gallons In One Acre-Foot.

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

A MONTHLY PUBLICATION OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
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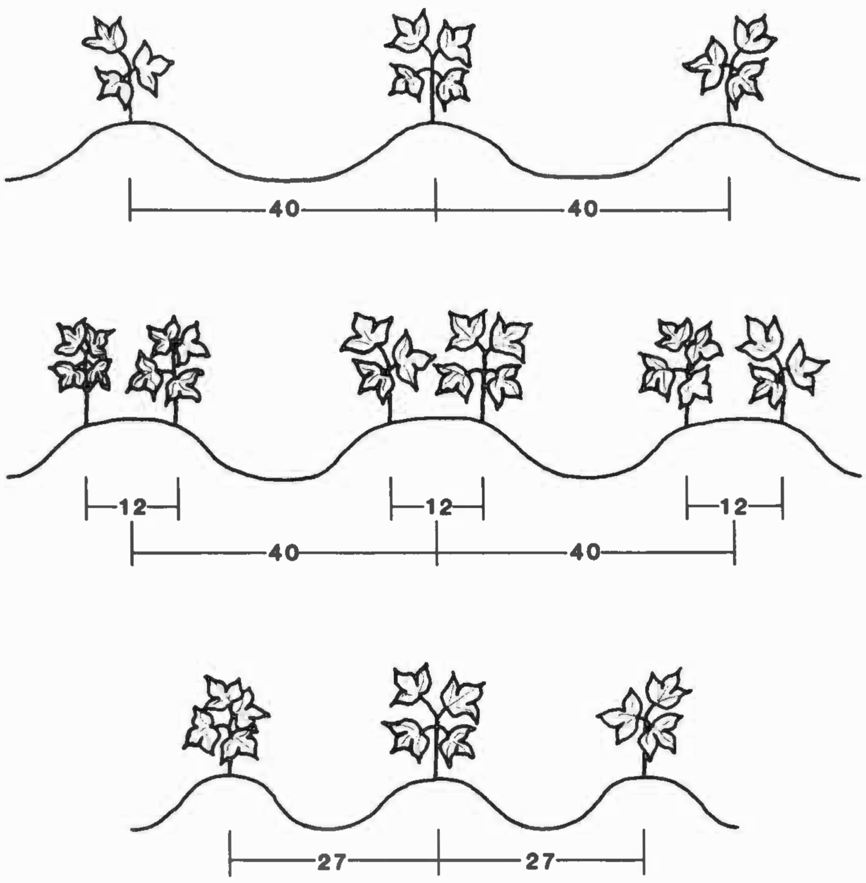
Applications for well permits can be secured at the address shown below the respective County Secretary's name, except for Potter County; in this county contact Sam Line.

Altering Row Spacings Increases Cotton Yield By 50 Percent

Texas Tech University scientists have succeeded in boosting cotton yields by 50 percent with modifications in the row spacing of the plants and a reduction in the number of plants per row. Yield comparisons were made for cotton grown on typical row spacings having 40-inch centers, beds with 40-inch centers where two rows of plants were spaced 12 inches apart, and rows spaced 27 inches apart. Additionally, the plant population was reduced to approximately 40,000 plants per acre or 10-12 pounds of seed per acre for typical varieties.

Dr. Dan Krieg, a Crop Physiologist with the Plant and Soil Sciences Department of the College of Agricultural Sciences at Texas Tech University, explains, "What we are seeing as the major yield benefit in row spacing is that when we spread the plants out and give each plant a little more space, it begins to fruit where it is supposed to begin to fruit and that's at the sixth node. Not only that, but the first fruiting branch and even the second fruiting branch has two fruits on it rather than one fruit per fruiting branch as we see in plants on a single row spacing. In effect, we are getting the plant to start fruiting earlier and getting more of the fruit set down on those bottom fruiting branches which means an early crop. We are not crowding the plants together and creating plant-to-plant competition which causes the plant to delay the onset of fruit to the eighth or nineth node and makes it end up being a late crop where the fruit is at the top of the plant rather than down at the bottom.

"In 1983," Dr. Krieg reports, "we experimented with five varieties of cotton that differed in their degree of determinacy. We used Paymaster 792 and GSA 78 to represent a real short maturity type of plant; GSA 71 and Cooker 5110 to represent the other extreme, a very long maturity; and then SP 37 as the intermediate. Then we imposed two different spacings. We had the same plant population, 40,000 plants per acre (10-12 pounds of seed per acre), we just spread the plants out on the land area more. In our 1983 experiments, we had one single row of plants per bed on 40-inch centers and then we had two rows of plants per bed spaced 12 inches apart on 40-inch centers.



COMPARING COTTON ROW SPACINGS indicates that dramatic yield increases can be attained just by spreading the plants out over more land area and reducing plant populations. Depicted above are three row spacings used in recent experiments at the Terry County Plant Stress Research Laboratory. Fifty percent yield increases were observed during 1983 through use of the planting configuration depicted in the center above.

"We were trying to do two things," notes Dr. Krieg. "First, we were trying to spread the plants out and give each plant more of the total light resource. Then secondly, we were trying to minimize the amount of bare soil exposed in the field which would contribute to evaporative losses and not contribute to actual plant water use." To explain, Dr. Krieg states, "Radiation is the driving force for water evaporation. So the question is, can we alter the micro-climate within the crop canopy to spread the plants out so that each plant has more total leaf area exposed to light to drive photosynthesis. Then can we shade the ground so that whenever we irrigate or whenever it rains, the ground will not be exposed to high radiation and thereby loose water immediately to evaporation. If water is exposed to free evaporation, that is wasted water."

Dr. Krieg enthusiastically reports, "I expected the yield to be better, but I didn't expect it to be that much better. If you just look at row spacing alone, we had a 50 percent yield increase just by changing the row spacing."

The practice of spreading the plants out is pretty easily adapted into a farming operation, states Dr. Krieg. "It's something that can be done immediately. In fact, I have talked to a number of people across this area, up at Floydada, down at Big Spring, and in the San Angelo and Brownfield areas that are using grain drills and cutting their planting rates down to maybe 12 to 14 pounds of seed per acre (50,000-60,000 plants) instead of 30 pounds of seed per acre (65,000-80,000 plants). Then they are spreading those plants out on 16-inch centers and their yields are going up dramatically with no more input . . . no more water."

Dr. Krieg does note, however, that there is one problem with adapting this new row spacing into your farming operation. "The problem is harvesting. You have to have a special type of harvester and that's a broadcast header. Everybody has row headers so they are pretty much locked in to their row spacings. That's the problem right now."

In continuing research on the same principles, Dr. Krieg indicates, "We are repeating these experiments this year and I expect the results to be just about the same. This year we've got one row per bed on 40-inch centers, two rows per bed spaced 12 inches apart on 40-inch centers, and then we have rows 27 inches apart. It looks like our 27-inch rows may be the best."

Dr. Krieg also reports that the row spacing experiments are only part of the research being conducted at the Terry County Plant Stress Research Laboratory. "We are concentrating not only on what we can do from the standpoint of spacing, plant population, planting dates, irrigation management, and those kinds of management decisions, but also trying to understand what the plant is doing now relative to producing dry matter, or yield, with the water it has available and what we can do about increasing the efficiency with which it uses its available water.

"Everything we are doing is of a rather basic scientific nature to understand some of the natural processes involved in how a plant interacts with the environment, with the soil and the atmosphere, to use its water resources efficiently," states Dr. Krieg. "Once we understand what processes inside the

continued on page 4 . . . ROW SPACINGS

USDA-SCS Target Funds Program Helps Irrigators Improve Efficiencies

Many irrigators in the area served by the Lubbock Area office of the USDA-Soil Conservation Service (SCS) are improving their irrigation application efficiencies by utilizing technical assistance provided by the SCS field office staffs. These on-farm irrigation application efficiency studies pinpoint water losses and thereby provide the irrigator with guidance on where and how he should modify his current irrigation practices to reduce water loss.

During 1984 an estimated 16,453 acre-feet of water was conserved as a result of this cooperative effort. Based on an estimated value of $100 per acre-foot, the 16,453 acre-feet of water saved for future use would have a value of $1,645,300. Improvements made by irrigators to increase their efficiencies in 1984 should carry over for at least five years on this same group of farms. This carry over effect could equal a long-term savings of 50,000 to 75,000 acre-feet of water which would have a value of $5 to $7.5 million.

In 1983 the U. S. Department of Agriculture designated twenty-seven Texas High Plains counties for a special targeting funds program. The funds from this program are being used to provide technical assistance to irrigators in the target area to help improve their irrigation application efficiencies. Mobile field water conservation laboratories used for field tests are provided by the High Plains Underground Water Conservation District with assistance from the Texas Department of Water Resources, State Soil and Water Conservation Districts, Commissioners Courts, and others. These laboratories are used by SCS field personnel to evaluate on-farm application efficiencies. The data from these field tests are used to determine where the irrigator can make improvements in his irrigation system or methods to eliminate water losses and obtain a more uniform distribution of his irrigation water.

MINI-LABS are equipped with the tools needed to perform irrigation application efficiency tests on all types of watering systems. Through use of these mobile labs and target funds provided by the USDA-SCS for technical assistance, irrigators have attained significant water and energy savings.

During 1983, the SCS provided irrigation efficiency assistance on 48,992 acres in the service area of the Lubbock SCS Area office. An average improvement in efficiency of 13 percent was

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CROP UNIFORMITY . . . continued from page 1

enough to learn how to water the field to obtain a uniform distribution of water with regular furrow watering. It is almost impossible without over irrigating. But, with this surge system, you can go anywhere in these fields and the crop is the same. I think this indicates that we can irrigate uniformly without over watering with a surge valve. There's not a bit of difference anywhere in these fields of crops."

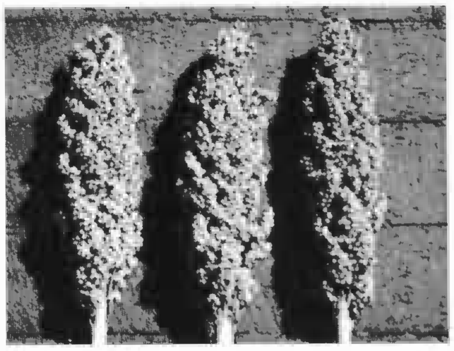
OUT STANDING in the middle of this field of milo it is easy to see that the size of the grain heads is pretty uniform for as far as you can see. This field of milo was pre-irrigated then watered one time during the growing season utilizing the surge time controlled irrigation system.

Another example where the use of surge irrigation valves has helped improve the uniformity in crop production is on the Ronald Schilling farm located near Slaton, Texas. In 1983, Schilling borrowed his first surge time control system from the High Plains Water District to experiment with it on his farm. Since that time he has purchased a system of his own.

"I have one lazy four-inch well, a two-inch well, and a two and one-half-inch well all tied into one underground line. I used my surge system to pre-irrigate 160 acres, watering every third row with the total production from the three wells," recalls Schilling. "Then during the summer I surge irrigated 60 acres of the 160 acres watering every third row.

"With my limited amount of water and trying to irrigate the number of acres I irrigate," explains Schilling, "coupled with the 1984 drought in my area, it was impossible to supply the crop's water needs with my small wells. We had less than ten inches of rainfall during the growing season this year. But, because I used the surge irrigation method, I think my crop is much more uniform than it would have been had I used continuous flow furrow irrigation as I had in the past. Normally my cotton will yield a bale and one-quarter in the upper end of the field, then taper off to half a bale or less in the middle, then pick back up to three-quarters of a bale at the end near the border. That's if I'm lucky."

Schilling's outlook this year is better. He explains, "This year I'm not sure what my yield is yet, but I think it will probably not vary from one end of my field to the other by more than 25 percent. Usually under continuous furrow irrigation, we over irrigate at the upper end of the field, then in the middle of the field we can not get enough water in the soil to keep the crop from suffering in late summer.



UNIFORMITY of crop production is one of the advantages of the surge irrigation system. The milo pictured above was cut from Charles Hedges field just outside of Shallowater, Texas. The grain head on the right was taken from the head of the field, the center one was taken from the middle of the field, and the head pictured at left was taken from the low end of the field. "There's just no difference," states Hedges.

Schilling concludes his thoughts by saying, "The surge irrigation method may provide that small advantage that will allow some producers with small yielding wells to continue to irrigate considering the high production costs and the low prices we are getting for our products."

ROW SPACINGS . . . continued from pg. 3

plant are currently causing inefficiencies, then we can begin to manipulate the plant to see if there is some genetic variability, say within cotton or sorghum, that we can use in a breeding program to build a better plant. We are trying to put the proper parents together to make a hybrid which will use its resources more effectively so that it will be more efficient in the environment in which we expect it to grow and produce more yield per unit water."

"It's just one component," states Dr. Krieg. "But, I personally believe we have a tremendous opportunity here."

Surge Irrigation Catching On

In a recent survey by the High Plains Water District, manufacturers and distributors of surge time control irrigation systems reported total 1984 sales amounting to 1,567 units. Considering the newness of this irrigation technique, this sales volume seems to indicate that there is considerable interest in the concept of surge irrigation.

During 1982, Dr. Arland Schneider with the U. S. Department of Agriculture Bushland Research Station and Jerry Walker, Area Engineer with the USDA-Soil Conservation Service performed experiments using the concept of surge irrigation and first introduced it into this area.

In 1983, the Water District purchased 17 surge systems and made them available through the local field offices of the Soil Conservation Service for testing and field demonstration in each county served by the District. Numerous field tests were conducted in 1983 by the Soil Conservation Service and Water District. Water and energy savings of 10 to 40 percent were commonly observed in these tests. These findings have resulted in a large demand for the equipment. However, due to limited availability of the equipment in 1983, less than 100 surge irrigation systems were actually purchased and put into use.

The high level of interest in surge irrigation stimulated several manufacturers and distributors to get into the business. There are now approximately ten manufacturers producing surge irrigation valves and time control boxes. Interest in this technique is expected to continue to grow and it is anticipated that in 1985 the purchase and utilization of the surge time control valves will double current use.

REAGAN SIGNS . . . continued from page 2

areas of the United States not included within the geographical scope of the act. In addition, aquifer recharge may, in some instances, provide a method of underground storage in lieu of traditional dams and reservoirs."

The Senate, on August 10, 1984, passed H.R. 71 with three amendments which: (1) requires specific line item appropriations for each demonstration project giving Congress the opportunity to judge each proposed project on its merits should it choose to do so; (2) involves the Environmental Protection Agency to the extent that it would assure that none of the projects would degrade ground-water resources which are, or may be, used for drinking water; and (3) prohibits the use of any funds authorized to be appropriated for the diversion of water from the Great Lakes or the Arkansas River Basin. Following House concurrence with these amendments on September 14, 1984, the bill was then sent to President Reagan for his signature.

TARGET FUNDS . . . continued from page 3

attained on 88 percent of the acres evaluated. This correlates to 13,834 acre-feet of water conserved in 1983. The improved efficiency should have been maintained on these same acres in 1984; therefore, the two-year savings would be about 27,668 acre-feet.

An additional 60,924 acres were evaluated in 1984 and changes were made on 56,251 acres to improve water application efficiency by an average of 13.5 percent. This equals the estimated water savings referenced previously of 16,453 acre-feet. The cumulative water savings during the two-year period should be about 44,121 acre-feet or about $4,412,100 for water valued at $100 per acre-foot.

Additionally, the immediate benefits of this program are a savings in fuel cost for pumping water. In the Lubbock area it costs about $4.00 per acre-inch for fuel to pump irrigation water. Fuel savings resulting from not having to pump 44,121 acre-feet of water would be about $2,117,808.

The Lubbock SCS Area office serves Bailey, Cochran, Hockley, Lamb, Lubbock, Hale, Crosby, Floyd, Dickens and Motley Counties. Similar technical assistance for other counties served by the Water District is directed by the Amarillo and Big Spring Area offices, and results from work performed in these areas will be reported later. This targeting funds program is scheduled to continue through October, 1985, and anyone interested in participating should contact their local USDA-Soil Conservation Service office to arrange for an irrigation efficiency evaluation.

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2930 AVENUE Q
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Ground Water: Is It Really "Free For The Taking?"

Proponents of state control for ground water are commonly of the opinion that under the private ownership doctrines of the State of Texas, landowners are encouraged to use as much of their underground water supply as they can. They reason that the underground water is "free for the taking to the landowner," and mimic fictional characters saying, "if I don't use all my water, my neighbor is going to get it." However, those who are knowledgeable of the many facets involved in the purchase, production and use of underground water, such as the High Plains irrigation farmer, would assuredly "beg to differ" with these opinions.

The High Plains landowner, under the private ownership laws of the State of Texas, has the right to capture and use his water resources as he sees fit. That is, provided there is no waste of precious underground water involved in his use. However, ground water does, to some extent, move through the underlying sand and gravel formation. The question then is, "If I don't use all my ground water, isn't my neighbor going to get it?"

Ground water in the Ogallala Formation in the High Plains of Texas moves at a rate of approximately 150 feet per year under a gradient of ten feet per mile. Under these conditions, it would require a time-period of 17.5 years for water to move across a 160 acre tract of land. Thirty-five years would be required for water to move one mile, thus the fear of the water moving out from under a farm before the landowner has a chance to use it is unfounded.

What is the price of ground water? If a person had decided to become an irrigation farmer in the High Plains of Texas in 1983, he would have had to pay an average of $175 per acre-foot for water to apply to his crops. This includes the purchase price of the water in the ground, the cost of a well to tap the water supply, the cost of a typical distribution system for applying water to cropland, and the fuel costs associated with pumping water.

"The costs involved in the use of underground water begin with the original purchase of a tract of land," states B. L. Jones, farm and ranch appraiser. "There's an appreciable difference in the sale price a potential landowner will pay for dryland, or land without adequate ground-water resources to support irrigation farming, and the sale price for land which has sufficient underground water for irrigation."

The firm of Jones Appraisal-Farm and Ranch routinely investigates land sales throughout the area served by the High Plains Water District in an effort to determine the cost per acre paid for irrigation water. "Our research includes recording the individual land sale transactions for both irrigated and dryland tracts on an individual county-by-county basis. Then we physically inspect the land involved to determine what kind of improvements might have attributed to the sale price. A determination of the value of the raw land is made by subtracting the value of the improvements from the original sale price. By averaging all of the raw per acre sale prices in a particular county together, we determine the average county-wide purchase price for each type of land."

Jones explains, "to come up with a split between the land cost and the amount paid for the underlying water resources is relatively easy. Take a dryland tract which is comparable to an irrigated tract as far as the surface topography is concerned, then subtract the dryland price from the irrigated price. That's the value placed on the underground water resources."

The average sale price for irrigated land acquired in the area served by the High Plains Water District in 1983 ranged from a high of $1,190 in Parmer

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District Voters To Cast Ballots

Registered voters residing within the boundaries of District Director's Precincts Three and Four of the High Plains Water District will be called upon to cast their ballots on Saturday, January 19, 1985, to elect two representatives to the Water District's Board of Directors and 21 County Committeemen. These elected officials are charged with representing the interests of the residents of each county they serve in all facets of the District's programs and activities.

The counties comprising District Director's Precinct Three are: Bailey, Castro and Parmer. Armstrong, Deaf Smith, Potter and Randall counties make up Director's Precinct Four. One position on the Board of Directors in each Director's Precinct and three places on the five-man county committee for each county are to be decided in the 1985 election.

Mr. James C. Conkwright of Hereford was elected to his first term on the Board of Directors representing Director's Precinct 4 in January of 1979. Mr. A. W. "Webb" Gober was first elected by the voters of Director's Precinct Three in January of 1973 to represent the views of that area. Both men are eligible for re-election at the upcoming election.

In Director's Precinct Three, Bailey County Committeemen David Stovall and Ernest Ramm have both served two consecutive four-year terms and are ineligible to run for re-election, while

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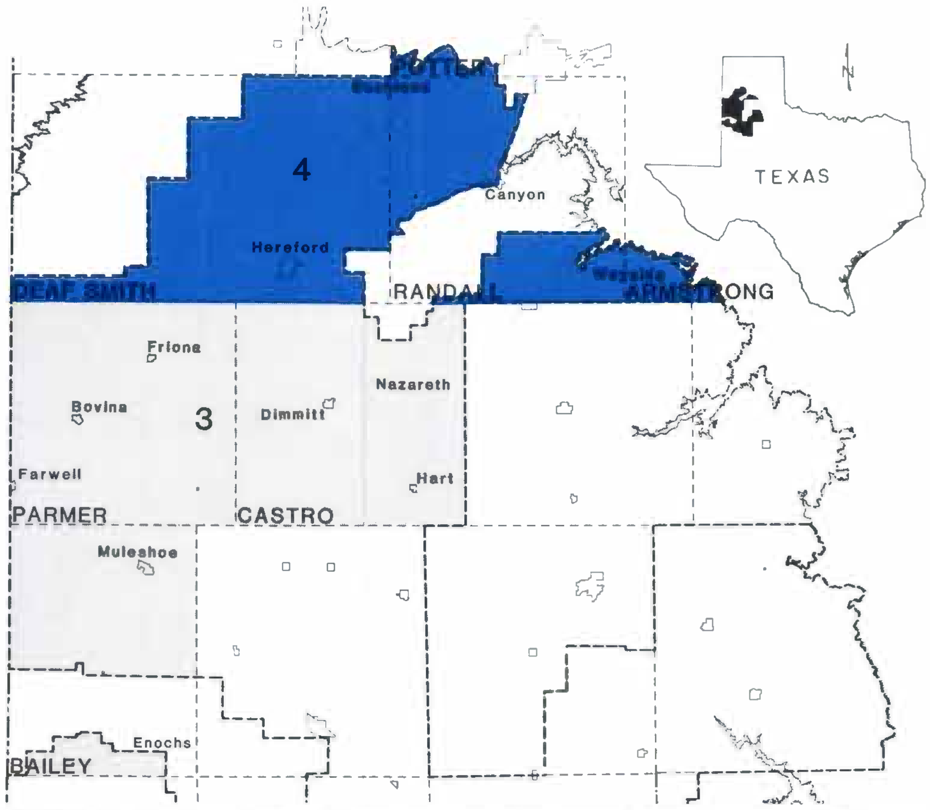

VOTERS in Director's Precinct Three and Four as defined above will be casting their ballots for two Water District Directors and 21 County Commiteeemen. All registered voters in the area served by the Water District in Potter, Deaf Smith, Randall, Armstrong, Parmer, Castro, and Bailey Counties are encouraged to go to the polls and vote.

Court Orders Tailwater Waste Stopped

On October 25, 1984, District Judge Marvin Marshall of the District Court of Castro County, Texas issued an agreed Temporary Injunction against a habitual tailwater waste offender.

The temporary injunction, which remains in effect through January 1, 1987, reads in part, "It is hereby ordered, adjudged and decreed that the defendant, his employees, servants, and agents, be, and they hereby are, enjoined and restrained from wilfully causing, suffering, and permitting underground water produced from the underground strata, and within the boundaries of the Plaintiff District (High Plains Water District) to escape into highways, roads, road ditches, and on lands of persons other than the owner of such well."

Basically the injunction prohibits the landowner from allowing any future tailwater waste to occur on his land. In addition it entitles the Water District to seek relief from the District Court in the form of penalties for contempt of court should additional tailwater waste occur prior to the expiration of the temporary injunction.

Ken Carver, Assistant Manager for the Water District, sees the issuance of a temporary injunction against a chronic tailwater waste violator, "as a reaffirmation of the rules of the District, and at the same time an enforcement of the District's rules." Carver

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GROUND WATER . . . continued from page 1

County to a low of $310 in Cochran County per acre of land. In the 15-county area served by the High Plains Water District, the average sale price for irrigated land was $763 per acre. The average sale price in the same area for dryland amounted to $274. Therefore, the average price paid for the water stored in the formation equaled $489.

"In other words," explains Jones, "let's assume a prospective landowner wished to purchase a 160 acre tract of land for the expressed purpose of producing irrigated cotton. Given our average per acre sale price for just the land and water, the prospective landowner could anticipate paying somewhere around $122,080 for a 160 acre irrigated farm. The land itself would account for $43,840 of that price and the remaining $78,240 would be the cost for the underlying water resources."

Once a tract of land which has sufficient underground water resources for irrigation purposes is purchased, an irrigation well is needed to turn that underground resource into a usable commodity. How much does an irrigation well cost? Ed Finley, Hi Plains Drilling Company, explains, "Let's assume we intend to drill a 24-inch diameter hole to a total depth of 300 feet. Then let's assume we want to gravel pack the well and install 16-inch casing with 100 feet of Johnson Irrigator well screen set in the bottom of the hole. The approximate cost of the drilling operation to get the hole drilled, cased and ready for a pump to

DRILLING a typical water well designed for irrigation purposes is but one of the costs involved in the purchase and use of underground water. A standard irrigation well can cost the landowner anywhere from $10,000 to $30,000 depending upon the size, depth, type and design of the well.

be set in the hole would run about $13,580.

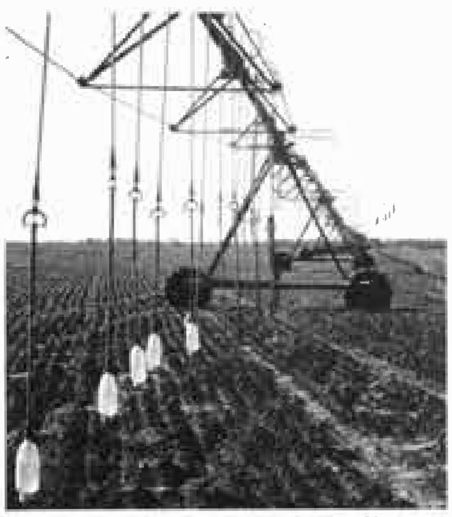
"Now that you have the hole," Finley continues, "in order to produce water you will need an irrigation pump and motor. This set up, for a pump and power plant that is installed and ready to produce water, would cost about $12,500. That's using ten-inch pump bowls with six stages. The pump is designed to produce 500 gallons of water per minute from a pumping level of 250 feet. There is a 60 horsepower electric motor used to drive the pump." Finley notes, however, "These figures are just one specific example. Drilling costs, well equipment and pumping plant expenses vary considerably depending upon the depth to water, well design, type and size of pump, and the type and size of the motor used."

So far, we have an irrigated tract of land and the means to produce water from the underlying water reservoir. In order to apply the water produced to the field, an irrigation water distribution system would be required. Distribution systems vary as greatly, if not more so, than the design of a well and pumping plant. Two of the most water-

UNDERGROUND PIPELINE is invisible to the uniformed observer once the installation process has been completed. But this buried line is used to transport underground water from the point of production to the point of distribution in the field, and is one of the many components in a water distribution system. Installing underground pipe normally costs the irrigator around $2.00 per foot of pipe.

use efficient methods of applying irrigation water are furrow irrigation including the use of a surge valve, and the use of a low pressure center pivot sprinkler system. Both systems have good water-use efficiencies; however, the costs involved in the purchase of such systems are staggeringly different.

Approximately $9,684 would be the cost of the underground line, risers, hydrants, a surge valve and time control box, plus all the necessary gaskets, end plugs, and gated aluminum pipe needed to irrigate 160 acres of land through furrow irrigation. The approximate cost of a low pressure center pivot sprinkler system would run about $55,000.



DROP-LINE CENTER PIVOT SPRINKLERS are one of the most efficient means of applying irrigation water to crops in the High Plains of Texas. Many irrigators who are looking for ways to make the best possible use of their underground water supplies, are turning to the installation of a low pressure system or are converting their existing high pressure systems to the more efficient drop-line sprinkler.

The only thing now lacking to apply water to the field is the fuel which it will take to power the pumping plant and distribution system. For an electrically powered pumping plant it would cost approximately $10,976 for fuel for the furrow irrigation system. This cost assumes a motor efficiency of

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??? DID YOU KNOW ???

Did you know that the quantity of water in storage in the Ogallala aquifer is 13 times greater than the total conservation storage capacity of the 71 major reservoirs in the State of Texas. As of the end of August, 1984 the Ogallala aquifer contained 19 times more water than these 71 reservoirs contained.

THE Cross SECTION

THE CROSS SECTION (USPS 564-920)

A MONTHLY PUBLICATION OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1

2930 Avenue Q, Lubbock, Texas 79405

Telephone (806) 762-0181

KATHY REDEKER, Editor

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NOTICE: Information regarding times and places of the monthly County Committee meeting can be secured from the respective County Secretaries.

Applications for well permits can be secured at the address shown below the respective County Secretary's name, except for Potter County; in this county contact Sam Line.

Moisture Blocks Help Irrigators Anticipate Crop Water Needs

The installation of soil moisture gypsum blocks, "gives you a detailed picture of what's going on in your root zone soil profile, instead of playing a guessing game," indicates Jack Brandt a Randall County farmer. Brandt, like many other landowners throughout the area served by the High Plains Water District cooperated with the District and the Soil Conservation Service county offices during this past growing season by having soil moisture gypsum blocks installed on his land.

"The concept behind our offices installing the blocks," explains Ken Carver, Water District Assistant Manager, "was to get a few blocks installed throughout the District. This way, we have someone in each county who is using the blocks and can offer his opinions and impressions as to how the blocks work in his area." During the 1984 growing season over 150 moisture block installations were accomplished throughout the District's 15-county service area on individual farms.

Charles Wood, a Lubbock County landowner, agrees with Brandt. "I think they're just a tremendous tool for the farmer, and that's just with the experience we had with them this year." Wood and his tenant Clifford Hamilton had their first experience with the blocks during the 1984 growing season. "What we found out in using the blocks was that you can better anticipate your irrigation needs. So much of the time over the years, we as farmers have just waited until the crop began to show visual signs of moisture stress, then we would start irrigating. With the blocks, the timing and amount of water application can better be determined."

Wood also notes that there are some interesting things to be seen using the moisture blocks in connection with furrow dikes. "We had cotton growing in a two rows in and one row out pattern on some slightly sloping ground. Then we had moisture blocks in cotton that we had planted every row on some flat ground. We were getting ready for harvest and had to take our dikes out on our two rows in and one row out cotton, but we left the dikes in on our every row planted to cotton land. Then it rained. It was real interesting to see how much more moisture we put in the ground with the furrow dikes.

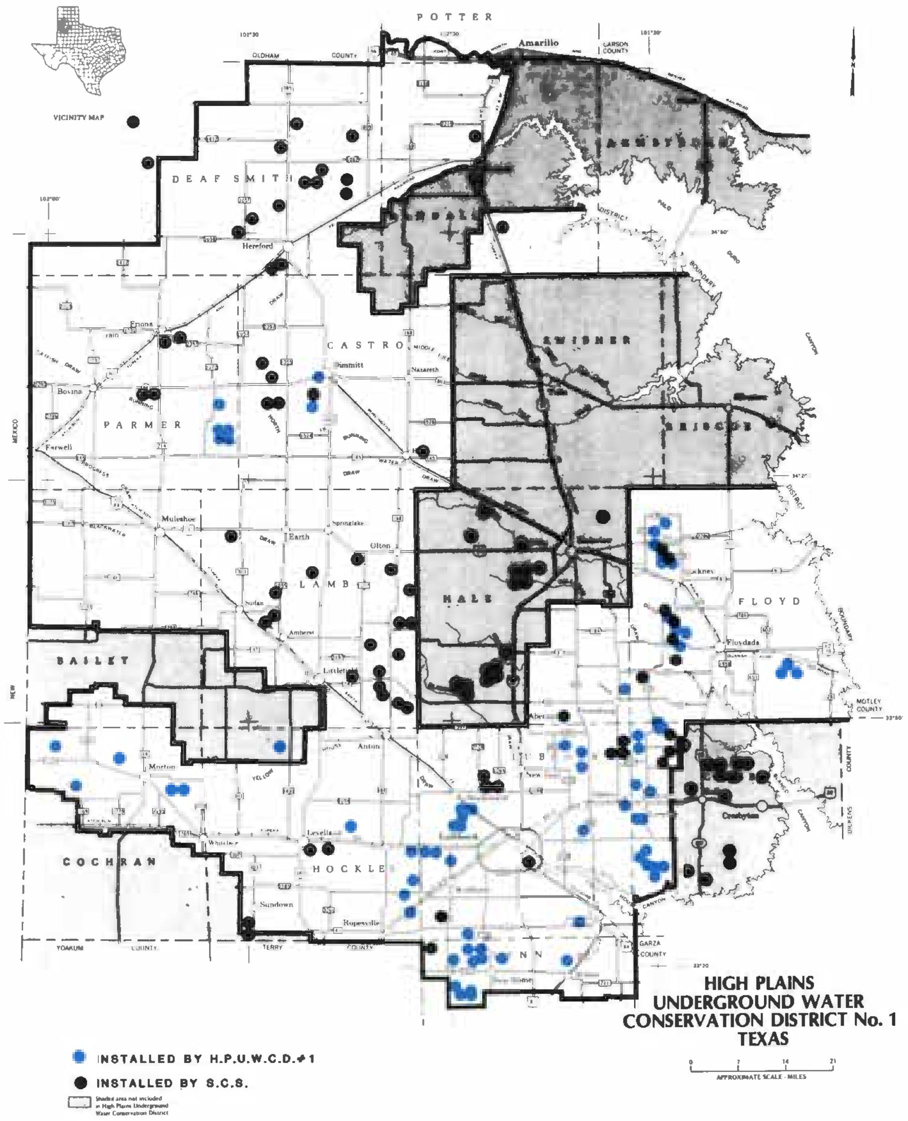
"In our two rows in and one row out field of cotton we also used the blocks with a surge valve. Using surge and the blocks, we could see where in the field we were putting the moisture with our irrigation. We could also determine to what depth we were getting our soil moisture. That was an interesting point and something that would help us too, knowing just how much of the water we're applying is getting in the soil profile and whether we were getting it wet in the center of the field and on the slope. We got a more even distribution of water in the field with surge irrigation and our block readings showed that."

Wood also notes that after 25 years of farming milo, he learned something about growing milo because of the moisture blocks. "People had always told me as I was growing up that milo only used soil moisture from the upper part of the root zone area. Using the moisture blocks proved to me that milo uses deep moisture just like cotton. If a farmer didn't know that and did not have good moisture down at that three and four foot depth, his milo could be in trouble. We were fortunate that we had good deep moisture at the beginning of the season.

Now that he has been exposed to the blocks, Wood plans to keep using them. "We're going to buy and install them ourselves next year. They're just another tool that we can use to better utilize our moisture and save water.

Farming just south of Lockney, Texas in Floyd County, Warren Mitchell expresses similar opinions. "You can sure see a trend in your moisture use patterns. I've been using them for about three years and I find that they definitely give you a better idea of when your soil moisture level begins to drop. That way you have some lead time to get cranked up and start irrigating."

Soil moisture blocks and the resistance meters which are necessary to read the blocks are available for purchase through the county Soil and Water Conservation Districts and the High Plains Water District. Anyone interested in purchasing and installing the blocks should contact their local SWCD or the Water District for details.



SOIL MOISTURE GYPSUM BLOCKS have been installed in over 150 locations throughout the area served by the High Plains Water District. These sites were installed during the 1984 growing season in a cooperative program of the Soil Conservation Service and the Water District in an effort to encourage irrigators to use the blocks. Irrigators who have used the blocks over the past few years find that the blocks are a water saving tool which will help them better determine their crop's water needs.

GROUND WATER . . . continued from page 2

90 percent, a pump efficiency of 60 percent, producing 500 gallons of water per minute, from a depth of 250 feet, for a standard 2000 hour irrigation season. Under the same conditions, only distributing water through a center pivot sprinkler system, the fuel costs would rise to approximately $15,008. In addition to the higher fuel costs, the added pressure of the sprinkler system itself would require a larger horsepower motor to handle the extra load.

Therefore, in order to purchase a tract of land, have a well drilled, install a pump and power plant, and install a distribution system, the potential irrigation farmer could anticipate a capital outlay of between $1,056 per acre on the low end of the spectrum to $1,375 on the high end for a 160 acre tract of irrigated farmland. Prorating the cost over the life of the system would bring the cost for one acre-foot of water applied to the land to about $175 per acre. The pump and distribution equipment would be depreciated over a ten-year period and the well would be depreciated over a 20-year life. There are additionally numerous other costs involved in the business of irrigation farming, such as land preparation costs, fertilizer, seed, equipment repair and replacement costs, interest, etc., which have not been taken into account when considering the costs of an irrigated farm. The High Plains irrigator can ill-afford to over-produce his underground water resources due to the cost associated with the water.

Irrigators Conserve Water

EDITOR'S NOTE: *As reported in the November, 1984 issue of The Cross Section, irrigators in the area served by the Lubbock Area office of the USDA-Soil Conservation Service had conserved a significant amount of water through improved application efficiencies. This month we would like to share with you the results obtained by irrigators in the area served by the Amarillo SCS Area office. We feel these results are equally as impressive as the Lubbock area results of this special targeting funds program.*

Irrigators in the area served by the Amarillo Area office of the USDA-Soil Conservation Service (SCS) are to be congratulated on conserving an estimated 74,133 acre-feet of water during 1984. This savings would translate into a savings of $7,413,300 for water valued at $100 per acre-foot.

These remarkable water savings are the result of irrigation application efficiency tests which are performed on individual landowners' farms by the SCS field office technicians through the use of specially targeted funds from the USDA-SCS. SCS technicians upon request evaluate a landowner's current application system and make suggestions on where improvements could be made which would eliminate water losses. As a result of these efficiency evaluations, area irrigators improved the efficiency with which they applied their irrigation water by an average of 14.75 percent on 38 percent of the 209,289 acres evaluated in 1984 alone.

Additionally, during 1983, the SCS Amarillo Area field offices provided technical assistance on 134,487 acres where an improved efficiency of 8.6 percent was attained on 30 percent of the acres evaluated. The outcome of the 1983 effort would convert to 31,527 acre-feet of water conserved or a savings of $3,152,700 for water valued at $100 per acre-foot.

The 1983 efficiency improvements should have been maintained on these same acres into 1984. Therefore, the combined two-year savings as a result of the special targeting funds program in the Amarillo area would amount to 137,187 acre-feet of water conserved.

Combining the results of both the Lubbock and Amarillo area targeting funds programs adds up to some pretty impressive results. During 1984 irrigators in these two areas conserved 90,586 acre-feet of water. That amount in addition to the estimated 45,361 acre-feet of water conserved in the two areas during 1983 makes for a combined two-year savings for the two areas of about 181,308 acre-feet of water or $18,130,800 for water valued at $100 per acre-foot.

This targeting funds program began in 1983 when twenty-seven Texas High Plains counties where designated for technical assistance by the U. S. Department of Agriculture. The program is scheduled to continue through Octo-

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COURT ORDER . . . continued from page 1

notes, "Upon the issuance of an injunction, the violator then becomes accountable to the court for further violations of the waste rules. Therefore, the violator is subject to the penalties of the court." These penalties could include fines and/or time in jail.

In this particular case, the District had compiled evidence over a two-year period of time beginning in 1982 of the occurrence of waste of underground water which had been produced for agricultural purposes from the Ogallala aquifer. Over this period of time the offender had been given notice by letter and personal contact by Water District staff who had investigated the tailwater waste. The waste became a habitual occurrence when the District was required to make at least yearly responses to complaints regarding the waste of water.

Water District personnel attempted to assist the irrigator in finding a permanent solution to the waste problem through suggestions of methods to control the water. Some methods which are currently being used to control tailwater runoff are: 1) the use of borders to hold the water on the land; 2) the use of tailwater return systems to capture and reuse the water; 3) the installation and use of sprinkler systems; and 4) a new method of furrow irrigation using a surge time control valve. When no permanent solution to this waste problem was implemented by the landowner and the waste of water continued, the District had no further recourse than to pursue the matter in court.

In the past four years the District has received three separate injunctions enjoining landowners from the waste of irrigation tailwater runoff. In 1980 an injunction was received against a Lubbock County landowner, then in 1983 an injunction was issued enjoining a Parmer County landowner from wasting irrigation water. In the 1980 case, a permanent injunction was issued against the landowner on May 22, 1980, and subsequent waste of water resulted in the assessment of a $300 fine.

In addition to the injunctions received through the courts, tailwater waste violators should be aware that there are damages for which they could be held liable. If the tailwater waste occurs on a public road or roadway and an accident were to occur as a result or partially as a result of the loss of water, the producer of the water could be held liable. Additionally, should damages occur to another landowner's property as a result or partially as a result of the tailwater losses, the producer of the water could be held liable for property damages as well as loss of crops.

LOSS OF IRRIGATION WATER from a producer's farm is considered a violation of the Water District's rules as well as a violation of state law.

The District hopes this action will encourage other landowners to eliminate any tailwater waste from their properties. District staff is available to assist anyone in finding a solution to their tailwater problems. Additionally, the District requests that anyone having knowledge of waste of tailwater should contact the District with information regarding the type of problem. Investigation of tailwater complaints is the responsibility of the Water District's staff. According to state law (Chapter 52, Vernon's Annotated Civil Statutes) and Rule 1(5) of the High Plains Underground Water Conservation District No. 1, irrigation tailwater waste is described as "Wilfully causing, suffering, or permitting underground water produced for irrigation or agricultural purposes to escape into any river, creek, or other natural watercourse, depression, or lake, reservoir, drain, or into any sewer, street, highway, road, road ditch, or upon the land of any other person than the owner of such well or upon public land."

IRRIGATORS . . . continued from page 3

ber, 1985. Anyone in the target area who is interested in participating in this program should contact his local USDA-Soil Conservation Service office to arrange for an irrigation efficiency evaluation.

Counties served by the Amarillo and Lubbock Area offices of the Soil Conservation Service are: Briscoe, Carson, Castro, Deaf Smith, Hartley, Moore, Oldham, Parmer, Swisher, Bailey, Cochran, Hockley, Lamb, Lubbock, Hale, Crosby, Floyd, Dickens and Motley.

THE IRS IS COMING!

The Internal Revenue Service Regional office in Dallas will be sending engineers Jack Page and Stonewall Brinkman to the Water District's offices sometime during the month of December. No—they're not coming to do an audit of the Water District's financial records or put anybody in jail. But they are coming to review and hopefully approve the data the District staff has developed to support landowners' claims for 1984 cost-in-water income tax depletion deductions.

A check with Carole Rosiak, Depletion Program Coordinator reveals, "Accountants and landowners who wish to request decline data for use in claiming their 1984 water depletion deduction can mail their requests to our office at 2930 Avenue Q anytime. After the IRS approves the decline maps, we will begin assigning decline values to the individual claims that we have on file." Carole notes, "We could really use the help of the accountants in submitting their claims early to assure a speedy return of the completed information." Accountants and landowners who submit their requests early, should anticipate receiving the completed forms during the first couple of weeks in January.

Any landowner who is expending his capital investment through use of his underground water supply in the business of irrigation farming is entitled to a cost-in-water income tax depletion deduction. Landowners who have not claimed a depletion deduction before and are interested in doing so this year, should supply their name, address, social security number and a complete legal description of the land involved to the Water District. The original date of purchase of the land is also needed to supply saturated thickness information for the date of acquisition. Request forms to help individuals through the process of supplying the District with all the information necessary to assign the decline information will be supplied upon request.

Any questions regarding the cost-in-water income tax depletion program should be addressed to Carole Rosiak, Depletion Program Coordinator, High Plains Water District, 2930 Avenue Q, Lubbock, Texas 79405, 806-762-0181.

BALLOTS . . . continued from page 1

Lewis Scoggin has just completed his first term and is up for re-election. Castro County Committeemen Dan C. Petty and Garnett Holland have both completed their first terms in office and are qualified to seek re-election. However, Castro County Committeeman W. A. Baldridge has completed his second term and will not be a candidate in the coming election. In Parmer County, Wendol Christian and John Cook have both indicated an interest in seeking their second terms in office, and Ronald Elliott will be leaving the county committee having completed two terms.

Armstrong County Committeemen, Tom Ferris, Larry Stevens and Kent Scroggins have all three just completed their first terms in office and are entitled to seek their second terms. Likewise, Deaf Smith County Committeemen, J. F. Martin, Troy Sublett and Virgil P. Walker were all elected to their first four-year terms of office in 1981 and are, therefore, eligible to serve again. Weldon Rea, Potter County Committeeman, has completed his second term in office, while Frank L. Bezner and Ronnie Johnson have only completed their first terms and are eligible to run again. Two Randall County Committeemen, Johnny Sluder and Jack Brandt, are ineligible to serve additional terms in office, but Gary Wagner has indicated his interest in seeking re-election.

Becca Williams, Election Chairman for the Water District, indicates "Traditionally, the county committeemen who are going off the committee solicit someone to fill their position. Normally this is an appropriate way to find an individual who meets all of the eligibility requirements of living within the county, living within a specific precinct, and who is 18 years of age or older. However, anyone who is interested in serving on a county committee or having his name placed on the ballot as a candidate for District Director is encouraged to contact the county secretary to discuss his eligibility and apply to have his name placed on the ballot."

Any registered voter having a valid voter registration, who resides within the boundaries of the Water District, and within the county where the balloting is to be conducted is eligible to vote in the election.

District Manager, A. Wayne Wyatt, invites and urges all residents of District Director's Precincts Three and Four to cast their ballots in the January 19, 1985 Water District election.

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
LUBBOCK, TEXAS 79405

SECOND CLASS PERMIT