THE Cross SECTION

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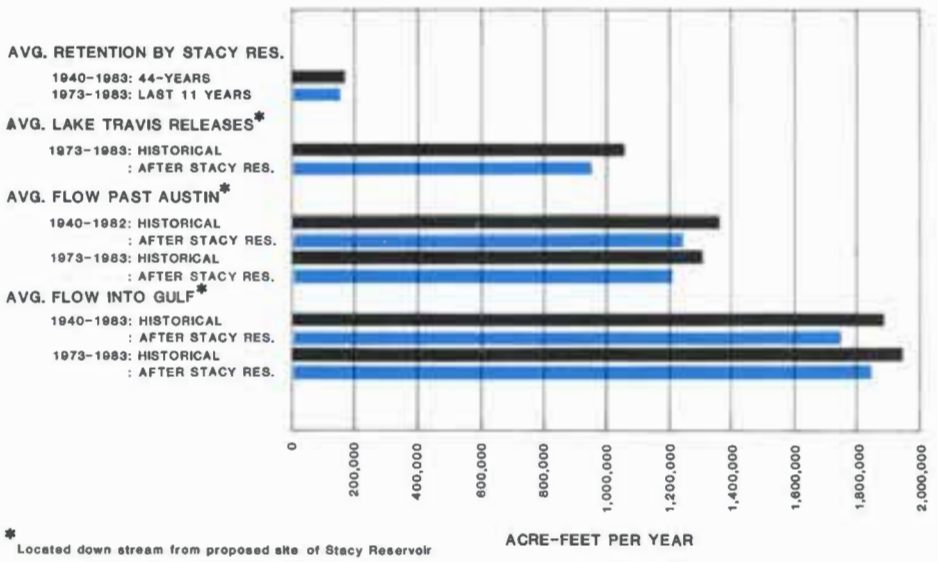
EFFECT OF STACY RESERVOIR ON FLOW OF COLORADO RIVER



* Located down stream from proposed site of Stacy Reservoir

THE TEXAS SUPREME COURT ruled that the Water Rights Commission could not issue a permit for the proposed Stacy Reservoir on the Colorado River approximately 30 miles northeast of San Angelo, Texas. The reason cited was a lack of water resources in excess of that already permitted along the river. The above illustrates the potential effects of Stacy Reservoir on Lake Travis, Lake Austin, and expected flow into the Gulf of Mexico. Note that over 1,800,000 acre-feet of water would flow into the Gulf after Stacy Reservoir as compared to approximately 1.9 million acre-feet prior to the dam's construction. If reservoirs such as Stacy cannot be permitted and constructed, the demands on ground water throughout the state will be significantly increased.

WATER RIGHTS PERMITTING . . .

Water Committee Seeks Action From Texas Legislature

The Water Committee of the West Texas Chamber of Commerce (WTCC) met in Odessa, Texas on December 2, 1984, just prior to the Annual Pre-Legislative Conference sponsored by the WTCC. Forty-two members of the Water Committee attended from throughout the 132-county WTCC service area.

The major topic of discussion centered on the recent Texas Supreme Court ruling dealing with the Texas Water Commission's permit for Stacy Reservoir. The Texas Supreme Court ruled that the Water Commission could not issue a permit for Stacy Reservoir due to a lack of water rights in excess of that already permitted for the Colorado River.

The Stacy Dam and Reservoir was to be constructed on the Colorado River. Permits previously issued by the Water Commission equal the historical average flow of the river; however, actual flow records indicate that almost two million acre-feet of water discharges into the Gulf of Mexico from the Colorado River annually. This illustrates the inequity in the way water rights permits are evaluated against actual stream flows.

The Water Committee members concluded that permits for the majority of the planned reservoirs in the State of Texas would fall in this same category. It was, therefore, deemed absolutely necessary that the Texas Legislature review the law under which the Texas Water Commission issues permits, and further, make necessary modifications to that law to allow for a more accurate accounting of actual stream flows.

Examples of the inadequacies of the old law, which was written in the early 1900's, are that it does not take into account irrigation return flows or municipal waste water return flows into the rivers and streams in assessing the total flow of a river system.

The Water Committee also discussed the additional demands which would be placed on ground water throughout the state if no new dams and reservoirs could be built in the future to supply municipal and industrial needs.

The committee considered recommending the adoption of a resolution

continued on page 2 . . . ACTION

Water Legislation In The Works For '85 Session

The state's three top lawmakers have joined forces to develop a legislative package which deals with all of the different phases of water development, management and conservation. When the Texas Legislature convenes January 8, 1985, a bill developed in a cooperative effort between Governor Mark White, Lt. Governor Bill Hobby and House Speaker Gib Lewis will be introduced into the Legislature. Harry Bradley, a member of Governor White's legislative staff indicates, "The bill addresses five general areas, 1) finance, 2) conservation, 3) agriculture, 4) bays and estuaries, and 5) ground water.

The new proposal doubles, to $600 million, the amount previously proposed for the state's "Water Development Fund," proposes a new twist to the issue of coastal protection, and leaves out state assistance to farmers who want to convert to water-efficient irrigation equipment. In addition, the bill would create a program allowing for the state to guarantee up to $250 million in bonds for local governments to build water projects, including water and wastewater treatment plants.

In looking at each section of the bill, Bradley explains, "We were trying to decide what is the best reasonable approach for everybody concerned. That was the whole idea. You can probably take any part of the bill to any of the different groups who are concerned, and none of them will like everything in the section that particularly addresses their concerns." The following presents the major points in each section of the bill.

Finance

- Authorizes $600 million in new bonds for the Water Development Fund: $200 million each for water supply, water quality, and storage acquisition. Additionally the bill removes the hardship requirement for loans to regional facilities.
- Creates a bond guarantee or bond insurance program with a pledge of $250 million in state credit to be used for water supply, water quality, conservation and flood control projects.

Bradley explains that the bond program included in the package is not money that is given away to cities or political subdivisions of the state. "Cities can get loans from the state for water or waste water treatment plants through the Water Development Fund. This way, the cities' interest rates would be a little bit lower than what they would normally pay if they sold bonds on the open market."

Conservation

- Requires that, as a condition for receiving a loan from the Water Development Fund, the applicant must adopt a water conservation program acceptable to the Department of Water Resources.
- Requires that an applicant for a water rights permit submit a water conservation plan and provide evidence

continued on page 4 . . . LEGISLATION

WTCC Members Rank Key State Issues

Respondents to a state affairs questionnaire, which was circulated to the membership of the West Texas Chamber of Commerce (WTCC), expressed their opinions that water was the number one key issue facing the State of Texas. The results of the recently completed survey show that the WTCC members are most concerned about water, followed by education and highways.

When questioned about several specific aspects related to water, support for each of the concerns received a majority of agreement. Ninety-seven percent of the respondents agreed that increased emphasis should be given to water conservation statewide, while eighty percent agreed that research on drought - resistant crops and plants should be stepped up. Three-quarters of the persons responding to the questionnaire agreed that more loan guarantees for local water projects were needed.

Support for the revised Texas Water Plan, "Water for Texas," which was recently released by the Texas Department of Water Resources, received agreement from 55 percent of the persons who responded to the questionnaire. It is interesting to note, however, that none of the respondents indicated disagreement with support of the plan. There was a fair percentage

continued on page 2 . . . KEY ISSUES

ACTION . . . continued from page 1

supporting the Texas Water Plan to the WTCC Board of Directors. However, the committee members felt that it had to withhold such a recommendation at this time because, without a change in legislation, most of the reservoirs outlined in the plan probably could not be constructed. The committee, therefore, recommended a resolution to the Board, which requested that the Legislature take whatever action necessary to modify the state's water rights permitting statutes to allow Texans to fully develop their surface water supplies.

Pre-Legislative Conference

The following day, December 3, 1984, two sessions of the Pre-Legislative Conference were hosted by the WTCC Water Committee. During the water sessions legislators from throughout the area served as panel members. Attending and participating in the panel discussions were Senator John Montford of Lubbock, Representative Tom Craddick of Midland, Representative Steven Carriker of Roby, and Representative Randal Riley of Round Rock. Each legislator was given an opportunity to express his views on legislative matters pertaining to water, which probably will come before the legislature during the upcoming session.

Following the panel members' comments, the meeting was opened for questions to the legislators from those in the audience on specific issues related to water. The principal topics of discussion in the session were possible changes in surface-water permitting laws and possible legislation addressing ground-water controls throughout the state. Also discussed were loans from the state for construction of dams and reservoirs, which require that conservation programs must be enacted by those towns and cities receiving the loans. Water legislation is expected to be the number one issue considered by the Legislature when it convenes in Austin in January.

Ogallala Aquifer Symposium Proceedings Available

Presentations made by forty speakers who participated in the technical sessions of the Ogallala Aquifer Symposium II have been compiled into a 593 page conference proceedings. Copies of the proceedings have just rolled off the press and are available for purchase from the Texas Tech University Water Resources Center in Lubbock, Texas.

Dr. Robert Sweazy, Conference Chairman and Director of the Water Resources Center, explains, "The proceedings include the text from presentations made during the three day meeting. Topics range from the latest research efforts aimed at extending the life of the Ogallala aquifer, to legal aspects of ground-water management in general, to quantative and economic projections. A listing of the conference attendees is also included."

"The proceedings of this conference contain information that would be of interest to anyone involved in the subject of ground water."

"The proceedings of this conference contain information that would be of interest to anyone involved in the subject of ground water," indicates Sweazy. "They are not just limited in value to persons working directly with or interested specifically in the Ogallala aquifer." Selected titles from the proceedings include, "A Generalized Method for Economically Evaluating Irrigation Decisions"; "Use of Computer Software to Improve the Energy Efficiency in Deep Well Water Pumping"; "Playa Lake Basins on the Southern High Plains of Texas, U.S.A.: A Hypothesis for Their Development"; "Federal Cooperation in Recharge and Replenishment" and "Scientific and Economic Research in Support of the Investigation of Secondary Recovery of Ground Water."

Registrants who paid full registration fees or specifically paid for copies of the proceedings when registering for different parts of the conference should be receiving their copies soon, if they have not already. Anyone interested in receiving a copy of the proceedings of the Ogallala Aquifer Symposium II should contact the Water Resources Center, Texas Tech University, P.O. Box 4630, Lubbock, Texas 79409. Copies are available for $40 each.

KEY ISSUES . . . continued from page 1

of the respondents who were as of yet undecided, however, with 45 percent responding that they had no opinion.

The subjects of alcohol, pari-mutuel betting, migrant labor, highways, education, and taxes were additionally responded to by WTCC members. Following the subject of water, the respondents ranked these additional topics in order of importance as follows: 2) education, 3) highways, 4) taxes and, 5) solid and hazardous waste. Alcohol, prison reform, workers' compensation, and pari-mutuel betting followed in order behind the five top concerns.

A. Wayne Wyatt, West Texas Chamber of Commerce Water Committee Chairman, expressed his pleasure with "water" being ranked as the number one key issue facing the state. Wyatt says, "We are delighted that the membership of the Chamber of Commerce has a good understanding of the state's water resources as well as the programs and practices which can be implemented to meet the state's future water needs."

★★★★★ VOTE ★★★★★
Water District Election
January 19, 1985

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KATHY REDEKER, Editor

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District Office at Lubbock

A. Wayne Wyatt ..... Manager
Ken Carver ..... Asst. Manager
Don McReynolds ..... Geologist
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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.

Teachers Promote Water And Water Conservation Education

District's Educational Tools Widely Used

Students attending classes in the 15-county area served by the High Plains Water District are becoming "water wise" at a much earlier age these days. In a recent poll of teachers in the Water District's service area, 72 percent of the teachers who responded to a questionnaire about water and water conservation educational materials available from the Water District, indicated that they had plans to use these materials in their classrooms during the 1984-1985 school year.

STUDYING HARD—Students attending classes throughout the Water District's 15-county service area are taking time out from their already busy curriculum to spend time learning about water as it effects life on the Texas High Plains. Looking at this student's pose, it seems to be a pretty involved subject.

Just a few years ago the Water District produced and distributed a supplemental textbook for adoption into earth and life science curriculums at the eighth and ninth grade levels. The text, "An Introduction to Water and Water Conservation With Emphasis on the High Plains of Texas," has additionally proven useful in augmenting study in vocational agriculture classrooms throughout the District.

Prior to the most recent contact with teachers, classroom sets of the textbook and associated teacher's aid materials had been placed in each of the 65 school districts in the Water District's service area. Recently, the Water District's County Committeemen contacted the teachers in their local school system to make sure that they were all aware of the materials and to see if any replacement or additional copies were needed.

Following up this contact, a letter and questionnaire was mailed to each school in an effort to get feedback from the teachers concerning their use of the materials. As a result of these questionnaires, the District staff found out that 48 percent of the teachers were aware of the materials, and that almost three-fourths had plans to use them in their classrooms.

Teachers who responded to the questionnaire indicated that their students could anticipate studying this interesting subject for one hour per day for a period of four to ten days or for as long as two weeks. Over half of the teachers who responded indicated their plans included use of the materials during the second school semester, while 14 percent had used the materials earlier in the year.

The materials were originally designed for use with eighth and ninth grade students. However, the teachers responding to the questionnaire indicated that the materials were being used anywhere from the fifth grade to the twelfth grade.

During the same time period when the textbooks were originally being distributed, the Water District purchased copies of four films dealing with water, and donated these films to the Educational Service Centers serving the Amarillo and Lubbock areas. A majority of the teachers polled were aware of these films and 65 percent had intentions to show one or more of the films in their classrooms. "Ground Water: America's Buried Treasure," a 20-minute film dealing with the hydrologic cycle and conservation of natural resources, as well as "You Never Miss the Water," a 30-minute color film on home conservation, seem to be the most requested of the films. "Water Follies," a seven minute cartoon which takes a laughable look at a day in the life of a water waster, is also a popular choice among students and teachers alike.

Apparently the teachers who responded to the questionnaire are in favor of providing their students with educational information on their water resources and ways in which they can help to conserve these valuable resources. Fifty-nine percent of the teachers who responded indicated that they would like to have additional materials on this subject for classroom use. The most popular choice for the type of materials the teachers would prefer was textbooks and teacher's guides, followed by films and classroom guest speakers.

Future Problem Solvers

Several classroom presentations have recently been made by Water District staff members to select groups of students in several schools in the Lubbock area who are identified as "Future Problem Solvers."

These students, from grades 4 through 6, have been given a "fuzzy situation" and are in the process of brainstorming their way through the problem. The "fuzzy situation" they are currently dealing with involves the water problems of the State of Texas.

In the beginning, the students received a directive to study the varying problems associated with water supplies and the demands on these supplies in the different areas of the state. Classroom presentations have been requested by the teachers to help the students get started on the right track.

Following their creative thinking exercises, the students will submit their solutions to the Texas water problem to Governor Mark White for his review and comment. Perhaps one of these students will come up with the solution we have all been looking for.

Puppets Teach Water Conservation

Just two years ago, the Junior League of Lubbock came to the Water District with a request for assistance in putting together a fun and informative presentation, which they could make to kindergarten students, to promote water and water conservation. The Water District assisted the Junior League with its effort, and as a result the League has for the past two school years been presenting a puppet show to kindergarten children in the Lubbock school system. The puppet show exposes these children to the concept of water, where it comes from, as well as ways they can help conserve it.

What's In The Works?

The staff of the Water District is currently putting together a set of slides with an accompanying script dealing with the hydrology of the Ogallala aquifer. When completed, this canned slide presentation will be distributed throughout the District's service area to vocational agriculture teachers for their classroom use.

This effort results from Water District staff contact with vocational agriculture teachers throughout its service area who expressed their need for information on the more technical aspects of ground water in the High Plains of Texas. The teachers indicated that the format of slide shows with accompanying scripts would be the most easily adapted into their classrooms. Hydrology was their number one choice of subject matter.

The Water District staff continues to try to meet the needs of the teachers throughout its service area so that the teachers can stimulate the minds of our younger generation and get them attuned to the subject of water. Hopefully, through these efforts and the efforts of other agencies as well, today's students will become tomorrow's problem solvers.

KINDERGARTEN STUDENTS are learning about water and water conservation thanks to DRIP AND DROP. These puppets speak through the efforts of volunteers of the Junior League of Lubbock to help students learn about the hydrologic cycle and how even the wise use of water will use up our limited supplies. The story-board shown at right helps get the children involved in the project by putting the pieces of the puzzle in place as Drip and Drop tell the story.

Depth-To-Water Measurements Taken

With the onset of January, the District's staff prepares to head out into the fields for its annual round of measuring the depth-to-water in the District's water level observation well network. This year, however, the water level measuring program has taken on an expanded look in some areas of the District.

Don McReynolds, Technical Division Director, explains, "The water level observation well network was established in the late 1950's. Wells have been added to the network since that time, and some wells have been lost to the program due to abandonment or the inability of our staff to attain a reliable measurement from a particular well. The wells measured are privately owned and are measured annually with the landowner's or operator's permission.

"Originally the program was designed to have a density of one well every three square miles. Due to the small number of wells in existence when it was first established, there were some open pockets left in the network. Since then, the staff has endeavored to fill in these open pockets, but a full evaluation of our coverage has not been made in several years," notes McReynolds.

"This year we are expanding our measuring efforts starting in the southern part of the District in Cochran, Hockley, Lynn and Lubbock Counties. The reason for this expansion is twofold. First, we want to get the best foundation of water level measurements possible for use in constructing 1985 hydrologic atlases. Secondly, the measurements we attain from the expanded readings in these counties will be used as a basis for evaluation of our entire water level observation well network."

Cindy Gestes, Water District Geologist, reports that much of the High Plains area has an irregular subsurface, which, depending on past pumpage, could result in a varied saturated thickness. "We believe that the current density in our water level observation well network might not be adequate to account for many of the existing differences in aquifer conditions."

The current measurement activities involve measuring one well per square mile. "Once we complete all of the measurements in each of these counties," states McReynolds, "we will evaluate the results. If we find that there are a significant number of occasions where the existing network did not adequately reflect the aquifer's true conditions, we will then look at expanding the special measuring effort throughout the District. Right now, this is a one-time effort until we evaluate the potential benefits of the expanded readings. We are simply trying to get the best, most accurate overall picture of the water table that we can."

This expanded measuring effort began in October, 1984, and will continue when the staff has completed taking the annual readings of the depth-to-water in the network of approximately 950 observation wells in the current system.

Actual measurements are taken by lowering steel tapes coated with blue carpenter's chalk into the well to a predetermined depth, which is usually about two feet below last year's water level. When the tape contacts water, that portion of the chalk exposed to water 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.

Measurements from the District's observation well network form the basis of the cost in water income tax depletion program as well as much of the mapping and water supply analysis work done by the Water District's staff throughout the year.

STEEL TAPE IN HAND, Obbie Goolsby, Water District Engineer Technician, measured the depth-to-water in this well. Only a small hole is needed to feed the steel tape marked with carpenter's chalk through the pump base until it reaches the static water level in the well. These measurements help the Water District staff keep a close eye on the effects of yearly pumpage of water from the underlying formation.

WATER LEGISLATION . . . continued from page 1

that reasonable diligence will be used to avoid waste and achieve water conservation.

- Allows the Water Development Board to establish technical assistance programs.

Agriculture

- Creates an Agricultural Soil and Water Conservation Fund, from which appropriations could be made for activities such as grants to underground water districts for technical assistance to farmers and for equipment purchases, grants for demonstration projects, brush control, agricultural water conservation activities within the Texas Department of Agriculture, Texas Department of Water Resources and the State Soil and Water Conservation Boards.
- Funding is to be derived from imposition of a fee amounting to 25 percent of the "rollback" taxes collected on five past years when taxable land loses its ag-use, open space exemption.

Bradley notes, "The agriculture part is not complete. There are some other things that will be amended, or that will be changed. This section of the bill will be 'beefed up' considerably. It may be more of the same with different wrinkles to it."

Bays and Estuaries

- Requires the Water Commission to maintain, to the extent practical and in the public interest, the ecological health of bays and estuaries when considering permits within 150 river miles of the coast.
- May require pass-throughs of natural river flow, but may not require releases of stored water unless permittee consents or costs are paid for.
- Establishes a list of items to be considered in reviewing a permit including needs and uses, effects of not granting the permit, effects of not protecting bays and estuaries, etc.
- Establishes a Marine Resource Protection Fund to be used by the Parks and Wildlife to purchase stored water.

Ground Water

"The bill does not include mandatory state control of ground water," explains Bradley. "What the bill does is change the way ground-water management districts are created and sets up a planning process whereby the state and the Department of Water Resources will cooperate with local citizens to assess the water problems associated with a particular region."

- Calls for the designation of 25 ground water planning regions in the state and amends the existing rules for setting up underground water districts.
- Allows the Texas Department of Water Resources to designate critical areas and allows the Water Commission to force an election on the formation of a district or the addition of land to an existing district.

Bradley further explains the creation of underground water management districts saying, "If the Texas Water Commission declares a critical area and forces an election, at the end of the vote, if the people of the area voted for the creation of a district, then the district goes into effect, but, if they vote it down, then it is over with at that point."

As with past water legislation packages, the voters of the State of Texas will have the final say. The legislation is keyed to constitutional amendments which will be submitted to the voters on November 4, 1986. Without approval of the amendments by voters in 1986, the proposals could not take effect, even if approved by the Legislature. Bradley indicates that the three offices involved feel "like we are in a better position now than we have been for years. We think we are in pretty good shape to go into the session."

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Area Moisture Deficits Range From Two To Eight Inches

Soil moisture deficits in the area served by the High Plains Water District range from approximately two inches to a little over eight inches going into the 1985 growing season. The soil moisture deficit is an indication of the amount of moisture which needs to be added to a five-foot crop root zone to bring the soil profile to field capacity prior to planting.

"The unusually late killing freeze in 1984 has contributed to drier than normal soil moisture conditions," indicates Mike Risinger, Soil Scientist for the USDA-Soil Conservation Service. "This is especially true in the cotton growing areas. In fields where the crops didn't freeze until mid to late November, plants continued to draw moisture out of the root zone. Consequently, we are looking at less favorable moisture conditions heading into the next planting season than we would have hoped for."

Risinger notes, "Generally, we are looking at soil moisture deficits in the range of four to six inches throughout the southern part of the District where soils can hold as much as 15 to 18 inches of water. In the northern part of the District, where the heavier textured soils can hold 18 to 23 inches of water, we are finding the deficits to commonly be as much as six to eight inches." Risinger adds, "Since only about 50 percent of the water a soil can hold is available for plant use, we are finding the soils are at about 25 to 50 percent available water capacity throughout the District."

The soil moisture monitoring crews have been out taking readings in the neutron access tubes across the District's service area since the first of December. Additionally, the crews have returned to some areas where they completed the readings earlier in the year to determine what effects, if any, recent rainfall might have had on improving the soil moisture conditions.

"In the southern part of the District in the sandier soils," indicates Risinger, "We are almost at field capacity in the top 12 to 18 inches of the soil profile due to the fall rains. But, within the next twelve inches, the soil moisture drops off to about 25 percent of available water capacity, and in most fields remains at this level to the bottom of the root zone."

Risinger indicates that similar conditions are found in the northern half of the District's service area. "In the top 18 to 24 inches, the moisture looks pretty good. Below 24 inches the moisture content decreases to about 25 to 30 percent available water capacity and stays there to the bottom of the root zone."

While these conditions are true for most of the cropland in the District, some exceptions were found. Fields which were fallowed during the 1984 crop year often showed deficits of only one to two inches. Other fields where heavy or late irrigations were applied also have smaller deficits. This situation is common in the corn growing region of the District. In the areas where both cotton and corn are grown, the cotton fields usually had deficits four to six inches greater than adjacent corn fields.

Due to such variations, individual landowners are encouraged to check their own soil moisture conditions. Landowners who used soil moisture blocks during the growing season and have not destroyed the lead wires, can still use their resistance meters to read their own soil moisture conditions. Others might wish to dig in their fields and check the soil moisture by use of the feel method. Risinger says, "If you don't check the moisture below 18 to 24 inches you will not see the drier soil and can be misled by the excellent near surface moisture conditions."

Risinger also suggests farmers should check for hardpans in their fields. If present, they should be destroyed to make the most of any rainfall received between now and planting season. "With our soil density meter, we are finding a high percentage of significant hardpans, especially in those fields where harvesting equipment was run under wet conditions. The wet conditions encountered during this year's harvest have been just perfect for the development of a compacted layer."

"Physically it is hard to find dense layers at this time, because of the moist soil conditions. But our density meter is not fooled by the moist soil. It measures the density, or compaction in the soil whether it is wet or dry. Any compaction increases the amount of rainfall which runs off instead of being stored in the root zone."

The soil moisture survey teams measured soil moisture at 248 sites over the 15 counties with cooperation of local landowners. Each site was chosen to represent the farm management and cropping patterns typical of the site area.

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 make more informed water management decisions and help them avoid both over and under irrigating in the spring. (See map page 4.)

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

VOTERS EXPRESSED THEIR CONTINUED SUPPORT of A. W. "Webb" Gober of Farwell (left) and James C. Conkwright of Hereford (right) by re-electing them as representatives to the Board of Directors of the High Plains Underground Water Conservation District No. 1 on January 19, 1985. Gober begins his seventh term in office representing Director's Precinct Three serving Bailey, Castro and Parmer Counties; and with his re-election, Conkwright begins his fourth term of service to the people of Director's Precinct Four serving Armstrong, Deaf Smith, Potter and Randall Counties.

TO IRRIGATE OR NOT?

Irrigators Study Rainfall Chances

Gambling on Mother Nature to provide the amount of moisture needed to fill the root zone soil profile to field capacity prior to planting can save the irrigator up to $15 per acre, or it can cost him money in reduced yields. To help solve this quandary, as to whether or not to apply a pre-plant irrigation, some producers are turning to rainfall probability charts and historical precipitation records as a water management tool to help them hedge against the odds.

Dr. Bill Lyle, Texas Agricultural Experiment Station, explains, "The starting point of using rainfall probability data is first determining the amount of moisture in the plant root zone and second, the depth at which this moisture is located. In other words, is the moisture stored in the top portion of the root zone or in the bottom?"

In the area served by the High Plains Water District, soil moisture deficits going into the 1985 spring and summer growing season range from approximately two inches to eight inches. Typically these deficits are found in the lower depths of the soil profile from two to five feet below land surface.

On page two of this issue of The Cross Section, monthly precipitation probabilities for the cities of Lubbock, Amarillo, Plainview and Muleshoe, Texas are presented. These rainfall probability figures were derived and provided by the Texas Department of Water Resources based on 51 years of National Weather Service precipitation data. This information provides the irrigator with the percent of probability of getting a portion of the moisture needed to fill the soil profile from seasonal rains.

By checking his soil moisture deficit and then looking at the rainfall probability chart for anticipated rainfall prior to the growing season, the irrigator can determine what would be his best water management decision. He may choose to fully irrigate his land to provide the needed soil moisture if the probabilities of receiving the necessary rainfall are low. He may decide to partially irrigate to fill a part of the deficit if the probability of receiving a portion of the moisture is worth gambling on. Or, the irrigator may decide not to irrigate and bet that the needed precipitation will occur prior to planting.

continued on page 2 . . . IRRIGATORS

IRRIGATORS . . . continued from page 1

James Mitchell, a Lubbock and Lynn County farmer, has been looking at rainfall probability charts over the past two years. Mitchell uses the data on rainfall probability in connection with his soil moisture block readings. Reading his soil moisture blocks gives him an indication of what his deficit is and at what depth soil moisture is lacking.

Mitchell explains, "A lot of my decision depends on the amount of moisture deficit I have. The way I look at it, if I have a big deficit, then I don't have any choice but to apply some pre-plant water."

Mitchell notes, however, "If I have just a two inch deficit and the capability of putting water out real fast and in a uniform pattern, then I'll watch the rainfall probability figures and take a chance on getting some rain."

For example, Mitchell explains, "Last year, we had good deep moisture and what we needed to add prior to planting was just on top. So we delayed our irrigation until the last minute. The later into the season you can wait to irrigate, the greater the probability of receiving rain. Of course, the probability got pretty great last year and it didn't rain until the first of June. That made us just a little bit late last year. However, had we gotten the rain, we would have saved our water and power by waiting.

"If you can wait and save just one watering," notes Mitchell, "then you have the savings of water, power, labor and whatever else you needed to apply that water. There is the potential for saving quite a little bit."

The decision on whether or not to irrigate, also depends on the amount of water and the type of irrigation equipment you have. Mitchell talks about his particular situation saying, "I need to have my soil moisture profile at field capacity going into the growing season, particularly if my deficits fall in the lower areas. In my limited water area, even with my drop-line center pivot sprinkler system, if I hedge against rain, and it doesn't come in large enough quantities to supply my crop water needs and get water into the lower depths, then there is no way that I can ever catch up."

Dr. Lyle suggests, on the other hand, if you have strong water and the equipment to apply lighter applications at even distribution rates, you could hedge a little bit further waiting on precipitation. "If you know how much moisture you have and where it is in the soil profile, then you can also look at the times when your crop is going to be extracting water from each depth.

"We really have two periods that are important when it comes to stored moisture. First, we have got to have good moisture to plant. Even though the plant, in the early stages of growth, is not going to be using much moisture, it is still important to have good moisture in the top portion of the root zone to carry the plant through to the next stage of growth. Then second, we need good moisture in the lower root zones when the crop gets into rapid leaf expansion and higher evapotranspiration rates from the plant canopy.

"This year we have good moisture for planting, but we have deficits in the lower root zone areas. If we have the right equipment, we should be able to avoid having to apply a pre-plant irrigation because we have the water we need in the top portion of the root zone," notes Lyle. "However, we are going to have to fill the lower depths between now and mid-July when the crop starts to need water from those lower areas. This is where we can have a little more flexibility and play the rainfall probabilities to some extent. Like Mitchell said, the later in the season you can wait for your moisture, the better the chances are of getting at least a portion of the moisture you need in the form of precipitation."

As an example, assume there is a moisture deficit of four inches, but the top foot of the soil profile contains good moisture for planting and seed germination. Then the decision has to be made whether or not to pre-plant irrigate to fill the lower depths to field capacity. It would then be necessary to look at the rainfall probabilities for getting up to four inches of rainfall between now and mid-July.

Checking the chart on page 2 reveals a couple of good chances (70 percent or greater) of receiving 1.5 inches of rain in the months of May and June. In the best case circumstances, the irrigator may get three inches of precipitation to supply his crop needs and replenish his moisture deficit.

Therefore, the irrigator in the Lubbock area who has a four inch or greater moisture deficit could conclude that he may want to go ahead and apply at least a portion of the moisture he needs, then gamble on getting the rest during the months of May and June to have his profile at field capacity by mid-July.

Using rainfall probability charts and following your best guess is no sure fire answer to the gamble of whether it will rain or not. But as James Mitchell sees it, "It gives us an option of not having to pump water to irrigate if the probability looks good for receiving what is really free water from Mother Nature. Of course, it helps if it rains."

Mitchell and Lyle both remind irrigators that runoff and evaporation losses commonly account for 50 percent of the rainfall received if preparations have not been made to maximize infiltration and minimize evaporation losses. Therefore, Lyle and Mitchell both recommend the use of furrow dikes to harvest precipitation.

Farmers Check Likelihood Of Rain

LUBBOCK WB.A.P. INDEX NO. 5411

Probability (in percent) of receiving rainfall during various months that is equal to or more than the amount stated.

Rainfall (inches)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.25	61	55	59	82	98	96	88	90	84	88	57	61
0.50	41	43	53	65	92	88	86	78	80	78	45	43
0.75	24	31	41	57	90	82	78	75	65	71	35	27
1.00	14	24	29	47	90	78	75	73	57	55	24	22
1.25	10	18	25	33	84	76	67	67	55	47	18	18
1.50	4	10	25	27	73	71	57	63	53	37	10	8
1.75	4	6	20	27	67	65	53	55	53	33	8	6
2.00	4	2	12	14	61	53	47	47	49	29	8	4
2.25	4	2	8	10	55	49	39	35	45	29	6	4
2.50	2	2	8	8	49	35	37	27	43	27	2	2
2.75	2		8	8	43	29	35	22	41	25		2
3.00	2		4	6	35	29	31	18	35	24		
3.25	2		2	4	29	27	20	16	33	22		
3.50	2		2		24	25	18	16	29	18		
3.75	2				24	24	16	14	20	18		
4.00	2				20	24	16	12	18	14		
4.25					16	18	10	10	16	10		
4.50					12	18	4	8	14	10		
4.75					12	16	4	8	14	6		
5.00					12	14	2	6	10	6		
5.25					12	12	2	4	8	6		
5.50					12	10	2	2	8	6		
5.75					12	6	2	2	6	6		
6.00					10	4	2	2	6	2		
6.25					10	4	2	2	6	2		
6.50					6	4	2	2	6	2		
6.75					6	4	2	2	4	2		
7.00					4	4	2	2	4	2		
7.25					4	4		2	4	2		
7.50					4	2		2	4	2		
7.75					4	2		2	2	2		
8.00					2			2	2			
8.25					2			2	2			
8.50					2			2	2			
8.75					2			2	2			
9.00					2				2			
9.25					2				2			
9.50					2				2			
9.75					2				2			
10.00					2				2			

PLAINVIEW WB.A.P. INDEX NO. 5411

Probability (in percent) of receiving rainfall during various months that is equal to or more than the amount stated.

Rainfall (inches)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.25	67	65	67	90	98	96	90	92	86	84	57	71
0.50	47	53	53	76	98	90	82	90	84	80	43	37
0.75	33	39	42	65	92	82	76	84	80	61	37	29
1.00	22	29	36	49	88	80	64	75	75	53	29	24
1.25	16	14	26	39	76	80	64	69	59	49	20	20
1.50	12	6	18	33	69	71	58	59	57	39	18	18
1.75	8	4	16	25	67	61	58	51	49	35	10	12
2.00	6	2	10	24	59	61	50	43	45	25	4	10
2.25	4	2	8	20	59	51	38	39	41	24	2	8
2.50	2		2	16	53	50	38	35	33	20	2	6
2.75	2		2	10	51	43	34	29	31	20	2	2
3.00	2		2	8	47	40	30	22	31	18	2	
3.25	2			6	35	40	30	14	31	14		
3.50	2			6	33	31	26	14	22	14		
3.75	2			4	29	31	20	10	16	14		
4.00				4	27	31	20	10	14	14		
4.25				2	25	12	16	8	14	12		
4.50				2	22	23	14	6	14	12		
4.75				2	20	20	14	6	12	10		
5.00				2	20	14	12	6	6	8		
5.25				2	16	10	10	6	6	8		
5.50					16	10	6	6	4	6		
5.75					14	6	6	6	2	6		
6.00					12	6	6	6	2	2		
6.25					10	4	6	4	2	2		
6.50					10	2	6	2	2			
6.75					10	2	2	2	2			
7.00					8	2	2	2	2			
7.25					4		2	2				
7.50					4		2	2				
7.75					4		2	2				
8.00					4		2	2				
8.25					4		2					
8.50					4		2					
8.75					2		2					
9.00					2		2					
9.25					2		2					
9.50					2		2					
9.75					2		2					
10.00					2							

AMARILLO WB.A.P. INDEX NO. 5411

Probability (in percent) of receiving rainfall during various months that is equal to or more than the amount stated.

Rainfall (inches)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.25	67	67	73	86	96	96	94	98	94	86	67	69
0.50	45	47	53	73	94	94	94	96	80	73	41	37
0.75	25	25	35	63	92	90	84	90	71	65	33	27
1.00	18	18	31	53	84	86	76	86	59	49	20	14
1.25	12	12	24	43	80	84	75	86	57	37	16	6
1.50	10	8	18	35	75	80	63	78	53	33	12	4
1.75	6	6	14	25	75	73	55	67	43	27	10	4
2.00	6	2	14	18	61	65	45	61	41	27	10	4
2.25	4	2	12	12	57	55	39	51	35	27	8	4
2.50	2	2	10	6	53	53	37	49	27	24	4	4
2.75		2	6	2	49	51	37	49	24	14	4	4
3.00			2	2	39	45	27	47	20	14	2	4
3.25			2	2	33	41	25	41	18	12	2	4
3.50			2	2	31	35	22	33	16	10	2	4
3.75			2		27	33	20	33	16	10	2	4
4.00					25	31	18	22	14	10		2
4.25					20	22	14	22	10	10		2
4.50					16	16	14	22	6	10		2
4.75					14	14	14	18	2	8		
5.00					12	12	14	14	2	6		
5.25					12	10	10	8		6		
5.50					12	10	10	6		6		
5.75					12	10	10	4		4		
6.00					10	10	10	4		4		
6.25					10	10	8	2		2		
6.50					8	10	8	2		2		
6.75					8	8	6	2		2		
7.00					6	8	6	2		2		
7.25					6	8	6	2		2		
7.50					6	8	4	2		2		
7.75					4	6						
8.00					4	6						
8.25					4	6						
8.50					4	6						
8.75					4	6						
9.00					4	6						
9.25					2	4						
9.50					2	4						
9.75					2	4						
10.00						4						

MULESHOE WB.A.P. INDEX NO. 5411

Probability (in percent) of receiving rainfall during various months that is equal to or more than the amount stated.

Rainfall (inches)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.25	61	65	56	74	96	94	96	94	88	74	62	56
0.50	49	45	37	58	82	86	90	88	80	70	45	35
0.75	25	21	23	50	76	80	86	80	74	58	35	21
1.00	16	14	18	43	69	78	75	76	67	49	24	18
1.25	10	8	14	35	61	69	69	73	61	37	18	14
1.50	10	4	10	25	55	67	65	71	59	31	14	6
1.75	8	2	6	22	43	63	61	55	51	25	8	4
2.00	2		4	12	37	49	51	43	39	24	8	2
2.25	2		4	10	33	47	41	37	39	20	2	2
2.50			4	6	29	41	33	37	33	16	2	2
2.75			2	6	27	35	29	33	29	16	2	2
3.00			2	4	24	29	24	27	25	14		2
3.25				4	18	27	20	25	20	12		2
3.50				2	16	24	14	22	10	12		
3.75					14	24	12	18	10	12		
4.00					10	22	12	16	8	12		
4.25					10	18	10	16	6	12		
4.50					8	12	10	16	6	12		
4.75					8	10	10	10	4	10		
5.00					8	10	10	10		4		
5.25					8	10	10	8		4		
5.50					8	6	10	8		2		
5.75					6	6	10	8		2		
6.00					6	4	8	8		2		
6.25					6	4	6	6				
6.50					6	4	4	6				
6.75					6	4	4	4				
7.00					4	4	2	4				
7.25					4	2	2	2				
7.50					2	2	2	2				
7.75					2		2					
8.00					2		2					
8.25					2		2					
8.50					2		2					
8.75					2							
9.00					2							
9.25					2							
9.50					2							
9.75					2							
10.00					2							

Historical Precipitation Measurements And Averages

AMARILLO PRECIPITATION—National Weather Service

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1911	.13	2.88	.50	2.76	5.88	.20	3.85	2.97	.83	.84	.94	.95	22.73
1912	*	1.94	.82	.72	1.67	1.90	1.88	2.28	2.28	.39	.02	1.18	15.08
1913	.11	.55	.59	1.76	1.41	2.32	1.80	.61	4.19	.81	1.98	2.84	18.97
1914	.06	.10	.15	.95	4.43	.84	3.07	2.97	1.07	4.46	*	1.17	19.27
1915	.72	1.60	1.00	5.05	1.70	1.04	4.14	5.85	4.69	1.55	.18	.13	27.65
1916	.36	.02	.57	1.71	.89	2.18	.94	3.82	1.76	2.90	.40	.88	16.43
1917	.69	.22	.25	.71	2.49	.83	2.68	6.17	2.05	.34	.59	.04	17.06
1918	1.01	.26	1.06	.48	2.23	1.44	2.23	2.36	.64	2.47	1.16	2.78	18.12
1919	*	.73	1.73	2.56	2.08	2.94	1.75	3.21	4.58	.67	1.26	.50	22.01
1920	1.11	.18	.51	.64	2.57	2.56	1.85	5.52	3.04	1.87	1.33	.64	21.82
1921	2.10	1.19	.68	.39	2.09	7.75	4.17	5.77	.76	.28	*	.06	25.24
1922	.78	1.44	4.06	3.25	1.60	3.77	1.04	.78	1.41	.23	1.39	.10	19.85
1923	.00	1.71	2.97	3.22	1.70	9.76	1.85	1.54	6.42	7.34	2.13	1.11	39.75
1924	.13	.56	1.75	.87	.67	2.82	3.66	3.57	1.13	.86	1.25	.63	17.90
1925	.51	.06	.11	1.33	1.94	1.71	5.13	3.19	4.88	3.35	.95	.37	23.53
1926	.48	.06	1.67	3.74	3.98	3.17	2.27	1.76	5.72	2.15	.29	.96	26.25
1927	.18	.23	.46	1.95	.07	1.51	1.68	5.31	3.40	.14	.02	.47	15.42
1928	*	1.11	.86	.77	6.48	3.45	5.39	6.15	1.31	2.77	3.54	.51	32.34
1929	.16	.34	1.84	*	3.19	.77	1.76	4.54	1.97	3.28	.91	.11	18.87
1930	.57	.00	1.27	2.19	1.49	4.47	2.42	1.61	.20	2.57	.33	.46	17.58
1931	.31	1.83	1.69	1.57	3.11	.69	1.40	2.19	.51	.92	2.89	1.24	18.35
1932	1.60	.41	.42	2.21	1.02	9.24	1.22	.70	2.79	.64	.02	.87	21.14
1933	.02	.29	.56	.64	2.01	.05	.66	6.02	.88	.49	.58	.02	12.22
1934	.09	.09	2.83	.77	3.21	1.94	.19	1.51	.96	.21	1.13	.40	13.33
1935	.75	.22	1.14	.05	2.57	.28	.81	5.32	2.03	.87	1.27	.18	15.49
1936	1.02	.25	*	.25	9.02	.84	.51	1.39	4.74	.82	*	.88	19.72
1937	.29	.18	1.10	.39	6.83	2.83	1.49	.64	2.61	.31	.14	.29	17.10
1938	.18	2.87	1.24	1.07	4.03	2.49	1.88	.15	1.62	3.06	.43	.08	19.10
1939	2.51	.17	.25	2.30	1.75	7.59	.57	3.28	.45	1.10	.06	.98	21.01
1940	.52	.88	.24	1.10	2.68	1.64	.88	.71	.54	.29	3.87	.27	13.62
1941	.40	.94	2.55	1.29	7.47	5.07	3.36	3.18	4.30	7.64	.33	.68	37.21
1942	.06	.63	.42	3.74	.91	2.29	.80	3.95	1.45	6.18	*	1.18	21.62
1943	.08	*	.01	1.06	1.82	1.01	6.64	2.09	.79	.72	.39	3.77	18.38
1944	1.67	.72	*	1.83	3.72	4.33	5.06	1.40	2.08	.84	.75	1.20	23.60
1945	.77	.28	.41	1.58	.42	1.61	1.62	5.17	4.02	1.31	*	*	17.19
1946	1.05	.33	.66	.55	.82	2.37	.12	3.96	3.25	5.73	.78	1.18	20.80
1947	.32	.07	.77	2.07	4.59	3.19	1.54	.39	.24	.12	.92	1.26	15.48
1948	.63	1.83	.72	.73	2.82	4.92	1.52	5.16	1.27	2.58	2.11	.09	24.38
1949	2.04	.59	.57	1.99	6.43	2.82	3.90	3.78	1.69	1.03	.01	.30	25.15
1950	*	.20	*	.64	1.83	3.25	7.32	4.54	5.02	*	.03	.35	23.18
1951	.38	1.17	.55	.43	9.81	4.34	2.01	1.52	2.01	2.37	.25	.45	25.29
1952	.53	.24	.56	2.46	2.05	1.75	1.36	.88	.32	.00	1.44	.50	12.15
1953	.64	.53	.38	.62	.70	.01	1.81	2.00	.26	4.56	.56	.98	13.05
1954	.25	.09	.17	2.31	4.44	1.95	.55	2.91	.30	.73	*	.19	13.89
1955	.53	.06	.33	.38	2.70	1.49	3.35	1.49	3.13	.13	.02	.10	13.71
1956	.09	1.10	.03	.23	1.99	2.03	2.82	.79	.48	.38	*	*	9.94
1957	.33	1.11	2.82	2.69	4.36	.53	.13	4.85	.88	2.57	.94	.03	21.24
1958	1.05	.58	2.36	1.74	2.45	4.22	6.16	2.08	1.60	.15	.60	.30	23.29
1959	.16	.06	.26	1.18	4.82	2.19	2.85	2.24	2.29	2.10	.14	4.52	22.81
1960	1.30	.95	1.66	1.66	.82	9.85	7.59	3.15	4.22	4.82	*	.65	36.67
1961	.12	.27	2.55	.24	3.40	3.42	4.10	3.14	1.87	.91	2.26	.16	22.44
1962	.47	.39	.02	1.48	1.76	10.16	7.51	3.29	2.66	.85	.53	.64	29.76
1963	.06	.67	.28	.47	3.66	3.60	2.04	3.93	.43	1.54	.33	.29	17.30
1964	*	1.37	.03	*	1.69	1.90	.94	5.69	3.95	.08	1.53	.79	17.97
1965	.55	.47	.72	.23	1.88	10.73	1.54	1.71	.79	1.02	.07	.38	20.09
1966	.43	.69	.01	.87	.19	4.62	1.37	3.77	2.40	.29	.08	.19	14.91
1967	*	.15	.42	1.95	1.40	2.55	3.70	1.81	2.47	1.61	.28	.51	16.85
1968	2.33	.73	.45	.93	2.84	1.68	2.96	3.35	.62	.90	.92	.26	17.97
1969	.02	.50	1.15	.30	2.93	4.09	2.55	4.51	2.77	2.56	.34	.83	22.55
1970	.02	.02	2.10	1.33	.23	1.54	1.39	1.27	.34	1.06	.26	*	9.56
1971	.10	1.65	.10	.77	.91	4.17	1.75	3.33	4.70	2.59	2.08	.89	23.04
1972	.21	.11	.11	.03	2.81	3.87	2.59	1.73	.71	1.66	1.19	.32	15.34
1973	.56	.42	3.99	1.88	1.43	.84	4.08	2.31	1.22	1.05	.10	.17	18.05
1974	.33	.24	.60	.04	4.06	3.33	1.31	7.55	1.65	3.44	.12	.42	23.09
1975	.28	1.33	.51	1.02	2.47	4.15	5.19	3.97	.76	.33	.92	.15	21.08
1976	*	.10	.79	1.65	1.36	2.94	1.77	1.78	4.28	1.14	.43	*	16.24
1977	.64	.53	.24	2.74	4.01	2.06	3.14	4.94	.03	.26	.32	.27	19.18
1978	.63	.80	.21	.55	5.76	6.50	1.82	1.61	2.42	.97	.47	.27	22.01
1979	.92	.28	1.46	1.29	3.94	3.19	2.03	5.08	.52	1.28	.40	.07	20.46
1980	.85	.55	1.38	.82	2.88	1.30	.65	1.80	1.55	.42	.84	.35	13.39
1981	.11	.23	1.87	.90	2.11	1.04	2.73	5.22	3.47	1.79	1.50	.03	21.00
1982	.15	.39	.52	.43	1.96	4.75	6.23	.55	1.37	.71	.75	.79	18.60
1983	1.78	1.19	.98	.83	2.85	1.76	.74	.28	.37	3.23	.33	.64	14.98
1984	.56	.37	.98	1.18	.04	6.76	.83	2.28	.95	3.19	1.09	.89	19.12
Average	.55	.64	.95	1.32	2.82	3.19	2.55	3.05	2.07	1.73	.76	.66	20.20

*Trace

LUBBOCK PRECIPITATION—National Weather Service

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1911	.38	5.83	.43	2.36	.72	.28	6.75	.21	1.33	1.08	.22	1.55	21.14
1912	.02	1.28	.61	.50	1.58	.96	3.35	2.37	.73	2.81	.01	.38	14.60
1913	.04	.20	1.18	1.82	.24	5.88	.40	.32	4.19	1.53	1.54	2.13	19.47
1914	.15	.10	.29	1.47	4.04	3.86	6.17	5.95	.46	7.12	.35	1.47	31.43
1915	.09	3.00	2.52	6.18	1.52	4.01	1.42	2.96	7.86	1.52	.04	.76	31.88
1916	.17	*	1.15	2.63	.39	1.52	.36	2.45	2.79	2.91	.55	.11	15.03
1917	.35	.05	.21	.58	1.07	.64	1.42	1.16	3.03	.14	.08	*	8.73
1918	.84	.58	.05	.72	1.67	2.95	.53	.79	.79	.51	.69	2.03	12.15
1919	.12	.25	3.39	3.53	2.10	3.52	2.28	2.83	5.70	7.34	.36	.19	31.61
1920	.90	.11	.24	.15	2.91	3.66	2.19	2.64	1.63	1.43	2.21	.09	18.16
1921	.14	.45	1.47	.24	.43	7.71	.84	.92	4.50	.02	*	*	16.72
1922	.34	.20	.55	3.59	3.50	2.43	1.36	.28	.17	.60	1.50	.07	14.59
1923	.24	.76	1.04	3.18	2.77	3.98	1.65	1.59	2.67	6.80	.85	.64	26.17
1924	*	.17	.96	.86	.90	1.79	1.20	1.76	1.25	.47	.03	.06	9.45
1925	.65	.02	*	1.12	2.31	.86	3.38	3.32	9.44	1.33	.11	.21	22.75
1926	.56	.04	1.64	1.81	5.14	1.10	1.03	2.75	4.15	8.40	.67	1.77	29.06
1927	.79	.37	*	.40	*	2.91	2.16	.59	1.16	.40	*	.81	9.59
1928	.31	1.18	*	.09	3.08	1.06	6.78	4.04	.08	2.10	.74	.28	19.74
1929	.43	.34	2.03	.15	6.91	.90	.20	1.68	1.36	3.56	1.00	.07	18.63
1930	.61	.03	.45	1.04	1.71	1.70	.12	1.34	.11	3.91	.94	1.44	13.40
1931	.32	1.98	1.34	1.82	1.32	.95	2.17	2.44	.72	3.47	1.39	1.44	19.36
1932	.93	1.09	.04	1.84	2.37	5.66	1.90	3.15	3.41	1.29	*	2.48	24.16
1933	.37	.95	.02	.06	2.97	.21	1.36	2.19	.71	.42	.99	.06	10.31
1934	.06	.06	1.98	1.08	1.26	.28	.65	1.66	1.86	.28	.55	*	9.72
1935	.12	.60	.89	.04	3.49	2.57	1.25	1.69	3.02	1.22	2.04	.33	17.26
1936	1.08	*	.59	.92	5.86	.92	1.13	.13	13.93	1.52	.74	.21	27.03
1937	.26	.01	1.81	2.01	4.00	3.12	1.32	2.06	3.85	3.22	.07	.52	22.25
1938	.91	1.18	.49	.14	1.99	5.89	4.01	.47	.63	.51	.27	.03	16.52
1939	2.45	.19	.09	.28	1.82	.67	1.73	2.75	.01	.94	.18	.60	11.71
1940	.23	1.97	*	1.84	1.74	2.06	*	1.57	.73	1.07	2.35	.20	13.76
1941	.55	.61	3.56	2.23	12.69	4.13	3.68	1.85	4.47	5.89	.17	.72	40.55
1942	.04	.18	.51	3.25	.35	1.74	2.58	4.97	7.61	3.39	.01	2.70	27.33
1943	.04	.02	.25	.53	2.71	2.37	3.17	*	1.16	.10	.62	1.87	12.84
1944	1.28	1.36	1.09	.84	3.03	1.75	2.93	2.37	3.73	.80	1.72	1.64	22.54
1945	.69	.39	.10	.46	.46	.36	3.08	2.17	2.22	2.26	.27	.32	12.78
1946	1.18	.15	.76	.07	1.49	2.72	.58	3.55	3.49	4.67	.44	1.04	20.14
1947	.73	.02	.69	1.06	6.35	1.56	1.06	.06	.08	.37	1.43	.52	13.93
1948	.14	1.38	.17	.33	2.88	2.31	1.75	.31	1.45	.98	.03	.13	11.86
1949	4.05	.29	.80	1.84	7.80	4.65	1.18	2.07	4.76	1.49	*	.43	29.36
1950	.28	.18	*	.88	3.93	.68	3.12	2.08	3.74	.14	.03	.03	15.10
1951	.32	.66	.78	.58	2.63	4.19	2.04	2.62	.70	.93	.06	.02	15.53
1952	.98	.05	.04	2.30	1.39	1.94	3.24	1.88	.92	.00	.96	.06	13.76
1953	.34	.16	1.07	.62	1.37	.45	1.47	2.57	.04	4.01	.16	.05	12.31
1954	.06	.00	.04	1.91	4.45	.51	.19	2.92	.00	2.82	*	1.09	13.99
1955	.83	.00	.03	.19	2.45	2.30	3.03	.62	2.76	4.53	.10	.00	16.84
1956	.01	1.59	.00	.36	1.80	3.26	.69	1.06	.03	1.73	*	.30	10.86
1957	.08	.73	.98	3.48	6.43	4.96	1.54	.32	.51	4.20	1.27	.06	24.56
1958	1.35	.33	3.23	1.97	2.94	.71	2.65	.21	2.90	.94	.34	.02	17.59
1959	.08	.07	.00	1.28	2.15	7.25	1.30	.72	.89	.98	.02	1.47	16.21
1960	.66	.94	.61	.26	1.16	5.72	5.37	.05	.34	5.83	.00	1.25	22.19
1961	.56	2.51	1.34	.10	2.05	4.03	4.06	1.78	.18	.55	1.31	.35	18.82
1962	.26	.02	.10	1.20	.10	2.56	4.85	1.31	4.17	2.66	.45	.67	18.35
1963	.06	.54	.73	.25	6.79	2.10	.37	2.67	.78	.59	1.13	.20	16.21
1964	.45	.16	.64	.11	1.67	5.00	.82	1.14	2.46	.30	.57	.90	14.22
1965	.08	.35	.22	.41	1.63	1.44	2.14	.62	5.68	1.06	.02	.50	14.15
1966	.52	.06	.13	3.03	.67	2.27	.57	8.85	2.18	.00	.11	.03	18.42
1967	.00	.14	2.09	.95	3.45	7.95	3.29	.71	.98	.45	.11	.52	20.64
1968	.94	.82	2.77	.58	2.01	1.81	3.14	2.72	.67	.81	2.67	.48	19.42
1969	.00	1.13	1.77	1.14	3.88	1.41	2.99	2.59	4.93	7.76	.77	.82	29.19
1970	.00	.11	2.15	.26	4.30	1.36	.00	1.18	1.80	1.34	.05	.08	12.63
1971	.00	.81	.21	1.36	2.44	2.25	.76	4.15	5.22	1.79	.43	.81	20.23
1972	.16	.13	*	.35	3.20	5.37	4.47	5.40	2.95	1.75	.97	.32	25.07
1973	1.44	1.26	1.90	1.40	.43	.32	4.16	.36	.73	.89	*	*	12.89
1974	.08	.01	1.56	.82	1.23	1.11	2.22	5.14	6.62	3.89	.89	.44	24.01
1975	.41	1.53	.04	.45	2.74	1.80	4.32	2.21	2.61	.06	1.18	.34	17.69
1976	*	.03	.24	1.76	1.19	2.46	7.20	1.99	3.28	1.39	.56	.01	20.11
1977	.24	.38	.82	2.90	2.46	2.28	1.13	4.31	.49	1.11	.02	.01	16.15
1978	.59	1.39	.23	.21	3.20	1.93	.15	.34	3.29	1.06	1.11	.17	13.67
1979	.33	.85	2.95	1.17	4.00	3.69	1.84	3.81	.21	.59	.09	1.29	20.82
1980	.54	.38	.19	1.13	3.46	1.78	.20	1.64	3.55	.19	2.29	.51	15.86
1981	.32	.67	1.19	2.05	1.25	.79	3.35	5.41	1.78	5.34	.64	.20	22.99
1982	.05	.39	.44	2.53	4.54	4.99	2.08	1.08	1.29	.48	1.18	1.95	21.00
1983	2.75	.32	.55	.77	1.23	1.79	.41	.32	.39	10.80	.54	.36	20.23
1984	.03	.17	.23	.23	.45	4.32	.53	3.72	.15	1.74	1.87	1.18	14.62
Average	.51	.63	.85	1.25	2.66	2.60	2.15	2.08	2.43	2.17	.63	.62	18.57

*Trace

Election Results In

Voters residing within District Director's Precincts Three and Four of the High Plains Underground Water Conservation District No. 1 had made their choices known as to who would represent their interests concerning the programs and activities of the Water District by the time the polls closed on election night, Saturday, January 19, 1985.

Re-elected to the Water District's Board of Directors were James C. Conkwright from Director's Precinct Four serving the counties of Armstrong, Deaf Smith, Potter and Randall, and A. W. "Webb" Gober from Director's Precinct Three serving Bailey, Castro and Parmer Counties.

Additionally, 21 county committeemen were selected by the voters. Armstrong County voters elected Tom Ferris from Wayside, Larry Stevens from Happy, and Kent Scroggins from Wayside to their second terms in office as County Committeemen-at-large.

Elected to serve on the Deaf Smith County Committee were J. F. Martin, Troy Sublett and Virgil P. Walker, all of Hereford.

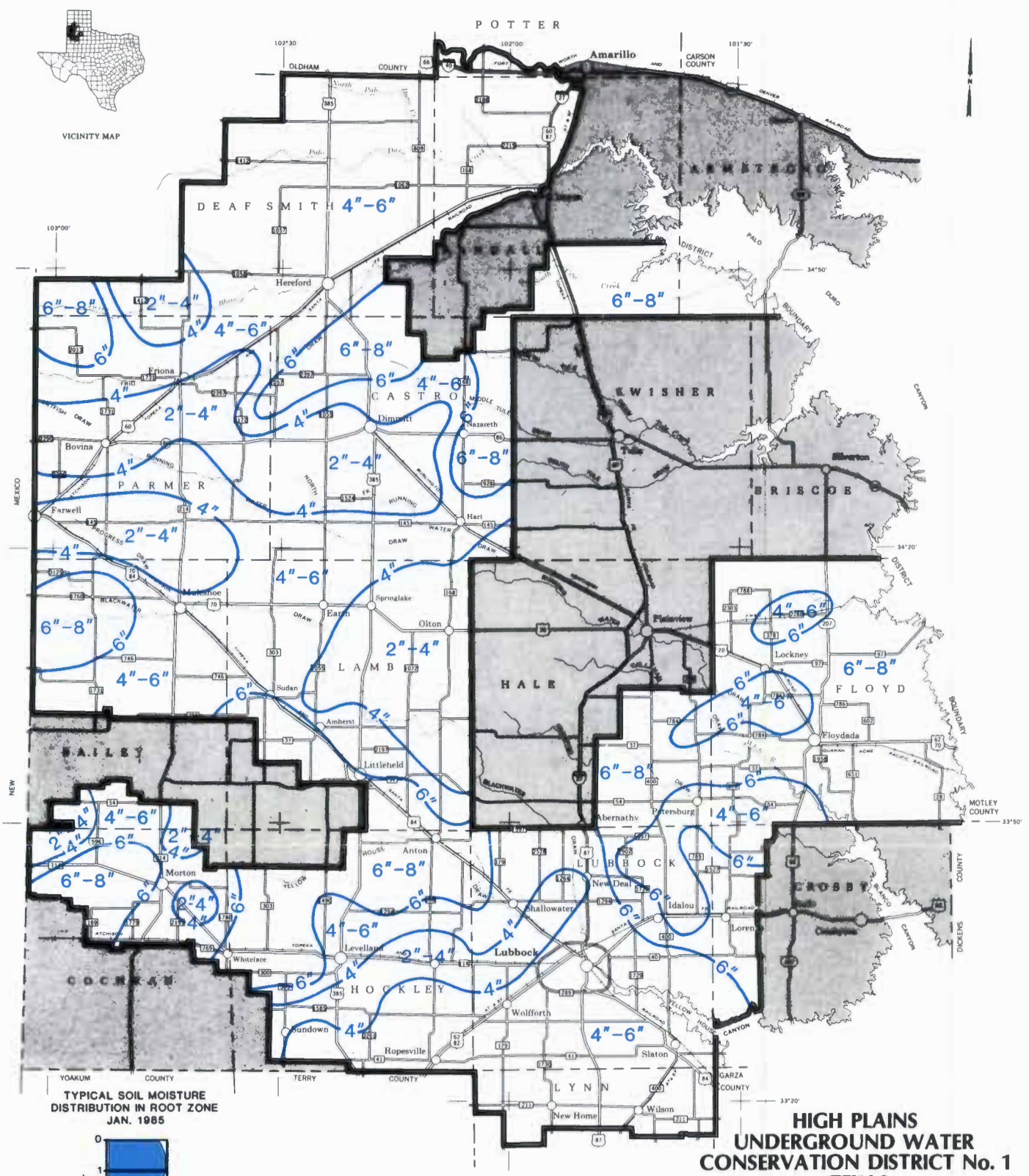
Potter County residents elected Committeeman-at-large Frank L. Bezner of Bushland to his second term in office. Robert Lolley and L. C. Moore will begin their first terms in office as Committeemen-at-large. Moore lives west of Amarillo and Lolley makes his home in Bushland.

Lyndon Wagner of south Amarillo and Charles Kuhnert of Umbarger were elected to their first terms in office by the voters of Randall County. Re-elected to the Randall County Committee was Committeeman Gary Wagner of Bushland.

In Director's Precinct Three, Castro County voters elected Garnett Holland, Mack Steffey and Gerald Summers to serve as County Committeemen. Holland resides in Dimmitt, Steffey lives in Hart and Summers makes his home in Dimmitt.

Parmer County residents elected John R. Cook of Friona and Wendol Christian of Farwell to their second terms in office. Robert Gallman of Friona was elected to his first term in office.

Joining the Bailey County Committee in the coming year will be Sam Harlan and Jay Herington, both of Muleshoe. Lewis Scoggin of Muleshoe was re-elected to the Bailey County Committee.



THE CROSS SECTION (USPS 564-920)
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2930 AVENUE Q
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THE Cross SECTION

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Aquifer Depletion Rate Levels

Improved water use efficiencies have substantially reduced the rate of net depletion in the Ogallala aquifer in the area served by the High Plains Water District. In the past 25 years, approximately one-third of the available water in the Ogallala aquifer has been utilized, leaving 66.6 million acre feet in storage. During 1984, however, the rate of net depletion of the Ogallala aquifer averaged less than one percent of the total quantity of water remaining.

The total quantity of gravity water in storage in the Ogallala aquifer within the 5.2 million acre area served by the High Plains Underground Water Conservation District No. 1 as of January, 1960 was almost 100 million acre feet. Twenty-five years later, as of January, 1985, that total quantity of recoverable ground water has been reduced by approximately one-third to 66.6 million acre feet.

Averaging the net depletion over the past twenty-five years reveals an average annual net depletion rate of about 1.3 million acre feet. However, during the past ten years, 1975 to 1985, the average annual net depletion rate has averaged about 77 percent of the 25-year average, for a net depletion rate of 1,013,325 acre feet per year.

Refining the average annual net depletion rate even further reveals that during the first half of this ten-year period, between 1975 and 1980, the average annual net depletion rate in the Ogallala aquifer was 1,249,315 acre feet. This annual rate of net depletion has declined during the past five years, 1980 to 1985, with the net depletion during this period amounting to about 777,336 acre feet per year. And, during this past year, 1984, the net depletion rate has dropped even further to 601,509 acre feet.

The 1984 net depletion rate of 601,-509 acre feet is 48 percent of the 1975 to 1980 annual net depletion rate, and 77 percent of the 1980 to 1985 net depletion rate. This past year's net depletion rate represents only 59 percent of the ten year net depletion rate for the period 1975 to 1985.

The accompanying hydrograph illustrates the estimated volume of gravity water in storage in the Ogallala aquifer and the rate of depletion of the aquifer in the 5.2 million acre service area of the Water District. On pages 2 and 3 of this issue of the The Cross Section, individual county hydrographs illustrating the same data for each of the 15 counties or portions of counties served by the Water District are presented.

There are numerous reasons for recent decreases in the rate of net depletion from the Ogallala aquifer. The most notable is the relatively stable or declining price producers receive for their products as compared to ever increasing production costs. Just one example of increased production costs is the 400 percent or more increase in energy prices for the fuel used to pump irrigation water from the formation. This does not take into account increases in price for other fuels used on the farm which have also occurred during the past ten years.

Additionally, increased interest costs to the producer of 15 to 26 percent during the past ten years as compared to six to eight percent for the prior ten years has tremendously affected the irrigator.

There have, however, been tremendous improvements made by irrigators in their irrigation water use efficiencies. The High Plains Water District, the USDA-Soil Conservation Service, Texas Tech University, Texas A&M University, the Texas Agricultural Research and Experiment Station, the Texas Agricultural Extension Service and the irrigation industry have all strived to assist irrigators in improving their water use efficiency.

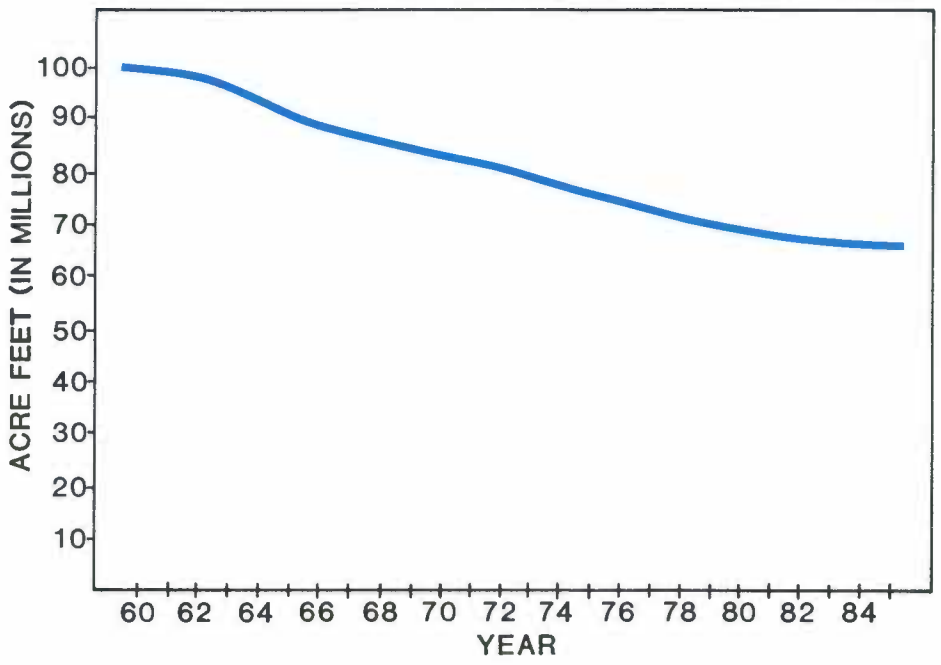
Examples of the efforts made by these organizations include the introduction and utilization of mobile field water conservation laboratories which are used to evaluate on-farm irrigation application efficiency. From these evaluations recommendations to the irrigator are made on how he might reduce water losses. There has also been the development of the drop-line center pivot sprinkler system. These drop-line systems virtually eliminate evaporative losses in sprinkler irrigation.

Another advancement is the introduction and demonstration of the surge irrigation valve and time control mechanism, which has increased efficiency in furrow irrigation by 20 to 40 percent. The demonstration of furrow dikes to capture and hold precipitation in place until it can infiltrate the soil is yet another example of recent technological improvements. The use of furrow dikes by some irrigators has resulted in a savings of their pre-plant irrigation or, in some instances, the savings of one summer irrigation for their field crops.

Extensive educational programs have also helped to make irrigators far more aware of the cost and value of their water resources. Consequently, they

continued on page 3 . . . DEPLETION

ESTIMATED VOLUME OF WATER IN STORAGE IN THE OGALLALA AQUIFER AND ESTIMATED RATE OF DEPLETION ,1960–1985 IN THE 5.2 MILLION ACRE SERVICE AREA OF HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT, SOUTHERN HIGH PLAINS OF TEXAS



Furrow Dikes – Cost Effective

The utilization of furrow dikes is a growing practice among High Plains irrigators. One of the contributing factors to the increased use of dikes may be attributed to the fact that the initial investment to use this technique may be recovered within the first season.

An April, 1984 survey of the number of acres furrow diked in the 15-county area served by the High Plains Underground Water Conservation District No. 1 reveals that there were approximately 365,000 acres utilizing furrow dikes at that time. The furrow dikes installed in the month of April, which is prior to the growing season for summer crops grown in the area, were being wisely utilized to collect and store water in the soil for mid or late summer use by field crops.

Dr. Bob Davis, professor of Agricultural Economics at Texas Tech University, assisted the Water District's staff in evaluating the occurrence and use of furrow dikes in the District's service area. Dr. Davis notes, "We actually took a one percent sample of the area within the District using a quarter section of land as the size of our sampling unit. Every quarter section in the Water District had a chance of being choosen as a sample unit.

"Then using a table of random numbers, we chose our sampling tracts and performed an actual on-site field inspection of those tracts choosen. Statistically speaking, the results for the area sampled would be expandable and representative of the entire Water District area."

Initial Investment

According to a U. S. Department of Agriculture report by Dr. Glen L. Wistrand, Natural Resources Economics Division, Economic Research Service, Technical Bulletin No. 1691, furrow diking equipment requires an initial investment of $140 to $300 per row. A producer using a nine-row tool bar to dike all furrows would need to invest $1,500 to $3,000 for the diker unit and dike removal mechanism.

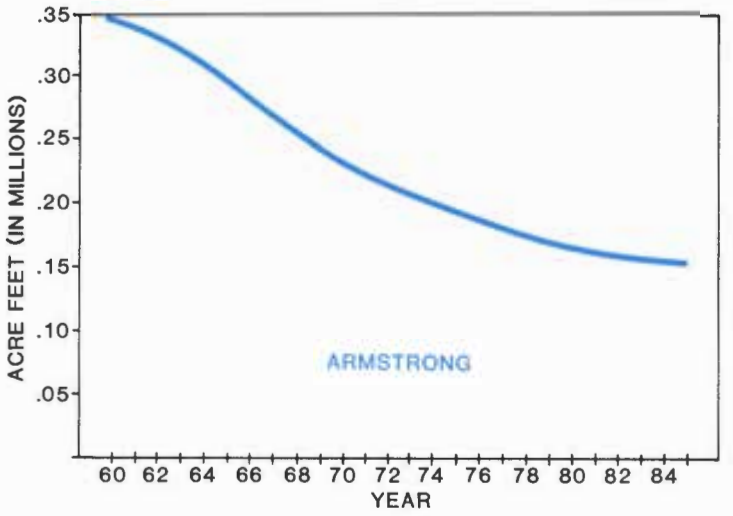
A one-year cost would be about $3.09 per acre. Average equipment utilized for seven years on 640 acres would cost approximately 44 cents per acre per year.

Assuming that the tractor used to pull the furrow dikers is not grossly overwhelmed by the additional weight and leverage of the dikers selected, operating cost for diking in conjunction with other operations is estimated at 43 cents per acre per year.

Total cost then is 44 cents per acre fixed and 43 cents per acre operational cost, a total of 87 cents per acre per year.

continued on page 4 . . . DIKES

ESTIMATED VOLUME OF WATER IN STORAGE IN THE OGALLALA AQUIFER AND ESTIMATED RATE OF DEPLETION ,1960-1985 IN THE 40,200 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN ARMSTRONG COUNTY, TEXAS



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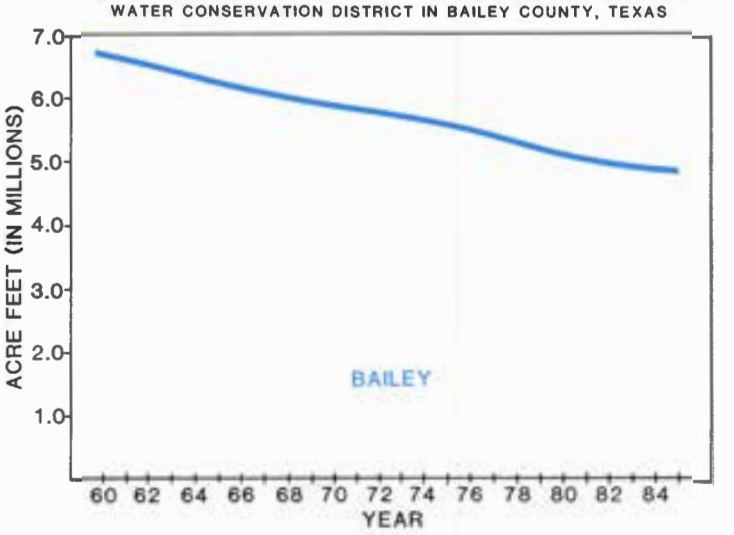

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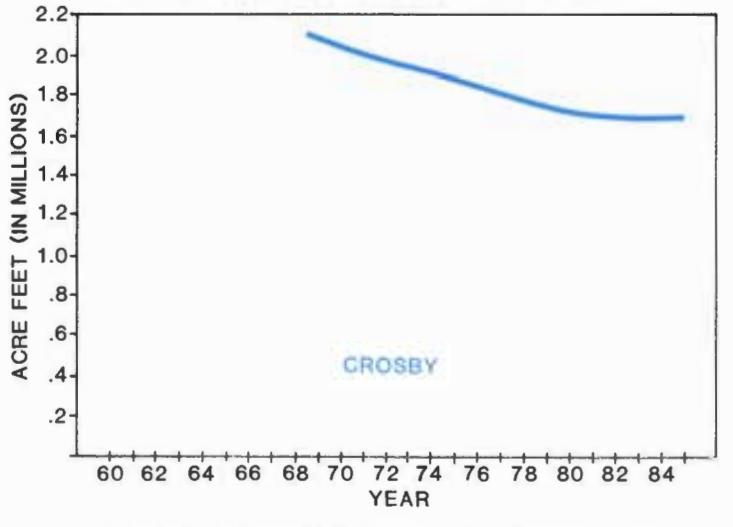

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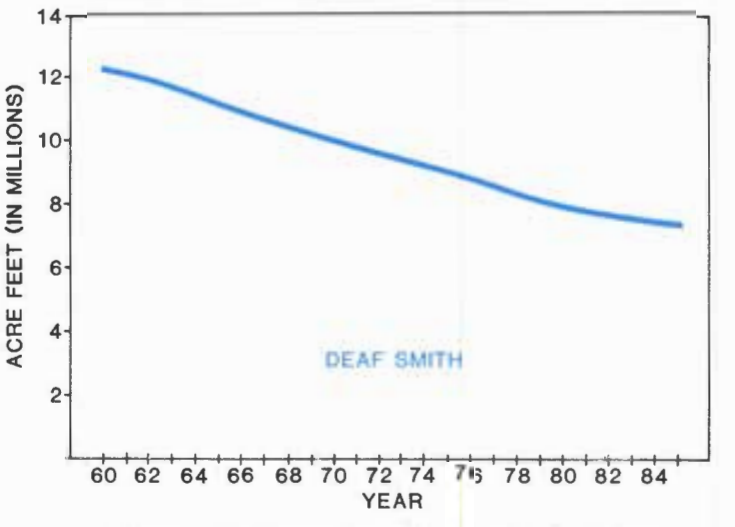

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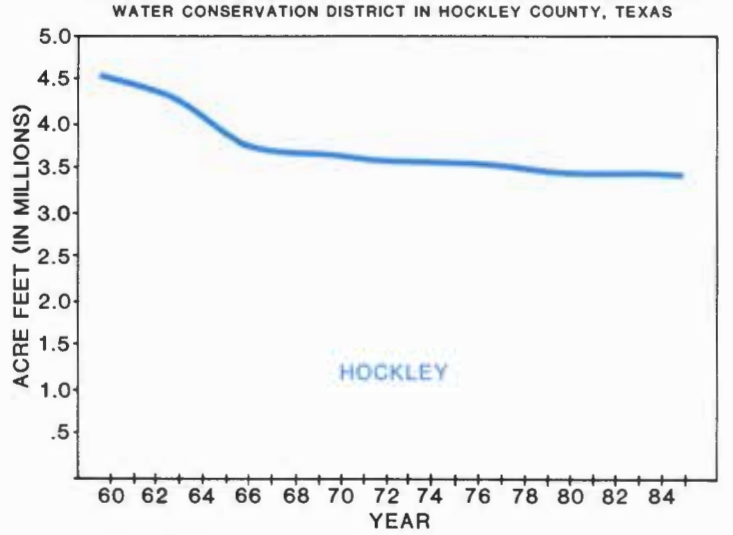

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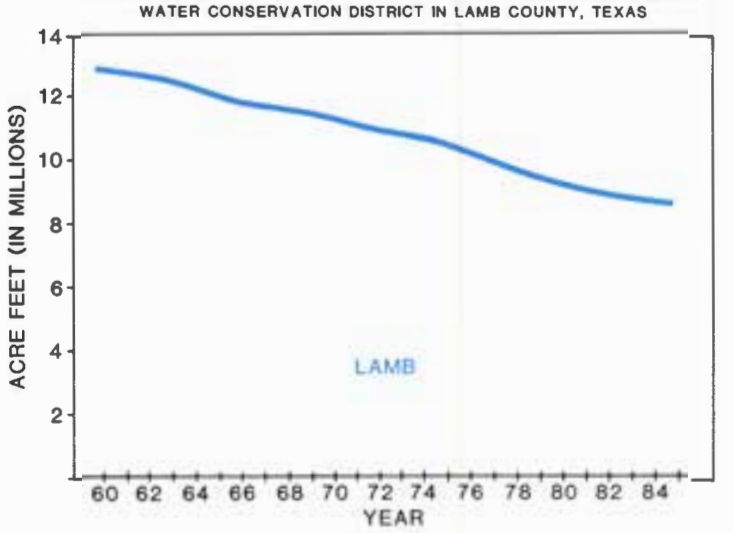

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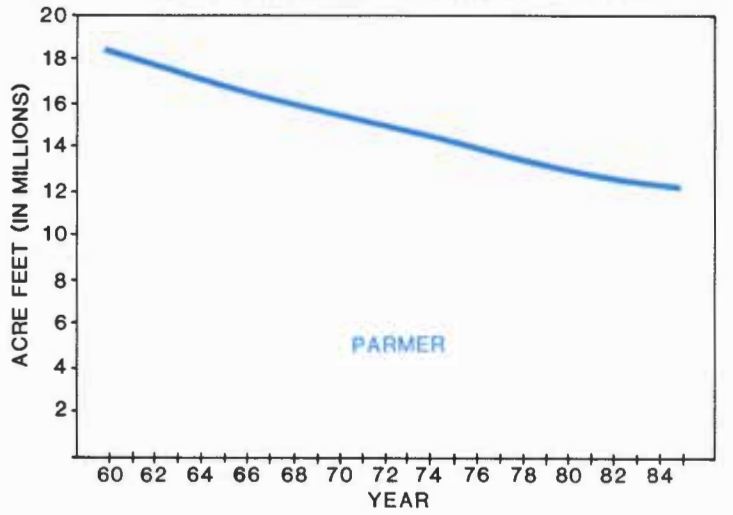

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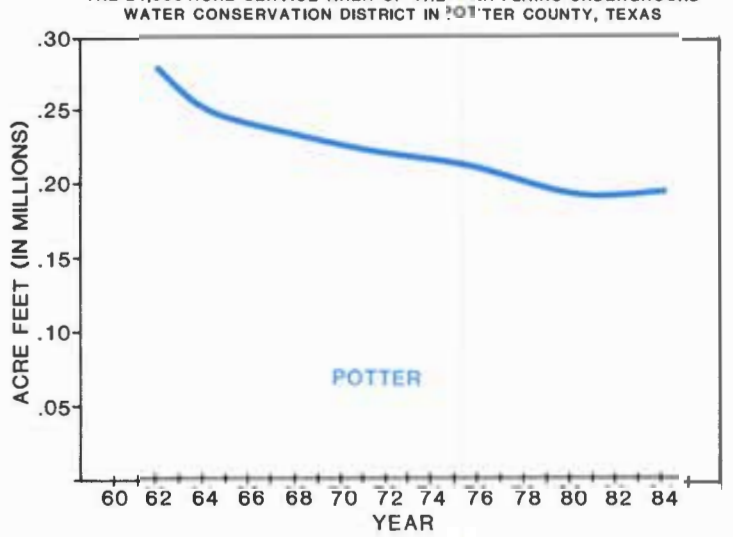

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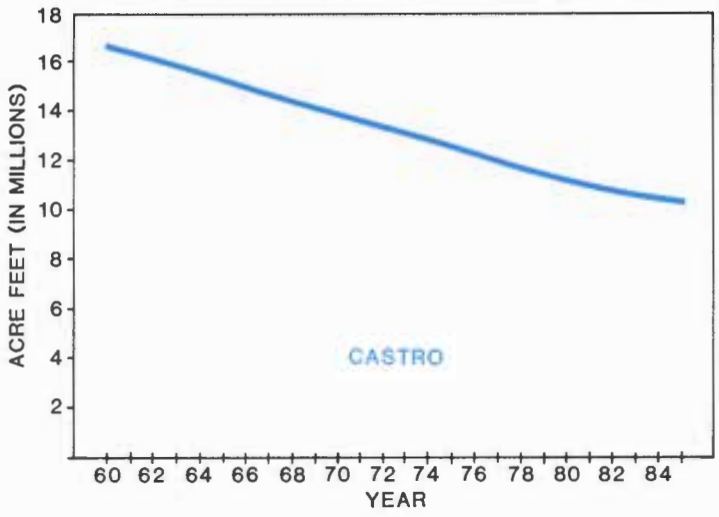

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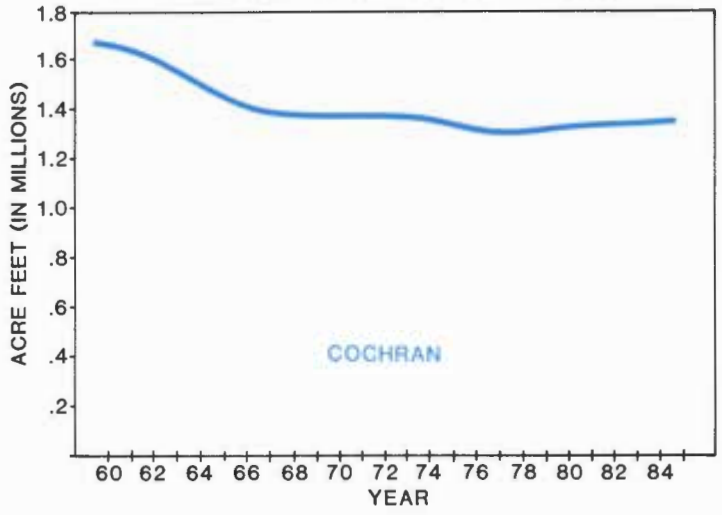

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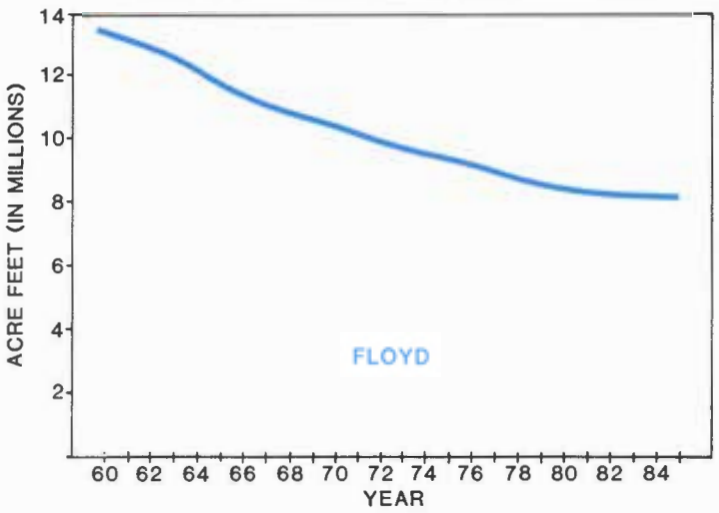

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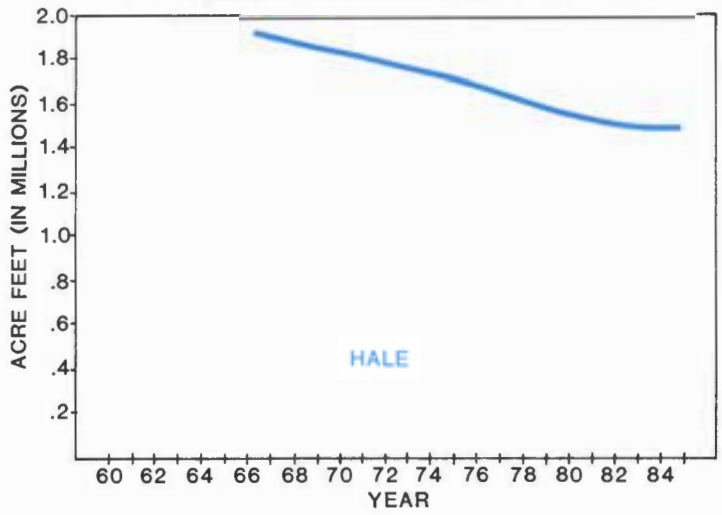
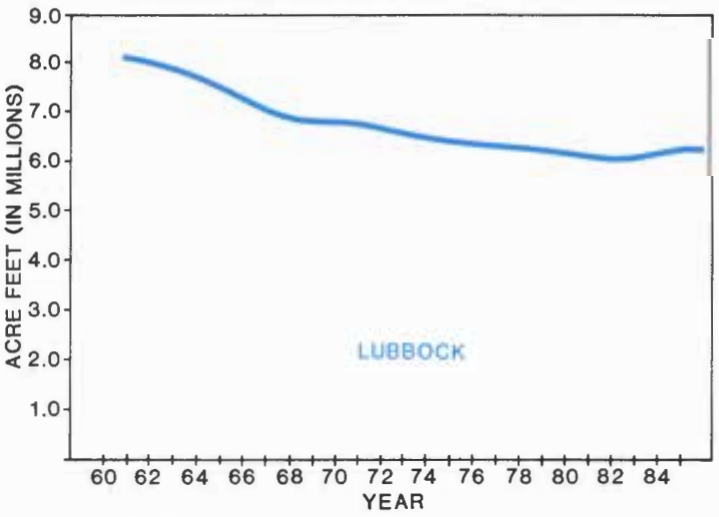
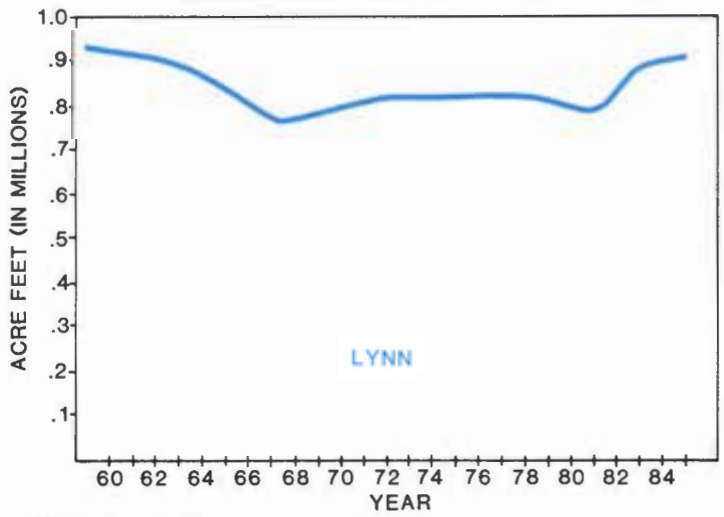


ESTIMATED VOLUME OF WATER IN STORAGE IN THE OGALLALA AQUIFER AND ESTIMATED RATE OF DEPLETION ,1960-1985 IN THE 580,050 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN LUBBOCK COUNTY, TEXAS



ESTIMATED VOLUME OF WATER IN STORAGE IN THE OGALLALA AQUIFER AND ESTIMATED RATE OF DEPLETION ,1960-1985 IN THE 152,150 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN LYNN COUNTY, TEXAS



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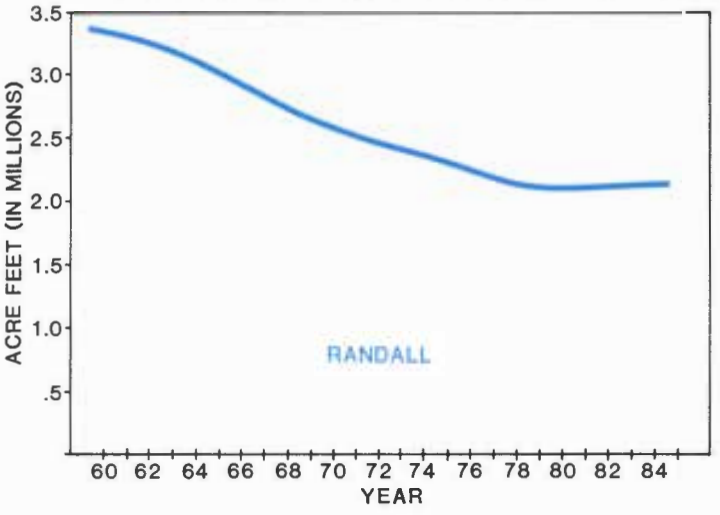

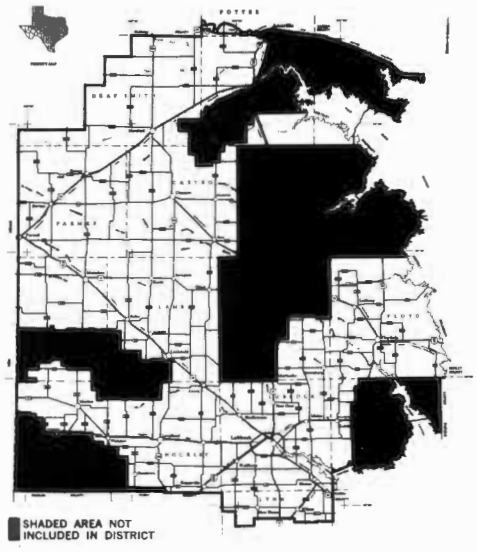

HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT No. 1—TEXAS

DEPLETION . . . continued from page 1

have turned to some of the aforementioned techniques as well as others in efforts to conserve water, energy and cut their production costs.

What happens when the agricultural economy turns around and it again becomes profitable for the irrigator to produce water for irrigation? A. Wayne Wyatt, Water District Manager, states, "It is my opinion that once the new technology is in place and improved conservation habits are developed by the individual irrigator, he will continue to conserve his water to his maximum potential. I do believe that in some areas water use will increase. But in those areas where maximum efficiency has not yet been attained, that savings will offset any increased water use in other areas."

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

County	Average Change 1984-1985		Average Change 1980-1985		1975-1985
	Wells In County	Average For County	Wells In County	Average For County	Avg. Annual In County
Armstrong	9	—0.61	8	—0.44	—0.78
Bailey	63	—0.20	61	—1.12	—1.40
Castro	81	—1.44	81	—2.02	—2.52
Cochran	50	+ 0.06	48	+ 0.03	—0.04
Crosby	22	—0.24	18	—0.90	—1.46
Deaf Smith	75	—0.58	76	—0.93	—1.48
Floyd	95	—0.98	87	—1.38	—1.51
Hale	26	+ 0.35	22	—1.45	—1.32
Hockley	88	—0.60	83	—0.11	—0.19
Lamb	81	—1.80	83	—1.94	—2.19
Lubbock	115	—0.39	104	—0.04	—0.15
Lynn	36	—0.37	34	+ 0.60	+ 0.33
Parmer	89	—1.72	90	—2.09	—2.54
Potter	6	+ 0.23	5	—0.26	—0.87
Randall	43	—0.02	28	—0.10	—0.44
District Avg.		—0.76		—0.98	—1.26

The average change in water levels during calendar year 1984 was —0.76 of a foot in the 5.2 million acre service area of the Water District. This compares favorably with the five year average annual change of —0.98 of a foot, which occurred between 1980 and 1985, and with the ten year average annual change of —1.26 feet, which occurred between 1975 and 1985.

DIKES . . . continued from page 1

Benefits of Furrow Dikes

The installation of furrow dikes may also afford conservation, and more efficient use of land, water and energy resources.

Numerous field and equipment experimental designs used in research show that soil erosion due to rainfall is practically nonexistent when furrow dikes are in place to contain and control rainfall.

In tests at two High Plains locations, diked land with a 1.2 to 2.3 percent slope and an infiltration rate of 0.1 of an inch per hour had no runoff. A maximum rainfall event of 3.1 inches was contained without any runoff.

Research plots at Bushland, Texas, compared dryland furrow diked grain sorghum to open furrow at two locations. The diked plots had no crop season runoff during a study period from 1975-80, while the undiked plots averaged 1.7 inches of runoff. In one of the years of study, the undiked dryland had 3.4 inches of runoff, while the diked had no runoff.

In similar research at Etter, Texas, in 1980, the results showed 2.4 inches of runoff from diked plots and 5.1 inches of runoff from undiked plots.

Every acre-inch of water held in place and not permitted to run off is available for cropping with no energy cost required to pump water from the aquifer. For instance, if 1.5 inches average rainfall runoff is saved and the need for irrigation is reduced a like amount, the cost of energy needed to pump the same amount of water would range from $2.50 to $5.00 per acre.

The potential for economic savings is even greater for retaining irrigation runoff. Runoff saved due to furrow diking in a Limited Irrigation Dryland (LID) system test represents a potential savings of irrigation water of $12.50 to $25.00 per acre.

In one test, irrigation water was applied to furrow diked land at a rate of 4.2 inches per hour for a total of 4.5 inches without runoff. Under a Low Energy Precision Application (LEPA) system, dikes retained water where applied without runoff, while nondiked areas had about five times more rainfall runoff and 15 times more irrigation runoff than did diked areas.

Runoff from conventional irrigation may be high because water infiltrates most of the irrigated soils slowly. Even with tailwater reuse, losses from irrigated fields may be 8 to 12 inches annually.

Actual energy consumption per unit of product in furrow diked LEPA and sprinkler irrigation systems was significantly lower than comparable undiked systems. Measured in killowatt hours per bushel, the advantages were 43 percent and 23 percent, respectively, over nondiked systems.

Reclamation of productive acreage is also possible with furrow dike use in the High Plains. A producer who holds moisture in place with dikes on the slopes of a 20-acre playa lake may realize $1,500 to $2,500 additional income without additional investments.

Soil moisture-rainfall graphs show soil moisture conditions comparing diked and undiked soil at planting favor the diked area.

In dryland graded furrow farming producing grain sorghum at two High Plains sites, positive economic results were attained. At the sorghum price of $4.50 cwt, net economic benefit ranged from $12.51 to $48.01 per acre above diking costs. The five-year average, including the years of no benefit, was $17.64 per acre. The one-year result from Etter, Texas, reported greater response than Bushland tests with a net benefit of $66.96 per acre. Net benefits to furrow diking would average $21.49 and $81.00 per acre for the two respective sites if sorghum prices were held at the long-term average price of $5.43 per cwt.

In a test of diked and nondiked LEPA applications, nondiked LEPA results in about five times more rainfall runoff and about 15 times more irrigation runoff than diked LEPA.

The amount of irrigation water pumped can be reduced by an amount equal to the amount of precipitation retained by furrow dikes, consequently reducing costs. In tests, the cost savings would be $5.93 per acre at $2.50 per acre-inch of irrigation, or $12.86 per acre at $5.00 per acre-inch of water not pumped.

New TAES Director Appointed

Dr. John R. Abernathy, a native of Altus, Oklahoma, was recently appointed Resident Director of Research at the Lubbock and Halfway Texas Agricultural Experiment Stations by Dr. Neville Clark, Director of the Texas A&M Experiment Station, which are a part of the Texas A&M University System. Dr. Abernathy's appointment became effective January 1, 1985. Dr. Abernathy replaces Dr. Bill Ott, who has been Resident Director since 1975.

DR. JOHN ABERNATHY

Dr. Ott was named Coordinator of Farming Systems Research for TAES also effective January 1, 1985.

Dr. Abernathy served as professor and project leader of weed research at the Texas A&M University Agricultural Research and Extension Center in Lubbock for the past 12 years.

As for the future direction of the Lubbock based Experiment Station, Dr. Abernathy said, "We are going to increase our emphasis on a systems approach. By that I mean, take our best research technology and package it so that the farmer has better access to it. We plan to demonstrate the system approach on our research farm for everyone to see."

Cooperation between agencies will be strongly emphasized under Dr. Abernathy's direction. "There is a lot of expertise in this area, from the U. S. Department of Agricultural, the Texas Agricultural Extension Service, the Texas Forest Service, and others. I am going to do my best to see that we coordinate our research efforts to make maximum use of all the expertise available."

Abernathy received his Bachelor's and Master's degrees in Agronomy from Oklahoma State University in 1967 and 1969. He continued his studies in weed science at the University of Illinois, where he received a Doctorate degree in 1972.

"Since I grew up on a farm," states Abernathy, "I am committed to helping farmers. This station is here to help the agricultural community in this area. Anytime anyone has a question or comment, we would be happy to hear from them."

The Texas Agricultural Experiment Station at Lubbock is located north of the city about five miles on the east side of U. S. Highway 87. Their mailing address is Route 3, Lubbock, Texas 79401 and the telephone number of the station is (806) 746-6101. Dr. Abernathy encourages anyone interested in the programs and activities of the Experiment Station to drop by or call to share their thoughts and concerns at any time.

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Row Spacing, Plant Population Keys To Cotton Production

Plant spacing, plant population and variety selection may be keys to making cotton production on the Texas High Plains profitable again. "For two years in a row now we have seen a very strong impact on yield increases due to changing the row spacing and controlling our plant population," states Dr. Dan Krieg, Crop Physiologist with the Plant and Soil Sciences Department of the College of Agricultural Sciences at Texas Tech University.

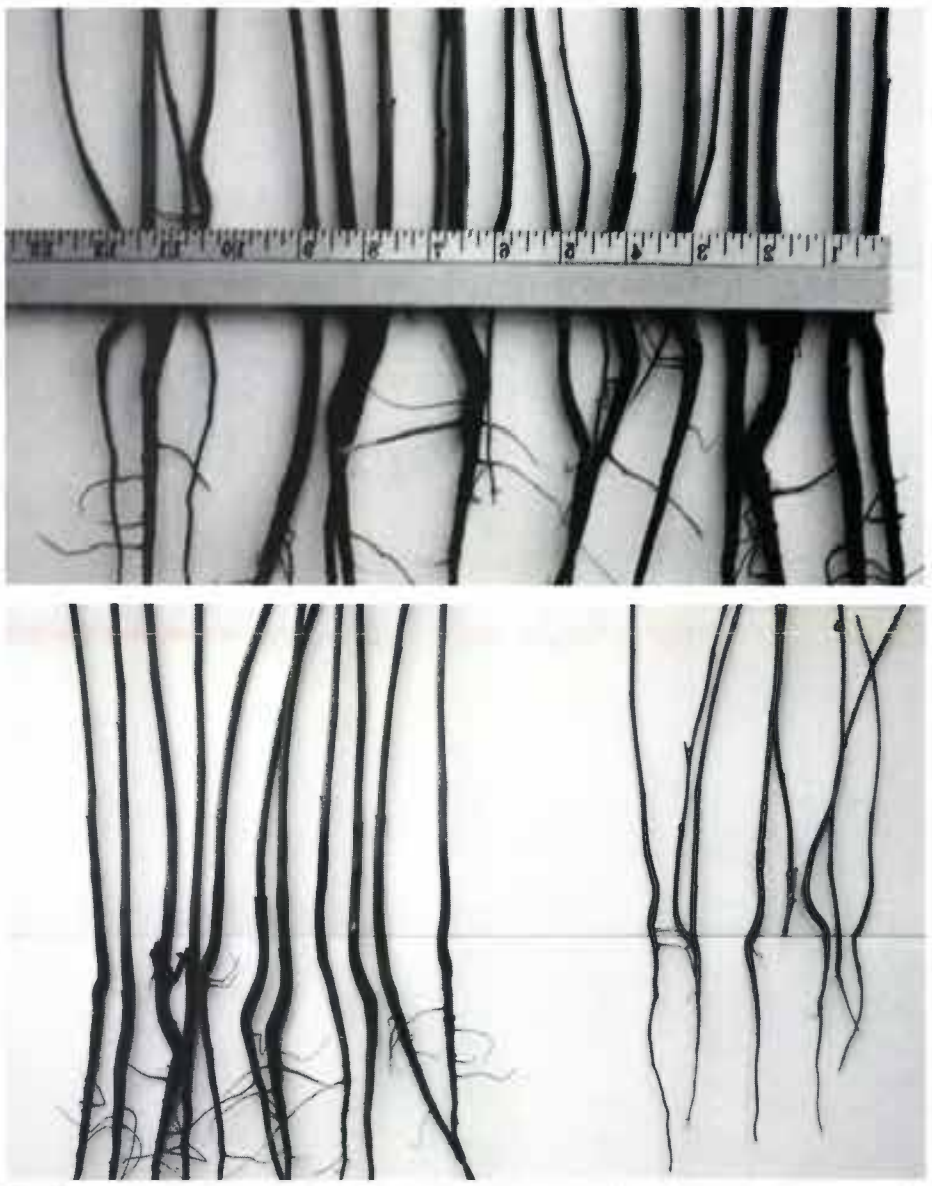
In 1984 research, cotton grown under dryland conditions on rows spaced 30-inches apart produced ten percent more lint per acre than did the same variety of cotton produced under fully irrigated conditions on 40-inch rows. Dr. Krieg explains, "We made 826 lbs/ac on 30-inch row dryland cotton, and we made 787 lbs/ac on the 40-inch row cotton that was fully irrigated.

"Nine inches of irrigation water applied to the irrigated tract cost us $45 per acre. Not only did we make less yield, we also had lower quality. Our micronaire was good quality under dryland 30-inch row spacing, but we had low mic on the 40-inch row irrigated cotton. So, we made less yield, we took a discount on the fiber quality, plus it cost us $45 per acre to irrigate.

"If you look at the bottom line," explains Krieg, "that is row spacing across all varieties and treatments that we have experimented with, there is about a 20 percent increase at the same plant population."

In a recent briefing of Lubbock area producers at the High Plains Water District offices, Dr. Krieg provided an overview of his research with cotton row spacings and plant populations to date. Dr. Krieg noted, "In the High Plains environment, especially with respect to cotton, we have some major environmental constraints. We normal-

continued on page 2 . . . COTTON



CONTROLLING PLANT POPULATION has proven critical to increasing cotton yields. Pictured above, 19 cotton stalks were obtained from a single foot of row in a field near Lubbock, Texas. Closer inspection of the stalks reveals that at least 8 of the 19 stalks were cotton "weeds," or plants too small to support mature fruit development. Note that while these plants do nothing to increase yields, they still extract valuable soil moisture and nutrients which could have been used by other more productive plants to support fiber development, and thus increased yields.

CONSERVATION TILLAGE

Producers Share Their Thoughts

Conservation tillage farming boasts several advantages in today's agricultural economy according to a group of farmers who are practicing conservation tillage farming. "First, the moisture savings," states Royce McFadden, a no-till farmer from Olton. "We can save four to five inches of moisture by having residue on the ground during the winter. Second, there is the time savings. And third, the savings in overhead expenses and labor costs."

The principal overlying advantages that were expressed throughout the day-long Conservation Tillage Workshop sponsored by the Soil Conservation Service were moisture savings, improvements in the condition of the soil, wind and water erosion control, and most important of all, increased yields.

Lonnie Mitchell, a farmer from Clovis, New Mexico, who practices no-till farming has doubled the acreage he farms since he started using conservation tillage. Mitchell echoes McFaddens' opinions saying, "In the last three years I have not had to wait for rain or had to irrigate to plant. There has always been enough soil moisture to plant into." Comparing moisture block readings on no-till land and conventional tilled land, Mitchell indicates that the no-till readings will be at 100 percent while the conventional till readings will have dropped to 80 percent or below just two to three days after a rain.

Another conservation tillage farmer, Rusty Rucker from Texico, New Mexico, takes pride in the fact that he has not pre-plant irrigated his land in three years. Additionally, in just two years of conservation tillage farming the savings he realized in overhead and irrigation expenses paid for his planter and cultivator.

Jerry Brorman of Hereford, Texas, who has been practicing both no-till and minimum-till, reports 7,000 pound milo yields produced under furrow irrigation, and after three years of growing dryland crops, Brorman has yields of 4,000 pounds of dryland milo. Brorman notes, "I can always get by without pre-watering to get my milo up, and I don't have any problems with a hardpan."

Conservation tillage farming does take additional use of herbicides to control weeds. But Brorman indicates that it just takes learning what to use and how to use it. "I use solid fertilizer instead of liquid. Keeping my weeds from coming up also saves more soil moisture. In fact, we save more than enough moisture to offset the cost of the chemicals. We never have had any trouble buying chemicals, but we never have had much success buying rain when we need it."

Practicing minimum tillage farming around Panhandle, Texas, Tom Dennis notes, "Without water or moisture your dirt doesn't do you any good. If we use conservation tillage properly and watch our rainfall, we can produce pretty good dryland crops." This year while many producers are looking at soil moisture deficits anywhere from two to six inches, Dennis indicates, "We only need another one to two inches to have our soil profile full."

At the bottom line, so to speak, Dr. Paul Unger with the U. S. Department of Agriculture - Area Research Station in Bushland, Texas, notes that in station tests they produced dryland sorghum under conservation tillage systems that yielded 4,000 pounds per acre compared to 1,500 to 2,000 pounds per acre without the stored soil moisture on conventional tilled land. "Each additional inch of water stored in the soil translates to 350 to 400 pounds per acre of grain sorghum." Another benefit of conservation tillage, notes Dr. Unger is the savings in soil moisture realized from not plowing your fields. "Every time you loosen the soil, water is lost to evaporation." Tom Dennis agrees with Dr. Unger, saying "Every time you run a plow you lose one-half to three-fourths of your moisture in that soil you turn over."

The producers who gathered for this

continued on page 4 . . . PRODUCERS

COTTON . . . continued from page 1

ly consider that cotton requires about 1600 heat units to mature. At Lubbock, our long-term weather records indicate that we get less than 1400 heat units. There are some years where we might get 1450, but we never get that 1600 needed for cotton. So our yields are limited because we have a limited growing season.

"But I think there are some things we can do with the environment to use the heat available more efficiently. There are also some things, especially with respect to water management, that we can do," notes Dr. Krieg, "as well as some cultural practices that I think we can adopt to increase productivity."

Variety Selection

One of the keys to managing production according to Dr. Krieg's research is matching your cotton growth habit, or variety selection, with the amount of water available. "We need to know what we have available in terms of our water supply. Then we need to choose the growth habit of the cotton we are going to plant accordingly.

"We have found that the more indeterminate our variety selection is under irrigated conditions, the less yield we get. But under dryland conditions in our research the indeterminate beat the determinate. So, if you've got water, plant something that is going to grow and mature; something with more determinancy." Determinate cotton varieties are classified as short season cottons, that tend to start fruiting earlier, make the crop early, and don't have the ability to re-grow in the fall of the year. However, Dr. Krieg states, "If you don't have water and you have to count on rainfall, you want the indeterminancy." Indeterminate varieties delay the onset of fruit. They are very responsive to water stress and shed fruit when there is water stress. But if they get a rain, they have the ability to come back.

Plant Population

Another important aspect of Dr. Krieg's research deals with the plant population operators normally have. "All of our research has been done at a constant plant population of 40,000 plants per acre," states Dr. Krieg.

"The past two years I have looked at fields all the way from Muleshoe to Floydada to Big Spring, and I cannot find any fields that have less than 40,000 plants. I have seen a lot of fields that run 80,000 to 90,000 plants, and when you look at that first fruiting position, it is up at the 10th or 11th node instead of the sixth node where it should be. It may strip better, but if you don't have anything out there to strip, it doesn't matter how good it strips.

"We have been planting one seed per two inches, or six seeds per foot of row, and then we hope that we only get three of those six to survive.

"What I want to emphasize is that plant population control is first and foremost the most critical factor. If you can control that population, and don't get beyond 50,000 plants per acre, then you can make that plant work in the temperature environment we have to live with. You can get earlier development and more mature fiber just by reducing the population.

Plant Spacing

"In our research during 1983 and 1984 we have been looking at three different plant spacings as far as changing the width within the row," Dr. Krieg explains. "We used the traditional 40-inch row, a 30-inch row and then two rows per bed spaced 12 inches apart on 40-inch centers. Basically all we are doing is giving each plant a little more room.

"One of our biggest problems out here is water use efficiency. Our average rainfall is less than desirable, but at the same time if we use that water which is available to us properly, and make as much of that water go through the plant and not lose it to runoff and free evaporation, we can do quite well with the rainfall we get. So, our purpose was to try to change the amount of total water available and give the plant an opportunity to have more of that total water supply and not lose so much to evaporation," notes Dr. Krieg.

"We had several concerns when we thought about changing the cotton row spacing. One of our concerns was if we got the leaf area out there, were we going to use our water too fast. Surprisingly we found in terms of leaf area index that as we progressed through the season our narrow rows and especially our two rows per bed, actually had less leaf area than the single row on a 40-inch bed. The reason for that is that we had earlier fruiting.

"We had flowers in the narrower rows seven to ten days earlier than we had flowers in the single 40-inch rows. For every day we gain on the front end of fruiting, it saves at least two days on the back end of the growing season when our September temperatures kill us in terms of fiber maturity. So, just by spreading the plants out at a constant population, we gained a six to seven day advantage on the front end."

Fruit Retention

Dr. Krieg's findings also reveal that 75 days after emergence, 30-35 percent of the fruiting sites were retained on the narrow rows where only 25 percent of the fruiting sites were retained on the single rows. At 100 days, however, the single 40-inch rows were catching up in fruit numbers. But at 100 days, if we plant in mid-May, that takes us to the first of September. So, while the 40-inch rows are still catching up in fruit numbers, there is not much chance of a bowl making a mature fruit if it is set in September. Dr. Krieg notes, "So by spreading the plants out, we had earlier floral buds and a higher percentage of those fruit retained by the plant. On our 40-inch rows, we had a

continued on page 4 . . . COTTON

COTTON LINT YIELD
1984 NORTH LUBBOCK COUNTY

CULTIVAR	WAT. SUP.	ROW SPACING: 1 row/40 ins.	2 rows/40 ins.	30 in. rows	Avg.
		(pounds/acre)			
Determinate PM 792	Irr.	1036	1086	1107	840.7
	Dry	554	545	716	
Mod-Det. SP 37	Irr.	844	1072	916	799.7
	Dry	624	643	699	
Indeterminate GSA 71	Irr.	787	945	985	805.7
	Dry	605	686	826	
Average		741.7	829.5	874.8	

BOLL DRY WEIGHT/LEAF AREA

PLANT AGE (days)	WATER SUPPLY	ROW SPACING: 1 row/40 ins.	2 rows/40 ins.	30 in. rows
		g/m^2		
75	Irr.	18.3	31.7	38.6
	Dry	44.1	56.6	60.6
100	Irr.	84.0	117.2	89.5
	Dry	108.6	99.8	119.6

FRUIT NUMBER/FRUITING SITES

PLANT AGE (days)	ROW SPACING: 1 row/40 ins.	2 rows/40 ins.	30 in. rows
75	0.25	0.33	0.36
100	0.25	0.22	0.21

Water-Level Decline Rate Slows

The amount of precipitation received annually and the portion of that annual precipitation which is received during the growing season is generally reflected in the average annual change in water levels throughout the area served by the High Plains Water District.

In the March, 1985 issue of *The Cross Section* hydrographs illustrating the total quantity of gravity water in storage within the High Plains Water District's service area and within each county or portion of a county within that service area were presented. This month, hydrographs illustrating the average annual change in water levels are presented on page 3 for those counties in the northern half of the District's service area (the Amarillo area).

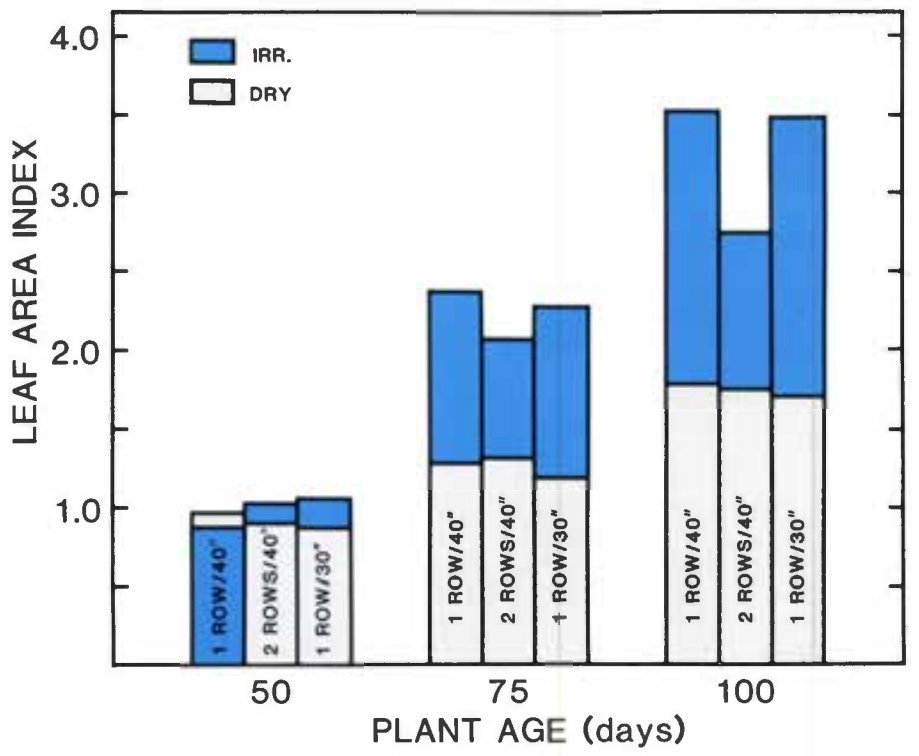
The change in water level hydrographs have been designed to illustrate the change in water levels as they relate to the average saturated thickness within each county. As an example, in Castro County in 1960, the average saturated thickness was approximately 185 feet. Twenty-five years later the decline in this same county has reduced the average saturated thickness to approximately 115 feet.

These change in water level hydrographs illustrate the same basic trend as did those net depletion hydrographs which were presented in the last issue of *The Cross Section*. Each hydrograph illustrates a general flattening of the decline trends.

Additionally, a hydrograph of the annual precipitation for the Amarillo National Weather Service station for the period 1960 to 1984 is presented. This hydrograph shows the percentage of the total annual precipitation which occurred during the growing season (April through September).

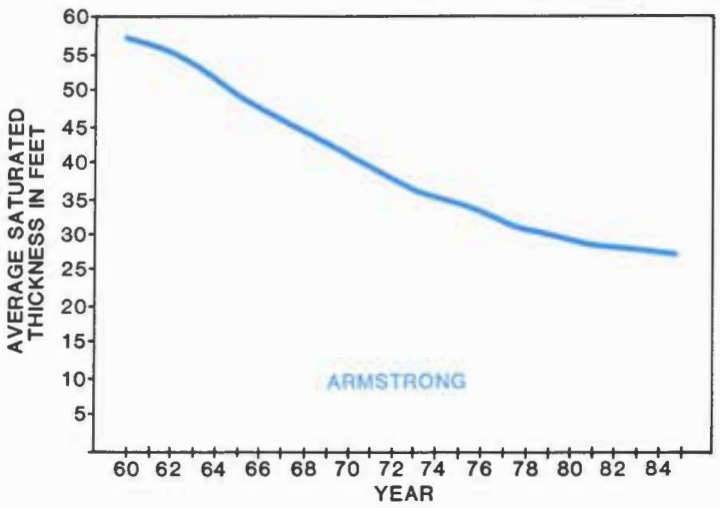
It is interesting to note that during those years when the average precipitation amounted to 75 percent or less

continued on page 4 . . . WATER LEVEL

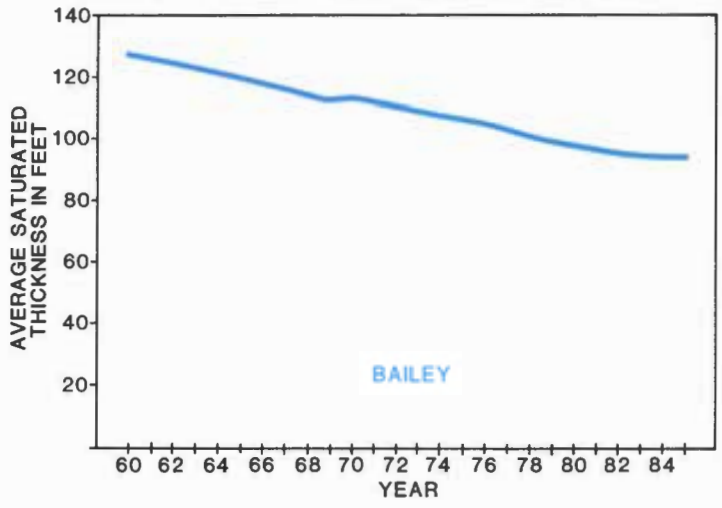


LEAF AREA INDEX actually proved to be less in the narrow row spacing than in conventional 40-inch rows. The reason for this is attributed to the earlier setting of fruit which stops the plant from growing vegetatively.

ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960-1985 IN THE 40,200 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN ARMSTRONG COUNTY,TEXAS



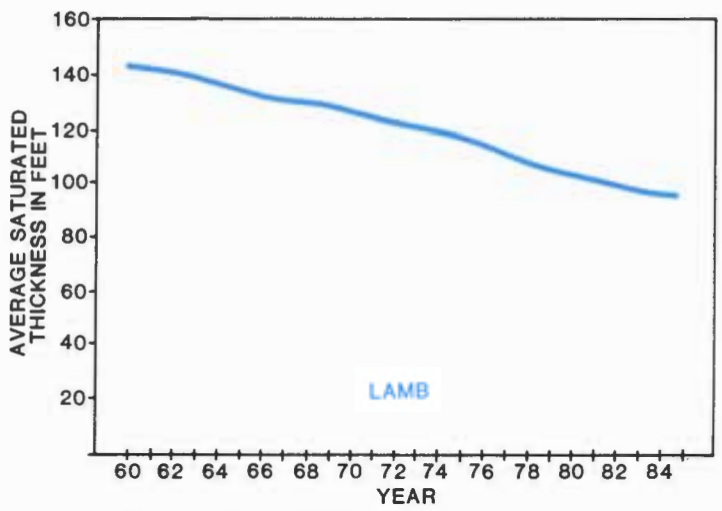
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960-1985 IN THE 351,050 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN BAILEY COUNTY, TEXAS



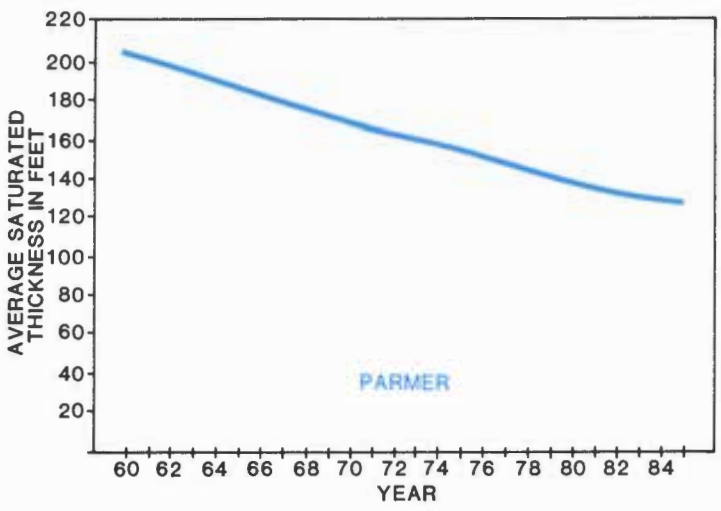
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960-1985 IN THE 589,830 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN CASTRO COUNTY, TEXAS

ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960-1985 IN THE 566,400 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN DEAF SMITH COUNTY, TEXAS

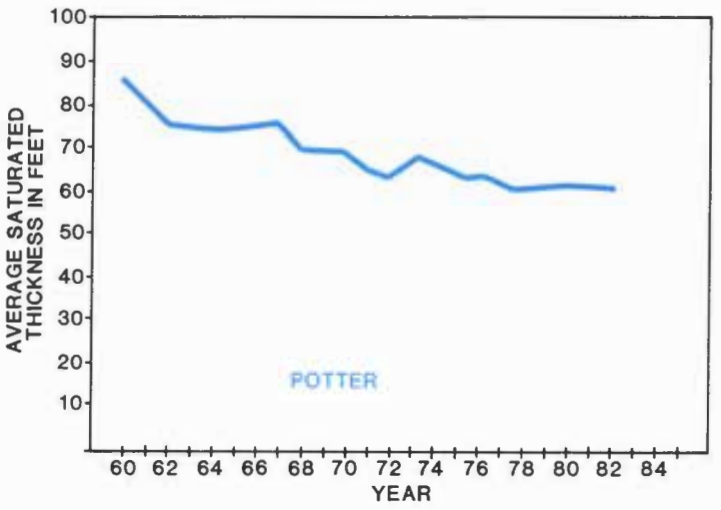
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960-1985 IN THE 564,100 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN LAMB COUNTY, TEXAS



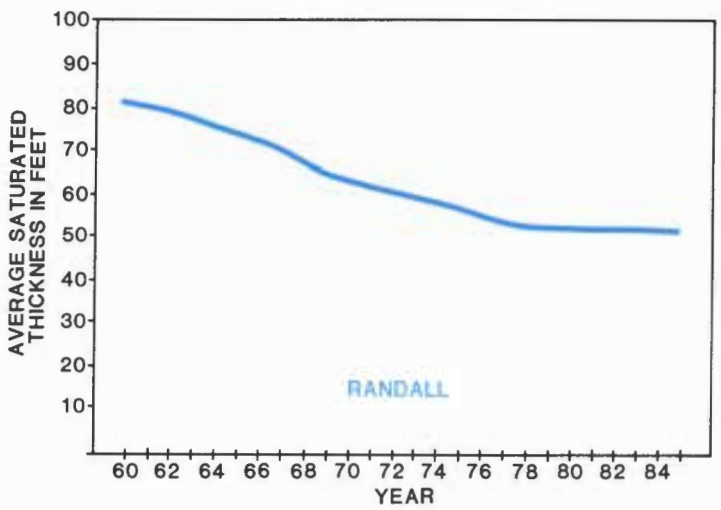
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960-1985 IN THE 577,950 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN PARMER COUNTY, TEXAS

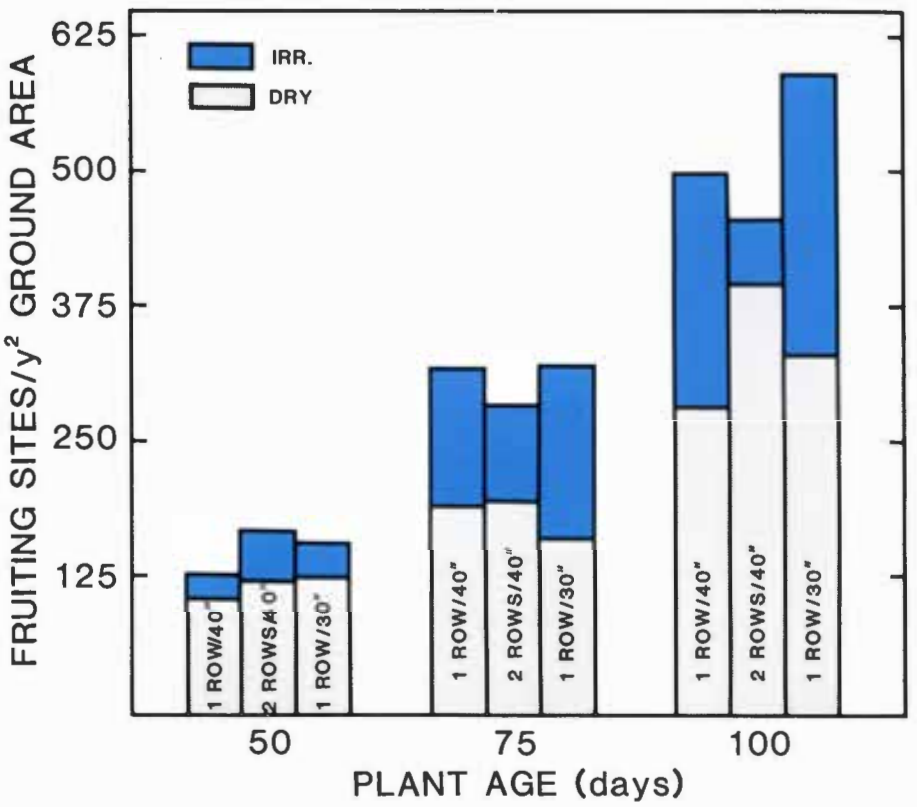


ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960-1985 IN THE 275,400 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN RANDALL COUNTY, TEXAS



ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960-1985 IN THE 21,500 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN POTTER COUNTY, TEXAS





EARLY FRUITING SITES retained by the plant results in more mature bolls and thus more fiber production. This graphic illustrates the number of fruiting sites, or nodes, per square yard at various growth stages and watering rates throughout the growing season. Note that the narrowest row spacing outperformed the 40-inch spacing under both dryland and irrigated conditions at the end of the season.

COTTON . . . continued from page 2

lot of unopened bolls at the top. The 30-inch rows and the narrow rows were mature cotton all the way to the top. And there is no question that narrower rows increased our mic. The single rows were running about 3 for mic, and the narrow rows were running 3.3 to 3.5. So we got much better micronaire."

Boll Worms

Dr. Krieg also notes an interesting side benefit of the narrow row spacing. Research was also performed on the effect of the narrow row spacing with respect to boll worm activity. Dr. Krieg states, "I might say that the boll worm moth did like the high irrigation and the narrow row spacing, but the beneficials liked it even more. We never had to spray our test plots, and one set of plots right behind us, just across the field row, was sprayed three times for boll worms. As a consequence, we saved about $40 per acre just in insecticides, and we never had much boll worm damage."

In summary, population control, according to Dr. Krieg's two years of field research, is the single most critical factor. Then secondly, if you can change row spacings and select your variety properly based upon your water, then you can increase yields and consequently profits in cotton production in the High Plains of Texas.

PRODUCERS . . . continued from page 1

meeting did admit that conservation tillage is "not a cure-all" to overcome the increasing input costs and declining profits in agriculture. In fact, Royce McFadden admitted that there are some disadvantages. "For example, the soil doesn't warm up as fast and that does effect many crops. It takes a while longer to get the crop out of our residue, and there are some problems with rotations. It takes a little more management to decide which crops you can grow."

But as Levon Harman states, "It's just the economics of it. We save more moisture which gives us increased yields. Our soil has improved, and we don't have to pre-water. At the bottom line, I have produced 270 pounds of cotton on a no-till field, where right across the row on conventional tilled land the production was only 100 pounds per acre. I can get anywhere from 100 to 200 pounds of yield increase on my no-till cotton."

Dr. Ott Ponders "Farming Systems"

In assuming his new position as Coordinator of Farming Systems Research for the Texas Agricultural Experiment Station at Lubbock, Dr. Bill Ott explains, "I will be looking at what we should address now in our research and engineering activities that will be designed for use in the 1990's. No one at this point knows what we should be looking at."

Dr. Ott was recently appointed to his new position by Dr. Neville Clark, Director of the Texas A&M Experiment Stations, which are a part of the Texas A&M University System. Dr. Ott's appointment as Coordinator of Farming Systems Research became effective January 1, 1985.

The new position, in scope, is "to coordinate engineering and new research associated with farming systems." Dr. Ott explains that the station already has some farming systems, for example the Low Energy Precision Application system. This system combines the redesign of the center pivot sprinkler system with herbicide application and furrow dikes into a total farming system.

The area involved in Dr. Ott's new position will be primarily West Texas. He will be working with the Research Centers in Amarillo, Lubbock, Chillicothe, Vernon and Pecos as well as other specific university departments and groups who have expertise which could be valuable in an interdisciplinary approach to farming systems.

Dr. Ott's primary responsibilities will be working with Center Directors and different unit heads to identify regional research needs in the agricultural sector and facilitating a multidisciplinary research effort. The primary emphasis of the new position is to speed the transfer of technology from the research station to the producer, utilizing the current resources already available to the experiment station which will not require additional funds or personnel.

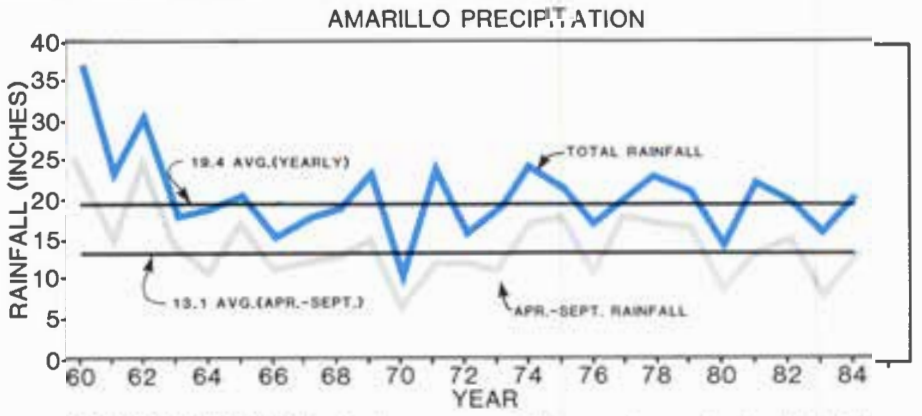
Dr. Ott hopes that anyone with suggestions or ideas for future farming systems research will contact him at the Lubbock Texas Agricultural Experiment Station. The Station is located north of the city about five miles on the east side of U. S. Highway 87. Their mailing address is Route 3, Lubbock, Texas 79401, and the telephone number of the station is (806) 746-6101.

WATER LEVEL . . . continued from page 2

of that considered normal, the change in water levels has generally reflected a decline rate at least 25 percent higher.

By contrast, during those years when precipitation has exceeded normal by 25 percent, and especially when this occurred prior to or during the growing season, the average annual change in water levels has been 25 percent or less than the average.

Plans for next month's issue of *The Cross Section* include the publication of hydrographs for the remainder of the counties served by the Water District (those in the southern half or Lubbock area). Additionally a hydrograph of precipitation for the Lubbock National Weather Service station will be presented.



PRECIPITATION TIMELINESS affects crop production, and can also be linked to the rate of water-level declines. Note that both 1980 and 1983 were particularly dry years and fell far below the average during the growing season. It stands to reason that water-level declines would have been greater during those years than in other more normal years had it not been for the massive conservation efforts employed by irrigators.

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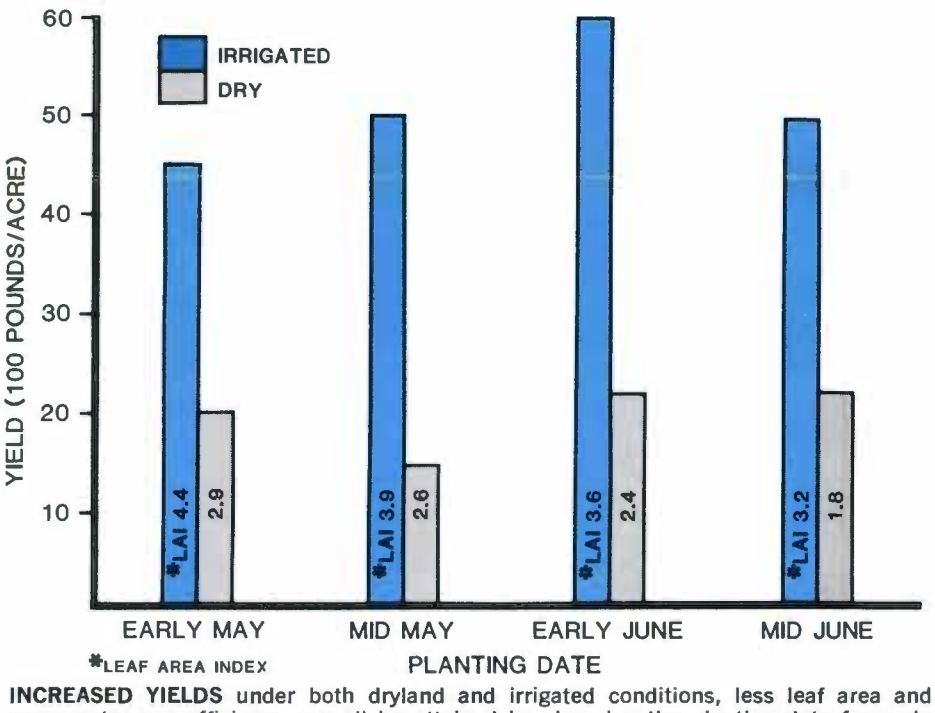
Planting Date Affects Grain Sorghum Yields

"A large number of studies throughout the Great Plains indicate that seed number per head of grain sorghum is the major cause of yield variations in grain sorghum production," indicates Dr. Dan Krieg, Crop Physiologist with the Plant and Soil Sciences Department of the College of Agricultural Sciences at Texas Tech University. Dr. Krieg and other university scientists have been experimenting with various management practices and grain sorghum varieties over the past several years to determine the effects of planting dates, nitrogen fertility and water management on the yield potential of grain sorghum on the High Plains of Texas.

"We have determined that if you treat the grain sorghum plant right, you can get about one-tenth of a pound of grain per head," notes Dr. Krieg. "In our tests, applying these management practices across four different grain sorghum hybrids that differ in maturity from the early to medium-late types, we received about a 25 percent increase in yield (pounds per acre) on irrigated grain sorghum and a 10 percent yield increase on dryland sorghum."



INCREASED YIELDS under both dryland and irrigated conditions, less leaf area and more water use efficiency can all be attained by changing the planting date for grain sorghum on the Texas High Plains from early-May to early-June as exhibited by the graphic above.

Grain Sorghum Development

Grain sorghum has three distinct phases in the development of the mature plant, each of which occupies about one-third of the life of the plant. The first one-third of the life cycle, after germination, is spent in vegetative development.

About 30 to 35 days after planting, the second one-third of the plant development begins. This stage is the most critical portion in the life of the sorghum plant as it ultimately affects yield. This period begins with the development of the panicle branches and continues through development of the individual florets. This period starts just prior to the stage commonly referred to as the booting stage. During this period of plant development, the plant is extremely sensitive to any type of stress such as high temperatures and water deficits, which will reduce the number of florets and therefore the potential seed number.

The third stage in grain sorghum development begins at full flowering and ends with grain maturity. Water stress during this period, where the grain is filling, greatly reduces photosynthesis, but has only a minimum effect on seed weight unless the stress becomes extreme. The reason for this is that the sorghum plant draws extensively on the carbon and nitrogen compounds stored in the stem and lower leaves to fill the grain.

continued on pg. 4 . . . PLANTING DATE

"How To" Brochures Available

On the Texas High Plains, water is the limiting factor in crop production. Knowing the amount of moisture that is stored in your crop root zone soil profile can give you the edge to increase yields and thus profit potential.

Four "Water Management Notes" that deal with the mechanics of soil moisture monitoring have just rolled off the presses and are available for use as guides by producers in determining the methods used and equipment necessary to monitor soil moisture conditions and in evaluation of the crops' water needs.

The first of these brochures, entitled, "Soil Moisture Monitoring, An Overview of Monitoring Methods and Devices," discusses the basic concepts of soil water and the water-holding capacity of different soil types. Additionally, it provides a brief summary of five techniques for monitoring soil moisture, from the simple "feel and appearance" method to the complex "neutron moisture probe." Also discussed are the "gravimetric" method, the use of "gypsum blocks with resistance meters," and "tensiometers."

Gypsum blocks, which are attached to resistance meters for readings, are one of the most commonly used tools for monitoring soil moisture. The second brochure in our "Water Management Note" series, entitled "Irrigating By The Block," provides a discussion of the use by gypsum blocks and a step-by-step formula for installation, reading the blocks to determine current soil moisture conditions, calculating the crop's daily water use, determining

continued on page 2 . . . BROCHURES

Water Well Drillers Regulations Protect Aquifer/Landowner

The Texas Water Well Drillers Board has adopted new rules to protect aquifers in the state of Texas from contamination by improperly completed wells. Gary Grant, Vice-President of the Texas Water Well Association and a member of the Texas Water Well Drillers Board, explains, "Basically the new rules require water well drillers to cement the annular space between the well borehole and the casing to a minimum of ten feet below land surface, then construct a concrete slab a minimum of two feet square and four inches thick surrounding the casing of the well. It is also a requirement in the new regulations that the casing extend one foot above this concrete slab.

"The main purpose of these regulations," as Grant sees it, "is to avoid contamination of the aquifer." However, as a partner in the water well drilling firm of Hi Plains Drilling in Abernathy, Texas, Grant sees many benefits to the landowner as well.

"The obvious advantages are the protection of the landowner's investment in the well, the protection of the landowner's ground water from contamination, and in cases where the water is consumed by humans, there is the protection of health.

"I have seen many instances, and each year we work on a number of wells where the soil under the pumpbase has caved in, thus causing the well to sink and fail. This can result from small insects and animals burrowing around the pumpbase. Eventually, the holes get large enough to cause the pumpbase to tilt to one side. In other instances, runoff water collecting around the pumpbase may wash out these small holes. Then water carrying silt and contaminants runs back into the well borehole causing contamination of the water in the aquifer," notes Grant.

"I have seen numerous instances where turbine pumps lock down as a result of the pumpbase sinking. Additionally, I have removed the hair of small animals from pump impellars which caused the impellars to lock down the pump, not to mention the effect of the dead animal on the quality of the water in the hole."

Grant notes that there has been less than total compliance with the new regulations by drillers statewide, but there are liabilities to drillers who do not comply with the law. "There is a tremendous liability for improper completion of the hole. If the driller shows on the log that the hole was completed as per the standards and a health hazard occurs, then an investigator will check the construction of the well. If the investigator determines that the log was falsified, then the driller's license

continued on page 2 . . . REGULATIONS

CHANGE-IN-WATER-LEVEL HYDROGRAPHS SHOW GENERAL FLATTENING DECLINE TREND

EDITOR'S NOTE: *In the April, 1985 issue of The Cross Section we provided information to our readers on the net change in water levels in the Ogallala aquifer for the 25-year period 1960 to 1985 for those counties in the northern one-half of the Water District's service area. As we promised, in this month's issue we are providing our readers with the same information for the southern one-half of the District's service, or that area around Lubbock, Texas.*

The timeliness of precipitation received prior to and during the growing season on the High Plains of Texas is important to crop production, but it is also extremely important to extending the life of the Ogallala aquifer.

In an average year in the southern one-half of the District's service area, 67 percent of the average annual precipitation is received prior to and during the growing season (April to September). Consequently, in these average years water levels in the Ogallala aquifer exhibit average rates of decline. Conversely, in those years when the precipitation received just before and during the growing season is less than the average, water-level declines in the aquifer could be expected to reflect higher decline rates, if it were not for the conservation efforts being used by area irrigators.

The accompanying hydrograph (page 3, top left) of the average change in water levels throughout the 15-county, 5,215,600 acre service area of the High Plains Water District reveals that the average change in water levels in the Ogallala aquifer during the 25-year period 1960 to 1985, has reduced the average saturated thickness from approximately 125 feet in 1960 to approximately 85 feet in 1985. This represents an average decline during this 25-year period of 40 feet, or slightly more than 1.5 feet per year.

Presented on page 3 of this issue of The Cross Section are hydrographs which illustrate the average annual change in water levels in those counties comprising the southern one-half of the Water District's service area. These hydrographs are presented to show the change in water levels as they relate to the average saturated thickness of the aquifer in each county.

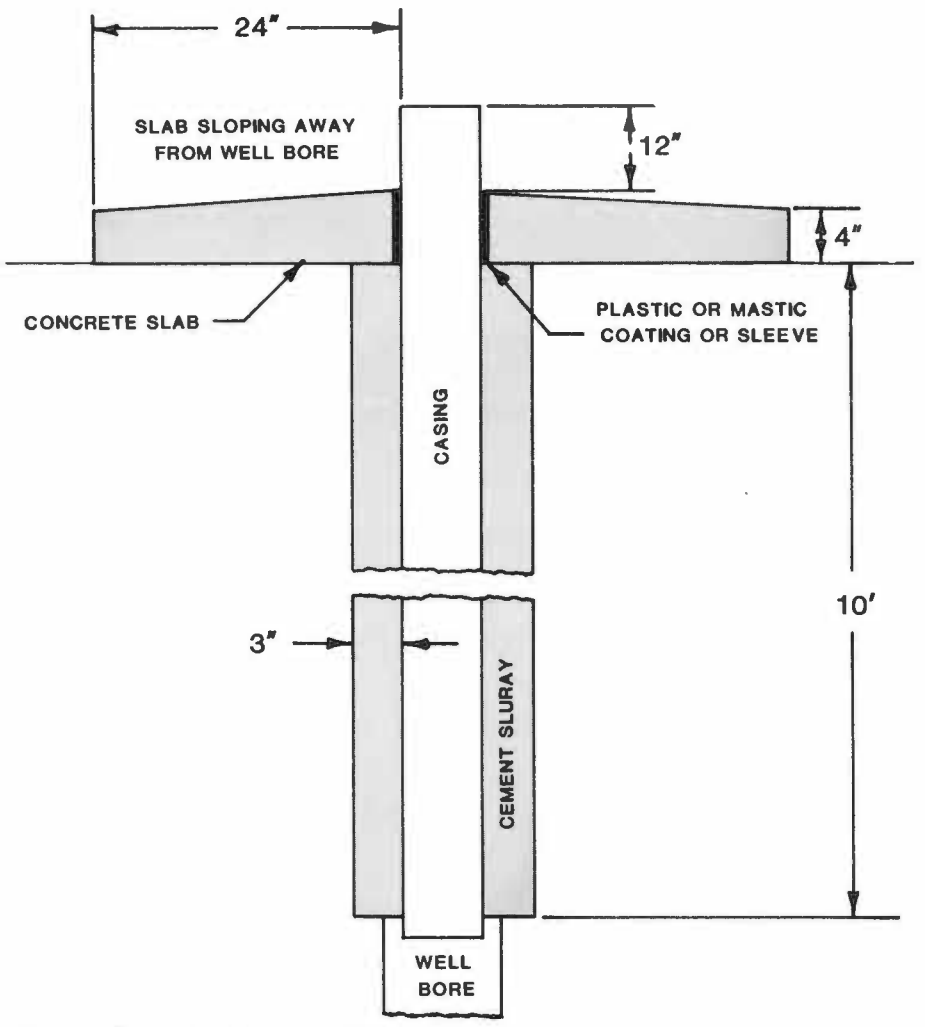
Checking some of these hydrographs individually reveals variations from the general District-wide trend. For example, the net change in water levels during this same 25-year period in Lynn County reveals that the average saturated thickness of the aquifer has declined only two feet. The Lubbock County hydrograph reveals a net change in saturated thickness of 21 feet in the same time period.

The important aspect of these hydrographs is that a general flattening decline trend is evident during the past five to ten year period.

The average change in water levels for the period 1960 to 1970 for the Water District's service area represents an average decline during this ten-year period of 15 feet or 1.5 feet per year. Calculating the average change in water levels for the period 1970 to 1980 reveals an average decline of ten feet for this ten year period, or an annual decline of one foot per year. This same trend has continued through the five-year period 1980 to 1985.

Accompanying these change-in-water-level hydrographs is a hydrograph showing the average annual precipitation as reported by the Lubbock National Weather Service office, and the percentage of the annual precipitation which was received prior to or during the growing season. Again, it is interesting to note that in those years when the average precipitation amounted to 75 percent or less of that considered normal, the change in water levels has generally reflected a decline rate at least 25 percent higher. By contrast, during those years when precipitation has exceeded normal by 25 percent, and especially when this occurred prior to or during the growing season, the average annual change in water levels has been 25 percent less than the average.

REGULATIONS . . . continued from page 1



DESIGNED to protect the aquifer from contamination, the above graphic represents the construction of a well borehole following the regulations adopted by the Texas Water Well Drillers Board.

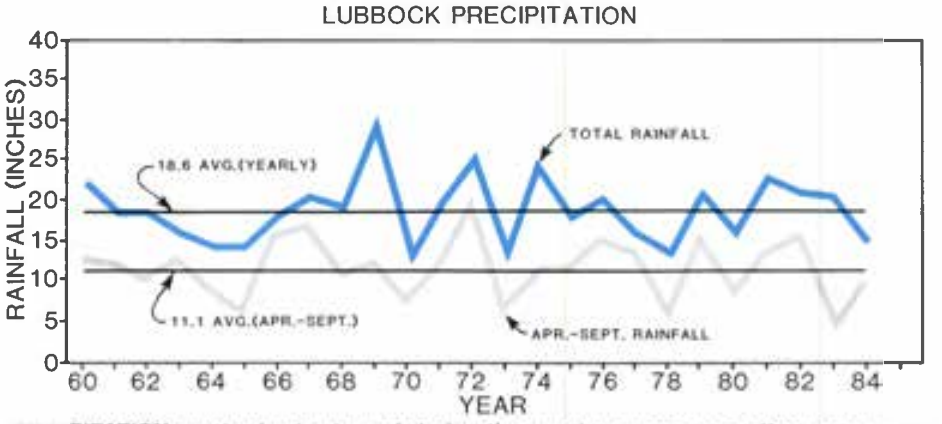
is subject to suspension or revocation, and the case is referred to the Attorney General who can levy fines to the driller of up to $1,000 per day."

"It is the responsibility of the driller to comply with these regulations. However, there is also a provision that if for some reason the landowner refuses, the driller is to report the refusal of the landowner to the Department of Water Resources and explain that the landowner would not allow the driller to complete the well in compliance with the law." Grant states, "These regulations are very worthwhile for no more cost than there is involved."

Grant notes that there are some additional costs to the landowner for the driller to comply with the new regulations, but "the costs for the cement slurry and concrete slab are cheap compared to the cost of losing a well." Grant estimates the additional costs for a domestic well at approximately $75, while the costs for the concrete block and annulus cement on an irrigation well may run $250.

Landowners who are interested in repairing an old well, or drilling a new well are urged by Grant to make sure that their contractor plans to complete the well according to the new regulations. "First, in the case of repairing a well, I would strongly encourage landowners to see that a temporary plugging device is installed in the well. This is not a part of the new regula-

continued on page 4 . . . REGULATIONS



PRECIPITATION received prior to and during the growing season can affect crop yields as well as water-level declines in the Ogallala aquifer. In the Lubbock area, 67 percent of the average annual precipitation is normally received during the period April through September, which is just prior to and during the growing season.

BROCHURES . . . continued from page 1

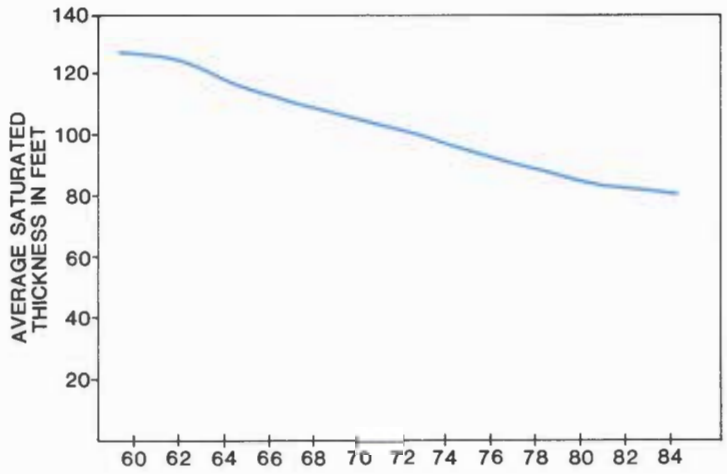
the amount of water which would need to be applied to bring the soil moisture profile to field capacity, and determining how long before the crop will need that next irrigation.

Tensiometers measure the amount of suction a plant root must exert to obtain water from the soil. A plant will permanently wilt and die when the soil dries to a level that it must exert 220 pounds per square inch of suction to obtain water from the soil. The third brochure in our series discusses the basics of soil water suction and the functions of a tensiometer in gauging soil moisture. Tensiometers are recommended for use in sandier soils when growing crops that require high soil moisture levels, such as corn and vegetables. The installation, record keeping, maintenance and taking readings when using tensiometers are also discussed in this brochure entitled, "Tensiometers, A Gauge for Measuring Soil Moisture."

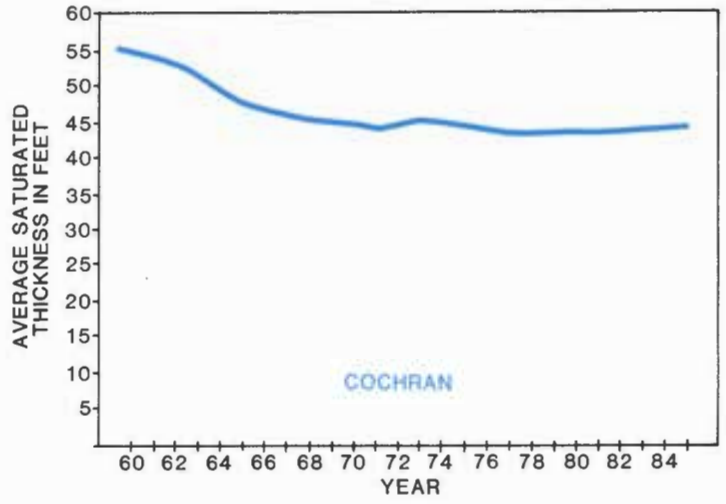
"Neutron Moisture Meters, The Scientific Approach to Monitoring Soil Moisture," rounds out the first four of our Water Management Note series. The neutron moisture meter is one of the most accurate devices available for measuring soil moisture. This brochure is presented to assist the layman in understanding the functions and operation of the neutron moisture meter. While this instrument is not yet commonly used by individual irrigators, understanding this water management tool should be of interest to anyone. Much of the soil moisture information obtained and published by the High Plains Water District and other agencies is obtained using this device.

Each of these first four "Water Management Notes" is available through the local offices of the USDA Soil Conservation Service and the High Plains Underground Water Conservation District No. 1. To obtain copies of any or all of the brochures, call, come by or write the Water District at 2930 Avenue Q in Lubbock, Texas 79405, or phone (806) 762-0181.

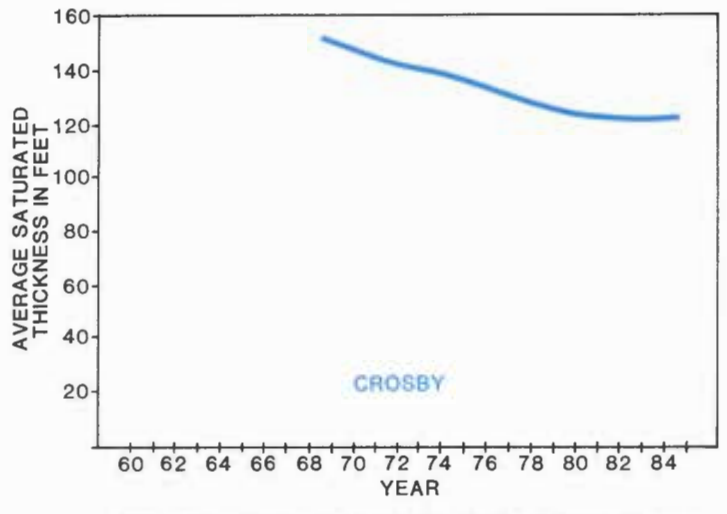
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960–1985 IN THE 5.2 MILLION ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT, SOUTHERN HIGH PLAINS OF TEXAS



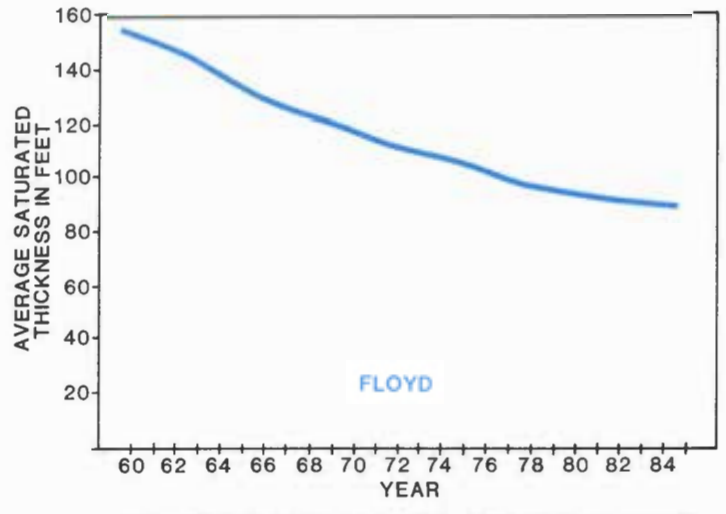
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960–1985 IN THE 202,200 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN COCHRAN COUNTY, TEXAS



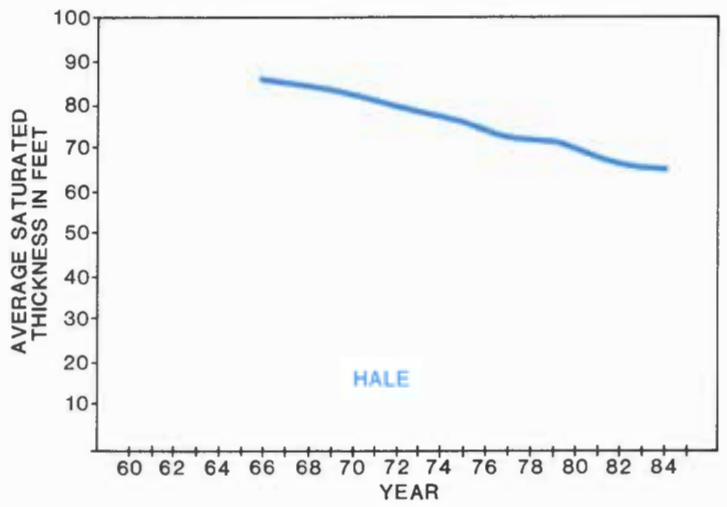
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960–1985 IN THE 90,150 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN CROSBY COUNTY, TEXAS



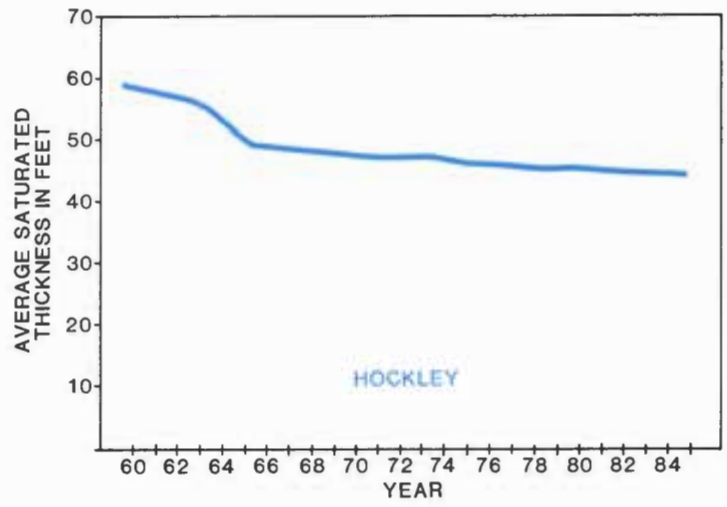
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960–1985 IN THE 577,650 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN FLOYD COUNTY, TEXAS



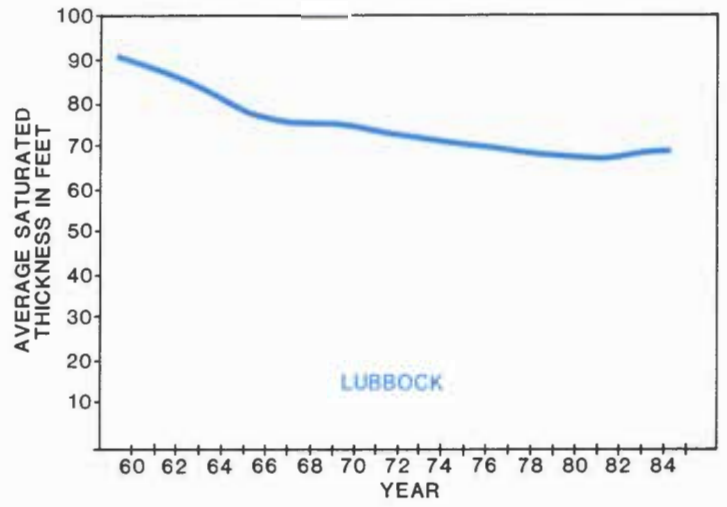
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960–1985 IN THE 146,730 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN HALE COUNTY, TEXAS



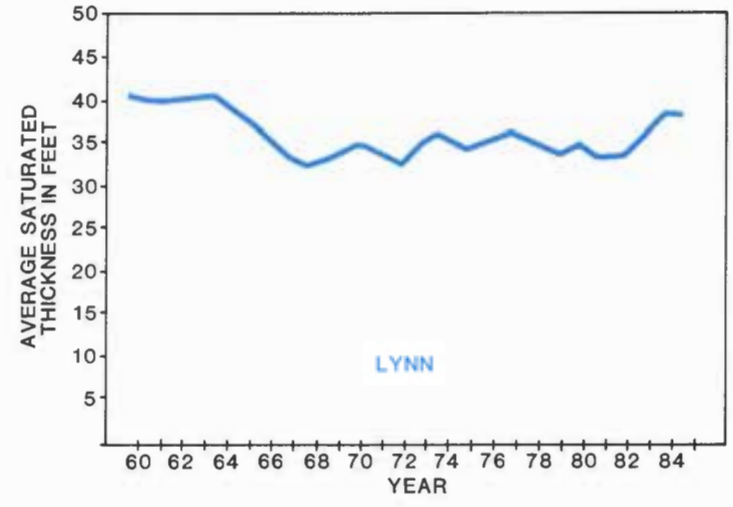
ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960–1985 IN THE 499,706 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN HOCKLEY COUNTY, TEXAS



ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960–1985 IN THE 580,050 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN LUBBOCK COUNTY, TEXAS



ESTIMATED RATE OF DECLINE AND THE DECREASE IN THE AVERAGE SATURATED THICKNESS IN THE OGALLALA AQUIFER, 1960–1985 IN THE 152,150 ACRE SERVICE AREA OF THE HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT IN LYNN COUNTY, TEXAS



PLANTING DATE . . . continued from page 1

Grain sorghum yield then, consists of three components: Grain yield equals the number of heads per acre times the number of seeds per head times the seed weight.

Planting Date

Grain sorghum development is quite responsive to accumulated energy, defined as heat units. The time from seeding to flowering requires about 700 heat units. Planting in early May, it takes about 70 to 75 days to accumulate this amount of heat. Planting in early June requires 60 to 65 days to reach flowering for a medium-late hybrid, but all maturity groups respond similarly.

"More importantly," states Dr. Krieg, "the number of seeds per head increases as the planting date is changed from early May to early June." Dr. Krieg notes, "What we found in our research is that by changing your planting date from early May to early June, we get a 30 percent increase in the number of seeds per head.

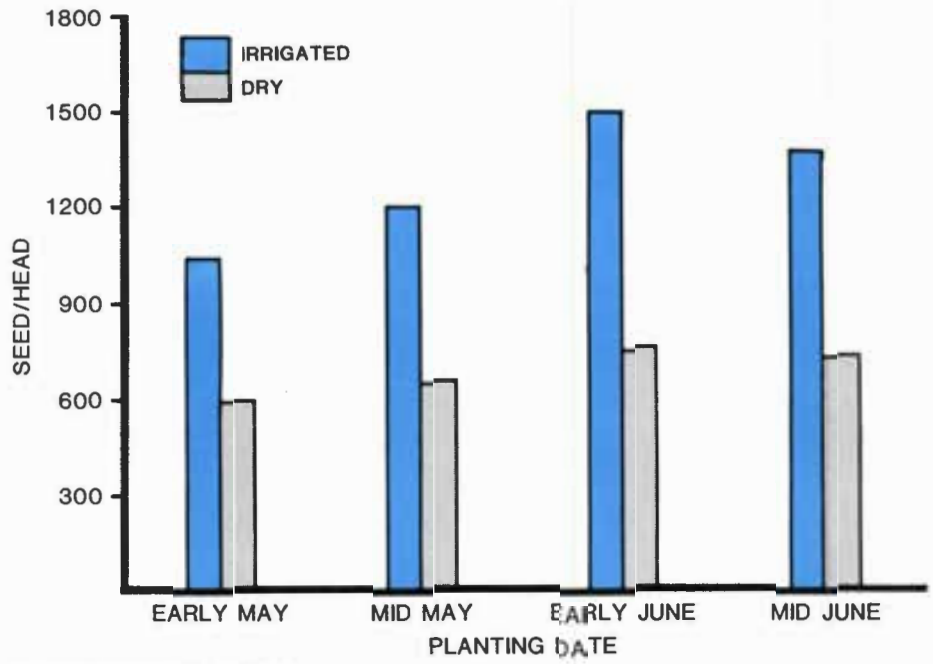
"What we did," explains Dr. Krieg, "is we had less heads per acre, but we had about a 30 percent increase in the number of seeds per head. The critical thing, however, is that the grain sorghum plant produced more seeds per head in less days and it did it with less leaf area. So even if we hadn't gained any yields, we gained water use efficiency because we had less leaf area and less days in our growing season.

"Less leaf area is important, because water use by grain sorghum is a function of leaf area and time (days)," states Dr. Krieg. "Planting in early June has the potential then to reduce total water use prior to flowering to some extent. Even if total water use is not reduced, which we believe it is, the increased yields, associated with the early June planting, result in increased water use efficiency and profitability."

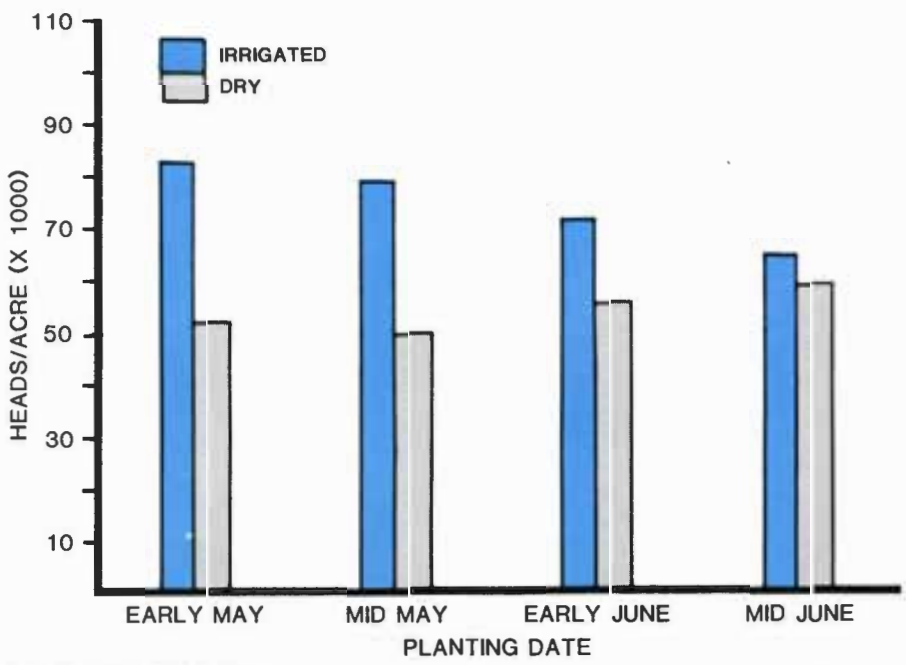
Nitrogen Fertility

Dr. Krieg also notes that nitrogen fertility management can alter productivity and water use efficiency. "If the plant population is 70,000 plants per acre, this means that 230 pounds of nitrogen are in the above ground portion of the plant. For each 1,000 pounds of grain there is 15 pounds of nitrogen. About 40 pounds of the grain nitrogen are in the plant at flowering, which means that 70 pounds must be assimilated after flowering. The total nitrogen requirement to produce 7,000 pounds of grain and 7,000 pounds of forage is about 300 pounds of nitrogen per acre.

"Applications of about one-third to one-half prior to planting, with the remaining requirement applied several times during the second growth period of the grain sorghum plant, results in the greatest yield increases per unit of nitrogen. The major yield response is again an increased seed number per head."



GRAIN SORGHUM YIELDS are primarily affected by the number of seeds per head. This graphic illustrates the increased number of seeds per head which were found in Dr. Krieg's research. Note that the number of seeds per head were increased both under dryland and irrigated conditions.



THE NUMBER OF HEADS per acre is reduced by varying grain sorghum planting dates from early May to early June. But the effects of fewer heads per acre are outweighed by the higher number of seeds per head.

Water Management

"The most critical portion of the plant growth cycle in terms of water management," indicates Dr. Krieg, "is during the second growth stage of the grain sorghum plant. Our research results over the past several years indicate that the sorghum plant needs eight to ten inches of water to produce any harvestable yield. The yield response then increases at a rate of 600 to 700 pounds of grain per inch of water above that threshold level.

"Due to the determinate nature of the sorghum plant, time and water are required to get a plant to the point where it is even capable of yielding. Adjusting the seed rate, and plant density are critical under rainfed conditions. For instance, a yield of 3,000 pounds per acre from a population of 30,000 plants per acre with 15 inches of total water is very possible. A seeding rate of three pounds of seed per acre should easily produce 30-35,000 plants. The water supply will not be exhausted in most soils prior to flowering, and the plants will get through that important second growth stage with the least possible stress. The result will be a higher seed number and greater yield potential than if a higher population had been used."

In summary, Dr. Krieg explains that "yield of grain sorghum is determined largely by the number of seeds per head at a given population. Managing populations based upon water supply is critical; however, minimizing stress during the second growth stage of the sorghum plant is extremely critical to maximize yield and water use efficiency. With proper management of our available resources," notes Dr. Krieg, "we can affect yield and profitability of grain sorghum."

REGULATIONS . . . continued from page 2

tions, but is a very good idea to avoid contamination of the well during the repair period. Second, if a landowner is contracting for a new well," Grant urges landowners, "to ask the contractor how he is going to complete the well and make sure that his plans will meet the legal requirements.

"If a consumer has a well drilled," explains Grant, "and does not feel it is properly completed, he can report the conditions to the Texas Department of Water Resources and/or the Water Well Drillers' Board." Either the Texas Department of Water Resources or the Texas Water Well Drillers Board may be contacted by writing P.O. Box 13087, Capitol Station, Austin, Texas 78711.

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
LUBBOCK, TEXAS 79405

SECOND CLASS PERMIT

THE Cross SECTION

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HOUSE/SENATE COMPROMISE

Gov. White Signs Comprehensive Water Legislation

Governor Mark White on May 23, 1985, signed a comprehensive $1.2 billion state water proposal, thereby sending two constitutional amendments to the voters of the state of Texas for approval on November 5, 1985.

One of the constitutional amendments called for by passage of H.J.R. No. 6, introduced and sponsored in the House by Representative Tom Craddick of Midland and introduced and sponsored in the Senate by Senator John T. Montford of Lubbock, will ask state voters to approve the issuance of $980 million in additional state bonds to be administered through the Water Development Fund by the Texas Water Development Board. Included in this $980 million bond package are:

- $400 million in state bonds to allow for state participation in the acquisition and development of facilities for the storage, transmission, transportation, and treatment of water and wastewater,
- $190 million for water quality projects,
- $200 million for flood control projects, and
- $190 million for water supply projects.

All loans made by the state from these bond funds are to be repaid in full, including interest.

Also included in this constitutional amendment is a $250 million bond guarantee, or bond insurance, program. Through this program the state would pledge its full faith and credit to ensure repayment of loans made under the bond programs.

The second constitutional amendment called for by passage of H.J.R. 6 will seek voter approval of the issuance and sale of $200 million in Texas agricultural water conservation bonds.

Steve Stagner, Legislative Aid for Lt. Governor Bill Hobby, refers to the state-wide water package as "a patchwork of different things. It is basically a patchwork, or a conglomeration, of different things. In actuality, though, that is just what the water problems of the state are, a conglomeration of different problems not all of which are interrelated.

"For instance, the goals of the coastal fisherman and the goals of the High Plains irrigator don't have a lot in common, except that they both fall at the general root of the water problems of the state. Certainly, no single solution will take care of both of these problems.

"Dealing with these problems, while at the same time dealing with the infrastructure financing needs of cities, means that you almost have to fall back on a piece of legislation which calls for a number of multiple initiatives. That is what this legislation does.

"We think it is a pretty balanced package. We have made some strides in a number of areas, and in almost

continued on page 3 . . . GOVERNOR

GOVERNOR WHITE'S SIGNING of the recently passed water bill brought out a very impressive crowd to witness the event. Key participants in passage of this legislation who were on hand to watch the signing include, Representative Tom Craddick of Midland (left front) with his wife, Nadine; Speaker Gib Lewis (directly behind Governor White), Senator John Montford (right rear) with his wife, Debra; and Lt. Governor Bill Hobby (left). (Photo courtesy Tom Milligan, TDWR, Austin, Texas.)

Board Adopts Mine Shaft Rule

The Board of Directors of the High Plains Underground Water Conservation District No. 1 at their regular meeting May 7, 1985, adopted a new rule regarding the "Permitting and Regulation of Drilled or Mined Shafts" within the boundaries of the Water District.

Board President James P. Mitchell explains, "this rule prohibits the construction, whether by drilling or mining techniques, of any new shaft where:

- the depth of the excavation is greater than its diameter,
- the excavation penetrates into or through the base of the fresh-water aquifers, and
- where the primary purpose of the excavation is the transportation of workers and materials to and from a destination, at depth, for the purposes of geologic studies, access to existing and planned subsurface mine workings, safety, or for ventilation of those workings,

unless a permit in compliance with all applicable permitting requirements has been applied for and received from the Board of Directors of the District.

Rule 23 applies to all drilled or mined shafts located within the District which are drilled after June 10, 1985, the effective date of the new rule, or which are modified or converted to a new purpose after that date. This rule does not cover potable ground-water wells.

Texas Senate Resolves Against Nuclear Waste Repository

Texas Senators have officially voiced their concerns regarding the selection of Deaf Smith County as one of the top three potential sites for the disposal of the nation's high-level nuclear waste.

On April 10, 1985, the Texas Senate voted to adopt Senate Concurrent Resolution No. 32 calling for the U. S. Department of Energy to "forego further consideration of both the Deaf Smith County and Swisher County sites, and reject such sites as potential nominees or candidates for a high-level nuclear waste repository."

Noting that both the proposed Deaf Smith County and Swisher County sites lie in close proximity to the Ogallala aquifer, the largest freshwater aquifer in the United States, and the Santa Rosa Aquifer, a locally valuable aquifer, the resolution expresses concern that construction of a shaft such as that proposed by the DOE could create a hydrologic connection between these aquifers and the proposed host salt formation. If such a connection occurred, this would compromise the relative dryness, isolation and other natural advantages on which the theory of nuclear waste disposal in deep underground salt is based.

Additionally, the Senate resolution expresses concern over the "technically and procedurally flawed site selection process," noting that the site-screening studies conducted thus far by the DOE have occurred without benefit of the sighting guidelines mandated by the Nuclear Waste Policy Act of 1982.

Also considered in the Senate's opposition to the proposed repository were concerns for the potential contamination of the underground supplies of fresh water, the value of the overlying farmland which would be taken out of production, the effects of the proposed site on local businesses, and the potential for damage to local communities and the citizens of the area should unforeseen releases of high-level radioactive waste occur during the transportation of waste and operation of the repository.

Citizens of the state of Texas are urged by SCR No. 32 to participate fully in congressional hearings, or deliver their comments to the DOE in writing, which is just what the Senate has done through adoption of this resolution.

Legislature Passes Bill Extending Directors' Terms

Effective with the election of members to the Board of Directors of the High Plains Water District in January, 1986, District Directors will serve four-year terms in office instead of the previous two-year terms.

House Bill 332, introduced and sponsored by Representative Foster Whaley in the House and sponsored by Senator Bill Sarpalius in the Senate, alters the length of the terms of office for District Directors and increases the amount of compensation the Directors may receive for their service.

The measure passed the House of Representatives on March 14, 1985, and the Senate on April 25, 1985. It was then signed into law by Governor Mark White on May 7, 1985. The law becomes effective as of August 26, 1985.

The bill basically states that elections for District Directors are to be held on the third Saturday in January of each even-numbered year and, beginning with the election to be held in January of 1986, that each member of the Board of Directors will serve four-year terms in office.

Prior to this revision, elections were held on the third Saturday in January of each year for the election of District Directors and County Committeemen. Under the old law, in even-numbered years Directors were elected from District Directors' Precincts 1, 2 and 5, and in odd-numbered years representatives to the Board of Directors in Precincts 3 and 4 were elected. The terms in office for Directors were two years.

Additionally, the compensation that District Directors may receive for their service on the Board was revised by HB 332. Heretofore, Directors could receive a maximum of $50 per day for up to four days per month in compensation for time spent away from their own businesses. Per diem for Directors' service under the new provisions allows a maximum payment of $100 per day for no more than five days per month. The Directors may set the per diem at any level below $100 per day for compensation for their services. Directors are compensated for time spent away from their businesses when attending called Directors' meetings and meetings at which they represent the concerns and interests of the citizens who reside in the District.

Board Members representing Director's Precincts 1, 2 and 5, will be the first to be affected by the change. These places on the District's Board are currently filled by James P. Mitchell, representing Director's Precinct No. 1 serving Crosby, Lubbock and Lynn Counties; Mack Hicks, representing Director's Precinct 2, serving Cochran, Hockley and Lamb Counties; and Gilbert Fawver, representing Director's Precinct 5, serving Floyd and Hale Counties.

"The primary purpose of the change in the election law is to reduce the costs to the taxpayers of the District of holding annual elections," states District Manager A. Wayne Wyatt. The Water District's elections are held in accordance with both the Texas Water Code and the Texas Election Code.

THANKS TO Senator Bill Sarpalius (left) and Representative Foster Whaley (right) HB 336 passed through the legislative process almost without a hitch.

S.B. 1144—MAYBE NEXT TIME?

Senator John T. Montford of Lubbock introduced and sponsored a bill in the Texas Senate designed to clarify the law governing the permitting of surface water rights in the state of Texas. The intent of this legislation was to allow that surface waters not being "beneficially used" may be reappropriated under additional water rights permits.

Concern regarding the permitting procedures which are followed by the Texas Water Commission in granting surface water rights' permits arose during litigation, Lower Colorado River Authority et al., vs the Texas Department of Water Resources et al. In deciding this case, the Texas Supreme Court interpreted the term "unappropriated water" to mean the amount of water remaining after taking into account all existing permits and certified filings valued at the level of the permit and not valued at actual reporting or use levels.

This interpretation, along with Texas Water Commission rules which prohibit double permitting of water rights, could have resulted in the prevention of substantial quantities of state water being "beneficially used" and thereby wasted.

A right to use state water under a permit or a certified filing is limited not only to the amount specifically appropriated but also to the amount which is being or can be beneficially used for the purposes specified in the appropriation, and all water not so used is considered not appropriated and is subject to a new appropriation.

Senate Bill 1144 allowed that the Water Commission, in determining whether water can be beneficially used under existing surface water rights or vested water rights, may consider:

- historical use data,
- demographic and other water use projections,
- the expenditures made or obligations incurred by the holders of existing water rights or vested riparian rights,
- the amount of time usually necessary to put water to beneficial use for the authorized purpose when diligently developed, and
- any other matters that the Commission considers relevant to secure the maximum beneficial use of state water without waste.

Senate Bill 1144, with amendments, passed the Senate on May 7, was referred to the Natural Resources Committee in the House on May 14, and did not come out of committee before the session ended.

THE CROSS SECTION (USPS 564-920)

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2930 Avenue Q, Lubbock, Texas 79405

Telephone (806) 762-0181

KATHY REDEKER, Editor

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A. Wayne Wyatt ..... Manager
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Mack Hicks, Vice President ..... Levelland

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Jim Conkwright ..... Hereford

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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.

GOVERNOR . . . continued from page 1
every area this bill incorporates some advancement over current law."

WATER QUALITY, FLOOD CONTROL AND WATER SUPPLY PROJECTS

State Participation in Regional Water Systems

"The $400 million, out of the $980 million bond package, is for regional systems," explains Dr. Herb Grubb, Principal Planner for the Texas Department of Water Resources. "This portion of the financing package basically allows for increased state participation in water development and for creation of larger regional systems. For example, these funds will be available for sewage systems, pipelines and water treatment systems, as well as for reservoir construction."

To explain the state's involvement in regional systems, Dr. Grubb sets up the following example. "Say for example, two or three small cities wanted to build a water supply system, but they couldn't afford to build the system to its optimum capacity right now. However, they anticipate growth and a need for additional water in the future.

"The idea of the legislation is for the state to put up bond money, up-front financing, to pay the cost of developing the project to its maximum potential. This way, rather than having a reservoir or other type of project built at less than optimum size, the full potential of the project is developed. Otherwise, without the input of state funds which allow for the project to be developed to its full potential in the beginning, a part of the potential for the project could be destroyed and not be available for development at a later date."

Stagner indicates that this provision will be applicable to any area of the state where there is a lot of development taking place. "The development of water supplies, water distribution systems, and water treatment facilities for these new developments needs to be handled in a rational way. I think in this bill there is a mechanism for the state to help steer this development in the right direction to make sure that the facilities that are developed are developed on a regional basis. This way you have one well rounded plan instead of a hundred little plans that are impossible to administer and finance."

"Under this type of bonding system," notes Dr. Grubb, "the funds would be totally repaid by the direct beneficiaries of the project. For instance in the example case above, the state would put up bond money to pay the cost of developing the project. Then the local sponsors as they grow and need the additional water resources, would have first option to buy the state's part, thus retiring the state bonds."

Municipal Water Systems

Also included in this legislative package is $190 million for funding of municipal systems for water supply and $190 million for funding of municipal systems for wastewater treatment. There is, however, a hardship criteria which has to be met in order to qualify for loans under these provisions.

In order to qualify and be classified as a hardship case, a city has to demonstrate that it cannot sell its own bonds in the open market at a reasonable rate of interest. This usually applies to smaller cities who either don't have a credit history or haven't been through the rating process.

A relaxation of the hardship criteria is allowed for development of a regional system for wastewater treatment and water supplies under these bonding packages. Again, this could apply where funds are sought for a suburban area where the developer is trying to get several small applications into a larger more efficient regional system.

Additionally, in order for cities to obtain loans under these bonding programs, there is a stipulation that an applicant must have in place or develop a water conservation plan in order to qualify for loans under these programs.

TWO KEYS TO passage of HJR 6 and HB 2 were Senator John T. Montford of Lubbock (left) and Representative Tom Craddick of Midland (right).

Flood Protection

Next, there is a $200 million bond program established for flood protection projects. Funds from this portion of the legislative package may be made available for loans for the development of floodplain management plans and for acquisition or construction of structural and nonstructural flood control projects throughout the state.

Prior to this legislation, there have not been funds available through the Water Development Fund for flood protection projects in the state of Texas. This creates a brand new program and new bond money would be dedicated to this program.

Bond Insurance Program

Additionally, approval of this constitutional amendment by the voters of the state would authorize the creation of a loan guarantee program in the amount of $250 million. There is no hardship criteria involved in this program, so any city wishing to apply for a loan guarantee for its bonds would be eligible to do so.

What this provision really amounts to is comparable to having your father go down and cosign your note at the bank, only the state is in effect the cosigner.

Primarily this would benefit the middle sized city whose credit rating is not as good as the credit rating of the state. It could perhaps allow these cities to borrow money at lower interest rates than they could get on their own. This then lowers the cost of the water supply and/or wastewater treatment facility, which in turn would be passed through to the consumer, lowering his water bill.

There is a $250 million limit as to how much the state would be authorized to pay out, but with the very conservative two to one leveraging authorized in the bill, the Texas Water Development Board could enter into a total of loan guarantees of up to $500 million. This is also a new program for the state.

AGRICULTURAL WATER CONSERVATION FUNDS

The second of the two constitutional amendments which will be sent to the voters on November 5, 1985, as a result of the passage of H.J.R. 6 calls for voters to authorize the issuance and sale of $200 million in Texas agricultural water conservation bonds.

First, the enabling legislation, House Bill 2, provides for the creation of the agricultural trust fund through the transfer of $15 million from the water assistance fund.

One-half of the interest earned on $10 million is put back into the agricultural trust fund. The remaining one-half of the interest is dedicated to be used to create the agricultural soil and water conservation fund. Monies available through this fund (the agricultural soil and water conservation fund) are to be used for technical assistance, research, demonstration, and education projects.

The remaining $5 million is dedicated for use in establishing a pilot program for making loans to state soil and water conservation districts or underground water conservation districts for these agencies to make low-interest loans to irrigators throughout the state for purchase of new water efficient equipment, modification of existing equipment to improve efficiency and associated installation and labor costs.

The funds in the pilot program are only available for use during fiscal years 1986 and 1987. A report to the legislature is required in 1987 on the benefits obtained from the loan of these funds. Following this report, the legislature, by a two-thirds majority vote of both houses, can approve the sale of the $200 million in Texas agricultural water conservation bonds to continue the loan program.

The reason for the report back to the legislature, according to Stagner is "what needs to be tested in the pilot program is whether or not there is interest in the program on the part of the producers and on the part of the soil and water conservation districts and the underground water conservation districts in administering the program."

ADDITIONAL PROVISIONS

Bays and Estuaries

Additionally, the new legislative water package provides for protection of state bays and estuaries as well as instream users. Basically, the enabling legislation establishes that the Texas Water Commission, in considering water rights permits, shall assess the effects of the issuance of the permit on bays and estuaries; and for permits issued within 200 river miles of the coast, the Commission shall include in the permit conditions that are considered necessary to maintain beneficial inflows of affected bays and estuaries.

H.J.R. 6 also establishes that five percent of the annual firm yield of water in any reservoir within 200 river miles of the coast be released to bays and estuary systems and instream users.

Creation of Underground Water Conservation District

Article five of H.J.R. 6 provides for the Texas Department of Water Resources to identify water management areas throughout the state of Texas, as well as designate areas of critical ground-water concerns.

Following identification of a critical ground-water management area, provisions are set forth in this legislation for the Water Commission to call for a hearing and to call an election to allow local residents to vote "for" or "against" the creation of a locally controlled underground water conservation district.

Stagner explains, "In the bill you have a mechanism for the state or the Texas Department of Water Resources to help local people find a solution to their ground water problems. In other words, to help them go through the planning process and lay the ground work for elections calling for the creation of local control districts."

The bill does not, however, provide for any type of state control of ground-water resources if local control districts are not created to take care of local problems.

HOW FAR DOES THE MONEY GO?

The New Texas Water Plan: Water For Texas

"I would say that the funding provided by approval of these constitutional amendments by the voters of the state would supply a portion of the financing needed to carry out the water development and protection objectives outlined in the official state water plan, "Water for Texas, A Comprehensive Plan For The Future," for approximately the next four to eight years," notes Dr. Grubb.

"This will not provide all of the financing needed. You must realize that the total investment in all of these things—reservoirs, sewage treatment plants, water treatment plants, pipelines and water distribution systems—is currently costing almost one billion dollars per year. Now, of course, not every city is going to want to borrow money under these new bonding programs."

"Most importantly," notes Steve Stagner, "this legislation has considerably expanded the state's ability to get involved in helping finance regional solutions to water and wastewater problems. Ultimately, it does not mean much to say the state needs to have a role in water development and protection, if you don't give the state the financial tool to do it with. In this legislation we have not only expanded the existing programs that already existed in terms of the dollar amount dedicated to these programs, but we have also expanded the ways that these funds can be used for water development throughout the state of Texas."

FEDERAL GOVERNMENT PROPOSES TO REGULATE STATE GROUND WATERS

Congress Proposes Amendments To Clean Water Act

Legislation has recently been introduced in both the House of Representatives and the Senate of the 99th U. S. Congress which would revive two previously controversial amendments to the Federal Safe Drinking Water Act. Sections 203 and 204 of the proposed amendments each provide for federal intrusion into the rights of the states to protect and manage their ground-water resources.

Senator Dave Durenberger of Minnesota has introduced S124 in the U. S. Senate, and Representative Edward R. Madigan of Illinois has introduced the companion bill in the House, H.R. 1650.

Section 203

Section 203 of the proposed amendments to the Federal Safe Drinking Water Act, as presented in H.R. 1650, requires that states must submit a plan to the administrator of the U. S. Environmental Protection Agency to protect underground drinking water supplies from contamination "that may adversely affect the health of persons."

Such a plan would be required to include:

- a specification of a lead state agency to be responsible for administering the plan;
- identification of each source of underground drinking water in the state, including quantity, quality, flow patterns, recharge zones and potential sources of contamination;
- descriptions of the location and type of human development which could contaminate the underground drinking water supply as well as those types of activities which would not contaminate the water supplies;
- set up regulations for a "best management plan"; and
- guarantee or provide alternative drinking water supplies when underground sources are contaminated.

Additionally, this section provides for the plan to include protection of the underground drinking water supplies from contamination in the development of oil and gas reserves.

Under the provisions of this legislation, the administrator of the EPA would have final approval of all plans.

The term "underground source of drinking water," under the provisions of these bills, means underground water which:

- supplies drinking water for any public water system,
- is reasonably capable of supplying drinking water for any public water system,
- or may be capable of supplying drinking water for a public water system if such system utilized technologically advanced treatment which has been commercially demonstrated to be economically feasible.

Waters in both the Ogallala and Santa Rosa aquifers in the High Plains of Texas could conceivable fit into this category.

Section 204

This section of the proposed amendments calls for the designation and protection of a ground-water recharge area for a sole or principal source aquifer as a "special protection area." Designation of such an area would be achieved through petition of the Governor of the state, with final approval given by the administrator of the EPA.

A petition for designation of a "special protection area" is to include, among other things, proposed boundaries for the area and an evaluation of whether:

- the proposed special protection area is a recharge zone for significant volumes of ground water with drinking water supply potential, and
- the ground water which is recharged through the proposed special protection area is of high quality.

Upon designation of a "special protection area" for an underground drinking water supply, the amendment would require that a comprehensive management plan be developed and implemented following approval of the management plan by the administrator of the EPA.

Additionally, this section of the bill stipulates that persons who are deemed responsible for the contamination of a sole or principal source aquifer may be required to provide adequate supplies of potable drinking water to persons served by the public water supply system, under penalty of not more than $5,000 per day for violation.

The entire land surface area above the Ogallala aquifer could be designated as the recharge zone for this aquifer and thereby require special protection under this legislation.

Funding

Appropriations are authorized to carry out the provisions of both Section 203 and 204 of the proposed amendments to the Federal Safe Drinking Water Act. There are provisions in the bill authorizing appropriations of $50 million per year for fiscal years 1986 and three years thereafter to carry out the provisions of Section 203. Additionally, $35 million per year is to be appropriated to carry out the provisions of Section 204, with $10 million appropriated to carry out development of management plans and $25 million appropriated to carry out the implementation of those management plans.

Each of these appropriations, as outlined in H.R. 1650, is required to be met on a matching funds basis by the state involved, with the federal government making grants to states for no more than 50 percent of the cost of the project.

Multi-State Water Resources Commission Created

Beginning September 1, 1985, the people of the state of Texas will have a commission whose primary responsibility is to study the water needs of this region of the United States after the year 2000.

House Bill 536, introduced and sponsored by Representative J. W. "Buck" Buchanan of Dumas in the House of Representatives and sponsored by Senator John T. Montford of Lubbock in the Senate, was signed into law on April 16, 1985, by Governor Mark White, thereby creating the Multi-State Water Resources Planning Commission. The Commission is officially charged with initiating and carrying out discussions with representatives of neighboring states, including Mexico, "relating to the identification and development of sources and methods of augmenting water supplies on a regional basis after existing water supplies are fully committed."

The Commission may contact and negotiate with other states to establish interstate compacts, address groundwater problems, needs and supplies if an aquifer underlies several states, and address other related subjects that would be beneficial to the states, including the conservation and beneficial use of water.

Additionally the Commission will, with the assistance of the Texas Department of Water Resources staff, study areas within the state of Texas where the present and future water supplies are insufficient to meet the future requirements of the area. The Commission may request the Texas Department of Water Resources to prepare studies considering utilization of floodwaters that are determined to be in excess of the reasonable foreseeable needs of any area where floodwaters are located.

The commission would, in effect, only make recommendations to the Governor and the Legislature regarding potential sources and methods to solve the water resource problems in areas of the state where water problems exist.

Six members representing different sections of the state as well as various professional backgrounds will make up the commission. Commissioners are to be appointed by the governor with the advice and consent of the senate. Two members shall represent the general public, and other professional backgrounds shall be represented with one from higher education, one from business, one from agriculture and one from an energy-related field.

The legislation creating the Multi-State Water Resources Planning Commission passed through the legislative process with little opposition.

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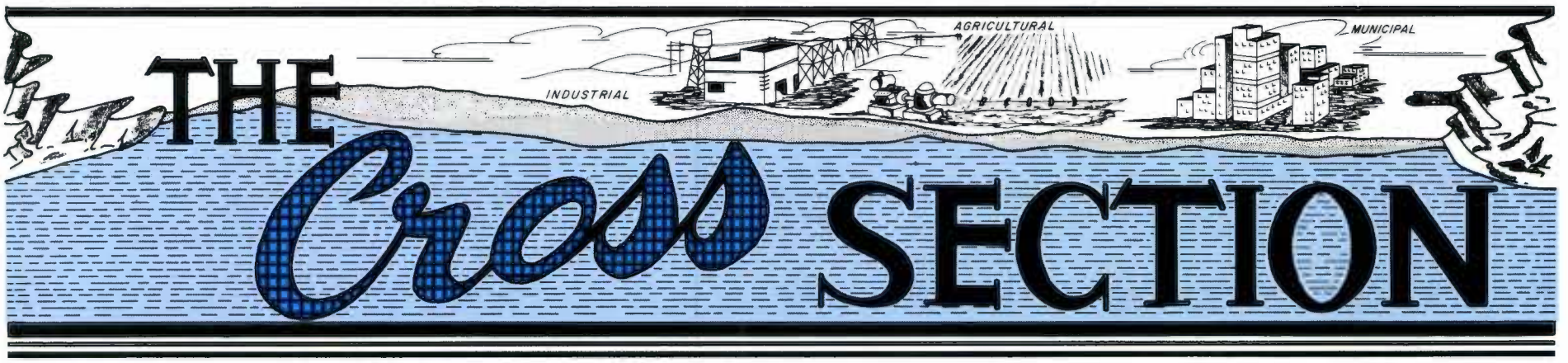

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SECONDARY RECOVERY RESEARCH CONTINUES

Mound Of Water Present Following Air-Injection Test

Continuing research into the theory of injecting air into the unsaturated sands of the Ogallala Formation to induce the release of capillary water has revealed some impressive results, some theories that appear comical on the surface, and an improved economic feasibility for this innovative technique.

Continuing Field Studies

In 1984, the City of Wolfforth joined with the Water District and the Texas Department Of Water Resources to conduct an air-injection test in the city's well fields in the hope that this test would increase the city's current water reserves.

As Mayor Don Bell explains, the test seems to have been successful. "Based on conversations I have had with farmers who have wells around town, they tell me that they had one-third more water to pre-irrigate their beds with this year than they had in previous years. Going by that, I know in my mind that the city has more water. Because the city wells are pumping under restrictions, it is hard to say that they are pumping more water. But I think we've got more water in the aquifer to be used at a later date. In those terms, I believe very definitely that the secondary recovery test has been beneficial to the city by prolonging the life of our water reserves."

Mr. Lloyd Hopper, a local landowner with land located approximately one and three-quarters miles from the test site, explains, "We had two wells where the water level was raised considerably. One well is here at the house, a domestic well, and the other is an irrigation well. I don't remember the actual water-level measurement, but seems to me it was raised several feet. I do know that these wells had been pumping air. I don't know whether they are now pumping any more water than they did before the air-injection test, but they have quit producing air."

The Wofforth test site was located on land owned by the Frenship Co-op Association Gin. Geologic evaluation of this site revealed that there were two separate unsaturated zones which air could be injected into during the test. These two zones were separated by a bed of hard rock, which would serve as a confining layer.

This secondary recovery effort was also approached from a different perspective than previous air-injection tests. In an effort to improve the economic feasibility of secondary recovery of ground water, this test was designed to inject low volumes of air under low injection pressures to release capillary water. Previous laboratory studies indicated that by applying two to three pounds per square inch of air-drive pressure, a 20 percent increase in water yield can be obtained over that available through gravity drainage.

Wolfforth Air-Injection Test One

The first test at this site was designed to inject air under low pressure (eight psi) at low air volumes (approximately 300 cubic feet per minute) into the unsaturated zone above the hard rock layer. During this test, air was injected over a 61-day period.

Several things happened during the first test. First, capillary water was released from the upper unsaturated zone. Prior to the air-injection test, the moisture content of the formation material in this upper section was 17 percent moisture by volume. This indicates a moisture content less than field capacity in the upper section. Field capacity for the type of formation material present in this section would range from 23 to 27 percent by volume.

Following the test, the moisture content of this zone, within 300 feet of the air-injection well, had been reduced to an average of 13 percent moisture content by volume. The air pressure front extended beyond this 300-foot area; however, no before or after soil moisture samples were collected for analysis beyond the 300-foot distance from the air-injection well.

Additionally, the capillary water released from this upper section penetrated the hard rock layer and moved into the lower unsaturated zone. This increased the moisture content of the lower zone. Increased moisture content in the lower zone was evidenced when formation push-core samples were collected and analyzed. The moisture content of these samples reveals that the moisture content by volume in this lower zone was increased from about 28 percent before the test to more than 40 percent after the test. Additionally, when the air-injection well was developed into the sand section below the hard rock layer, the borehole from the top of the rock layer to the bottom of the hole filled with water. This indicates that gravity water was abundant in the sand section below the rock after the first test.

Wolfforth Air-Injection Test Two

During the 36-day second test period when air was injected at low pressures with low air volumes below the hard rock layer, some interesting observations were made. First, the test achieved the release of some of the capillary water which had been made available in the lower sand section as a result of the previous test.

Additionally, researchers encountered a gravel lense in this zone which appears to have "short-circuited" the secondary recovery process in terms of actual observed water-level rises. Air pressure monitors located at the test site indicated that for several hundred feet away from the air-injection well, significant air flow and pressure occurred in the gravel lense. Right above the gravel lense very little formation pressure responses were observed. This indicates that air flow from the air-injection well took the path of least resistance, flowing into and through the gravel lense.

Contrary to initial reactions, this occurrence was not all bad. The researchers were able to document increased yields in irrigation wells during and after the air-injection test within a two-mile radius of the test site.

Researchers have several explanations for this occurrence. One is that during the air-injection test water was pushed through the gravel lense; both the water released from the upper and lower unsaturated zones, plus the water held in the gravel lense itself. Another theory is lovingly referred to

continued on page 2 . . . AIR INJECTION

Rainfall Runoff Furthers Playa Lake Recharge Research

Recent rains around the area have provided the rainfall runoff necessary for researchers at Texas Tech University to continue their investigation into artificially recharging playa lake water through the use of commercially available fabric underdrain materials.

Dr. Bill Claborn, Associate Professor of Civil Engineering at Texas Tech University, and Dr. Lloyd Urban, Assistant Director of the Texas Tech University Water Resources Center and Associate Professor of Civil Engineering, installed fabric underdrain materials in a playa lake located nine miles northwest of Lubbock in early 1984. Prior to the recent rains received in the area, the researchers had received a maximum of only nine inches of runoff water into the playa lake during the previous year.

That runoff was received in June of 1984 and provided a "shake-down" of the design of the field test site and monitoring equipment. The shake-down went pretty well, with approximately 20 percent of the water in the playa following that June, 1984, runoff event, passing through the filtration/metering system and into the recharge well.

At that time, varying flow rates through the filtering materials ranged from insignificant through two lines to over five gallons per minute in four lines.

As of this writing, four rainfall runoff events have occurred where runoff water collected in the lake. Dr. Claborn notes, "The first rainfall event we had this summer provided as much runoff water as we had previously had in the lake."

In this new approach to artificial recharge, the original objectives of the project were:

- to further test the concept of using "wick" filters, geotextiles and available drainage materials to attain water suitable for recharge,
- to test a wide range of filter materials and design configurations in order to determine design parameters, and
- to examine water quality parameters associated with the recharge operation.

Water Quality

"I believe, with this test, we are now in a position to answer the quality questions regarding the water that drains from the lake through the filtering materials," notes Dr. Claborn. "When all the data is in, I think we will have a reasonably good handle on the water quality aspect."

continued on page 3 . . . RECHARGE

CHANGE IN WATER LEVELS 143 DAYS AFTER AIR INJECTION AT THE WOLFFORTH TEST SITE

(Uncorrected For Extensive Area Pumpage)

Scale
0 1 2
(miles)

N

Within the "0" contour line indicated on the map, a mound of water exists following the air-injection test which is estimated to contain 8,677 acre-feet of water that was not present prior to this test. Within the dotted line, an area of 36-square miles, three miles in each direction from the air-injection site, the mound of water contains an estimated 4,463 acre-feet. Researchers have looked at the effects of natural recharge, and irrigation recirculation, as well as the effects of the air-injection test as contributing factors to the presence of this mound of water.

AIR INJECTION . . . continued from page 1

by those very close to the project as the "gas can theory."

The "Gas Can Theory"

Don Rauschuber, P.E., Consultant for the project, explains the "gas can theory" in these terms: "As we moved air beneath the hard rock layer through the gravel lense, we provided a pressure relief valve for area irrigation wells.

"The geologic logs in the general area of this site, as well as delayed responses in the formation to atmospheric barometric pressure changes, indicate that the Ogallala Formation below the hard rock layer is semi-confined. In a confined or semi-confined situation, the air pressure that exists on the surface of water in the well as the well is being pumped and the water level drops, does not immediately equalize with air pressure at the surface. A partial vacuum is created, which may increase pumping levels and/or reduce well yields. So you have a pressure differential, sort of like the pressure you have when you try to pour gas from a gas can into your lawn mower or car without opening the air valve. The gas pours out very slowly, because air is trying to get inside the can to relieve the vacuum.

"Essentially, forcing air through this gravel lense in a secondary recovery test in this semi-confined area provided an air relief valve in the formation, just like the air relief on the gas can. This allowed ground water to flow more freely through the aquifer toward the well."

Wolfforth Air-Injection Test Three

A third test was also performed at the Wolfforth test site. During this 12-day test period high volumes of air at high air-injection pressures were injected into the lower unsaturated zone. A final set of formation core samples were collected following this air-injection phase. Only a small change in moisture was found to have occurred.

Researchers attributed the small change to the fact that the air-injection process was short-circuited by the presence of the gravel lense. Therefore, the lower section was never subjected to an air-pressure front of sufficient pressure to cause the release of large quantities of capillary water. Additional drainage is, however, expected to occur over time as a result of the influence of gravity. In time, it is expected that the moisture content in this section will decline to about 25 percent from the current 43 percent by volume level.

Wolfforth Test Results

One hundred and forty-three days after completion of the air-injection test performed at the City of Wolfforth, a mound of water occurs over an area of approximately 100 square miles with the air-injection well being located near the center of the mound. Within the "zero" contour line on the accompanying map on page 2, the mound of water contains approximately 8,677 acre-feet of water, as compared to that quantity of water present prior to the air-injection test.

This mound of water exists despite pumpage by area irrigators and the City of Wolfforth. The City of Wolfforth pumped 303 acre-feet of water during 1984, and pumpage by irrigators within the immediate 36-square mile area of the test is estimated at 7,152 acre-feet during 1984. This amount of pumpage should have resulted in a water-level decline of about two feet over the entire area had no natural recharge, irrigation recirculation or release of capillary water occurred.

Effects Of Natural Recharge

A review of precipitation data within the area during 1983 and 1984 leads the researchers to believe that some of the mound may have been a result of natural recharge.

In 1983, during the months January through September, the area's rainfall was extremely sparse, amounting to only 8.53 inches. Then in October of 1983, the area received more than 10 inches of precipitation, some of which was collected in area playa basins. Considering the nine-month drought which preceded these large rainfall events, it is unlikely that natural recharge occurred in significant quantities, except within the playa basins.

The playas were dry when the October rainfall events occurred, and they were only filled with sufficient quantities of runoff water to bring the water level up to or slightly above the Randall clays. Randall clays inhibit the movement of water; therefore, if the playas were not filled above these clays, it is unlikely that a significant amount of natural recharge occurred.

The total rainfall for 1984 was 14.62 inches, which is approximately 78 percent of the 18.57 inch norm for the area. This below average rainfall, plus the fact that no large rainfall events occurred in 1984, indicates to the researchers that little or no natural recharge could have occurred in 1984 as a result of precipitation.

Irrigation Recirculation

Records of fuel use by irrigation wells and well yield tests during 1983 and 1984 for select farms in the study area indicate that the amount of irrigation water applied, plus the precipitation received prior to and during the growing season, did not equal the crop water demands in inches. Therefore, little, if any, irrigation recirculation could have occurred to contribute to the mound of water.

In December of 1983 and January of 1984, the regional soil moisture survey was conducted. In the Wolfforth area a soil moisture deficit of four inches was noted. Part of this deficit was a result of heavy vegetative growth, which occurred after the large rainfall events in October and before the first freeze experienced in the area in 1983.

Air Injection

The researchers offer the following explanation as to why such a large area experienced increased water levels after the air-injection test. Large quantities of air were injected into a gravel lense during the second and third tests. This resulted in the distribution of air and the air pressure front throughout a substantial area, consequently releasing capillary water over a large area.

Because the gravel lense occurred only a few feet above the existing water level, the researchers do not know what to expect as far as future drainage in that area below the gravel lense is concerned. However, the researchers will continue to monitor the water level within the test area. In the area of the city, where water was released from above the rock and drained into the area below the rock filling it to a level above field capacity, the researchers expect drainage to continue for a long period of time.

Water Quality Evaluation

During the Wolfforth air-injection test, researchers also evaluated the effects of the air-injection process on the quality of water within the city's wells. Through cooperative arrangements with the Texas Department of Health, sixteen water quality constituents were evaluated on a pre and post test comparison basis.

There were no significant changes in the area of ground-water quality as a result of the air-injection test. An analysis of the data indicates that five of the sixteen constituents had slightly higher values (indicating lower water quality) after the test than before the test. The remaining eleven constituents all reflected slightly higher water quality than pre-test conditions; however, all post-test values were well within acceptable limits.

Land Subsidence

It has been theorized by project observers throughout the secondary recovery research effort that as capillary water is removed from the clays and/or sands in the formation, possible structural changes could result from air injection, such as the collapsing of the pore spaces, thereby causing land subsidence. Consequently, during and after the Wolfforth and Idalou tests, elevation data were collected to determine if subsidence occurred.

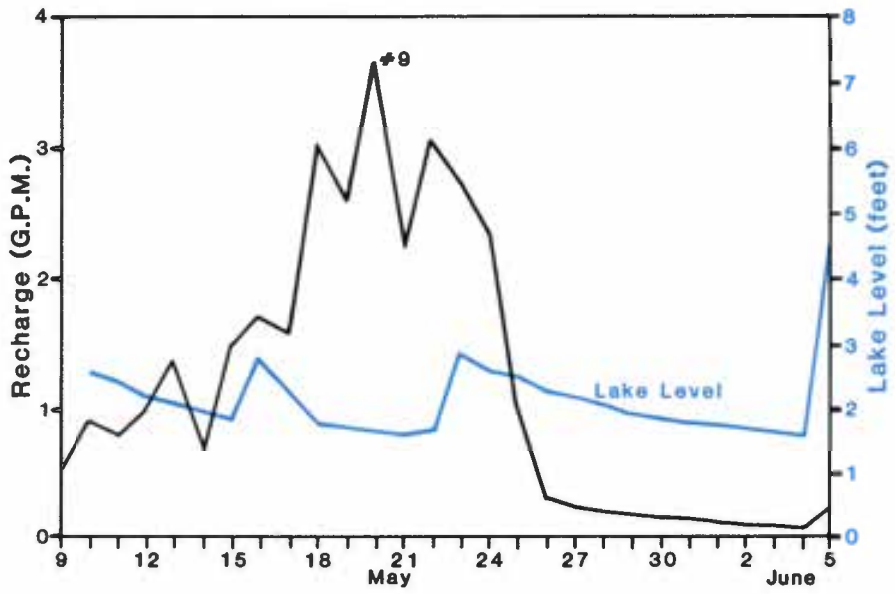
Based on the land surface elevation study, as of May 8, 1985, no subsidence has occurred as a result of secondary recovery tests at either the Idalou or Wolfforth sites.

Additional Objectives

As a part of the continued research into secondary recovery of ground water, projects directed at both mathematical and physical modeling of the theory and concepts of secondary recovery are progressing.

With respect to the mathematical modeling effort being conducted by Bill J. Claborn, PhD, Water Resources

continued on page 4 . . . AIR INJECTION



PERFORATED PVC pipe wrapped in Polyfilter-X material is identified as filter line number nine at the playa lake recharge site. This filter seems to have proven itself as one of the promising candidates for further investigation by exhibiting flow rates up to 3.65 gallons per minute during recent field investigations. Researchers note, however, that this material exhibits the same characteristics as many of the other types. Most filters respond to increases in the lake level with higher recharge rates, then trail off with time.

RECHARGE . . . continued from page 1

Dr. Urban notes that after about a week and a half they had collected approximately 500 water samples from the filter installations right after the initial rains. "The only data from lab studies that I have seen so far is the total dissolved solids. Values for this parameter have correlated very closely with the amount of runoff. In other words, in the initial runoff stages, the water from the filter lines is very low in dissolved solids. Then, as the lake level drops, the total dissolved solids seem to increase, which is to be expected. The apparent total suspended solids, on the other hand, seem to be a function of turbidity in the lake—high immediately after runoff occurs, then dropping or improving with time."

Last year the researchers did notice a growth of slime, in some of the lines leading to the recharge well. Dr. Urban notes, "Prior to this last big rain, there were a few filters that were again showing a kind of black deposit forming on the pan where flow is collected before discharging into the well. This would lead us to believe that there may be a similar problem occurring again. But with this last big rain and the increased flow, it flushed all of that out and the lines cleared up again. So we may be looking at some biological activity forming back in the lines between the filter and the well when little or no water is flowing through the lines.

Filter Performance

The theory of this particular recharge project employs the use of "wick" filters, geotextiles and other available drainage materials which are buried in shallow, sand-filled trenches in the lake bottom then covered with a thin layer of the natural clay. The purpose of the clay cover is to serve as a natural filter to prevent clogging of the fabric filters. In the laboratory this design exhibited an ability to provide high quality recharge water over a sustained period of time.

Dr. Claborn explains, "I think we are seeing the same type of occurrence that has historically been the deterent to artificial recharge projects. We are seeing a lot of sediment settling onto the lake bottom that is impeding the flow of the water down to the filter materials.

"This then brings up the questions as to what do we do about it? Of course, with each runoff event we are depositing more silt in the lake bottom. What then will be the long-term effects? At least it is on the surface where there is a lot more surface area to spread the silt over, and where we can do something about it."

Following the rainfall runoff event of June, 1984, the researchers were getting good recharge rates from several of the lines without having any quality concerns other than the slime growth in a couple of the lines. Since that time, the lake has dried. Researchers noted some fantastic weed growth at the site after the June rain last year.

"We had a 60-plus day growing season out there last year before we had a chance to get in and mow the weeds. I think the weed roots penetrated into the bottom of the lake and possibly into the filter materials," notes Dr. Claborn. "After we knocked them down and we didn't get any fall rains, the roots died and decayed. So when the rains came this summer, I think one of the things that we saw was water bypassing the clay and going directly into the filters through these root channels.

"After the first rain, when we turned some of the filters on, the water was really murky. Just like the lake water. Fortunately, the water coming through the filters cleared up in about 12 to 24 hours.

"Given this occurrence, the first thing you would say is that the water has to settle out in the lake for a while before you begin filtration and recharge. But that's not right. If you take a sample of the lake water in a beaker and set it in your office for a week or so, it doesn't settle out that rapidly. So, I believe it is something besides just settling time in the lake. At this point though, we don't know whether the water actually has to pass through the filter or whether there has to be some sort of settling out of the lake itself.

"The interesting thing is that every time we have had runoff, without the lake drying in between each event, we have had the same phenomenon occurring. We get initial water through the recharge lines that is very murky. But they do clear up and I can't explain that," notes Dr. Claborn.

"Additionally, we are seeing a general decline in flow rates in virtually all of the filters. Initially, they come in with some good flow rates, then they all begin to trail off. One obvious explanation for this occurrence is that the water level in the lake is going down. So, we've got less force, less effective head, to push the water through the filters. That would also explain why when the lake level comes back up, we get an increased rate of flow in the filter lines. However, even though the flow rates come back up when additional water comes into the lake, they don't come back to what they had been previously."

Physical Inspection

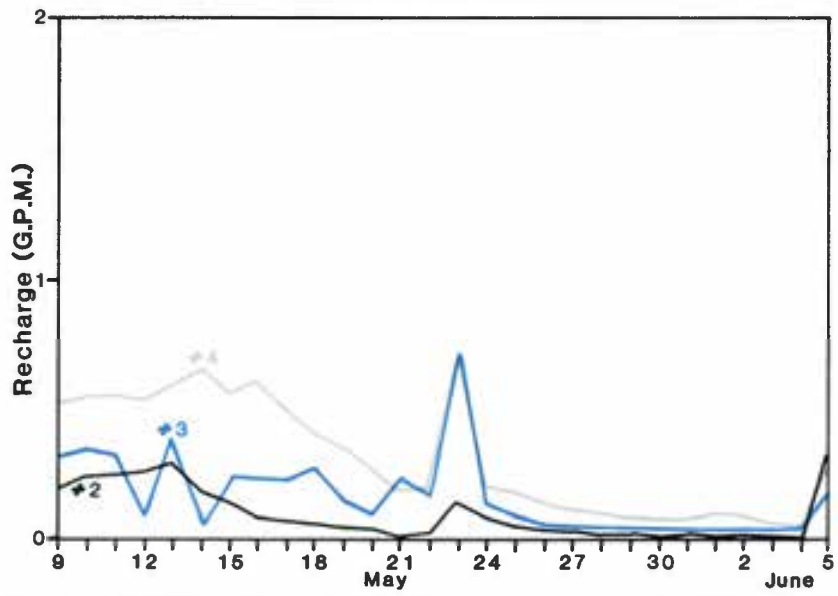
To answer some of these questions, the researchers have plans to dig up some of the filter lines as soon as the lake dries. "We want to get some type of explanation through this physical inspection to see if we can determine why the water becomes turbid right after the rains, in the initial filtering times." One thing they will be looking for is those root holes they think are present.

The researchers also want to watch the surface of the lake bottom between now and the next rainfall runoff event to see what happens to it. Does it crack all the way down to the filters? What about root decay this winter?

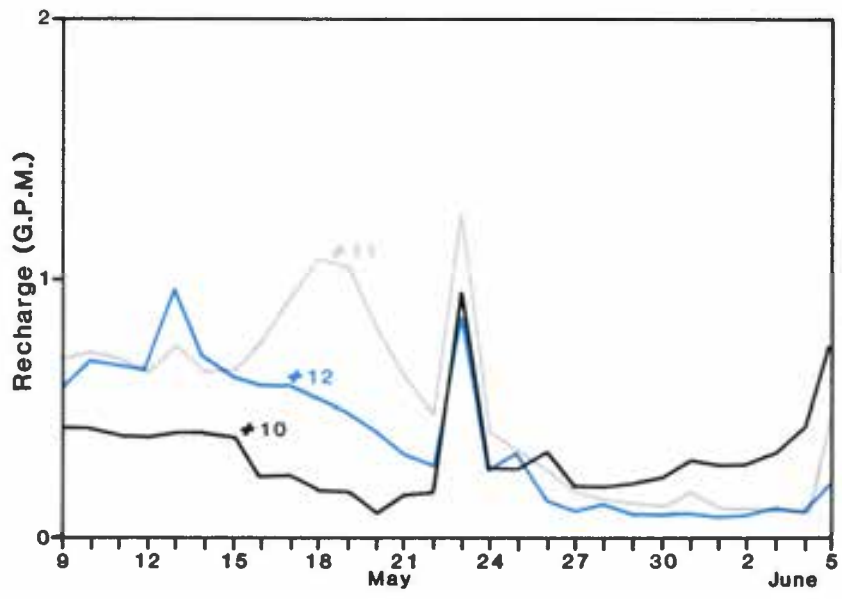
Dr. Claborn notes, "Again, our objective with this project was not actually recharge of large quantities of water. But we wanted to gather information on which of the filters works best, and what their performance is over time, as well as develop some design criteria. We need to know which of the design configurations works the best, long lines, short lines, square pads?

"I'm optimistic. I believe that we are working with something that will evolve. We're just not there yet. The goals that were set at the beginning of the project are still the goals today. We want to have something that provides water with an acceptable quality, at an acceptable rate, with little or no maintenance. I don't think we can yet say that we have the quantity of water that we want at the consistency we want."

As Claborn says, "We waited eleven months for it to rain, now we're praying for it to stop raining."



HITEK FILTER material was also evaluated in a design parameter test involving the length of filter materials. Filter lines 2, 3 and 4 varying in length with number 2 running 60 feet, number 3 running 100 feet, and number 4 extending for a distance of 40 feet. Note that the shorter filter length (number 4) outperformed the longer lengths, however, all flow rates trailed off with time.



FILTER LINES 10, 11 and 12 are all Hitek Filter material that has been installed under varying design parameters, ranging from 9 inches down to 3 inches of natural clay material having been placed over the filter beds. It is interesting to note that filter number 11, which has 6 inches of clay cover, outperformed the other two.

AIR INJECTION . . . continued from page 2
Center, Texas Tech University, Lubbock, Texas, a model has been developed to simulate the secondary recovery process at the Idalou, Slaton and Wolfforth test sites. However, the model is too large to operate on mainframe computers available to the project team. As of this writing, time on a "super computer" has been requested to verify the model.

The concept of a true physical model of secondary recovery in the Ogallala Formation was considered by Donald Reddell, PhD, Texas A&M University, College Station; however, abandoned due to difficulties involved in scaling. It is extremely difficult, if not impossible, to scale down water. Therefore, in lieu of a true physical model, construction of a sand-tank model was initiated. Once completed, this model will be capable of simulating a secondary recovery test in a confined or unconfined aquifer. Measurements of the changes in permeability as the model is dewatered, as well as other parameters, will be available from this sand-tank model.

The wedge-shaped sand tank, which is being constructed by Dr. Reddell, measures 24 feet in length by 12 feet in height, with a circumference of eight feet. Its potential, first of all, is to simulate field responses to air injection. Secondly, data developed from the physical model can be used to test the mathematical model.

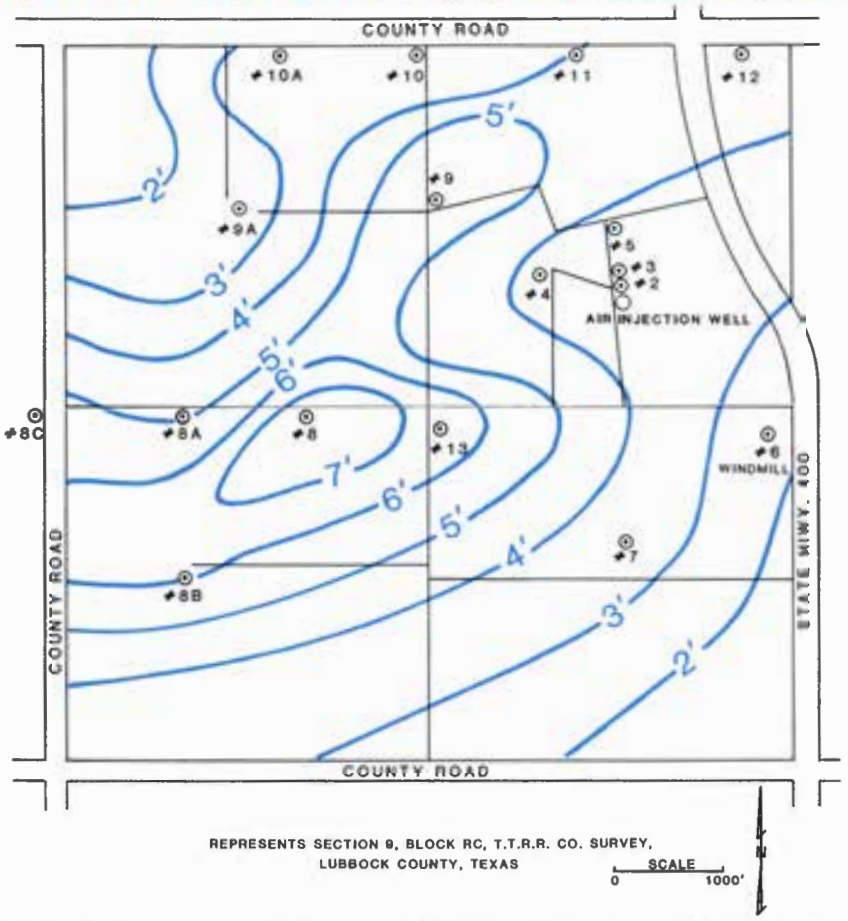
Idalou Updated Test Results

Updated information from the Idalou secondary recovery project, approximately 1,000 days after the air-injection test ended, reveals that an estimated 787 acre-feet of water were made available within a one-square mile control section as a result of that air-injection test. Based on 787 acre-feet of additional water being made available for pumpage by area wells, the cost for the release of capillary water would be about $24.00 per acre-foot within the control section.

Researchers documented, however, that the secondary recovery test at this location affected an even broader area than the 640-acre control section. Adding the mound of water outside the 640-acre control area, researchers estimate that a total of 1,100 acre-feet of water was made available for pumpage as a result of this test.

Water drainage at the Idalou test site has continued for almost three years following the air-injection test. This additional water reduces the per acre-foot cost of released water from $50 as originally reported, to about $17. The above estimates do not consider the cost of lifting water to land surface.

CHANGE IN WATER LEVELS 1,000 DAYS AFTER AIR INJECTION ENDED AT THE IDALOU TEST SITE
(Water Level Rises Remain Through Three Seasons of Irrigation)



Within the 640-acre control section at the Idalou air-injection test site, water level rises ranging from two to more than seven feet have been documented as a result of the air-injection test performed at this location. These water level rises exist despite three seasons of irrigation pumpage in the area. It is estimated that 1,000 days following completion of the air-injection test, there is a mound of water containing 787 acre-feet of water within the control section, and 1,100 acre-feet taking into consideration the mound of water which exists outside the control area.

Research Results To Date

To date, the principal researchers involved in the secondary recovery project believe that several conclusions can be drawn from field programs and laboratory testing, as well as physical and mathematical modeling efforts. Among these are the following conclusions.

- Secondary recovery of capillary water can be accomplished.
- There is an estimated potential of 1.46 billion acre-feet of capillary water underlying the High Plains of Texas.
- Injection of compressed air is the most economical and successful mechanism for secondary recovery.
- Twenty-five to thirty percent of the capillary water in storage can be released under induced pressures of less than eight pounds per square inch at the injection point.
- Regional secondary recovery field programs can be constructed to recover capillary water.
- At this time, secondary recovery of ground water is economically feasible for municipal/industrial purposes and marginally feasible for agricultural purposes based on current commodity prices.
- Secondary recovery is successful even in formational material that has a moisture content less than field capacity.
- Post capillary water drainage occurs for months/years after short-term injection periods.

This final observation comes as no surprise to District Manager A. Wayne Wyatt. "A review of monthly water-level measurements made back in the 1940's following abnormally heavy rainfall events in 1941 reveals that water levels in area wells continued to rise for five years after these heavy rains were experienced.

"Comparing the drainage that results from secondary recovery tests with the drainage that occurred as a result of this natural recharge, it has not been a surprise to us that drainage has continued over long periods of time after secondary recovery operations have been completed."

Ronald Schilling, owner of the land where the Slaton air-injection test was conducted, and Clifford Hilbers, owner of the test site in Idalou, both boiled down the benefits of secondary recovery to very meaningful personal terms.

Hilbers relates, "I think that the secondary recovery test helped me some. My irrigation wells seem to hold their own now, instead of dropping off in yield. I can't see that it did anything but help me a little. In fact, if I had another place where they wanted to make a test, I'd just tell them to get after it."

Schilling states, "I shut off my irrigation wells the year they performed the test because my water levels had fallen off so much. But the big thing about secondary recovery as far as I am concerned is that I don't think we will ever be out of domestic water thanks to this new technology. Before the test we were concerned about running out of domestic water for our home. Since the test I feel like I'll never run out of water for the house."

The estimated quantity of gravity water in storage in the Texas portion of the Ogallala aquifer as of 1980 is about 375 million acre-feet, according to the U. S. Geological Survey. The current volume of capillary water estimated to be in storage in the unsaturated zone equals 840 million acre-feet. This estimate increases by 625 million acre-feet of capillary water which will be held in storage when the Ogallala is ultimately depleted of all gravity water. The total of the two, 1.46 billion acre-feet, indicates that almost four times as much water will remain in storage in the unsaturated portion of the Ogallala aquifer than is presently considered recoverable by gravity flow into wells. Secondary recovery could potentially double the life of the current ground-water supplies available to the area.

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TEXAS DEPARTMENT OF WATER RESOURCES

Legislature Dissolves TDWR

A Senate bill eliminating the Texas Department of Water Resources has been signed by Governor Mark White and will become effective on September 1, 1985. The bill originated in the Senate and narrowly passed the House on a 68 to 65 vote. The new law profoundly alters organization of the state's water agencies that are charged with managing and financing water development and with protecting water quality. It returns the state water agencies' organizational structures to a form similar to that in effect before the current structure was adopted in 1977.

The new law establishes the Texas Water Commission as one of the most powerful bodies in state government. The Commission will establish the policies for water development and water pollution control. It will implement these policies by granting or withholding permits. It will employ enforcement personnel to determine if its directives are being carried out to the Commission's satisfaction. If the Commission decides that its orders are not being observed, it may levy substantial administrative fines.

In 1977, two independent state water agencies, the Texas Water Quality Board, and the Texas Water Rights Commission were dissolved. At the same time, the Texas Water Development Board (Board) was continued, and a sub-agency was created and placed under the jurisdiction of the Water Development Board. This agency was the Texas Department of Water Resources. Additionally, the Texas Water Commission (Commission) was created. The Commission's principal functions were to grant water permits and to protect water quality through control of wastewater discharge permits. The staffs of the three former agencies, with the exception of hearing examiners for the Water Rights Commission, were combined into the newly formed Texas Department of Water Resources (Department).

The theory of the 1977 reorganization was to create a separation of powers and a system of checks and balances. The Board was assigned a policy making role and control over finances. The Commission was to be a quasi-judicial body exercising final authority over water and wastewater permits, subject only to overruling by a court. The Department had the executive or administrative role, providing staff support to both the Board and Commission. The director of the Department was made a party to all water and wastewater permit actions and had the responsibility to represent the state's interests. The director was appointed by the Board and imple-

continued on page 2 . . . TDWR

REORGANIZATION of the state's water agencies has brought some new faces to the forefront of state water business. Assuming the role of Executive Director for the Texas Water Commission is Larry Soward (left). Soward previously served as Chief Hearings Examiner and General Counsel for the Commission. Currently, Charlie Nemir (right), serves as Executive Director for the TDWR. Under the reorganization, Nemir will serve as Executive Administrator for the Texas Water Development Board.

PASSAGE OF S.B. 249 makes the Texas Water Commission the lead water agency for the state of Texas. Pictured above are (from left to right) Commissioner Ralph Roming; Mary Ann Hefner, Chief Clerk of the Commission; Chairman Paul Hopkins; new Executive Director of the Texas Water Commission, Larry Soward; and Commissioner Lee Biggart during one of the Commission's regular meetings.

Water Commission, Development Board Name Agency Heads

The three member Texas Water Commission comprised of Chairman Paul Hopkins of La Marque, Lee B. M. Biggart of Austin, and Ralph Roming of Bovina, have appointed Larry R. Soward as the Executive Director of the Commission effective September 1.

Soward is currently the Chief Hearings Examiner and General Counsel of the Commission, a position he has held since January 1, 1983. Soward joined the Texas Water Quality Board in Austin in 1975 as a Hearings Examiner and, after the merger of the three water agencies in September of 1977, he served as an Assistant Chief Hearings Examiner for the Commission dealing with water quality matters.

Additionally, Allen P. Beinke, Jr., has been named Deputy Executive Director of the Texas Water Commission, also effective September 1. Beinke is currently General Counsel and Senior Analyst with the Texas Sunset Advisory Commission which he joined in 1982.

On July 11, 1985, the Commissioners also named James K. Rourke, Jr., as Chief Hearings Examiner and General Counsel to the Commission replacing Soward. Rourke currently serves as Assistant Chief Hearings Examiner for the Commission. The Commissioners also reaffirmed that Mary Ann Hefner will continue as Chief Clerk of the Commission. Both of these appointments are also effective September 1.

In recent action by the Texas Water Development Board, Charles E. Nemir was appointed Executive Administrator of the Board effective September 1, 1985. The appointment was made by the six-member citizen's Texas Water Development Board following their regular monthly meeting. Nemir has been serving as the Executive Director of the Texas Department of Water Resources since December, 1982. That agency will go out of existence on August 31, 1985, as a result of the reorganization of the state's water agencies in the last session of the legislature.

The Water Development Board will administer the Water Development Fund, long-range statewide water planning, the federal construction grants funding program for municipal wastewater treatment facilities, and other functions.

Herb Grubb, currently Principal Planner for the Department, has been appointed by the Water Development Board to serve that agency as Director of Planning. Grubb has been with the state water agency since March, 1976, a position he assumed after serving as Director of Economics Analysis in the Governor's office.

The Water Development Board is chaired by Louis A. Beecherl, Jr., of Dallas. George W. McCleskey of Lubbock, serves the Board as Vice-Chairman, and other members include Glen E. Roney of McAllen, Lonnie A. "Bo" Pilgrim of Pittsburg, Louie Welch of Houston, and Stuart S. Coleman of Brownwood.

Producers Try Direct Marketing

Opening amid a good crowd of consumers with healthy appetites for farm fresh fruits and vegetables and encouraged by the high enthusiasm of area producers, the High Plains Farmers' Market got off to a great start opening day, Saturday, July 13, 1985.

Thirty-one members of the High Plains Farmers' Market Association began selling their wares from pickup beds, tables, and trailers at 8:00 a.m. opening day and will continued to do so every Tuesday, Thursday and Saturday from now until the end of the fresh fruit and vegetable growing season.

Among the varied selection of fresh, vine-ripened produce available on this opening day at the Farmers' Market were boxes, bags and truck beds full of sweet corn, both yellow and zucchini squash, some of the best watermelon ever sliced into, mouthwatering cantaloupe, and peaches juicy and tasty enough to lure children away from candy.

Additionally available were green beans, okra, pickles, farm fresh dill, green peppers and a selection of some of Texas' best jalapeno peppers, not to mention unbelieveably tasty vine-ripened tomatoes.

Producers anticipate that as the market progresses, the selection of fresh produce available at very competitive prices will increase as more of the area's fruits and vegetables ripen on the vines and trees and are harvested and brought to the market.

In ribbon-cutting ceremonies, Commissioner of Agriculture Jim Hightower, whose agency assisted in organization of the farmers' market, said, "The new High Plains Farmers' Market is a diamond in the rough that should become a shining example of the potential of new direct sales by farmers and ranchers on the Texas High Plains and Panhandle. When farmers' markets succeed, everyone benefits—farmers, consumers and local communities."

Slicing into a home grown Texas watermelon, Hightower referred to the recent pesticide-tainted watermelon episode in California, noting, "In the first place, you shouldn't be buying California watermelons. The only way you can get hurt by a Texas melon is if you get hit with a seed someone spits in the wrong direction."

OPENING CEREMONIES at the High Plains Farmers' Market gave Commissioner of Agriculture, Jim Hightower, just the opportunity he had been looking for. Hightower just couldn't resist taking a big bite of one of the home-grown watermelons offered by local producers at the farmers' market ribbon cutting ceremonies July 13, 1985.

Producers within a 150-mile radius of Lubbock are eligible to become members of the High Plains Farmers' Market Association. For membership information and application forms, interested producers should contact E. M. "Jimmy" Collins, Secretary-Treasurer, High Plains Farmers' Market Association, P. O. Box 123, Petersburg, Texas 79250.

Consumers interested in purchasing some of the highest quality produce available throughout the area should visit the West Texas Industries warehouse, donated as an outlet for the market by father-and-son team Harris and David Underwood. Open each Tuesday, Thursday and Saturday from 8:00 a.m. until all the produce is gone, the market is located at 24th and Avenue E in Lubbock.

EL PASO, TEXAS

Wastewater Treatment Pioneer

Approximately 60 percent of the water used in and around the home during a day's time is discharged as waste. This wastewater leaves the home, enters the city's wastewater treatment system, and is never thought of again by most of us. City planners throughout the state of Texas are constantly seeking solutions to wastewater treatment problems and water supply concerns.

Thanks to innovative thinking by the engineering firm of Parkhill, Smith and Cooper, Inc., of Lubbock, Texas, cities throughout the state and the rest of the nation may one day look to the city of El Paso, Texas, as having pioneered the solution to at least a part of these water supply and wastewater treatment concerns.

Parkhill, Smith and Cooper, Inc., Engineers, Architects and Planners, has recently designed and placed into operation a full-scale wastewater treatment plant that is specifically designed to treat raw sewage effluent and bring the quality of the treated water back up to drinking water standards. The system includes the recharge of the treated water into the ground-water aquifer for future use.

In a ten-step treatment process, wastewater is treated, filtered and disinfected. The treatment process is reported to remove virtually all of the organic pollutants, solid particles, heavy metals, and nitrogen from the wastewater.

After the ten-step treatment process, the water is recharged into the Hueco Bolson aquifer through a series of ten 350-foot deep injection wells. According to city officials, the treated water will travel through the aquifer for approximately two years before it reaches the fresh water supply point for reuse.

The Hueco Bolson aquifer is the source of two-thirds of the fresh water used by the City of El Paso, and the aquifer is projected to be 97 percent depleted by the year 2040 at currently

continued on page 4 . . . PIONEER

TEXAS WATER DEVELOPMENT BOARD members (from left to right) Lonnie A. "Bo" Pilgrim; Stuart S. Coleman; newly named Executive Administrator, Charlie Nemir; Chairman, Louis A. Beecherl; Vice-Chairman, George W. McCleskey; Louie Welch; and Glen Roney will continue to administer the state's water development funds, the construction grants program and state water development planning under the reorganization called for in S.B. 249.

TDWR . . . continued from page 1

mented the policies and rules established by the Board. The director was also responsible for enforcing the permits granted by the Commission.

In accordance with Sunset procedures, the Sunset Advisory Commission and its staff conducted a comprehensive review of the Texas water agencies during 1985. Public views as to the agencies' performances were obtained through a hearing process. Some testimony expressed dissatisfaction with actions taken by the agencies with respect to waste discharge permit violations, while others held that the present agencies were basically sound and were performing their missions satisfactorily.

At the conclusion of its review, the Sunset Advisory Commission staff prepared a bill which would have made some changes in the organizational makeup. These changes included the transfer of certain enforcement personnel from jurisdiction of the Department to that of the Commission, transfer of rate supervision for private water companies from the Public Utilities Commission to the Texas Water Commission, and appointment of a deputy director of the Department who would answer directly to the Commission. These proposals were filed as companion bills S. 249 and H.B. 474.

A substitute bill was introduced by the Senate Natural Resources Committee. The substitute bill, C.S.S.B. 249, made the Commission the governing body of the water agencies rather than the Board. It eliminated the Department and assigned the Board a diminished role of managing the water development fund, administering the construction grant program and undertaking planning of state water development. The Commission was given primary responsibility for administering state water law and for regulatory policy and enforcement. The Commission is to continue to grant all water and wastewater discharge permits. It will oversee the river authorities and water districts. Jurisdiction over retail water and sewer rates will be transferred from the Public Utilities Commission to the Water Commission, which already has jurisdiction over wholesale rates between cities and water agencies. Hazardous waste disposal control will also be transferred to the Commission from the Department of Health.

Evidence of public witnesses at the Senate hearing was confined to two specific instances of alleged departmental shortcomings: a report of dissatisfaction with water rates charged by a private water company and allegations of unsatisfactory sewage treatment. However, it was quickly apparent that there was substantial support in the Senate Natural Resources Committee for a radical overhaul of the Department of Water Resources. More than 100 amendments were offered by members to C.S.S.B. 249, and most were accepted. The Senate substitute bill was passed out of the Committee and passed by the Senate. The bill was later passed by the House of Representatives.

Under the new bill, the concept of separation of powers and the provision of checks and balances appears to have been discarded. The Commission will establish the rules and regulations for water and wastewater matters. It will grant water and wastewater permits subject to its own rules. It will enforce its own orders and will have authority to assess administrative fines up to $10,000 for violations of its orders on water pollution and hazardous waste disposal control.

The Governor appoints Commission members for six-year terms, and the law requires only: that they be from different parts of the state; that the appointment be non-discriminatory as to sex, race or religion; and that neither the member nor the member's spouse do business with the Commission. A commissioner may be removed: for violating a condition of appointment; because of disability due to illness; or for being absent from Commission meetings more than half the time.

The Commission is a full-time, salaried position requiring residence in Austin during the week. The current Commission includes a former county commissioner, a farmer and an attorney.

The Board consists of six non-paid part-time appointees from different parts of the state. Current members include two businessmen, an engineer/rancher, an attorney, a banker, and the head of a non-profit organization.

Wind Stripcropping Cuts Soil Erosion, Saves Moisture

Wind—It robs the soil of life giving, yield-increasing moisture. It can severely damage young plants, particularly when combined with blowing dust. And most important of all, wind steals one of the farmer's most valuable resources—his soil.

Farmers spend tremendous amounts of time, labor, and fuel combating this critical problem. But there is an alternative—Wind Stripcropping.

INSPECTING some newly planted Weeping Love Grass on Roger Kitten's farm is Lubbock County District Conservationist Randy Underwood.

Randy Underwood, USDA-Soil Conservation Service District Conservationist for Lubbock County, explains, "Primarily wind stripcropping is essentially for controlling wind erosion. By planting either an annual crop such as wheat or a permanent grass such as Weeping Love Grass in windstrips on a calculated interval, we hope to hold wind erosion down to five tons per acre or less. Five tons per acre erosion sounds like a lot, but it is equal to about the thickness of one dime spread over an acre of land. This is an acceptable erosion level. By limiting erosion to this level, a producer can still maintain productivity or even improve it."

The Concept of Stripcropping

Basically, wind stripcropping involves creation of a plant barrier designed to lift blowing wind off the ground, thereby reducing its erosive force. As wind blows across open fields, it picks up speed and loose soil particles. Wind blowing into a wind strip, however, is forced back into the atmosphere by the influence of the wind stripcrop and remains there for a calculable distance, depending upon the effective height of the plant barrier.

As wind drops back to the ground, it picks up speed until another barrier is encountered. There is a calculable distance before wind picks up its destructive speed after it has encountered a barrier. In wind stripcropping, ideally the next wind strip is encountered prior to the wind regaining maximum speed and force.

The ideal planting time for a permanent grass wind stripcropping system is early April when a high probability of rainfall exists. Odds are 80 percent or better for getting a good stand that will survive the winter, if you get the seeds up utilizing spring rains and give the wind strip time to get established before first frost. Harvestable crops can also be used as wind stripcrops. Commonly, wheat is used in a type of rotation program, as well as providing wind erosion protection.

Wind strips are most commonly utilized in parallel terrace farming systems, but can also be utilized on flat ground or planted in a circle under a center pivot sprinkler system. Normally, the wind strip is designed on a maximum interval of 300 feet between strips for a tolerable erosion loss. However, most strips are commonly placed at intervals of 200 to 240 feet. The interval between the wind strips is reduced at times to match the producer's farming equipment.

Wind Strips on Terraces

Roger Kitten, farming near Slaton, Texas, utilizes wind stripcropping on some terraced land he farms. "In this particular instance," notes Underwood, "there are two rows of Weeping Love Grass planted on a 40-inch band on top of a one and one-half foot tall terrace with a 20-foot base. When the permanent grass reaches maturity, it will be three and one-half feet tall with an effective height of four and one-half feet.

"Multiplying the effective height of the wind stripcrop by ten gives the distance travelled before the wind reaches the ground again. Normally, it takes wind 100 feet or more to get back to full power. Then you're about to another terrace wind strip. Roger usually has 80 rows he farms between his terraces."

WIND STRIPS recently planted to Weeping Love Grass on Roger Kitten's farm are planted in a 40-inch wide band just on the top of the terrace into wheat subble.

Conversely, on some land owned by Yellowhouse Farms near Shallowater, Texas, wind stripcrops are planted over the entire terrace. Underwood notes that the reason for this is to avoid any terrace maintenance. "Usually if you farm a terrace, you eventually plow it down. It costs anywhere from $5 to $10 an acre to get out in the field with a one-way plow or other tool to pull the terrace back up and get it to its effective height. This probably needs to be done at least every third year when the terrace is farmed.

"If you don't have your terraces to their effective height, and you get a good rain, then you've got real problems. Normally, one will over-top. It starts as water cuts a small hole in the terrace. Then, in just a little while, you've got big holes, and finally the terrace breaks. Once one of them breaks, the odds are pretty good that the rest of them will break also."

Utilizing permanent grass wind stripcropping can eliminate this potential threat. "If you put some type of permanent grass on the terrace, and you have neighbors around that have soil erosion, the wind strip will probably catch the soil instead of allowing it to blow away," explains Underwood. In effect this builds up the terrace instead of pulling it down.

Another advantage to wind stripcropping as Underwood sees it is that producers have, in the past, been able to utilize annual crop acres in meeting their ACR set aside.

STANDING AMIDST wheat stubble, Ute Becton (left) and Randy Underwood (right) note that cotton will be planted no-till into this wheat stubble next spring.

A Unique Blend

Ute Becton, Vice-Chairman of the Lubbock County Soil and Water Conservation District Board and a farmer near Idalou, Texas, has adapted wind stripcropping into a very unique farming system. In effect, Becton's 60-acre test plot incorporates wind stripcropping with conservation tillage and a rotation program all in one.

"This is our first year to test this system out," indicates Becton. "After our cotton came off last year, we drilled wheat right back into the cotton stubble in November on every other set of 24 rows. Then early this year, when our cotton was real small, we had the wheat there as a kind of wind strip to protect the young cotton.

"After we harvested the wheat, we left the stubble. The idea there is to try to catch rainfall this summer and not plow any of it out. Then next spring, I want to come in here with some no-till cotton and plant it into this wheat stubble. Where the cotton is this year, I'll come in this fall and plant that to wheat.

"Basically what we are looking for is wind protection for our young cotton as well as looking at the conservation tillage as a way of cutting our moisture loss, plus the advantage of cutting our operating costs and cutting our irrigation requirements."

Becton is also working closely with a local chemical company to try to keep his no-till system cost effective. "So far, we've found out that we need more fertility when we're double cropping than what we normally have. Also, we're trying to get our chemical costs down to below $10 per acre. I'm kind of like everybody else. I don't like to drive by and see a lot of weeds. So if we can keep the weeds down to their present level, or better, then I think I'll like it."

Additionally, Becton is utilizing soil moisture blocks to help keep track of his moisture conditions. Becton notes, "I got into this primarily as a way of cutting our moisture losses. There's either a plant root, evaporation or a plow that's going to take your stored soil moisture away. We ought to have a full soil moisture profile on our wheat stubble rows, except in the top inch or two. Lower soil moisture in that area is primarily due to evaporation. Moisture is not going to evaporate very far down unless you do something to encourage it."

Cooperative Research

Underwood also explains, "We have a cooperative program with some folks out at Texas Tech University to look at wind stripcropping. Generally, we're looking at the economic advantages of stripcropping. We estimate that if we can save two sand-fighting trips and maybe one cultivation by use of the wind stripcropping pattern, then we have an economic benefit. The big concern about anything we do these days in any type of erosion control business, is that it's got to be economically feasible. Wind stripcropping doesn't cost that much to establish a permanent vegetation, and wheat doesn't cost that much to use in the long run. So, wind stripcropping is pretty economical. You can do it for a few dollars an acre, whereas some other measures may not be so cost effective.

"Additionally, we're checking to see if there are insects that will over-winter (survive the winter) in the wind strip and cause problems later. We're also running a comparison test to determine the soil erosion difference between a wind stripcrop system and a clean till system.

"All in all, wind stripcropping is a multi-purpose alternative to help hold down soil erosion and maintain soil moisture. "Primarily," notes Underwood, "a producer's got the benefits of holding down the amount of wind erosion on his land and helping maintain soil moisture. Just like Ute said, if you don't plow your land, you're not going to lose much moisture."

Additional benefits offered by a wind stripcropping pattern may include grazing stocker cattle and cutting down on the number of tillage operations required, which is going to cut down the cost per acre production expense. Also, there is something there to protect the young plants from the sometimes damaging forces of the wind.

Update: "Who's Who" On Your District Staff

As you walk through the doors of the Water District's Lubbock office, you'll be met by several of the District's more attractive features. These pretty faces belong to the District's Receptionist / Secretary, Mrs. Rosie Risinger; the District's Chief of the Permit Section, Ms. Becca Williams; the lady who keeps track of all the nickels and dimes, Ms. Johnita Franklin; and probably the cutest geologist you've ever seen, Ms. Cindy Gestes. These four ladies are all relatively new additions to the Water District's staff.

Rosie, the first person anyone will see when they enter the office, is a "perky" brunette that came to the Water District in November of 1984. In addition to Rosie's duties as Receptionist and Secretary to the District's 16-member staff, she's in charge of the District's cost-in-water income tax depletion program. Rosie handles all of the processing of landowners' claims for water depletion information used in claiming a water depletion deduction on their federal income tax returns. Not only that, but Rosie also handles all of the behind-the-scenes paperwork that keeps this program running on an even keel, which is no small task.

With a quick wit and always a smiling face, Rosie handles just about anything that comes along. Maybe that comes from raising two children, her daughter, Sarah, who is eight, and Dennis, her son, who is nine. "Rosie's a life saver," notes a fellow staff member. "I'm always coming up with something that has just got to go out in the mornings' mail. Anytime you need to get something done, all you have to do is just ask Rosie, and she's right there willing to help in any way she can."

Rosie came to the big city of Lubbock from Knox City, Texas, where she was born and raised. Just a home-town girl, Rosie enjoys her job and says, "It's nice to work with a group of people like we have here at the District. I always liked staying at home with the children, while Mike (her husband) worked his way up in the ranks of the Soil Conservation Service. But at home there's nobody around except the children. I guess maybe that's why I'm just a child at heart."

Becca Williams, our chief permit lady, is the next smiling face that visitors are likely to see when they enter the office. Becca was born in Lubbock and graduated from Texas Tech University with a Bachelor of Arts degree in English, a minor in Spanish, and a teaching certificate.

Since then, as she puts it, "I've lived the life of a gypsy," living in Seattle, Wisconsin, Denver, and most interesting of all, Mannheim, Germany, which is near Heidelberg. "Mannheim was very interesting. We lived upstairs in a house that belonged to some Ugoslavian refugees. Frau Roth and her husband were very understanding and watched out for me. I didn't speak a word of German when I got there." It was either continuing her education, or out of necessity, that Becca went to the University of Heidelberg while in Germany to learn to speak German. "I never did get very good at it, so Frau Roth would always stand around when I visited with the lady next door. Even though we were both speaking in German, Frau Roth would translate for us."

Becca's duties with the District include processing all of the permit applications that are issued by the Water District's county offices, including locating the permit site on the District's maps, verifying the data on the permit, and maintaining the permit files. Becca also coordinates District activities with the County Secretaries and County Committeemen.

One of the things the District needed most when Becca came to work for us in December of 1983, was someone who could make sense out of our reference library. "Becca's previous library experience has been an invaluable asset," indicates District Manager A. Wayne Wyatt. "Now you can even find things in the library when you need them."

"I like the contact that I have with the people in the District's service area," indicates Becca as she ponders her role as permit chief. "I feel that what I am doing is important. I've had a couple of those glamour jobs where you work yourself silly, but you can't figure out just who really cares. Here I feel I'm doing something supportive."

One of the District's newest employees is Johnita Franklin, the District's bookkeeper and cost accountant. Sixteen years of bookkeeping experience have helped Johnita handle her job well with the Water District in just four short months.

Johnita officially joined the staff in April of 1985, when Kay Atcheson, our former bookkeeper, decided to try her hand at being an artist and enjoying life with her husband, Dan. Since that time, Johnita has really had her hands full. She's not only learned the Water District's bookkeeping system, but tackled a new computer system as well.

"I have a brother that is a computer nut," notes Johnita, "and he had always tried to get me interested in computers. But I really didn't have any use for them at that time. Now that I've started working with this one, I wish I'd have let my brother get me involved before."

Always hard at work, Johnita comes by her diligence and enthusiasm naturally. Prior to joining the Water District's staff, she worked for over four years with the American Red Cross as an emergency case worker. Working through natural disasters like the Wichita Falls tornado where she worked night and day for several days running, Johnita is no stranger to hard work. After hours, she continues "work" around her home. She's taken on the project of making an afghan for each of her nine grandchildren.

A dedicated lady, Johnita was born in Honey Grove, Texas, which is located between Bonham and Paris, Texas, in Fannin County. Johnita feels, "I'm the luckiest person in the world to have been selected for this job." But we know that we're the lucky ones for having found such a jewel in Johnita.

It's not quite true to say that our next pretty lady is really "new" to the District's staff. Cindy Gestes, has worked for the District in her official capacity as District Geologist since June of 1984. But, she was no stranger to us when she was officially hired.

Cindy had previously worked for the District during the summer of 1982 while working on her Masters degree in geology. Cindy did some mapping work for the District during that summer. Her work included contouring the saturated thickness, base of the Ogallala, 1980 water table elevation and percent depletion of the Ogallala in several counties during just those three short months.

Cindy's a native Texan, born in Crosbyton, and a 1973 graduate of Plainview High School. Following high school, Cindy went right to work on her professional objectives by attending college at Wayland Baptist University. She graduated from Wayland in 1980 with a Bachelor of Sciences degree in earth sciences, then received her Masters degree in geology from East Texas State University in 1984.

"Cindy came back to work for the District on a part time basis while hunting for that first job," indicates District Manager A. Wayne Wyatt. "Well, she was just so sincere and dedicated to working in the area of water, and particularly water in the High Plains of Texas, that we just decided we couldn't let her get away."

An admirable, sweet and attractive lady, Cindy knows what she wants and knows just how to go about getting it: through hard work. "She's a very dedicated, hard worker, and we're lucky to have her."

"Each of these ladies brings something special to the District's staff," notes Wyatt. "We've got a very strong team of dedicated people, who are ready to work for the benefit of the people we serve."

PIONEER . . . continued from page 2

estimated withdrawal rates of 150,000 acre-feet per year.

In the High Plains of Texas, treated wastewater is utilized in cooling towers and for irrigation of thirsty crops. The Cities of Lubbock and Amarillo use treated sewage water for both cooling and irrigation, while most smaller towns and cities in the area provide the water to local farmers for irrigation.

The El Paso project is a prototype for larger-scale treated wastewater recharge systems.

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
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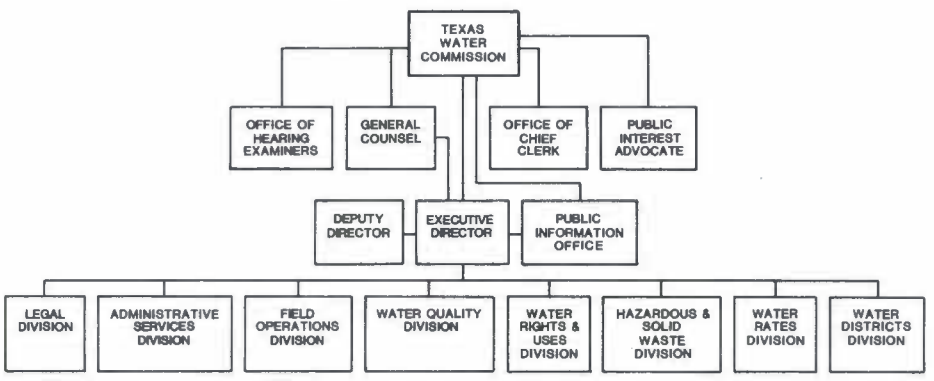
TEXAS WATER COMMISSION PROPOSED ORGANIZATION STRUCTURE
EFFECTIVE SEPTEMBER 1, 1985



PERSONS needing information or assistance from the reorganized Texas Water Commission can refer to the organizational chart above to identify which division of the new state water agency could best respond to their inquiry.

Texas Water Commission, Development Board Reorganized

The Texas Department of Water Resources in Austin closed its doors on September 1, 1985. Its duties and functions have been transferred to other agencies. The Department had served as the state's lead water agency since its creation in 1977.

Senate Bill 249, passed in the last session of the Texas Legislature, calls for dissolution of the Texas Department of Water Resources and the transfer of many of the Department's duties and functions to the realigned Texas Water Commission, as well as transfer of the remainder of its duties and functions to the Texas Water Development Board.

The Texas Water Commission was assigned the majority of the Department's duties and functions. The Commission has been busy making staff appointments in anticipation of assuming these new functions and duties.

Recent appointments made by approval of the Texas Water Commission include Larry Soward as Executive Director, James Rourke as Chief Hearings Examiner and General Counsel, and the reaffirmation of Mary Ann Hefner as Chief Clerk for the Commission. The Commission also approved that Jack Cox will continue in his present role as Public Interest Advocate.

Texas Water Commission Division Directors were named by Executive Director Soward as follows:

- J. D. Head will direct the Legal Division,
- Harold Jobes will direct the Administrative Services Division,
- James Larkins will direct the Field Operations Division,
- Thomas Mason will direct the Water Quality Division,
- Harry Pruett will direct the Water Rights and Uses Division,
- Bryan Dixon will direct the newly created Hazardous and Solid Waste Division, and
- Tom Milligan will direct the Public Information Division.

Two additional Water Commission Divisions have been created by Executive Director Soward: the Water Rates Division and the Water District Division. Directors for these divisions will be appointed in the near future.

The Texas Water Commission will also take on expanded duties through the transfer of the municipal hazardous waste program from jurisdiction of the Texas Department of Health to the Commission.

The Texas Water Development Board has appointed Charles Nemir as Executive Administrator. Nemir has also begun reorganization of the staff of the Water Development Board. Named by Nemir thus far in the transition stages are Dr. Herbert W. Grubb as the Director of Planning and M. Reginald Arnold as the Water Development Fund Manager. Future editions of The Cross Section will provide more information on the organization of the Texas Water Development Board.

Tailwater Violator Cited For Contempt Of Court

On August 9, 1985, Judge Jack Miller of the 64th Judicial District, including Castro County, Texas, entered an order finding DeWayne Brown of Hart, Texas, guilty of contempt of court for violating an Agreed Temporary Injunction which prohibited the waste of water produced for irrigation. The judge's order further provided that Mr. Brown would be fined $500 for violation of the injunction, but that this fine would be remitted if Mr. Brown constructed a tailwater pit(s) on his land prior to his beginning irrigation in calendar year 1986.

Water District attorney Don Graf, with the firm of McCleskey, Harriger, Brazill and Graf of Lubbock, represented the High Plains Water District during the contempt of court proceedings. Graf agreed to the judgment following policy outlined by the Water District's Board of Directors which seeks elimination of tailwater waste rather than the collection of fines.

Following the entry of the judge's order, Graf stated, "Hopefully this type of ruling by the court will encourage a permanent solution to the tailwater waste that has been occurring on this farm. It is unfortunate that contempt of court proceedings have to be used to obtain the needed results in some cases."

The original Agreed Temporary Injunction against Brown was entered October 25, 1984, by District Judge Marvin Marshall of the District Court of Castro County, Texas. This 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, this injunction prohibited the landowner from allowing any future waste to occur from his land. Additionally, it entitled the Water District to seek relief from the District Court in the form of penalities for contempt of court if additional tailwater waste occurred prior to the expiration of the temporary injunction. In this case, further waste of irrigation tailwater was observed; and, therefore, the contempt of court proceedings were brought against Brown.

According to Water District Assistant Manager Ken Carver, "The policy of the Water District's Board of Directors is to attempt to work out solutions to waste problems with landowners prior to seeking court injunctions. Unfortunately, this is not always possible."

When no permanent solution to waste problems is implemented by the landowner and waste of water continues, the District has no further recourse than to pursue the matter in court.

Carver notes, "At the current time the Water District is working with approximately 90 tailwater violators. Some have filed plans with the District on actions which will be taken before the next irrigation season to permanently solve their tailwater runoff problems. In some instances, however, injunctions will be sought if permanent solutions are not implemented by the landowners before the next irrigation season."

Attorney Graf notes that the compilation of documents the District maintains from its investigations of tailwater waste complaints could eventually be used against the violators in order to secure damages by adjoining landowners. Graf states, "The assessment of damages has recently been upheld by an out-of-state court and in the Friendswood Case near Houston where damages were assessed to adjoining landowners for the negligent use of water which caused land subsidence.

"Additionally, in a more recent case in Ohio, the ruling court provided for recovery of damages from an adjoining landowner because overuse and waste of water had caused injury to the complaining party."

Tailwater waste violators who end up with their cases in court may face maximum fines of $500 per violation. Each day of violation can constitute a separate penalty, thereby incurring additional fines of $500 per day for as many days as the waste occurs. Additionally, judges have the authority to put violators in jail under a contempt of court order for up to six months per violation.

Considering the high costs involved in the production and distribution of irrigation water, the unlawful waste of a precious and limited natural resource, and the possible penalties involved in judgements against tailwater waste violators, it would seem to be a simple choice to make beneficial use of all water produced for irrigation.

1985: A Year Of Achievement For District Staff

As the summer sun fades, the temperatures begin ever so slightly to cool, the days get just a tiny bit shorter, and the cotton blooms have made their transition to bolls signaling that harvest time is not far off, the feeling in the air is that autumn lies just around the corner. As autumn approaches and we all begin to slide toward winter and the approach of a new year, we take a short look over our shoulders at this year to see what we've accomplished and where we need to go from here.

As District Manager A. Wayne Wyatt ponders the accomplishments of the Water District's staff for 1985 he notes, "The activities of our staff during this year have been diverse and numerous. Our staff's activities ranged from the very backbone of the District's programs such as the issuance of water well permits, the search for and investigation of open holes, and handling tailwater complaints, to such complex and innovative studies as artificial recharge and secondary recovery. Our staff has been extremely busy, and the results show accomplishments for the year. I am very pleased."

Just one thing disturbs Wyatt. "Our goal has been to provide information and demonstrations to the producers of our service area on the most cost-effective tools and technology available for improving water use efficiency. It is unfortunate that the state of the agricultural economy is such that the irrigators and dryland farmers cannot afford to implement all of the technology available to enhance their irrigation efficiencies."

DEMONSTRATION AND TECHNOLOGY TRANSFER

On-farm irrigation demonstration days are a prime example of the District's efforts to demonstrate cost effective tools and technology to the irrigators of our service area.

Demonstration Days

"We have held seven community field days this summer," indicates Agricultural Division Director Ken Carver. "The purpose of these demonstration days is to show the farmers some of the latest irrigation water management techniques and equipment available. At these field days, Mike Risinger or I usually demonstrate soil moisture monitoring tools, Jerry Funck and David Swaringen discuss pump plant energy efficiency testing, personnel from the Soil Conservation Service demonstrate and discuss irrigation application efficiency testing, and many times either David or I will demonstrate the use of a surge irrigation system.

"The basic objective is to get people to come out and see these tools. This year our attendance in numbers hasn't been as good as we had last year, but I see one big difference. Those who have attended this year seem to be truly interested. We have had a lot more irrigators that want to get down and handle the instruments and see exactly how they work. They ask a lot of questions. So I think we'll see more results and adaption of the technologies this year."

Carver also notes that other agencies have been and continue to be involved in the field days. "We have always worked closely with the Soil Conservation Service, both the field offices and area offices; with the Soil and Water Conservation Districts; and on occasion with the Texas Agricultural Extension Service. But this year we've seen other agencies get involved as well. So that indicates to us that the program is producing some positive results."

Soil Moisture Monitoring

In addition to demonstrating soil moisture monitoring at field demonstration days, the District also has a cooperative program with producers to install soil moisture gypsum blocks on their farms.

"David has been primarily responsible for working with our cooperators this year," notes Carver. "In this program we furnish a meter and gypsum blocks to irrigators. They take the readings, record the information, then furnish a copy of their records to us at the end of the season. The purpose is to get them acquainted with the use of these tools. Hopefully, after two years of being a cooperator in the District's effort, they will see the benefits and continue a soil moisture monitoring program on their own."

So far our success has been good. Most of our cooperators continue the program. They see the benefits of knowing what their soil moisture is and how much water they need to apply. They like being able to do a better job of watering their crops.

Pre-Plant Soil Moisture Survey

Information on existing soil moisture conditions can be very important for those who, for one reason or another, do not practice soil moisture monitoring on their own farms. In that regard, Mike Risinger heads up a program designed to provide information on the pre-plant condition of soil moisture throughout the District.

Carver notes, "Basically, we monitor soil moisture in about 100 soil moisture sites scattered throughout the District each year, usually around the end of November. Then as soon as we get all the measurements in and the data analyzed, we publish the pre-plant soil moisture maps. These maps show the amount of moisture in the root zone soil profile and the moisture deficit, or the amount of water which would need to be stored in the soil profile to fill it to field capacity prior to planting.

"This information can be used by farmers throughout the area as a general guide. It is not intended to be site-specific to a particular farm. It just helps the irrigator make decisions as to whether he needs to apply a light application or heavy application, or whether he can go into planting without that pre-plant application, depending on where his better moisture is stored in the root zone soil profile."

Pump Plant Energy Use Efficiency Testing

Concerned about the high cost of fuel to power irrigation wells, the District in the past few years has expanded its services to help irrigators hold the line on pumping costs.

"Jerry Funck has worked mostly in the northern counties of the Water District this year to provide 50 to 60 pump plant energy use efficiency tests on producers' farms," notes Carver. "We've been fortunate to get timely rains in the cotton growing portion of the District, so there's not that much pumping going on in the southern parts of the District.

"It seems to me that with the high cost of fuel, greater pumping costs, and larger volumes of water, there has been a greater need for higher efficiencies and thus more concern in the northern areas of the District this year. It just costs a lot more to pump water these days than it used to."

MAINSTAYS OF THE DISTRICT'S PROGRAMS

In addition to demonstration programs and actual field testing, the District maintains other programs designed to help the irrigators and other residents of the District. These programs are the mainstays of the District's existence. Included are activities ranging from monitoring the quality and quantity of the ground-water resources throughout the District to observing the location of open holes or abandoned irrigation wells which have not been properly sealed to protect the water supply and possibly human or animal life.

Open Holes

An open hole or an uncovered abandoned irrigation well can pose serious threats to human and animal life in several ways. Ken Carver notes, "This year Obbie Goolsby worked, with the assistance of other staff personnel, to locate and close approximately 250 open holes in the District's service area. Normally, these holes were left open after having the pump pulled or something else, and the landowners just never got around to getting the hole covered properly."

In this effort, the District corresponds with the landowner regarding the open hole and suggests ways to remedy the situation by properly covering the hole. Additionally, the District maintains a stock of plugs that can be installed for a landowner by District personnel, for the minimal cost of $35, if the landowners so desires.

Tailwater

Producing irrigation water from the Ogallala aquifer and then letting that water go to waste in the form of irrigation tailwater costs producers not only the wasted water, but the money they paid to produce that water. Therefore, another of the District's mainstay programs is to help producers find solutions to their tailwater runoff problems.

"This year," notes Carver, "Obbie, with assistance from other staff personnel, worked approximately 100 cases of irrigation tailwater during the irrigation season. Fortunately, irrigation tailwater is not nearly as prevalent this year as it has been in previous years. There's a lot of work involved in handling tailwater complaints."

First an investigation must be made and the evidence of the tailwater violation documented. Then the landowner is contacted to see if a permanent solution can be worked out. If a solution is not achieved and the loss of irrigation water becomes a habitual and willful occurrence, then the wheels of justice are set in motion.

Carver notes, "We, meaning the District's Board of Directors and staff, want to work with landowners to solve tailwater problems without the need for litigation and attorneys getting involved. But if none of our steps to solving tailwater problems proves effective, then the Board of Directors' policy is to pursue legal remedies."

Issuing Water Well Permits

One of the original programs of the Water District when it was created in 1951 was to require that a permit be issued for water wells which will produce in excess of 69.4 gallons per minute. Although no great, news-breaking accomplishments can be bragged about from year to year in this program, it can be touted as one of our most successful.

"Becca Williams is the Chief of our Permit Section," states Carver. "Thanks to her efficient work and close coordination with the county secretaries, permitting wells these days is as easy as spreading butter. All it takes is a little organization of the facts and figures, and a trip to the appropriate county office. After that, the landowner is well on his way to having a new permitted well."

Permitting of wells is a management strategy used to reduce interference between wells and to prevent the excessive depletion of the aquifer in localized areas. Well spacing based on the production capacity of the well assures each landowner an equal opportunity to utilize his ground-water resources.

Monitoring Your Ground-Water Resources

Before any irrigation well can be drilled, any crops planted, or that first drop of irrigation or domestic water

continued on page 3 . . . ACHIEVEMENT

ACHIEVEMENT . . . continued from page 2

produced, residents need to know how much water is available to support their farming and domestic needs. Well, the District knows.

"We have just completed new saturated thickness maps for Cochran and Hockley Counties," notes Technical Division Director Don McReynolds. "These maps are the result of some extensive supplementary water level measuring work the District's staff performed last year. Our goal is to measure one well per square mile throughout the District's service area in addition to our normal observation wells.

"In our supplementary, one-time measuring effort, we actually went through Cochran, Hockley and Lubbock Counties before we ran into the irrigation season. Since we're measuring static water level, that forced us to wait to do further measuring. Our plan is to do additional counties as time and conditions allow, with the ultimate aim being to update our hydrologic atlases to 1985. Each county will then have a new altitude of the water table and saturated thickness map for 1985."

Hydrologic atlases have over the years following their release proven of tremendous benefit to anyone seeking information on the groundwater resources of a particular county. "Anyone looking for a guide to the water resources can pick up a hydrologic atlas and know approximately what the county-wide situation looks like. Then, if they want more specific information on a particular tract, we can discuss the tract with them," notes McReynolds.

One side benefit of this extensive measuring program, previously discussed, was the location of numerous open holes. McReynolds expects as the staff of the District continues this effort, more open holes will be located and ultimately sealed.

Updating The Water Level Observation Well Network

To keep all things running on an even keel takes maintenance. The demands of other programs, such as secondary recovery, have caused some delays in maintaining the District's records of water level observation wells, but not for long.

"Dan Seale has spent most of the summer getting our records back in shape," notes McReynolds. "We had finally gotten to the point that it was very difficult to perform our yearly well measuring program. We might go out to find a well that was still listed as an active well in our records and find that the well was no longer in existence. The worst part of that is that you may have driven several miles just to get there, only to find out that the well was not there any more."

The update of the records of this program not only involves Water District records, but involves the records at the Texas Department of Water Resources as well. According to McReynolds, updating the records is no simple task either. "Approximately 75 to 80 percent of the updates involve an actual visit to the site of the well to update the records of the equipment installed on the well or to find out why a replacement well is needed. I suspect that in most cases when a well is reported by someone as needing to be replaced, Dan goes by the old location just to check it out before he sets up a new well. There are a lot of subtle things that can happen to a well or the equipment in a well that would make it unmeasureable. Just a change in equipment, the age of the well, or a change in the water table can prevent us from being able to get a static water level reading on a well."

Bacteriological And Chemical Analyses

One of the District's more recent programs involves the collection of water samples for residents of the District. The District staff performs limited chemical analysis and fecal coliform bacteriological analysis on samples of our water supply. "Dan, in addition to the work with the water level observation well program, has spent a considerable amount of time this year running bacteriological and chemical analyses. This is usually performed as a result of someone calling the District's office to describe some change in the quality of their water supply. In most cases it is a drinking water or domestic water supply problem."

It takes a man of experience to go out and properly collect a water sample for analysis. "Dan, because of his years of experience, can usually predict out in the field what he is going to find when he analyzes the water just by looking at the conditions he found at the well. If it is an unclean situation, then Dan can pretty well guess what he'll find from the analysis of the water sample."

McReynolds notes, "Nine out of ten times Dan finds a non-sealed situation, meaning something is getting into the top of the well to cause a contamination problem. While Dan is there, he makes recommendations for solving the problem, both to clear up any contamination which may be present and to prevent further contamination." Fortunately, the results of these water sampling efforts are not normally bad. "One-fourth to one-third of the samples we collect show some type of bacteriological or chemical contamination. If the results of the bacteriological analysis come back good, then you move on to analyze the chemical aspects. A person with Dan's experience can recognize while he's in the field something that may be causing a chemical contamination problem.

"If you take 25 samples during a year's time and find even one that has some type of bacteriological contamination, then that makes all 25 trips worth the effort. We prefer to go out, collect the samples, and analyze them and be able to report back to the landowner that all of our results were negative," states McReynolds.

A Helping Hand

As a sideline benefit of the bacteriological and chemical analysis program, the District helps the Railroad Commission, the Texas Department of Health and the Texas Department of Water Resource keep an eye on waste disposal. We help them do their job by doing our own.

"We feel obligated to monitor the proper disposal of salt water and brines associated with petroleum production and waste disposal associated with feedlots, just to mention a few, because of our responsibility to protect the aquifer from contamination," states McReynolds.

Additionally, because of our responsibility to protect the aquifer, the District's staff has very closely monitored the Department of Energy's proposal to dispose of nuclear waste below the Ogallala aquifer. Don McReynolds has served as the District's primary "watchdog."

INNOVATIVE RESEARCH

During the course of 1985, the District's staff has also been heavily involved in continuing research into the secondary recovery of water from the wet sands of the Ogallala aquifer.

Cindy Gestes, Water District geologist, notes, "The field test of secondary recovery at the Wolfforth test site was completed in late 1984. This year has been spent analyzing and compiling the data from that test, as well as updating the results of the two previous tests at the Slaton and Idalou test sites."

Additionally, one of the requirements of the District's contract with the Texas Department of Water Resources is the compilation of a final report on the continuing research of secondary recovery. This report, a mere five volumes of material, has required "all hands and the cook" to complete.

Summing It Up

"All of this field work, technology transfer, education, and assistance takes a team effort to accomplish," notes District Manager Wyatt. "There is a lot of behind-the-scenes work," states Don McReynolds, "without which the accomplishments of the year would not have been so great."

You don't recognize the skill and accuracy of the District's draftsmen, Keith Whitworth and Richard Howard, unless you're involved behind the scenes. You don't realize that without the District's secretaries, Rosie Risinger and Bobbie Bramblett, letters to landowners regarding tailwater, open holes, and the results of their water quality tests would gather dust on the shelves. And you don't see the lady who watches the expenditures and pays the District's outstanding accounts, Johnita Franklin.

"But it takes all of these people, plus the cooperation of the landowners and operators throughout the District to make our programs and activities successful," notes Wyatt. "Our personal ambitions for the year were to accomplish more than has been accomplished. However, the work load of each individual has been heavy and necessitated that some of the things we had hoped to accomplish would suffer some delays. Fortunately, the year's not over."

Looking forward, Wyatt says, "We look toward the challenges of the remainder of this year and a time when the agricultural economy improves to a point where the farming sector can implement a maximum water conservation effort throughout the entire area."

UPDATE . . . continued from page 4

as its Agricultural Engineer, but he's more than just that.

Jerry's a volunteer. He offers his assistance to the staff and to the farmers in the area to help in any way he can. A craftsman as well, Jerry recently built a working scale model of a center pivot sprinkler system and is now building a scale model of a surge irrigation system which will be displayed at regional fairs. Jerry also helps out with all of the programs and activities of the Agricultural Division.

Ken Carver, Agricultural Division Director, states "Jerry's primary responsibilities lately have been serving as our pump plant efficiency expert during our community field days. Jerry's interested in agriculture and the plight of the West Texas farmer. He really cares."

Born in Amarillo, Texas, in 1957, Jerry graduated from Pasadena High School, then pursued his education at the infamous home of the Texas Aggies, Texas A&M University. According to Jerry, "there are only two real schools. One's Sunday school and the other's Texas A&M University."

While attending college, Jerry majored in and received his Bachelor of Sciences degree in Agricultural Engineering specializing in soil and water. "I wanted to work with irrigation and primarily with irrigation on the High Plains. My family has lived here since the late 1800's and with the exception of my parents who live in Houston, my family still lives in and around Dimmitt."

In his spare time, Jerry serves as President of the Lubbock Area Young Farmers. "It's a good place to get together to find out more about the things that I am involved in and to find out what others are involved in." Also, Jerry likes sports including softball, bowling and hunting. If it moves, Jerry hunts it, just about. Jerry especially likes to hunt birds, deer, prairie dogs, bobcats, snakes, coyotes, and squirrels, not to mention girls. And when he's not doing anything else, he reloads all types of shells. "It may sound stupid, but I really like manual labor. It gives me a good break from all the mental work I normally do in a day's time."

Jerry likes working on the farm and particularly around animals. "I like working with farmers. They generally know what is really going on."

"Each of these gentlemen brings an special expertise to the programs and activities of the District, notes District Manager Wayne Wyatt. "We're very fortunate to have them all."

As for "the leader of the pack," Ken Carver, we're saving him for a later edition of The Cross Section.

Staff Update: Ag Division "Who's Who"

It takes a lot of hard work to make all of the programs and activities of the Water District's Agricultural Division run effectively and efficiently. It takes everything from working long, hot, sweaty days out in the field in 90°+ weather digging soil moisture monitoring holes, to being an eagle eye constantly on the lookout for a clump of weeds in an open field that might signal the location of an open hole or that telltale stream of water that might reveal a tailwater waste violation. It takes everything from running pump plant energy efficiency tests on all types of pumping equipment with the skill of a master craftsman, to having a special knowledge and understanding of soils and the capability of putting a neutron soil moisture probe to work checking soil moisture content throughout the District's service area.

Fortunately for us though, there are five men in our Agricultural Division that have the talent and education to get these jobs accomplished. Our "crackerjacks in the field" include Obbie Goolsby, "jack of all trades"; David Swaringen, "conqueror of the auger"; Mike Risinger, "master of soils"; Jerry Funck, our own "gentleman Jerry;" and Ken Carver, the "leader of the pack."

Obbie Goolsby serves the Water District as an Engineer Technician. A humble man who doesn't talk much about himself, Obbie calls himself, "a jack of all trades and master of none." But, we know better.

"Obbie's the kind of fella you can call on at any time to do anything," notes a fellow employee, "and he'll find a way to get it done. Not only that, but it will be beautifully done as well."

With the District since January of 1968, Obbie performs all of the field investigations necessary for the permit section, tailwater complaints, and the open hole program. He's always available whenever needed to help take water level measurements, help install soil moisture blocks, and take soil moisture readings. In his spare time he does the paperwork necessary to back up the field investigations, builds shelves for the District's warehouse and keeps everything in order. Obbie also does the building and finishing work that is necessary for exhibits the District's staff sets up at regional fairs. He serves as picture framer, helps keep the District's displays of publications stocked, assigns water decline values for landowners' water depletion claims, and just about anything else anybody needs.

Born in Wichita Falls, Texas, Obbie has lived most of his life in Lubbock. "After I was born, we moved quite a bit, and when I was seven years old we moved to Lubbock. I've been here ever since. What little schooling I had was in the Lubbock Independent School District." Wise beyond what he'll admit, Obbie, like many others, has gotten most of his "schooling" the hard way . . . while on the job.

A Navy veteran of World War II, Obbie married Geneva, his wife of 36 years, in 1949. "We have two children, a son, Jerry, and a daughter, Teresa Gail, and four grandchildren we are very proud of." His children are pretty proud of their father as well, and that pride beamed in their eyes as their father was recently honored as Patron of Lubbock Chapter No. 76 of the Masons.

Obbie doesn't talk much about the work he's accomplished during his many faithful years of service. All he'll say is, "I've enjoyed working for the District all these years, and I've enjoyed being able to get to meet and get to know a lot of good people. All the people I've met over the years while working for the District have been really good people." We at the District office think Obbie's one of the best.

Our "conqueror of the auger," and a new addition to the District's staff, is

David Swaringen. David started to work for the District in May of this year, and since that time he's become very good friends with the soil auger he uses to install soil moisture gypsum blocks on producers' farms.

David's a "home town boy" who never strayed far from home. Born and raised in Brownfield, Texas, David says, "I like to be able to go home and get a good home-cooked meal every now and then."

A 1981 graduate of Brownfield High, David went directly to Texas Tech University after high school, and in July of 1985 he graduated from Tech with a Bachelor of Sciences degree in Mechanized Agriculture with a specialization in Agricultural Business. "The major in mechanized ag with a specialization in ag business," notes David, "gives you the mechanical end of agriculture and then the economics necessary to make the mechanized part of it work."

We also call David our "expert snow skier" because, according to him, "I don't like to go skiing unless I fall." And from the stories he tells, he does a pretty good job of that. "I like going over moguls when I ski, and during my best fall ever I hit three moguls in a row. Well, I ended up face down, spread eagle in the snow and came up looking just like Santa Claus. I heard people laughing all around me, but I had to clear the snow out of my eyes before I could see who it was. To go skiing, you need to be good enough so that you don't get hurt, but I don't like to take skiing so seriously that I can't fall and enjoy laughing about it."

David's about to take another plunge as well, only this one's not into a snow bank. As of this publication, he and his new wife, Linda, will have just returned from tying the knot and plunging into the ocean surrounding the beaches of the Bahamas on their honeymoon.

"I like working with farmers," states David. "To me there are no better, more down - to - earth people than farmers. My dad and I do a little farming on the side, sort of piddling. So, I know where the farmers stand and can relate to them a little better." A pretty down-to-earth fella himself, we think the people in the District's service area will like working with David as well.

Our master of the soil," Mike Risinger, is not officially an employee of the Water District. He is, however, as much a part of our family as anyone else.

Mike is actually employed by the USDA-Soil Conservation Service as a Soil Scientist, but fortunately for the Water District, we were able to work out a cooperative arrangement with the SCS to have Mike work part-time for the District. Mike's primary duties with the District involve the soil moisture monitoring program.

Wayne Wyatt, District Manager, indicates, "Mike has been invaluable to the District in our work with soil moisture. His understanding of different types of soils and the way water is held in soils, as well as what the water-holding capabilities of soils are, has improved the accuracy of our data greatly. Mike's a true asset to the District."

"I got started in soil sciences thanks to the Texas Tech soils team and Dr. B. L. Allen," says Mike. "When you're doing soil survey work, you are doing something that not many people can do. I've always enjoyed the work I've done, especially since I started working with the District and working on both soil and water conservation. It's been a different job every day and I really like what I'm doing."

Mike also notes, "I like making things. When I was little, I liked taking things apart and putting them back together. I guess every toy I ever had I took apart; and, if I could, I'd put it back together. Then when I was eight or ten, I built a motor scooter and worked on lawn mower motors.

"You could say I'm a hot-rodder at heart. But I can't afford to be a real hot-rodder, so I settle for just working on my own cars. I enjoy doing my own work, and I don't think I've ever had to take a car into the shop to have it fixed. There's just not much you can't fix on your own car if you'll work at it.

"Right now I'm rebuilding a 1966 Mustang and maybe, if I'm lucky, it will be finished by the time my ten-year-old son, Dennis, gets ready for it." Mike and his wife, Rosie, who you read about last month in The Cross Section, have two children, a son, Dennis, and a daughter, Sarah.

Mike started his career with the Soil Conservation Service as a student trainee in 1967 and then went to work full time after he graduated from Texas Tech in 1969 with a Bachelor of Sciences degree in Agronomy and Soil Science. In 1975 Mike obtained his Masters degree from Tech in Soils. "Mike's a hard worker, and I've learned a lot about soils and grasses from him," notes District Manager Wayne Wyatt. "We're very fortunate that Mike has come to this area with the SCS. He's added a great deal of expertise to our staff."

"Gentleman Jerry" is really just that . . . a true gentleman. Honest, loyal, and trustworthy, Jerry's a pretty bright fella as well. Jerry serves the District

continued on page 3 . . . UPDATE

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CONSTITUTIONAL AMENDMENT 1

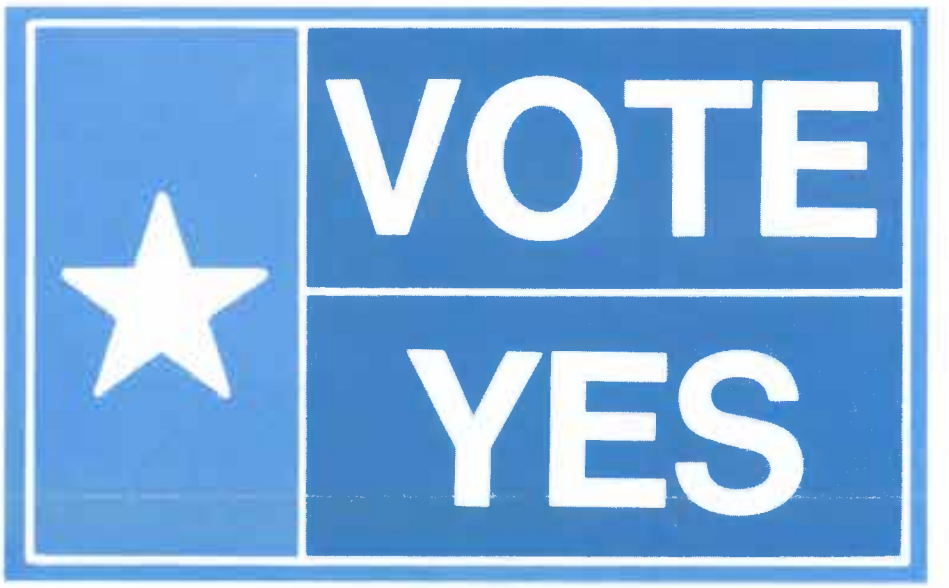
Voter Approval Assures Municipal Water Financing

Passage of Constitutional Amendment No. 1 in the general election on November 5, 1985, could provide a source of low-cost funding for many towns and cities throughout the state as they look at their wastewater treatment and handling needs and at assuring their residents of an adequate, good quality water supply. Additionally, voter approval of this constitutional amendment and the resultant availability of low-cost funding sources has the potential to save the residents of these cities and towns a considerable amount of money.

Constitutional Amendment No. 1 authorizes the Texas Water Development Board to issue an additional $980 million of water development bonds. The basic provisions of this amendment are:

- $590 million of bonds, the proceeds of which are to be used for financial assistance to local governments for water projects and for state participation in the acquisition and development of storage, transmission, transportation, and treatment facilities for water and wastewater. $400 million of this amount is specifically dedicated to the state acquisition and development of these facilities;
- $190 million of bonds, the proceeds of which are to be used for water quality enhancement purposes; and
- $200 million of bonds, the proceeds of which are to be used for flood control projects. Proceeds may be used for acquisition and construction necessary to achieve structural and nonstructural flood control.

These bonding proposals are additions to the $600 million of Texas Water Development Bonds which the Texas Legislature had previously authorized for water development within the state. According to Reg Arnold, water development fund manager for the Texas Water Development Board, there are approximately $105 million of Texas Water Development Bonds remaining in the Texas Water Development Fund. Arnold indicates that this amounts to a two-year funding supply if managed very carefully.



Funding Assistance

Funds available through all of the proposed bonding programs could be used by cities and towns throughout the state. However, there is a hardship criteria which has to be met in order to qualify for a loan under these programs. In effect, cities and towns would have to demonstrate that they cannot sell bonds on the open market at reasonable interest rates.

Through these bonding programs, these cities and towns could take advantage of the state's Triple-A bond rating. Additionally, developers working to bring several small projects together into one regional system could also benefit from these bonding proposals.

By taking advantage of any of these bonding proposals, the cost of the facilities developed would be reduced, which would in turn reduce the cost to local residents who will be taking advantage of the facilities created.

All loans made by the state from these bond funds are to be repaid in full, including interest, by the direct beneficiaries of the projects.

continued on page 2 . . . FINANCING

Amendment 2 Passage Can Help Irrigators Conserve Water

Every irrigator knows that if he could implement the latest water conservation measures available to him today, he could reduce his water use, which would extend the life of his water supplies for future years. Additionally, conservation of water in agriculture could have the potential to make water supplies available for future use by municipalities and industries.

Unfortunately, under today's economic conditions of low commodity prices and high production costs, the irrigation farmer is hard-pressed to afford the implementation of all the water conservation measures that could conserve his valuable water supplies for future use.

Approval of Constitutional Amendment No. 2 by state voters in the general election on November 5, 1985, could help to alter this situation. Voter acceptance of this constitutional amendment, which provides for the issuance and sale of $200 million in bonds to create the Agricultural Water Conservation Program, will set the wheels in motion for irrigators throughout the state to obtain low-interest loans for upgrading the efficiency of their irrigation application systems.

Seventy-two percent of the water currently used in the state of Texas is used by agriculture. Consequently, conservation in this sector has the potential for the greatest water savings.

At the onset of this bonding program, a pilot program funded with $5 million will be established. During the two-year pilot program, an evaluation of the success of this type of bonding program will be made. Before the $200 million can be made available for irrigation equipment loans, a report to the legislature is required in 1987. This report will detail the interest exhibited by state irrigators in applying for low-interest loans, as well as the success of the administration of the low-interest loan program. At the conclusion of this report, the House and Senate must, by a two-thirds majority vote, approve to release the $200 million before it can be used.

If finally approved by the House and Senate, proceeds from the sale of bonds under this program will be loaned to soil and water conservation districts and the underground water conservation districts throughout the state. These agencies will then make loans to irrigation farmers for upgrading the efficiency of their water application systems.

Loans under this bonding program could be made by the soil and water conservation districts and underground water conservation districts to individual farmers for the purchase of new equipment or modification of existing equipment. There are numerous equipment improvements that can afford substantial water savings.

Examples of the types of equipment that might qualify for loans under this program include:

- Purchase of a new drop-line center pivot sprinkler system.
- Modification of conventional center pivot sprinkler systems to the more efficient drop-line center pivot sprinkler system. This type of modification has been documented to improve water-use efficiency, reducing by 30 percent the amount of water necessary to pump for growing crops.
- Installation of underground pipeline, which eliminates evaporation and deep percolation water losses in the transportation of irrigation water, may also be funded under this bonding program. Water losses from 10 to 20 percent per 1,000 feet can be eliminated through the installation of underground pipeline to replace the transportation of water in an open unlined irrigation ditch.
- Purchasing a surge irrigation system may also be funded. The use of surge irrigation as compared to conventional furrow irrigation improves

continued on page 3 . . . IRRIGATORS

FINANCING . . . continued from page 1

Loan Guarantees

One other provision of Constitutional Amendment No. 1 creates a new $250 million loan guarantee program to be administered through the Texas Water Development Fund. Under this insurance program, the Texas Water Development Board could enter into insurance contracts with cities, counties, special governmental districts or authorities, or other defined political subdivisions of the state. In essence, the state would agree to pay outstanding principal of and interest on water bonds or other obligations of the local governmental entity in the event of default or impending default by the local governmental entity.

Insurance contracts under this provision are limited to bonds or other obligations of local governments that are issued for water conservation, water development, water quality enhancement, flood control, drainage, recharge, chloride control, desalinization, or any combination of these purposes.

The total amount of insurance that may be executed by the state under the bond insurance program is set by the constitution at twice the total amount that the state is obligated to pay under this amendment. This means that the state may insure payment of up to $500 million in bonds and other obligations.

Primarily, the bond insurance program will be of benefit to middle-sized cities throughout the state whose credit rating is not as good as the Triple-A credit rating of the state. By utilizing the credit rating of the state to secure the sale of bonds, cities and towns could borrow money at lower interest rates. This then lowers the cost of the water project, which in turn is passed through to the consumer, lowering his water bill.

Costs of the Program

There is no long-term cost to state taxpayers for these bonding proposals. The only cost to state taxpayers would occur in a worst case scenario in the loan guarantee program, and even then the cost would be minimal. The only cost involved would be in the case of a city or town defaulting on its loan, and the odds against that happening are pretty good. Cities and towns throughout the state who have previously taken advantage of Texas Water Development Fund loans have set an excellent track record, and to date there has not been a case of a default of a loan under this program.

Interbasin Transfers

Currently, the constitution prohibits the use of water development funds for a project that contemplates or results in interbasin transfer of water except on a temporary interim basis. This transbasin diversion limitation also applies to the use of money under this proposed amendment.

Wide-Spread Support

Thus far many organizations and agencies throughout the state have voiced their support for these amendments. As Morris Wilkes, legislative assistant and press aid to Senator John Montford, indicates, "We have the most wide-spread support for these amendments that a water proposal has ever received in the state before."

Among those supporting the amendments are the League of Women Voters; the Texas Municipal League; the Mayor's Committee; the West Texas, East Texas, South Texas and Rio Grande Valley Regional Chambers of Commerce; The Texas Water Conservation Association; the Texas Water Well Association; the Trinity Improvement Association; Trinity River Authority; Brazos River Authority; the Association of General Contractors of Texas; various trade associations; and all announced or prospective gubernatorial candidates, just to mention some of the support for these programs. The only agencies voicing opposition to the proposals are the Audubon Society and the Texas Committee on Natural Resources. The Sierra Club, who has historically opposed water proposals, has chosen to remain neutral.

Wilkes notes that the only thing holding back passage of these amendments at this time appears to be a lack of voter turnout and apathy toward the amendments.

Constitutional Amendment No. 1 will appear on the ballot as: "The constitutional amendment to authorize the issuance of an additional $980 million of Texas Water Development Bonds, to create special water funds for water conservation, water development, water quality enhancement, flood control, drainage, subsidence control, recharge, chloride control, agricultural soil and water conservation, and desalinization, to authorize a bond insurance program, and to clarify the purposes for which Texas Water Development Bonds may be issued."

Amendment Pro and Con Offered

EDITOR'S NOTE: The following positions, both in support of and opposing the passage of Constitutional Amendments No. 1 and 2 were presented in the "Legislative Scan" as compiled by Walter B. Grubbs.

CONSTITUTIONAL AMENDMENT NO. 1

FOR:

1) An adequate, clean, and controlled water supply has been a key ingredient in making Texas a good place to live and work and in providing a strong, growing, and varied economy. The authorization of additional funding and funding mechanisms for water conservation, water development, water quality, flood control, desalinization, and other purposes is urgently needed to allow the state and local governments to continue to provide adequate, clean, and controlled water supplies for the well-being of the state's people and economy.
2) Authorization of the state legislature to create special funds for water purposes and to appropriate money to those funds will provide the necessary flexibility for the state to meet the varied and changing water needs of the state in a quick and efficient manner.
3) Expanding the state water financing programs and other programs to include flood control, desalinization, protection of the bays and estuaries, agricultural soil and water conservation, and other areas of water needs that have either been neglected or provided with inadequate resources will for the first time assure all areas of the state an opportunity to work with state government on a major scale to solve local water problems, while at the same time allowing the state to provide a more comprehensive water program for all its citizens and to address many major problems before the expense or ability to solve those problems is beyond the state's control.

AGAINST:

1) The state is facing increasing needs for services in all areas at a time when state revenues are declining and the necessity for new sources of revenue has become a pressing problem. The adoption of a water program that includes the expenditure of funds in the amount proposed by this amendment does not appear practical at such a time.
2) Before the state embarks on programs based on this constitutional amendment and its implementing legislation, more research should be done and study should be given to the state's priorities for funding and to alternative funding sources to assure that state money will be spent to fulfill state water needs in the most economically feasible manner.
3) Over the past 15 or 20 years, the state and the voters have considered many large water programs that were designated by proponents as essential for the state to meet its water problems; however, the failure to adopt those programs does not seem to have substantially affected the state's water situation and there is no proof that failure to adopt the program proposed by this amendment will have a detrimental effect.
4) Although the programs proposed by this amendment and its implementing legislation attempt to speak to a broader range of water problems than past proposals, the proposals in this amendment are still not adequate to solve many of these problems. Therefore, this program should be defeated, so that the legislature can reconsider and offer more comprehensive water proposals.

CONSTITUTIONAL AMENDMENT NO. 2

FOR:

1) Agriculture in the United States and in this state is suffering from an economic depression. At that same time, some of the most critical water problems exist in agricultural areas. Adoption of this amendment will assure that adequate funds are available to meet existing water problems in agricultural areas and to assure a healthy and viable agricultural economy.
2) As opposed to other types of funding, the issuance of state secured bonds would provide the most economical and efficient funding for agricultural water conservation assistance.

AGAINST:

1) The state and federal governments already have a multitude of agricultural programs in place, and there is no need to spend more money on new programs when adequate programs are already available.
2) If proposed Amendment No. 1 is adopted, adequate funding will be available for agricultural water conservation and the program proposed by this amendment will be an unnecessary expense.

WHO'S WHO . . . continued from page 4

storehouse of information on the ground-water resources of the High Plains, and also in preparing updates for the District's hydrologic atlases. Cindy's an excellent source of contact for persons seeking information on the water resources under a tract of land they may be considering for purchase. She also helps prepare the maps used to illustrate changes in water levels used in the cost-in-water income tax depletion program. The Internal Revenue Service engineers verify the accuracy of these maps before information from the maps can be used to support the claims.

Cindy's main "love" among her assignments is her work with the District's secondary recovery investigation. Through this work, Cindy recently helped compile a report of the results of a field test at Wolfforth and updated the results of previous field tests at Slaton and Idalou. The report comprises a mere five volumes of text and data as well as conclusions and recommendations for further investigation and research.

Cindy keeps busy outside the office working as a volunteer and through her involvement with local organizations. Cindy is a volunteer for the American Red Cross and a member of the disaster action team. As a member, she is assigned a team who is there to assist firemen and aid families that are the victims of a disaster. She is also a member of the American Business Women's Association and the American Association of Petroleum Geologists. Cindy also enjoys playing the guitar and singing.

These five special people also perform many other functions in their daily activities at the District. As District Manager A. Wayne Wyatt notes, "Each of these individuals brings an expertise to their particular assignment. Additionally, they share a concern for the residents of this area and work very deligently to see that accurate and detailed information is available concerning the ground-water resources and ground-water quality. They'll all help anyone in any way they can."

As for the "chief," Don McReynolds, we'll have more on him in next month's issue.

High Well Efficiencies Obtainable With "Agri-Screen"

The ultimate objective in the drilling of a new irrigation well is to obtain the highest possible yield with the least amount of drawdown or pumping lift. One of the principal components contributing to the potential success of high yields with minimal drawdown is the material used in construction of the well.

Higher efficiencies in the production of water can be obtained through the use of well screens as compared to that received by use of perforated or slotted well casings. However, the high cost of well screens, averaging about $40 per foot, has historically not compared favorably with the cost of perforated or slotted well casings, which cost $17 to $21 per foot. Therefore, the higher costs of well screen has forced the irrigator to choose the less efficient, but less expensive well casings.

Fortunately, the Johnson Division of Signal Environmental Systems Inc., has recognized the problem and is now offering the irrigator an efficient, reasonably priced well screen; the "Johnson Agri-Screen."

JOHNSON AGRI-SCREEN is an innovative soution to irrigators' quandary over well equipment costs versus well efficiency. The new low price makes screen a good choice over traditional perforated or slotted well casings.

Mike H. Mehmert, geologist for Johnson Industries, explains, "Ideally, the perfect well would be one that has as close to 100 percent open area to the formation as possible." The installation of any type of casing in a well, reduces the amount of open area to the formation to some extent.

Generally speaking, however, wells cannot normally be developed and produced without some type of casing to hold the formation open and allow the production of water without excessive pumpage of fine materials.

The amount of open inlet area in a well casing affects the development of the well, the volume of water the well will produce and the drawdown in the well.

"There are three key economic advantages to use of the Johnson continuous-slot Agri-Screen," notes Mehmert. "First, the screen improves the efficiency of well development." The more open area allowed through the casing in the development phase, the more effective bailing, high pressure jetting and other well development techniques will be in dissolving any mud pack created on the well borehole walls during the drilling process.

"Second, entrance velocities are lowered through use of well screen." The higher the entrance velocities of water into the well, the more apt the well is to produce sand.

With low velocities, less potential for sand pumpage is encountered, and "according to research at the Johnson plant in St. Paul, Minnesota, higher entrance velocity create higher rates of corrosion in wells. With lower velocities, there can be extended use of the screen and a longer service life for the well."

"Third, and probably most important of all," Mehmert says, "the cost of operating the well is lowered." Mehmert notes that well production costs are lowered in direct proportion to the reduction in actual drawdown, or total dynamic head, in the well. More open area allows water to enter the well resulting in lower entrance velocities, less friction and less head loss to overcome in the production of water. These losses increase the actual drawdown, thus increasing pumping costs.

One example of high well efficiency using Johnson Agri-Screen can be seen in an experiment in Paxton, Nebraska. Paul Heinrich, a producer, had a well drilled in 1978 to a depth of 380 feet that produced 800 gallons per minute at a 293 foot pumping level. The well was equipped with a 125 horsepower motor, 330 feet of column pipe and an eight stage bowl assembly.

In 1985, Heinrich drilled a new well and Johnson screen was installed. The new well produced the same 800 gallons per minute from a 217 foot pumping level using only a 90 horsepower motor, 260 feet of column pipe and a six stage bowl assembly. The screen allowed an open area of 40 percent in the new well as compared to 12 and 17 percent open area in the old well through bridge-slot casing.

The estimated savings in energy costs amounted to $1,370 per 1,000 hour season. The savings in the cost of the new pumping unit amounted to $5,280, for a total savings over the 20 year life of the well of more than $1,600 per year.

One of the first of the new Agri-Screens to be installed, was recently lowered into a new well being drilled near Clovis, New Mexico. It is expected that the installation of this screen will save the irrigator approximately 30 percent in overall irrigation costs.

Mehmert explains that the only difference in the new Agri-Screen and the Hi-Cap Screen, previously produced by Johnson, is the amount of support rods used inside the screen. The Hi-Cap Screen contained 70 support rods around which a continuous length of surface wire was wrapped. The new Agri-Screen contains only 35 support rods, but according to Mehmert, these support rods are larger than the original rods and thereby maintain the strength of the original screen.

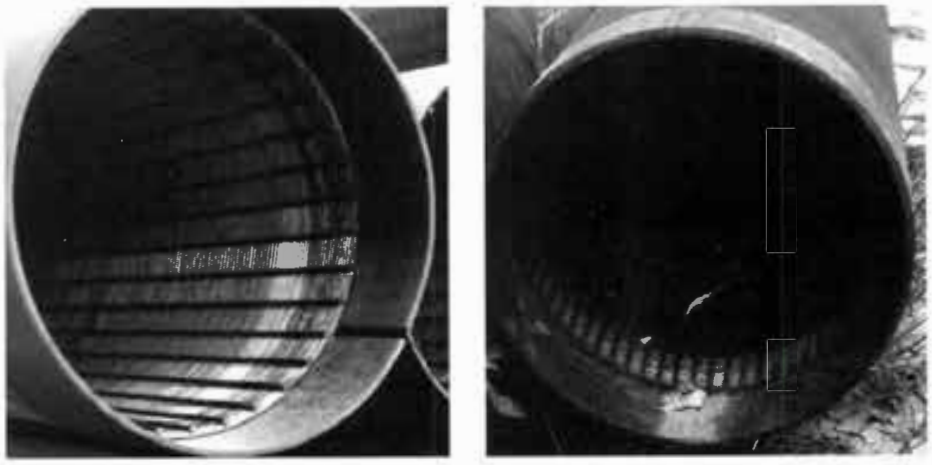
Another aspect involved in the economical cost of the new Agri-Screen, as Mehmert explains, is that it's basically just Hi-Cap screen mass produced. Johnson designed the new Agri-Screen for use primarily in drilling situations encountered in the Great Plains, Ogallala area. The screen is currently only available in 16-inch diameter and is designed for the average drilling depth in this area of 700 feet.

The new Johnson screen is installed basically the same as any currently used well screen or casings and no added labor or time is incurred. Driller, L. K. Howard of Howard and Sons Drilling Company, installed the screen in the well near Clovis. Howard notes, "The only disadvantage I see with use of screen is in removal of the screen. I doubt that the screen could ever be removed from the well in one piece." However, Mehmert notes that the Agri-Screen rated consistently stronger than other types of well casings in strength tests.

Drilling a new well these days is not cheap, and the equipment used to complete the well is no bargain either. Couple these purchasing decisions with the farmer's desire to drill a well that will produce water at the highest efficiency level possible, and you come down to an inevitable trade-off. In most past instances, the irrigator has been forced to give up some efficiency for a less expensive well.

Today, as irrigators seek efficiency in well design, there seems to be no doubt that the new Johnson Agri-Screen will find its place in the irrigation industry. "Although slotted pipe and torch-slot casings are the most commonly used pipe by drillers today," concludes Mehmert, "we can prove that there is greater efficiency with our screen, and that there is an increase of 30 to 50 percent in the well's open area to the formation. Now that we have a competitive price, we feel we can compete with the other types of casings and help the irrigator increase his production efficiency eliminating that historical trade-off."

LOWERING THE SCREEN—Drillers, L. K. Howard and Sons, install the new Johnson Agri-Screen into a well near Clovis, New Mexico. The screen slides into the hole with ease and obviously presents no additional concerns for the driller.



AN INSIDE VIEW of the new Johnson Agri-Screen (right) as compared to the Johnson Hi-Cap Screen (left) reveals the difference in the number of support rods used in the production process. The notch in the coupling ring on the Agri-Screen is used by the driller in sighting his weld.

IRRIGATORS . . . continued from page 1

water-use efficiency anywhere from 10 to 40 percent.

Under the provisions of Constitutional Amendment No. 2, the only cost to state taxpayers would be in the case of a default on a loan made under the Agricultural Water Conservation Program. Even then, the cost would be minimal.

In the case of a default on a loan, the equipment purchased under the loan would be sold at public auction. The proceeds of this sale would be used to repay the loan. Any balance remaining on the loan would then be split on a 50-50 basis between the soil and water conservation district or the underground water conservation district issuing the loan and the state.

In recent consideration and review of this constitutional amendment, the Board of Directors of the High Plains Water District, which would be one of the underground water conservation districts eligible to make loans under this bonding program, voted to apply for a loan from the pilot program fund, should the constitutional amendment pass voter approval.

Constitutional Amendment No. 2 will appear on the November 5, 1985 ballot as "The constitutional amendment authorizing the issuance and sale of $200 million of Texas agricultural water conservation bonds."

Who's Who In Our Technical Division: A Staff Update

Monitoring the ground-water resources of the 5.2 million acre service area of the High Plains Water District, updating information on the current depth-to-water in wells, and performing bacteriological and chemical water quality analyses on water samples taken from domestic and irrigation wells, requires care and an eye for detail. Fortunately, the District has five dedicated people who can handle these programs and activities with expert skill.

The four men and one lady who comprise the technical division are Don McReynolds, "the chief"; Keith Whitworth and Richard Howard, "our perfectionists"; Dan Seale, "our analyzer"; and Cindy Gestes, "our enthusiast."

"The chief" of the group, Don McReynolds, technical division director, oversees all technical division activities, including all projects related to studies of ground-water resources, both quantity and quality. "Anything that is not related directly to agricultural production or that doesn't need a permit, we get," states Don.

Included in this "catch-all" is the preparation of saturated thickness maps, which provide estimates of the quantity of water within the Ogallala Formation on a county-by-county basis. This information is also used by the District staff to supply information for landowners' claims for cost-in-water income tax depletion deductions on their federal tax returns.

"Having a dependable, good quality water supply is essential to everyone," notes Don. "It becomes particularly important when a rural family is totally dependent on a domestic water well for all their water supply needs."

The District's "analyzer," Dan Seale, is a native Lubbockite. Dan started with the District in 1968 and serves as engineer technician. Among Dan's many duties are organizing the District's water level observation well records, including annually updating the records on the wells that are a part of this program.

Additionally, Dan collects water samples to perform limited chemical and fecal coliform bacteriological analyses.

Bacteriological water quality analyses are performed by the District staff free of charge for District residents who requests this service. Upon receiving a call from someone who is concerned about the safety of their private water supply, Dan takes his "tackle box" equipped with his sampling tools and heads out to the well to collect a water sample. Dan says, "Most of the domestic wells I've checked have shown little or no contamination, and most problems can be solved with treatments of chlorine."

At home Dan keeps busy with hobbies and various special interests. Dan is currently serving as the national vice president for the National Association For Neighborhood Schools Inc., which he says is the largest and foremost anti-busing group in the nation.

Dan began working with this organization seven years ago when the busing movement first began in Lubbock, and he has since worked with local officials and political leaders to oppose busing enforcement and legislation.

Very interested in art, Dan has been taking oil painting lessons for over a year. Although he has painted all types of subjects, his favorite is scenery. "Our class has a good time, and painting is very relaxing," he comments. Dan is currently nearing completion on his latest "masterpiece" of a thunderstorm, and said his next project will be a Collie.

Dan's wife of 20 years, Dorothy, is a busy homemaker and mother of two children. Susan, Dan's daughter, is a junior at Coronado High School, and his son, Jeff, is a sophomore at Texas Tech University, majoring in pre-medicine.

Whenever Dan can squeeze extra time into his busy schedule, he helps his parents. "My parents keep themselves busy with art projects, and I enjoy helping them," he says. "We also have a lot of fun participating in art exhibits."

Another vital part of the technical division's activities involves the drafting and preparation of graphics and photographs, as well as visual aids for slide presentations, brochures, pamphlets, the District's newsletter and informational programs. The District's "perfectionists," Keith and Richard, are the men the staff turns to for help.

For seven years Keith has worked with the District as a draftsman, and he currently serves as chief of the drafting and graphic arts support unit.

A native of the Hub City, Keith graduated from Coronado High School in 1976. From high school, he went directly to work with the City of Lubbock in the utilities water and sewer division.

He and Tricia Davis married on Valentine's Day in 1981 and will be "proud parents" this November. Although Keith says he has no preference as to whether the baby is a boy or girl, he admits, "A little boy would be nice because that's what every man wants. But I really don't care."

Time permitting, Keith is very involved with outdoor sports, and has been riding motorcycles for 10 years. He is a member of the Lubbock Trail Riders. Competing in dirt bike competition, Keith won second place in his class in the 1984 High Plains Enduro Circuit. Although motorcycles have been associated with numerous accidents, Keith said that he has been very lucky and has never had a stitch or broken bone.

Keith's second passion is sailing. In fact, he said he'd give up cycling for sailing.

Adding a bit of expertise and humor to the drafting and graphics arts support unit is our assistant draftsman, Richard. Born in Plainview, Richard was reared in Lubbock and has been working with the District for the past five years.

Richard is currently working part-time in the office while he busily studies and tries to complete his degree at Texas Tech. He entered Tech as a Range and Wildlife major, but redirected his aim to a degree in Mechanized Agricultural Business and hopes to graduate in 1986.

Richard has previously worked full-time at the District and gone to school part-time. However, this year he reversed the two to complete his degree. "When I figured out that at my current rate I might graduate by the time I was 40, I had to reverse my hours," says Richard.

Richard assists Keith in, "whatever needs to be done," he notes. "When we're working on a real tight schedule, I help process photographs as well as help put slide shows together."

Richard is also trained in radiation safety and is certified to work with the neutron soil moisture monitoring equipment the District uses in its pre-plant soil moisture monitoring program.

At home, Richard spends time with his wife, Darla, and their 14-month-old son, Monty. Richard is an avid football fan, particularly the Dallas Cowboys. "I almost had to quit watching the Cowboys because I'm in a bad mood all week if they lose." Richard keeps busy around the house with yard work and is a member of the Masonic Lodge.

The one lovely lady who joins these hard working men in the technical division is our "enthusiast," Cindy. A vital part of this division, Cindy, who serves as geologist, offers her special knowledge and expertise whenever needed.

A native Texan, Cindy received her bachelor of science degree in earth sciences from Wayland Baptist University, then pursued her postgraduate studies and obtained her master's degree in geology from East Texas State University.

When Cindy first entered college, she planned on becoming a teacher, and only lacks her student teaching to receive her certification. "I changed my mind," states Cindy, "when I took a class observing children in the classroom. I knew then that I wouldn't enjoy that."

As a child, Cindy's family went on camping trips, and with her father, she observed hills and mountains, and they discussed the terrain. Spurned by her childhood memories and a college professor, Cindy changed her major during her senior year of school and aimed her studies toward earth sciences and geology.

Working with the technical division, Cindy helps measure observation wells, which provides depth-to-water measurements. Through this effort, Cindy is aided in updating the District's

continued on page 2 . . . WHO'S WHO

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
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John Houchins Joins Texas Water Commission

JOHN O. HOUCHINS, former attorney, receives the nod from Gov. White as the new member of the TWC.

On September 4, Governor Mark White named a Houston attorney, John O. Houchins, to the three-member Texas Water Commission. Houchins was appointed to the position to replace Lee M. Biggart, whose term ended on August 31. Biggart was appointed to the position by former Governor Bill Clements.

Houchins joins Chairman Paul Hopkins of Galveston County and Commissioner Ralph Roming of Parmer County on the commission.

Houchins has business and law degrees from Baylor University and a master's degree in business from the Wharton School of Finance at the University of Pennsylvania. He previously headed the Law Office of John Houchins before his appointment as water commissioner.

The Texas Water Commission meets as necessary, usually several times each week, and is charged with the protection of Texas' water resources. Houchins' new responsibilities, along with Hopkins and Roming, include review of applications for municipal and industrial waste discharge permits, review of hazardous waste and industrial solid waste management and disposal permits, ruling on surface water appropriations, ruling on weather modification permits, creating and supervising water districts, reviewing petitions to alter water rates, and issuing or denying water rights permits.

Soward Declares Strict Rules Enforcement

"A new era" for Texas water has been proclaimed by Larry R. Soward, executive director of the Texas Water Commission. Recently, Soward told each owner of a wastewater discharge permit in Texas that he is prepared to uniformly enforce all provisions of state law which pertain to water quality matters.

In a letter to each permit holder, Soward said that he is, "firmly committed to take whatever actions are necessary or appropriate to actively and aggressively enforce all rules, standards, orders, permits, licenses and laws under the jurisdiction of the Texas Water Commission."

Similar letters will be sent to owners of permits to withdraw water from the state's lakes and streams and to owners of permits to dispose of hazardous wastes.

"It is a new era in Texas," Soward said in explaining his letter. "Enforcement is going to be at the forefront of our efforts. We want everyone to know that we mean business."

On September 1, the Texas Water Commission assumed enforcement responsibilities relating to the protection of the state's waters. Those responsibilities had been under the jurisdiction of the Texas Department of Water Resources, which was abolished by the 1985 Legislature.

The Legislature also gave increased enforcement powers to the Water Commission. Hearings are now mandatory for permit holders who have been out of compliance with their permits for over four months. The Water Commission has been given increased power to levy administrative fines and civil penalties.

Soward called upon the holders of the permits to do their share to help him improve and maintain good water quality in Texas. He told the permit holders that he plans to be fair and uniform in the administration of the new responsibilities, but cautioned that he will not hesitate to fully use "whatever powers are available to me."

Notes Encourage Wise Water Management

"Don't pray for rain if you don't take care of what you get," is the first statement readers will see in a new Water Management Note recently published by the High Plains Water District. This 1937 quote by R. E. Dixon, superintendent of the Texas Agricultural Experiment Station at Spur, Texas, is just as true today as it was 48 years ago when Mr. Dixon made the statement at a field day at the Spur Experiment Station.

In an effort to encourage irrigators to harvest the rainfall they receive as well as make wise water management decisions with the irrigation water they apply to their crops, the Water District, with assistance from the USDA Soil Conservation Service, has just completed three new "Water Management Notes."

The first brochure, "Furrow Dikes, Small Reservoirs Of Yield Potential," discusses the beneficial uses of furrow dikes. Research has proven that the use of furrow dikes to harvest precipitation is the single most cost-effective conservation practice that the producer in the High Plains of Texas can implement to increase his yields and profits.

Maximum utilization of precipitation through the use of furrow dikes will help reduce the withdrawal of water from the Ogallala aquifer, reduce production costs associated with supplying the crop's water needs, and increase the potential for higher crop yields.

In this note, photographs of various types of furrow dikers are shown. Research statistics are also provided to illustrate potential crop yield increases as a result of the additional water being made available to the crops through the use of furrow dikes.

The second of the new brochures entitled, "The Pre-Plant Soil Moisture Survey, A Guide to Water Management," outlines and explains the three principal objectives of the annual soil moisture survey.

First, the survey is designed to provide the irrigator with an estimate of the amount of water in storage in the plant root zone profile prior to planting. Secondly, estimates of the amount of water needed to fill the root zone

continued on page 2 . . . NOTES

SOIL INFILTRATION is explained to SCS Chief Wilson Scaling and OMB Representative Dale Didion by SCS-SS Dan Blackstock during a recent field tour and information exchange visit by the Washington officials to the High Plains.

Dual Nozzle MFIS Sprinkler System Can Improve Efficiency

By ROBERT L. HANEY
TAES Science Writer

An irrigation system has been designed and developed to apply both water and chemicals through separate nozzle systems from the same basic moving pipe and tower structure.

The primary objective of the dual-nozzle system is for efficient irrigation, along with very accurate application, and total coverage of water-conserving type chemicals, such as antitranspirants, growth regulators and soil surface evaporation suppressants.

However, all chemicals currently being used in agricultural production may also be accurately applied through the system, according to Dr. W. M. Lyle, agricultural engineer with the Texas Agricultural Experiment Station, who with J. P. Bordovsky, developed the new system.

Lyle and Bordovsky, who earlier developed the LEPA (Low Energy Precision Application) system, say the new Multi-Function Irrigation System is a second generation LEPA system, with improvements.

It is designed to make the most efficient use of water and energy, two of the most important resources essential to maintaining a stable irrigated agricultural economy.

The economic viability of irrigation in many areas is being threatened by the high cost of energy and actual—or economically-induced shortages of water. Despite these critical resource problems, irrigation practices are often very inefficient, Lyle says, due to the inherent inefficiency of the irrigation systems in use.

This is due primarily to their inability to cope with variable soil and climatic conditions, which relate directly to the inefficiencies.

Perfection of the LEPA system, whose operation is not adversely affected by uncontrollable soil and climatic variables, has consistently yielded application efficiencies of 98 to 99 percent.

In addition, Lyle says, distribution uniformities in the range of 95 to 97 percent may also be expected, along with energy savings on the order of 30 to 50 percent, depending upon the type of conventional system being replaced and the depth from which water is being pumped.

In addition to placement of water-conserving chemicals already mentioned, another objective in the development of this system was the accurate placement of all other chemicals (fertilizers, pesticides, herbicides, etc.) in order to facilitate complete no-till crop production.

Chemigation, (the application of chemicals simultaneously while irrigating), has been accomplished with both surface and sprinkler systems. However, surface methods are obviously limited to soil-applied chemicals and the distribution uniformity of the chemical is no better than that of the applied water, which can be very low in many instances.

Chemicals injected directly into the irrigation water and applied through the sprinkler systems are also subject to the non-uniformity of the water application, which is rather drastic in high-wind conditions.

Other problems in sprinkler-applied chemicals, according to Lyle, stem from the fact that a single nozzle, located above the crop canopy, is used to apply both soil- and foliage-active chemicals.

Therefore, poor results are often noted for foliage-applied chemicals, due to washing by excess applied water. Likewise, some soil-applied chemicals are intercepted by leaves and are lost by volatilization.

Application of chemicals with ground-type (tractor driven) sprayers is often limited and untimely due to wet soil from irrigation and/or rainfall. Also, damage to crop foliage and unnecessary soil compaction are possible in the wheel tracks.

Aerial application is subject to several factors which may adversely affect coverage, Lyle says. These include canopies, wind, inversion layers and inadequate amounts of applied liquid.

Research has shown that a very low percentage of an aerially-applied chemical penetrates the lower part of some crop canopies and, therefore, fails to reach areas of insect infestation.

To overcome these deficiencies and to achieve precise chemical and water application, the Multi-Function Irrigation System has two independent and adjustable nozzle systems.

One set of nozzles is designated for irrigation through which chemicals may also be injected. The remaining nozzle system is exclusively for chemical injection.

The two nozzle systems (chemical and irrigation) are both completely adjustable in the vertical and horizontal directions.

This allows them to be positioned at any location above, in, or below a crop canopy for maximum effectiveness. Positioning is accomplished by a chain and sprocket drive system which is powered by electric motors and activated with switches from the control platform of the system.

Both nozzle systems may be operated manually or automatically. In the manual mode, after a position is selected, the nozzles remain stationary at that vertical and horizontal location.

In the automatic mode, both sets of nozzles are controlled by a programmable controller which causes the nozzles to oscillate up and down with a pre-determined amplitude in the vertical plane with any desired period of oscillation.

This allows complete coverage (top to bottom) of different size crops and can focus the chemical application to a specific location in a crop canopy.

CHEMIGATION is accomplished through the new MFIS sprinkler system designed for simultaneous irrigation and chemical application.

In the field, in order to insure precise water and chemical application, the multi-function system has a newly designed lateral-move system that gives steady uniform forward movement.

To accomplish this, Lyle and Bordovsky designed a propulsion system which utilizes variable frequency control to the 480-volt, three-phase electric motors which are the prime movers for the system.

The speed of the system is established by setting the base-operating frequency.

Guidance and alignment control is provided by linear position transducers, which provide appropriate signals to solid-state motor controllers, which in turn change the frequency to the motors necessary to bring about an adjustment in alignment or to cause the system to return to the correct track.

The new system, in 1985 tests, has achieved new levels of irrigation efficiency and effectiveness of chemical usage. We believe, Lyle says, that it sets new standards for conservation and effective use of water, energy and chemicals.

EDITOR'S NOTE: *Any question regarding this column should be addressed to Science Writer, Department of Agricultural Communications, Texas A&M University, College Station, Texas 77843.*

NOTES . . . continued from page 1

soil profile to field capacity are provided so that the irrigator can determine his pre-plant irrigation needs. And third, the Water Management Note describes how information on the distribution of moisture in the root zone soil profile can be helpful to the irrigator.

"Estimating Soil Moisture By Feel And Appearance," is the third brochure. The "feel and appearance method" of monitoring soil moisture allows irrigators to estimate the amount of moisture stored in the plant root zone at any root depth in the field without the purchase of specialized equipment.

This method of determining soil moisture conditions entails the physical collection of soil samples and firming the samples in the hand. Different soils react and appear differently when squeezed when they contain various amounts of moisture. By comparing his soils with pictures provided in this note, the irrigator can estimate the amount of water held in each soil sample.

"Irrigating By The Block, Soil Moisture Blocks and Resistance Meters," has been printed again. This Water Management Note provides a discussion of gypsum blocks and their uses when attached to resistance meters for monitoring soil moisture. Also included is a step-by-step formula for soil moisture monitoring, reading the blocks to determine current soil moisture conditions, calculating the crop's daily water use, determining the amount of water needed to bring the soil moisture profile to field capacity and determining when to irrigate.

Copies of these new brochures, or copies of other Water Management Notes can be obtained by contacting the local offices of the USDA-SCS or the High Plains Underground Water District No. 1, 2930 Ave. Q, Lubbock, Texas, 79405.

The Texas Legislature included a requirement for several local and regional water agencies to adopt and implement a water conservation program in numerous pieces of legislation introduced and passed during the past legislative session. An example of the directive is as follows:

"CONSERVATION PROGRAM. The board shall adopt and implement a program of water conservation that incorporates the practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses and that the Texas Department of Water Resources determines will meet reasonably anticipated local needs and conditions."

Sprinkler Drop-Lines Can Save Time, Money, Water

Converting a conventional high-pressure center pivot sprinkler over to the more efficient drop-line center pivot design or purchasing a center pivot with drop-lines has the potential to save the irrigator time, money and water.

Dale Gober, a Parmer County farmer who recently purchased a new drop-line pivot sprinkler system, explains his observations about the system. "This is the first year we've had the sprinkler, and I ordered it with drops down to six feet above the ground. The system was also designed to operate under low pressure approximately 20 pounds per square inch. So far, I am very impressed, even after just one irrigation season."

Gober had two similar plots of corn this year, and he watered one with a surge irrigation system and the other with his new drop-line sprinkler system. Comparing the two systems, Gober noted, "To put on about two inches of water, I ran the sprinkler for about 90 hours. It took 144 hours to water the same number of acres on the tract we row watered. That's a difference of 54 hours and on the furrow irrigated tract, I put on more water than the two inches I wanted to apply.

"After we harvested corn, I calculated my fuel cost for the irrigation season. On the row watering tract, we had a fuel cost of $51 per acre and under the pivot sprinkler our fuel cost was $41 per acre. Basically, the difference amounts to a $10 savings per acre. I am also sure that the savings with the sprinkler really amounts to more than that if you calculate the savings of not running the well and extending the life of your pump and motor.

"This year, we didn't have to pre-irrigate. In those years when we need that pre-irrigation, which is usually our most expensive watering, I think the difference in fuel cost between the pivot and row watering will be even more."

Gober also noted that the corn under the pivot yielded better than that he had furrow irrigated. "I can't say that the sprinkler made all the difference, because the acres we row water probably wouldn't yield as well as the other quarter normally because it's just not as good a quarter. I do think that we did a better job of watering under the sprinkler.

"I feel like we got a more even distribution of water everywhere in the field. When you row water, you don't get that even distribution pattern in your field. However, we did use surge to do our row watering, and I think we did a better job of row watering with the surge than we had in the past. For row watering, I'm sold on the use of a surge system.

"When our corn got to a height that it stood above our drops, we were a little bit more concerned about being able to get an even distribution pattern. We must have done all right though, because when we harvested, we couldn't tell that we had any hot spots or bad places."

Another benefit Gober noticed was an actual savings in the amount of water needed to irrigate the corn under the sprinkler. "On our row watering acres I used 1.62 acre feet of water this year. Under the pivot sprinkler I used 1.008 acre feet. In essence, I used half an acre foot less water under the sprinkler, and we made more corn per acre. I can't say that will happen every year, but I feel like we saved that much water with the sprinkler.

"One reason for that water savings is that with row watering you have to put out a lot more water than you really need. With a sprinkler you are timed on the end tower to run a certain percent every minute. The pivot moves and stops, moves and stops. If you want to put on two inches, you set your sprinkler to put out two inches, and if you're pumping the amount of gallons per minute the system is nozzled for, you are going to get that amount applied.

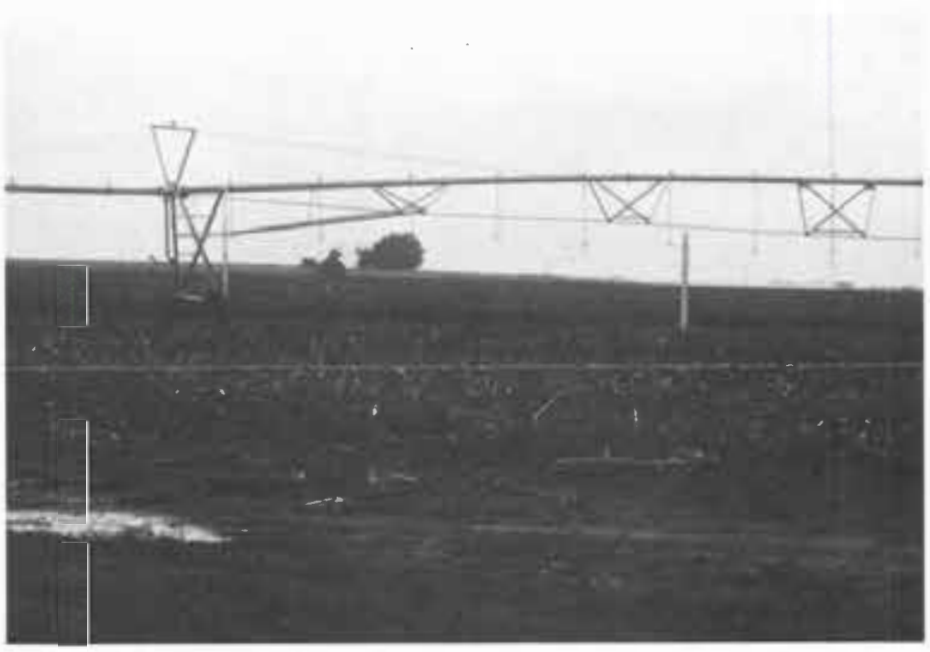
"I also think that with the sprinkler we probably don't really realize just how much it will save us. For instance, there's the time we saved in getting the field ready to row water, and we normally spend a lot of time putting up borders and laying out pipe as well as all it takes in fuel and labor."

Additionally, Gober was able to apply all the nitrogen he needed for his corn through the pivot sprinkler system and eliminate tractor trips across the field to apply fertilizer. "Depending upon the tillage operation, we figure we can save anywhere from $2 to $5 per acre for each trip," he said.

"I have one system that is pumping about 500 gallons per minute, and I dropped it on down to about 12 inches off the ground. I think that works well with the smaller well yield. With my 1,000 gallons per minute system, dropping that far down seems to be hard on the crop. By that I mean it is just like a hard rain, which is rough on the foliage.

"We're still pumping the same amount of water as we used to, but the same amount does a little more good. The name of the game is profit. I only watered this cotton once and did not pre-water. I don't have a lot in this crop, so a bale an acre is not bad."

"I USED HALF AN ACRE FOOT LESS WATER UNDER THE SPRINKLER, AND WE MADE MORE CORN PER ACRE."



DROP-LINES hang dormant now after having served their purpose of applying irrigation water and fertilizer to the harvested corn crop while cutting the hours and water needed to do the job.

Planning the work needed to get both fields ready for next year, Gober counts about 11 tillage trips that will be needed to prepare his row watered field for next year's crop. "Under the sprinkler I think I will be able to limit my tillage trips to seven trips," he said.

"I have no doubt that the sprinkler will pay for itself. In fact, I believe it would pay for itself in the savings on plowing and fuel costs alone. I think we can operate more on a minimum till basis and be in the field less times with the sprinkler. Again, I believe we don't really realize just how much time and money we spend in getting a field ready to row water."

John Lee Carthel who farms in Floyd County, echoes some of the same advantages in using his drop-line pivot sprinkler systems. "There is a fuel cost advantage, as well as an advantage in the uniformity of your water distribution.

"I started out with a conventional pivot with low pressure nozzles. Then in 1978 and 1979, I dropped down to seven feet above the ground. Two years ago, one of my neighbors went to drops all the way to the ground, or just below his knee cap. I watched him for a year or two and the drops really did seem to help his corn uniformity.

"The big advantage that I see to the drop-lines is that you have less evaporation. The fellow that does my entomology monitoring for me commented that since I put in the drop-lines, my crop is a lot more even than it was before.

"I think I saved myself some money by cutting down the evaporation and getting a more even application. I can put on a lighter application and still do the job. With the seven foot drops, I found I had to apply more water to get a very even application, and even then on the nozzles next to the pad, I had lots of places that did not get enough water. That was really the reason for bringing the drops on down.

"My drops are right at the top of the cotton, about 18 to 20 inches off the ground. I just try to get a good wetting pattern. Right now, I think the cotton I have this year will make about a bale per acre.

Each irrigator has pondered making the conversion to complete drops down to the ground for a Low Energy Precision Application (LEPA) system. "When a fellow gets more versed in running a sprinkler," noted Gober, "LEPA would probably be the way to go." Carthel thought about the LEPA system as well and said, "I may go that far eventually."

Whether either man decides to go all the way to the ground with the pivot system, each has noticed substantial savings in time, money and water through the use of drop-lines to feed water to their crops in a more efficient and uniform manner.

HANGING ABOUT KNEE HIGH, John Lee Carthel's drop-lines provide the even watering pattern that he is looking for.

Fair Displays Exhibit Water Conservation

Conserving water resources and promoting conservation in both rural and urban communities is one of the principal goals of the Water District. To exemplify these efforts, the District displayed exhibit booths at the Amarillo Tri-State Fair and the Panhandle South Plains Fair in Lubbock.

The Tri-State Fair exhibit was an educational game that challenged children and adults to correctly answer questions dealing with everyday water usage in and around the house. The game, which resembles an old fashioned pinball machine, featured the "Water Wizard." Questions in the game included; how much water is needed to take a bath, how many gallons are used to brush your teeth and how much water is used to water the lawn in one hour.

CARTOON PANELS and the "Water Wizard" draw players in to test their knowledge of home water use.

To play the game, the player selects a question by turning the pointer to one of the questions printed on the face of the table. The player then selects an answer from those printed on the game board and presses the corresponding button to signal his answer. If the player chose the correct answer, small water drops leading to the drop marked "Yes" lit up. However, if the player selected the wrong answer, lights lead to the "No" water drop, letting the player know that his answer was incorrect.

To promote water conservation on the farm, a working model of a surge irrigation system was exhibited at the Panhandle South Plains Fair. Surge irrigation practices continually capture the interest of furrow irrigators, and the exhibit was designed to provide information to producers who might be considering the purchase of a surge valve and a time control mechanism.

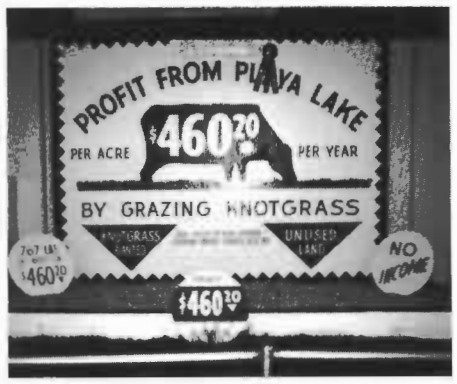
Surge users say that 10 to 40 percent less water is needed to irrigate their fields than with conventional furrow irrigation systems. Surge systems give irrigators a chance to improve the uniformity of their water application as well as eliminate deep percolation and tailwater runoff. Not only do surge systems save water and time, they reduce the irrigator's energy costs.

With wise water use being a top priority on the Texas High Plains, many individuals and groups have joined to remind residents that water conservation is of vital importance. At the Panhandle South Plains Fair, two area Vocational Agriculture programs entered exhibits which emphasized the importance of wise water use and conservation as well as innovative farm management concepts.

The Vocational Agriculture Department of Frenship High School won a blue ribbon with their display encouraging the establishment of knotgrass in playa basins for livestock grazing. Especially suited for playa lakes in the Texas High Plains, knotgrass spreads by creeping stems above and below the ground, forming a thick flat mat in ditches and playa basins. Because of its remarkable growth, knotgrass is readily grazed by cattle and horses from spring until fall. Knotgrass can also withstand heavy grazing, is valuable in preventing soil erosion and will withstand long periods of time under water.

The Monterey Vocational Agriculture Department also won a blue ribbon for their entry. Their exhibit emphasized water conservation through a display demonstrating the savings incurred by producers who use furrow dikes. Using the Growers Seed Association as a reference, the display stated that furrow diking can increase cotton income an estimated $20 per acre.

Research has proven that using furrow dikes to harvest precipitation is the single most cost effective conservation practice that area producers can implement to increase crop yields and profits. Through the use of furrow dikes, the withdrawal of water from the Ogallala aquifer can be reduced and production costs associated with supplying crop water needs are lowered.



AREA VO-AG STUDENTS' exhibits promote the benefits of knotgrass and furrow dikes to fair-goers at the Panhandle South Plains Fair.

STARTING OFF ON THE RIGHT FOOT— Robinson stops by the Water District to establish a cooperative working relationship between the Extension Service and the District.

Robinson Assumes Direction Of Local Extension Service

Robert G. "Bob" Robinson, a veteran educator with the Texas Agricultural Extension Service, has been named that agency's new district director for agricultural programs in the 20-county South Plains District.

Following the retirement of Billy Gunter on August 31, Robinson assumed the district post on September 1. Robinson has served as Randall County Extension agent for agriculture for the past nine years.

In Randall County he was responsible for educational programs for agriculture, and for the Randall County Program Building Committee area committees in beef, swine, dairy, crops, horse, sheep and horticulture-gardening. Additionally, he trained several assistant agents and his annual demonstration tour and implement show was attended each year by more than 200 producers and agribusiness leaders.

A native of the Amarillo area, Robinson grew up in Happy, Texas. He holds a bachelor of science degree in agriculture from West Texas State University and a master's degree in animal sciences from Texas A&M University.

Robinson joined the Extension Service in 1970 as assistant county agent in Potter County. In 1972, he was named county extension agent and was appointed Randall County Extension agent in September 1976.

In assuming his new role, Robinson spent several days during those first few weeks visiting with each county extension agent, getting to know the area and visiting with area agencies who share the Extension Service's goals.

Robinson notes, "The role of the Texas Agricultural Experiment Station is to develop the research. Our role, that of the Texas Agricultural Extension Service, is to get the information to the producers. We have to be on the leading edge in this critical time for the agricultural producers. That's our challenge, and we are going to do our part."

THE CROSS SECTION (USPS 564-920)
HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
2930 AVENUE Q
LUBBOCK, TEXAS 79405

SECOND CLASS PERMIT

THE Cross SECTION

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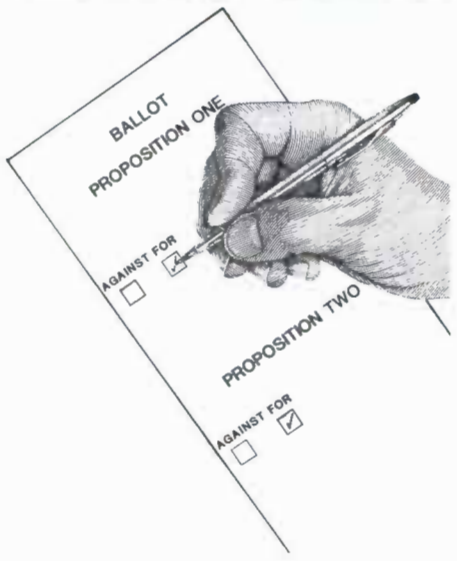
Voters Resoundingly Approve Texas Water Package



In statewide balloting on Tuesday, November 5, voters overwhelmingly approved both Propositions One and Two, the Constitutional Amendments otherwise known as "the Texas Water Package."

Approval of these two amendments by state voters authorizes the issuance and sale of an additional $980 million in water development bonds for municipal financing and $200 million in bonds to create the Agricultural Water Conservation Program. Additionally, a $250 million loan guarantee program was established with passage of these two amendments.

Statewide, 74 percent of the votes cast were in favor of Amendment One, while Amendment Two was passed with 69 percent of the vote in favor of the amendment.

Congratulations In Order

The Board of Directors and staff of the High Plains Water District are delighted with the percentage of voter turnout for this important election and with the percentage of voter approval for both of the water amendments in the High Plains of Texas. The Water District's Board of Directors expresses its sincere appreciation to the people of the area for their support in the passage of these constitutional amendments.

Additionally, the Water District's Board of Directors congratulates all of those who worked hard to inform state voters regarding the specific provisions of these constitutional amendments and encouraged voters to participate in the election.

Special commendations are extended to Governor Mark White, Lt. Governor Bill Hobby, Speaker of the House Gib Lewis, Senator John T. Montford of Lubbock and Representative Tom Craddick of Midland for their untiring efforts in bringing enlightening information to the citizens throughout the state on these amendments.

Waiting Period Required

Texas law requires a waiting period of 60 days prior to implementation of the enabling legislation following a constitutional amendment election. This allows for contest of the election,

continued on pg. 3 . . . WATER PACKAGE

SECONDARY RECOVERY UPDATE

Tests Produce Water-Level Rises, Rules Of Thumb

Progress on the investigation of the release of water from the wet sands of the Ogallala Formation has to date been very gratifying. A tremendous amount of knowledge has been gained since the investigation of the concept began in mid-1981.

Field Tests

Three sites have been field tested and the changes in water levels which have occurred at each site are illustrated on the maps on pages two and three of this issue of *The Cross Section*. The maps illustrate rises in water levels which have been measured at various time intervals following the air-injection tests.

The first item of significance observed from these tests is the fact that water levels rose following each test, which indicates that water is released when air is injected under pressure into the wet sand formation. Secondly, water level rises continue to occur for at least a three-year period after an air-injection test has been conducted.

Thirdly, it has been noted that the length of time that air needs to be injected into the formation is relatively short; and there is a direct relationship between the volume of air injected and the injection pressures to the area of material which can be stimulated to release water.

All three of the field sites tested thus far are located in areas that have a high density of wells that have been seasonally pumped. This has made it somewhat difficult to monitor the total effects of secondary recovery operations. Pumpage of local wells masks, to some extent, the long-term drainage.

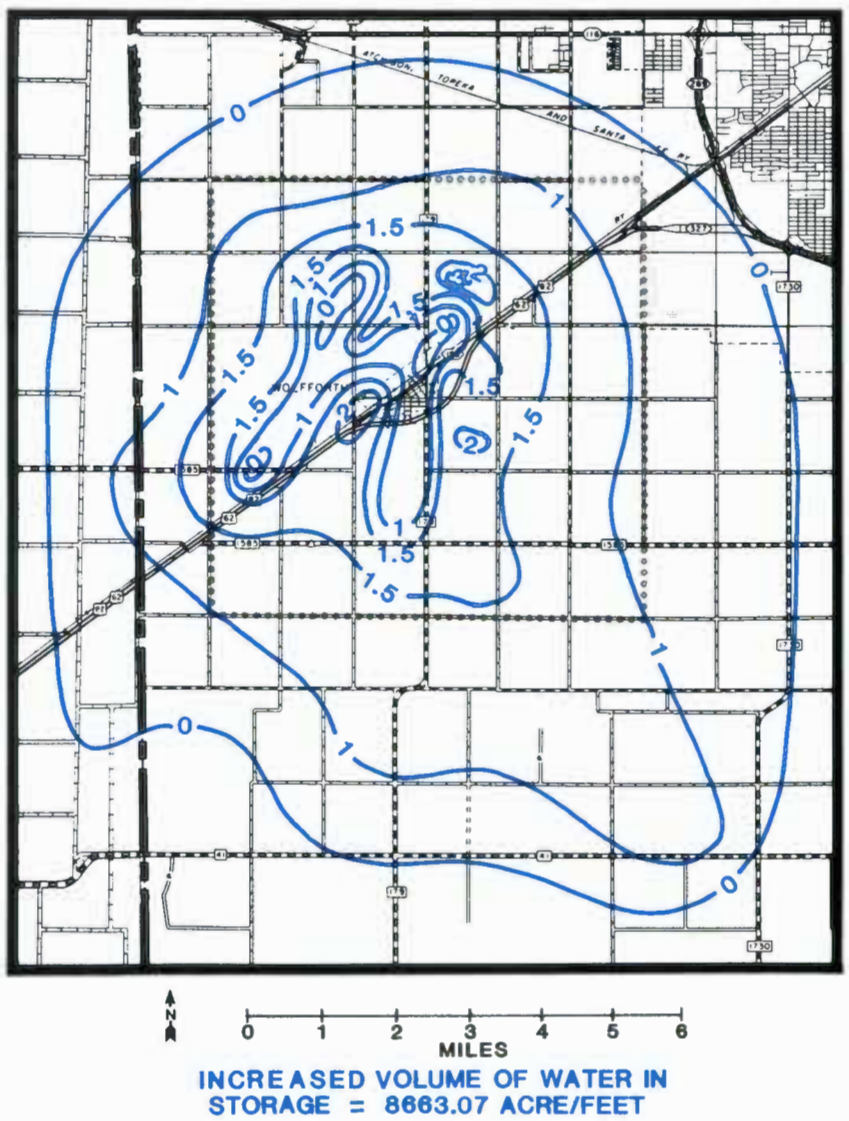
The increases in the quantities of water in storage illustrated on the maps do not reflect the amount of water that has been removed from the aquifer by pumpage in area wells, nor the addition of water to the aquifer from natural recharge and/or irrigation recirculation. The numbers presented reflect only the net increase in water levels at specific time intervals following the air injection tests.

Rules Of Thumb Developed

The learning experience associated with these three field tests of the theories of secondary recovery of water has lead to the development of "rules of thumb" as to the distance from the air-injection well that the formation will be stimulated adequately to release capillary water with certain air volumes and pressures. This rule of thumb has been expressed in a mathematical equation. A greatly simplified version of the formula with examples has been developed for the lay person who does

continued on page 2 . . . TESTS

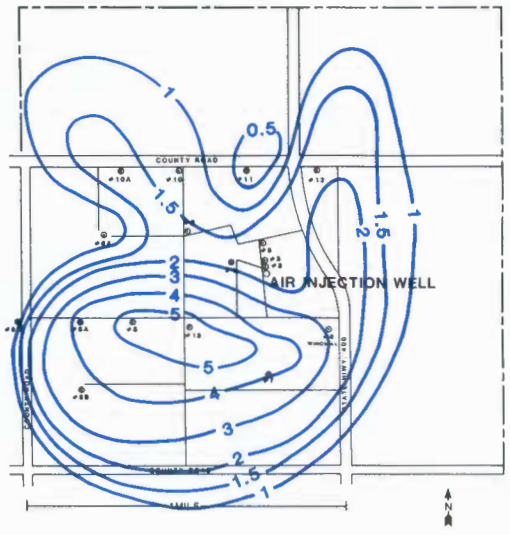
CHANGES IN WATER LEVELS – WOLFFORTH TEST SITE
OCTOBER 17, 1983 TO MARCH 7, 1985
(CONTOURED IN FEET)



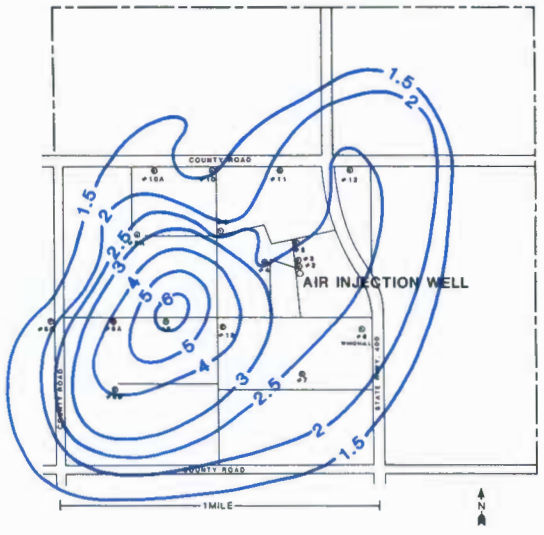
INCREASED VOLUME OF WATER IN STORAGE = 8663.07 ACRE/FEET

Idalou Test Site Water-Level Rises Contoured

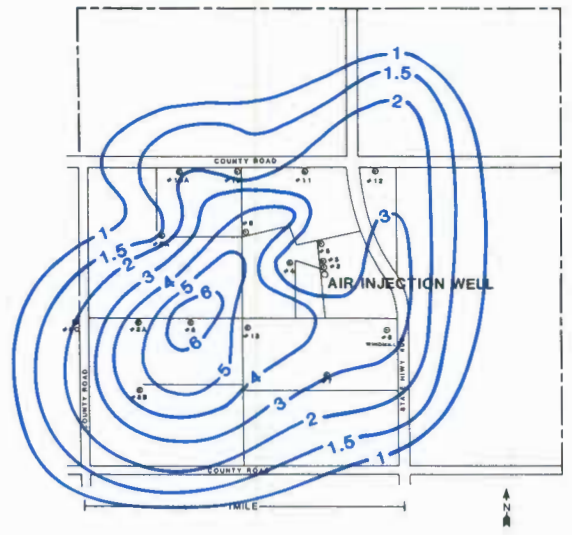
CHANGES IN WATER LEVELS – IDALOU TEST SITE
JUNE 26, 1982 TO SEPTEMBER 30, 1962
(CONTOURED IN FEET)
INCREASED VOLUME OF WATER IN
STORAGE = 371.33 ACRE/FEET



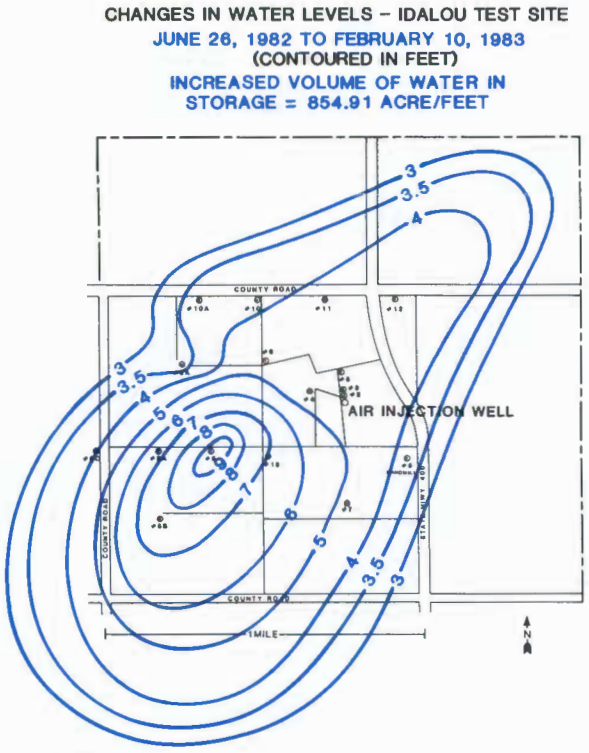
CHANGES IN WATER LEVELS – IDALOU TEST SITE
JUNE 26, 1982 TO OCTOBER 26, 1982
(CONTOURED IN FEET)
INCREASED VOLUME OF WATER IN
STORAGE = 453.47 ACRE/FEET



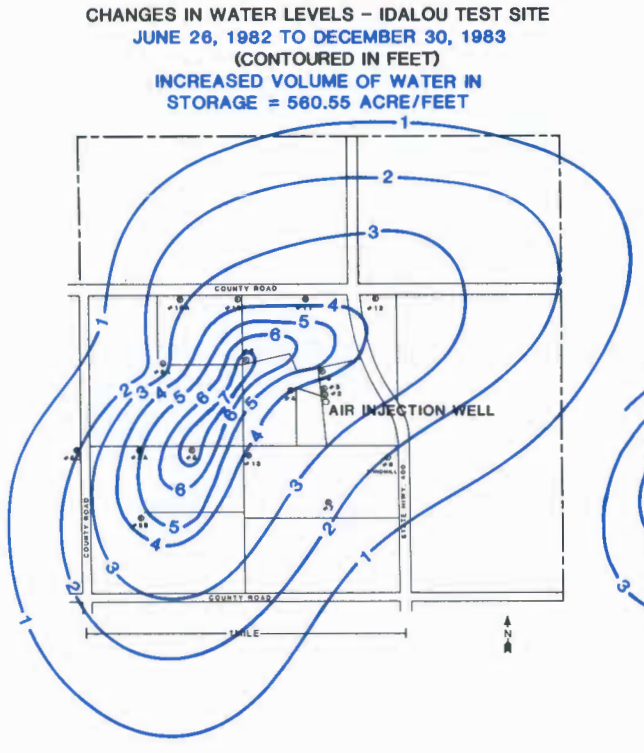
CHANGES IN WATER LEVELS – IDALOU TEST SITE
JUNE 26, 1982 TO NOVEMBER 29,1982
(CONTOURED IN FEET)
INCREASED VOLUME OF WATER IN
STORAGE = 425.69 ACRE/FEET



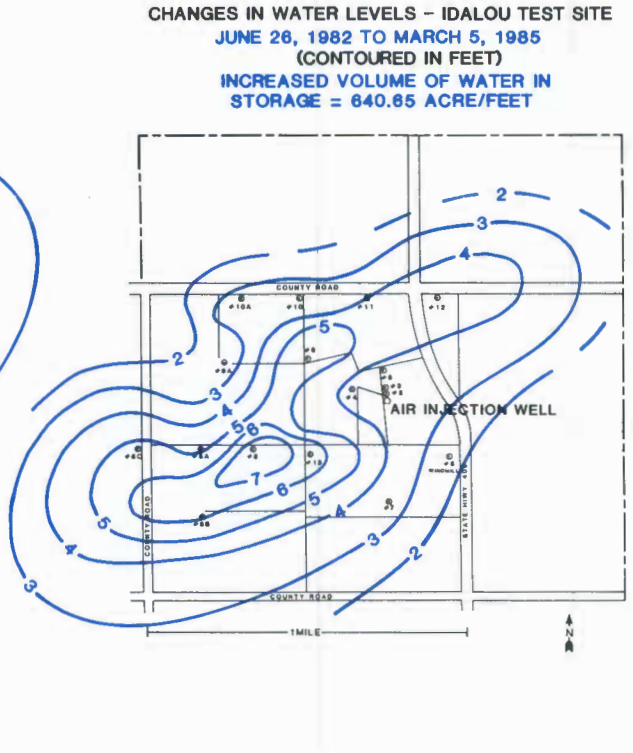
CHANGES IN WATER LEVELS – IDALOU TEST SITE
JUNE 26, 1982 TO FEBRUARY 10, 1983
(CONTOURED IN FEET)
INCREASED VOLUME OF WATER IN
STORAGE = 854.91 ACRE/FEET



CHANGES IN WATER LEVELS – IDALOU TEST SITE
JUNE 26, 1982 TO DECEMBER 30, 1983
(CONTOURED IN FEET)
INCREASED VOLUME OF WATER IN
STORAGE = 560.55 ACRE/FEET



CHANGES IN WATER LEVELS – IDALOU TEST SITE
JUNE 26, 1982 TO MARCH 5, 1985
(CONTOURED IN FEET)
INCREASED VOLUME OF WATER IN
STORAGE = 640.65 ACRE/FEET



TESTS . . .

continued from page 1

not delight in unraveling complicated mathematical equations. The formula and equations are being checked for accuracy by project advisors and will not be expressed here, but will be available in the near future for those desiring this information.

Original Estimates Accurate

The Water District has not changed its opinion as to the potential quantities of water which might be released by secondary recovery operations in the Ogallala Formation in the High Plains of Texas. Early studies indicate that there are 840 million acre-feet of capillary water currently in storage in the wet sand section of the Ogallala Formation in the High Plains of Texas. There will be an additional 640 million acre-feet of capillary water in storage in that portion of the formation currently saturated when it is dewatered. At least 25 percent of the capillary water present can be released for future recovery by wells by the air injection process.

One misconception that tends to crop up from time to time involving the theory of secondary recovery is that the injection of air into the formation pushes the water up in the well, and that pressures are maintained on the formation to hold this water at an artificially high level. In all three field tests, shortly after the injection of air had been completed, air monitor valves were opened, and the air injected into the formation and resultant pressures were released. These artificial formation pressures and the volumes of air injected had dissipated within a short period of time.

Land surface elevations have been taken before and after the air-injection test at each site. There is no indication that land subsidence has occurred as a result of any secondary recovery test.

Additionally, water quality analyses were made prior to, during and after the Wolfforth field test. These analyses do not indicate any significant change in water quality at this site.

Future Plans

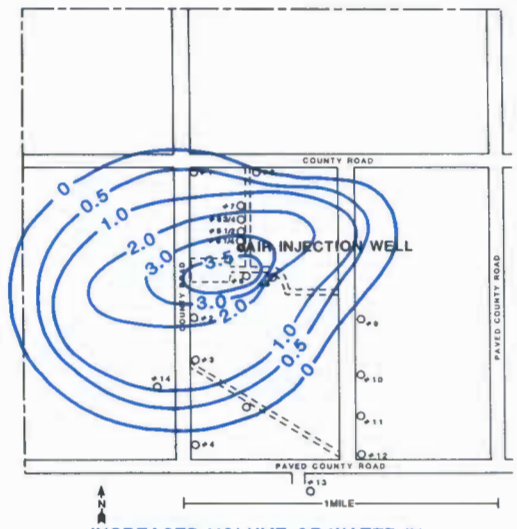
Several cities have indicated an interest in using secondary recovery techniques to increase their water supplies. However, none have immediate plans for doing so, because, at the present time, they do not need additional water to meet their foreseeable future demands.

The agricultural economy is such that even though many irrigators have expressed an interest in increasing their current water supplies, it would be difficult for them to economically justify the expense unless they absolutely had to have additional water supplies for irrigation. Fortunately, this is not the case.

The Water District hopes to develop a regional air-injection test utilizing existing unused gas transport lines to transport the air to be injected and to negotiate for a power supply to run the compressors during off-peak power use periods to lower the energy costs. It is believed that such a regional test would subject a wide variety of formation characteristics to the effects of secondary recovery. Through the monitoring of changes in water levels which occur throughout the region, researchers believe that at the conclusion of the test they can identify the best and least productive areas and possibly determine why some results were obtained. This information should prove beneficial in advising local landowners and operators as to expected results of secondary recovery operations under particular site specific conditions.

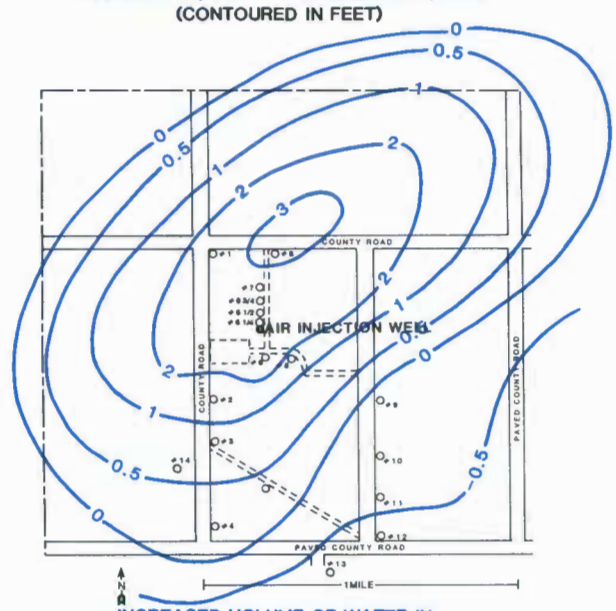
Contours Show Slaton Water-Level Rises

CHANGES IN WATER LEVELS – SLATON TEST SITE
DECEMBER 23, 1981 TO DECEMBER 7,1982
(CONTOURED IN FEET)



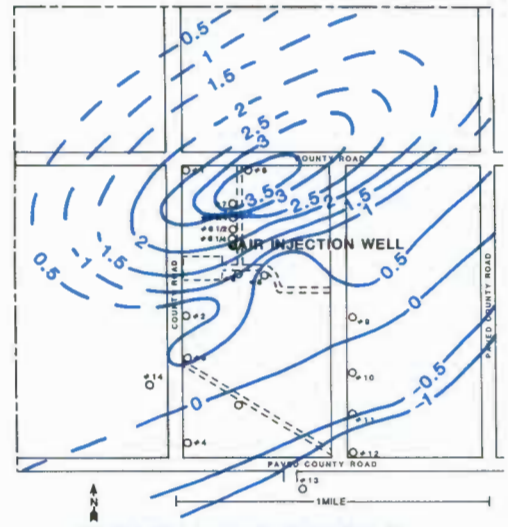
INCREASED VOLUME OF WATER IN STORAGE = 43.73 ACRE/FEET

CHANGES IN WATER LEVELS – SLATON TEST SITE
DECEMBER 23, 1981 TO DECEMBER 30, 1983
(CONTOURED IN FEET)



INCREASED VOLUME OF WATER IN STORAGE = 201.68 ACRE/FEET

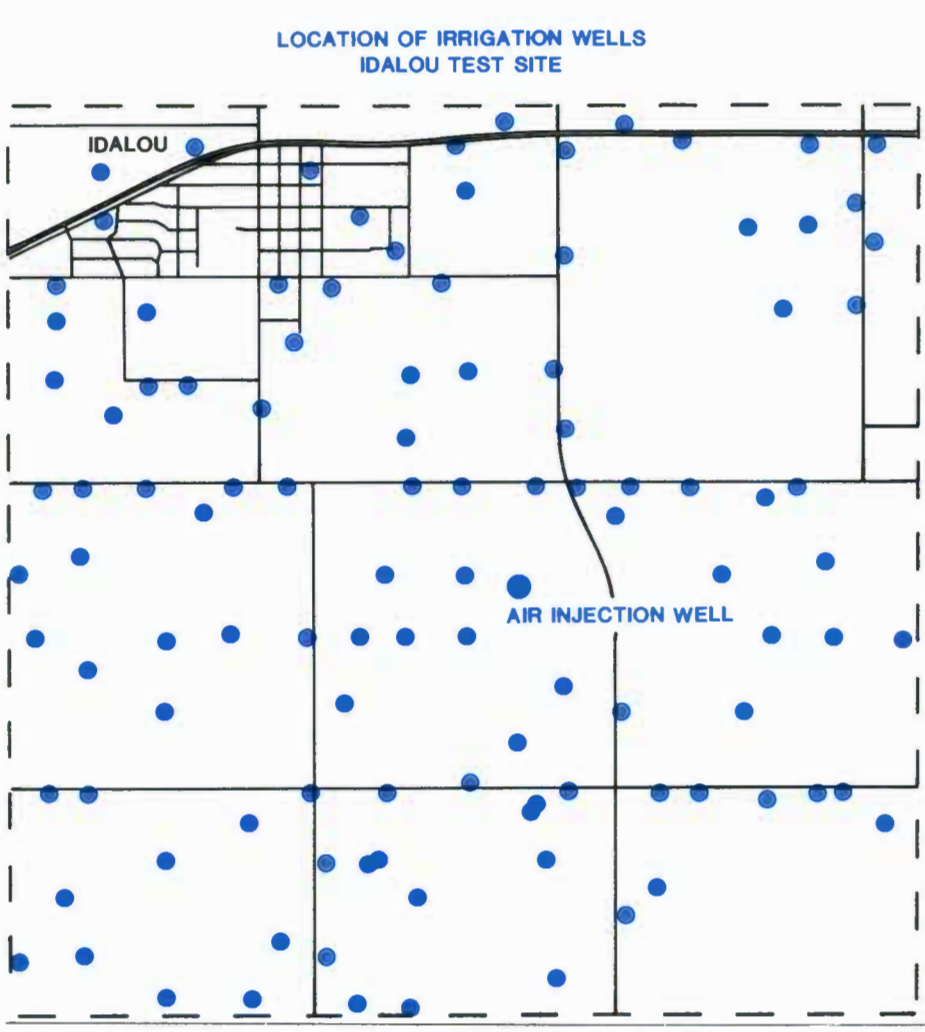
CHANGES IN WATER LEVELS – SLATON TEST SITE
DECEMBER 23, 1981 TO MARCH 5, 1985
(CONTOURED IN FEET)



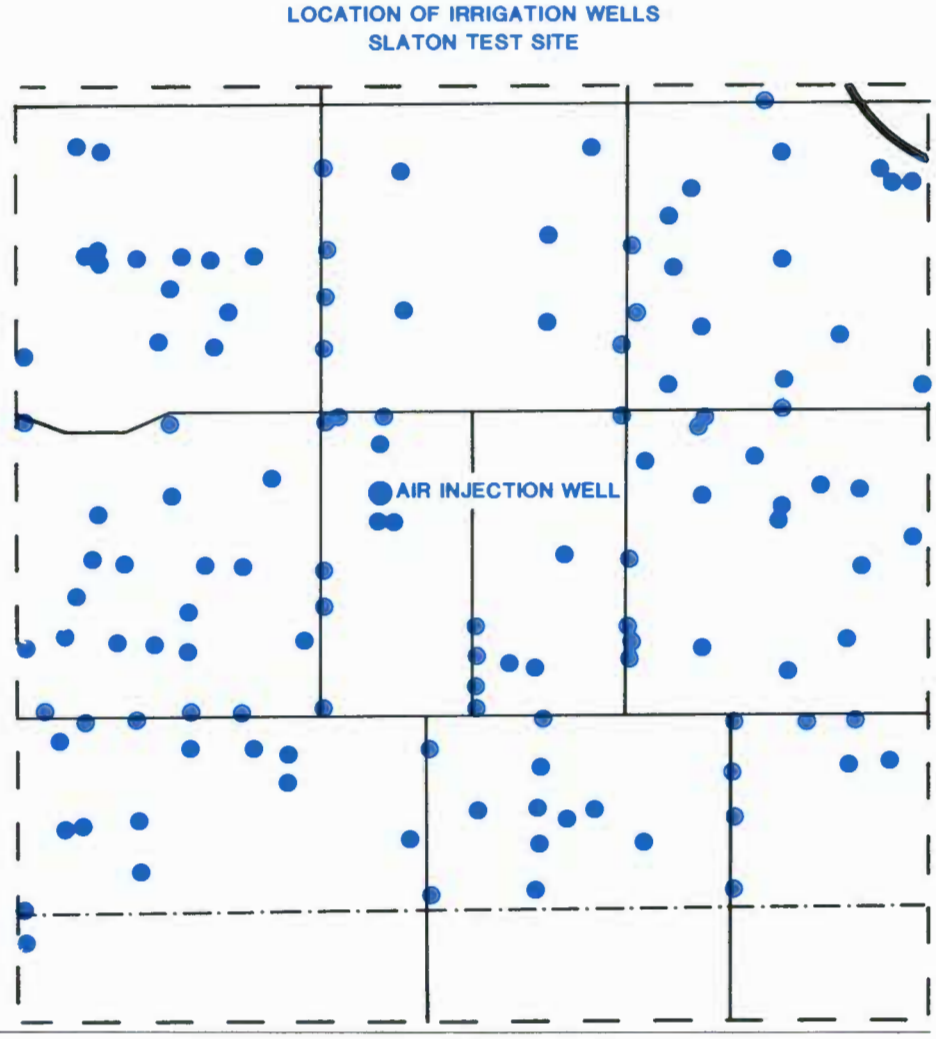
INCREASED VOLUME OF WATER IN STORAGE = 196.99 ACRE/FEET

Irrigation Wells Dot Test Site Areas

LOCATION OF IRRIGATION WELLS
IDALOU TEST SITE



LOCATION OF IRRIGATION WELLS
SLATON TEST SITE



WATER PACKAGE . . .

continued from page 1

should anyone believe irregularities occurred during the election. With this waiting period in mind, January 5, 1986, will be the first date on which action can be taken under the enabling legislation, House Bill 2, for these two constitutional amendments.

Board Prepares For Amendment Two

The Board of Directors of the High Plains Water District, after consulting with its 75 elected county committeemen, has submitted an informal request for a loan of one million dollars to begin implementation of the pilot agricultural water conservation loan program within its service area.

On November 21, the Texas Water Development Board met in Austin in a work session to begin developing guidelines for the implementation of this loan program.

The staff of the Water District has been directed by its Board of Directors to proceed in its efforts to secure a loan and develop guidelines for the loan program within the District's service area. These guidelines will be presented for Board consideration during the regular December meeting.

Persons interested in obtaining an agricultural water conservation loan from the Water District, or who think they might be interested in obtaining such a loan, may contact the Water District office. Following this initial contact, names will be added to a mailing list which will be used to keep interested parties informed of progress made in our efforts to make these loans available to local irrigators.

Information On Amendment One To Be Provided

Additionally, the Water District will be mailing information on how cities within its service area can make applications for loans available following passage of Proposition One to each city within its service area.

SCS Target Funds Beneficial To Area Irrigators

By TIMOTHY J. DYBALA
Agriculture Engineer,
USDA-Soil Conservation Service

Eight counties in the Lubbock area continue to benefit from increased funding and personnel levels as a result of the U. S. Department of Agriculture's targeting program. The purpose of this special program is to provide assistance to local farmers who are trying very hard to conserve the waters of the Ogallala aquifer. The counties included in the targeting program in the Lubbock administrative area of the Soil Conservation Service are Bailey, Cochran, Crosby, Floyd, Hale, Hockley, Lamb and Lubbock.

Mobile Field Water Conservation Laboratories receive heavy use during the irrigation season. The eight labs in the Lubbock area have been provided by the High Plains Underground Water Conservation District No. 1 with assistance from the Texas Water Development Board, State Soil and Water Conservation Districts, County Commissioners' Courts, and others. The equipment in these mobile laboratories is used by Soil Conservation Service employees to evaluate on-farm application efficiencies at the request of local irrigators. This information is interpreted by SCS technicians so that the farmer can decide how he can make improvements in his irrigation system to make optimum use of water.

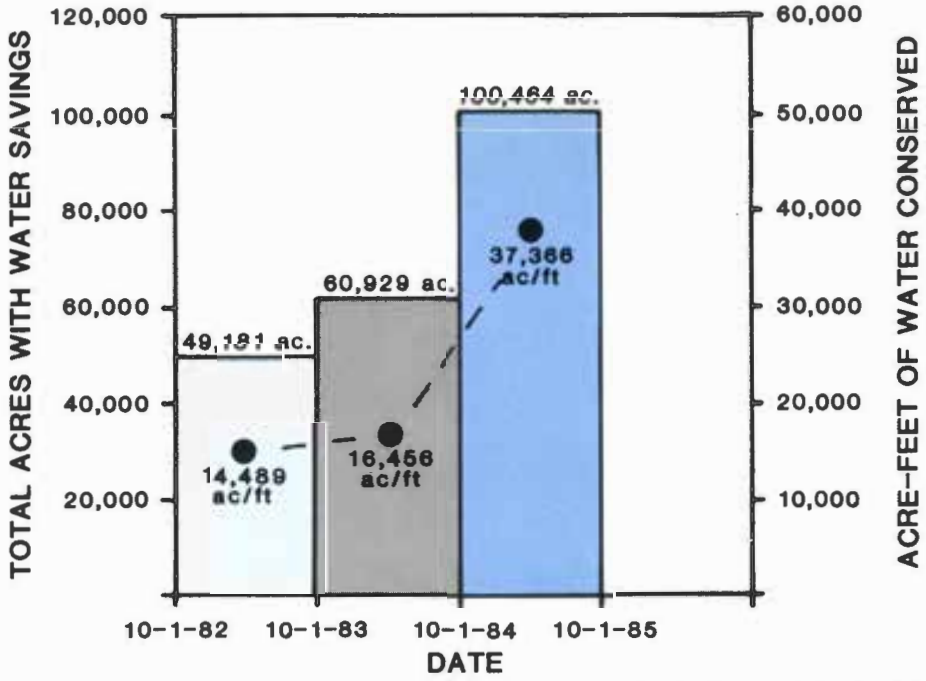
Soil Conservation Service water management assistance in this eight-county area during the past year has resulted in an estimated 37,366 acre-feet of water savings through increased irrigation efficiencies or reduced groundwater depletion. Irrigation system efficiencies were improved an average of 16.7 percent on 71,270 acres of irrigated land this past year. A total of 100,464 acres were reported to have water savings in 1985 as a result of local irrigators implementing advice given by SCS personnel.

These water savings were realized through better management by individuals after receiving some type of technical assistance. This aid may have taken one of several forms. Evaluations of pumping plants and irrigation systems, as well as planning assistance for conservation tillage, furrow diking, contour farming, and level terraces allowed Soil Consevation Service personnel to make recommendations on how to conserve water. A summary of irrigation system evaluations for the Lubbock area during the past year include:

22 furrow irrigation systems evaluated,
32 center pivot irrigation systems evaluated,
2 stationary sprinkler systems evaluated,
230 pumping plants checked for efficiency and cost, and
43 pumping plants checked for cost.

The water conserved by these efforts has an immediate impact on the irrigator in terms of the cost of pumping water. In the target area, it costs an average of $4.00 per acre-inch for fuel to pump irrigation water. Fuel savings resulting from not having to pump 37,366 acre-feet of water during 1985 would amount to $1,793,568. Sixty-eight thousand three hundred and eleven acre-feet of water with a value of $3,278,928 (fuel savings) have been conserved by irrigators in the last three years (see bar graph).

One other way of looking at the amount of water conserved by targeting efforts is to compare it to the water needs of area cities and towns. Water conserved since the beginning of the targeting program in the Lubbock area is enough to supply the City of Lubbock for approximately 21 months. For towns such as Brownfield and Lamesa, the water conserved would be adequate, at the present rate of consumption, to supply their needs for 42 years.



ANNUAL SUMMARIES of the amount of water saved as a result of improved irrigation efficiencies are illustrated above. Annual water savings achieved in 1983 and 1984 have probably been maintained in each succeeding year, so that the cumulative benefits of this program are significantly greater than revealed in the actual yearly totals.

Efficiency Discussed With Ag Lenders

Members of the financial community who are responsible for the consideration of agricultural production loans were recently presented with information on the cost-effectiveness of on-farm water and energy efficiency improvements which can be made to help producers reduce production costs while maintaining or possibly increasing crop yields.

On November 19 and 21, the High Plains Water District in cooperation with the North Plains Water District, the Panhandle Ground Water Conservation District, the USDA-Soil Conservation Service, the Texas Agricultural Extension Service, the Texas Agricultural Experiment Station and the College of Agricultural Sciences at Texas Tech University, conducted conferences in Lubbock and Amarillo, respectively, to share efficiency information with financial lenders.

The basic premise behind these two meetings was to inform the financial community of on-farm efficiency improvements which can be made, the documented savings which can be attained as a result of these improvements, and to encourage these lenders to consider financing for efficiency improvements when they consider farm operational loans.

In opening remarks, Dr. Kary Mathis, chairman, Department of Agricultural Economics at Texas Tech University, noted that on-farm efficiency improvements must be adopted for producers to improve the profit potential of their farming operations. Additionally, Dr. Mathis encouraged the lenders in attendance to consider efficiency improvements on an individual farmer and farming situation basis.

During the course of the day's activities, lenders representing local banks, Farmers Home Administration, Production Credit Associations, Federal Land Bank and other agencies concerned with farm financing heard discussions on the economic benefits of efficient farming techniques such as the installation of underground pipeline, surge irrigation systems and center pivot sprinkler systems. Additional topics included playa lake modification and playa water reuse, furrow diking, conservation tillage farming systems and pump plant efficiency evaluations.

Mickey Black, Area Conservationist for the Lubbock Administrative Area of the Soil Conservation Service, noted that the results of efficiency evaluations performed during the period 1983 to 1985 on 210,000+ acres had resulted in efficiency improvements on 81 percent of the land evaluated, for a weighted efficiency improvement of 14.5 percent.

Bringing all of the concepts back to the producer's perspective, Mack Hicks, vice president, Board of Directors, High Plains Water District and manager of Whiteface Farms, noted that landowners and operators do need help in financing equipment to improve their efficiencies. In relating his personal experiences with modification of a center pivot sprinkler system to the more efficient drop-line system, Hicks noted, "I didn't realize how much all of these things affected me. We are fortunate at Whiteface Farms to be in a profitable situation as a result of all the changeovers we have made."

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