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OKLAHOMA water news

MONTHLY NEWSLETTER OF THE OKLAHOMA WATER RESOURCES BOARD

Secondary Recovery Works on Oil; Why Not Ground Water?

Conservationists agree that if mankind continues to borrow from nature that which he cannot repay, earth's most vital natural and human resource, water, could become a priceless commodity, bought and sold in the open market.

Underlying a substantial portion of western Oklahoma, primarily the agricultural-rich Panhandle, is a vast reservoir named the Ogallala Aquifer. This primordial water storage tank, which contains some 86.6 million acre-feet of water, stretches under eight states through the High Plains region of the central U.S. (One acre-foot equals 325,000 gallons.)

Although the Ogallala underlies only nine percent of Oklahoma, the contribution it makes to the economy is crucial. Ogallala water nourishes 75 percent of Oklahoma's total irrigated wheat, 85 percent of the total irrigated sorghum and 76 percent of the state's total feed corn crop. Nationally, the aquifer provides 30 percent of the total water used for irrigation.

Since the 1950's, irrigated agriculture in Oklahoma has increased each year by an average rate of 7.5 percent. The annual overdraft in the Ogallala—water extraction exceeding recharge—is 14 million acre-feet, an amount equal to the natural flow of the Colorado River. And as the water table declines, the cost of drilling for water increases exponentially. According to some Ogallala-watchers, depletion may occur in some areas within 10 years, and they surmise, natural recharge will raise the Ogallala's fluctuating water level a mere two feet in 100 years.

Many methods have been proposed to preserve this precious resource; among them, improving management practices, regulating water use, weather modification, constructing additional surface impoundments, altering cropping practices, water transfer and simple conservation. Unfortunately, many of these methods remain politically and economically unsound.

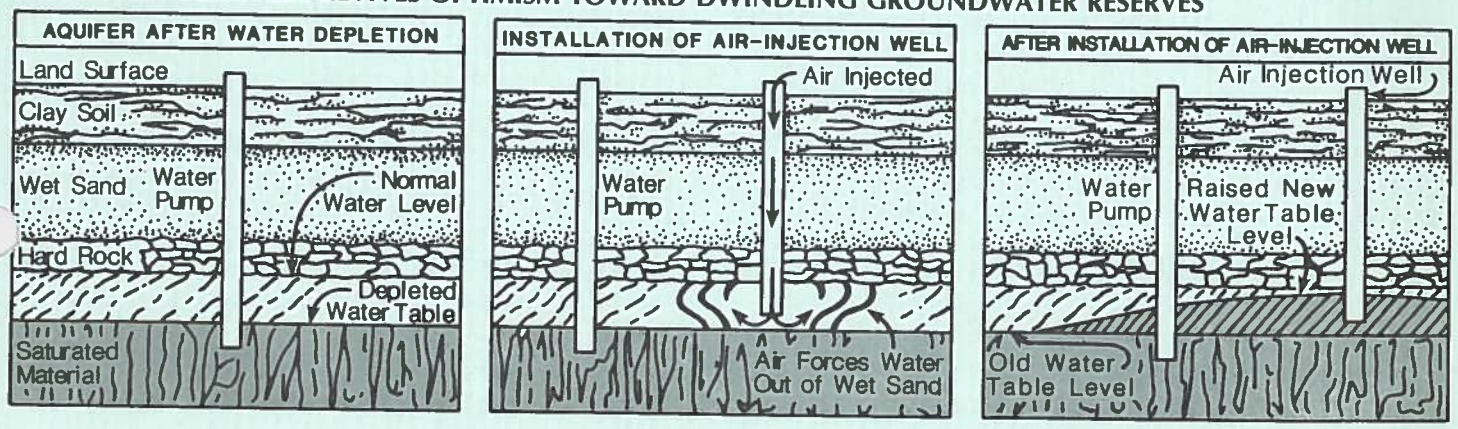
One relatively new procedure, developed by Wayne Wyatt, manager of the High Plains Underground Water Conservation District, was adapted from a popular technique applied in oil recovery using carbon dioxide. It works on the theory that conventional pumping does not free all water contained in an aquifer, but leaves some trapped in the saturated sands of the formation.

Wyatt theorized that additional water can be forced out by injecting pressurized air into the zone surrounding the aquifer, an idea developed from experiments performed in 1981 in his garage. He punched holes in the bottom of an ice cream bucket, which he used as a crude aquifer model, and plugged the holes with fishing corks. Wyatt then put a coffee filter in the bucket and filled it with sand. After soaking the sand with water, he removed the corks. Only about one-third of the water flowed out of the bucket, leaving two-thirds in the sand, held in place by surface tension. Wyatt then fitted a valve stem onto the bucket lid, sealing it onto the bucket with tape. By injecting air from a compressor into the bucket, the remaining water was forced out through the bottom holes.

Wyatt commented on a related phenomenon which occurred near Houston in the late 70's when a gas well blew

Continued on page 2

SECONDARY RECOVERY REVIVES OPTIMISM TOWARD DWINDLING GROUNDWATER RESERVES



Secondary Recovery, continued from page 1

out underground, "Shortly after the explosion, water levels raised significantly in a 20 to 30 mile area around the break. After the gas line was mended, water levels lowered but then stabilized at a level higher than before."

With bucket in hand, Wyatt took his theory to Texas Tech where his close friend, former professor of civil engineering, George Whitstone, helped him to research the theory on secondary recovery. Subsequently, the university conducted lab experiments with equipment more sophisticated than Wyatt's ice cream bucket. Their results were surprisingly similar.

Backed by the university's successful lab result, Wyatt presented his theory before the Texas House of Representatives and the Natural Water Resource Committee.

"I told them, 'Listen, I don't know if enough water is there, but if I am right, there is such a tremendous amount of water—the potential for the state is so vast—that casting a few nickles out to investigate is really such a small gamble.' "

The House responded by allocating $250,000 for core sampling to determine if there was enough water to justify a full-fledged study and to design and accurately monitor the injection wells.

Field testing of Wyatt's theory began in January, 1982 in Slaton, Texas, where the researchers met with only mild success. Despite this, Wyatt remained optimistic.

After six months of testing in Slaton, the project moved to a farm near Idalou, Texas, northeast of Lubbock, where Wyatt termed the testing "very successful." Sixteen wells were dug for monitoring soil conditions and one for injecting air. Air was pumped for six days at a pressure of 160 pounds per square inch. Almost immediately, the water table began to rise and a week after the pumping ceased, it had risen two feet. After eight months, the water table peaked at nine feet.

A third series of tests began in Wolfforth, Texas in June in the city's well fields. Geologic evaluation of the site revealed two separate unsaturated zones into which air could be injected. The zones were separated by a confining layer of hard rock.

The first test in this series injected air under low pressure (8 pounds per square inch) at low volume (300 cubic feet per minute) into the unsaturated zone below the hard rock layer for a 61-day period. Monitoring showed that capillary water was released from this zone as the moisture content dropped from 17 to 13 percent. This led directly to an increased moisture content in the lower zone from 28 to 40 percent.

In the 36-day second test at Wolfforth, air was injected at similar pressure into the zone below the hard rock layer. This resulted in a release of some of the capillary water made available by the first test. Here, researchers encountered a gravel lense which "short-circuited" the secondary recovery process. Air forced through this semi-confined lense created an air relief valve in the formation, similar to the air valve on a gas can. As a result, water flowed more freely through the aquifer, increasing yields in irrigation wells within a two-mile radius of the test well.

This gravel lense also had an affect on the third test. Air, at high volume and high pressure, was injected into the lower unsaturated zone for 12 days. Only a small change in moisture content was observed, again due to the presence of the gravel lense which leaked pressure and prevented the release of large amounts of capillary water.

A 100-square-mile mound of water occurred around the air injection well 143 days after tests concluded at Wolfforth. Testing of the mound revealed that natural recharge and irrigation recirculation made little or no contribution to the aquifer. Researchers surmised that the large quantities of air injected into the gravel lense during the second and third tests accounted for the higher water levels.

Further testing of the mound revealed that no land subsidence occurred in the area due to the movement of capillary water, neither had water quality changed significantly.

Several other important conclusions were drawn from the Wolfforth and Idalou tests:

Secondary recovery of capillary water is possible.

25 to 30 percent of capillary water in storage can be recovered under induced pressures of less than eight pounds per square inch.

Post capillary water drainage occurs for months/years after short-term injection periods.

Injection of compressed air is the most economical and successful method for secondary recovery, especially for municipal/industrial purposes. It is marginally feasible for agricultural purposes.

Secondary recovery has the potential for doubling the life of the ground water supplies in the Texas High Plains region of the Ogallala Aquifer.

Wyatt firmly believes that secondary recovery is economically feasible largely because the cost associated with the Wolfforth and Idalou tests has continued to decrease due to continued drainage.

"Of course, the cost of the project stopped when it was completed. There is such a large area involved that, despite no dramatic water level rises, there has been significant water recovered. With continued drainage, the cost at Idalou is down to less than $20 an acre-foot, while at Wolfforth, it's down to about $10 to $15 an acre-foot," he said.

Wyatt has a definite plan for secondary recovery he would like to see implemented.

"Beneath west Texas, there is an intricate web of natural gas pipeline that fuels area irrigation wells. By drilling air injection wells along this network we can drastically reduce the cost of the secondary recovery process. We can achieve the same results by using the cheaper off-peak energy of electric power generating plants," he said.

Wyatt adds that the present economic situation of the High Plains precludes full implementation of a secondary recovery program. He notes that perhaps once the farming community starts making a profit again, they'll try it out.

Probably the most vital conclusion drawn from the tests is that although secondary recovery is economically feasible, it cannot be fully implemented until the procedure is even more cost-effective. But however costly the technology, the potential of this water conservation strategy could be of vital importance in the face of growing water shortages throughout the world.

Well Inspections Protect Water

The Ground Water Division of the OWRB is currently taking advantage of the clear weather and extra seasonal employees to spot check water wells throughout Oklahoma. Random inspections help to assure that Oklahomans will continue to have clean, pollution-free water to drink, said Duane Smith, Ground Water Division chief.

The most common characteristic of "bad" wells, Smith informs, is extensive rust, a product of non-use. He adds that the main concern of the program is verifying that wells are constructed and functioning according to state sanitary standards. "One of the biggest problems we encounter is the drillers' failure to apply required cement casing around the well shaft," Smith points out.

Rigid Board construction standards for water wells specify that cement casing be grouted from the land surface to a minimum depth of 10 feet. Without this water-tight seal, contaminants such as animal wastes, agricultural chemicals and fecal organisms may trickle down the well shaft to pollute the aquifer.

All commercial water well drillers in the state must be licensed by the Board, post a $5000 bond and pass a written test. "The complaint we hear most often from licensed drillers is that there is inadequate enforcement," said Smith. He adds that licensed drillers are effective watchdogs for their own industry, often reporting fellow drillers operating in violation of state law.

In addition to inspecting active wells, the OWRB checks abandoned wells for proper capping and plugging. Abandoned, open wells can also allow pollution and may cause dangerous falls and injury.

"Most of the wells we inspect are properly constructed," says Smith, "and Oklahoma drillers should be commended for complying with standards and encouraging licensing."

Since the OWRB issued the first license in 1973, the Board has licensed more than 250 water well drillers.

mainstream

Drillers Committee Holds First Meeting

Duane Smith, OWRB Ground Water Division chief, has announced the formation of the Water Well Drillers Committee, an organization which allows state drillers direct input into the regulation of their own industry.

"The committee receives direct input from drillers in regard to rule changes, enforcement activities, methodology for enforcement, well construction standards and other pertinent matters," said Smith. "It also gives drillers an opportunity to see how the Board conducts its program of licensing state water well drillers."

The committee, composed of seven members from the Oklahoma Water Well Association, held its first meeting in August.

Members are Michael Chatham, Larry Hudgens, Jay Jackson, Kathy Knott, Wayne McCarthy, David Poindexter and Richard Squires.

ACTIVE CONSERVATION STORAGE IN SELECTED OKLAHOMA LAKES AND RESERVOIRS AS OF AUGUST 26, 1985

PLANNING REGION LAKE/RESERVOIR	CONSERVATION STORAGE (AF)	PERCENT OF CAPACITY
SOUTHEAST		
Atoka	109,300	88.0
Broken Bow	881,525	96.0
Pine Creek	75,747	97.0
Hugo	137,835	87.0
CENTRAL		
Thunderbird	102,405	96.7
Hefner	68,300	91.0
Overholser	15,900	100.0
Draper	75,800	75.8
SOUTH CENTRAL		
Arbuckle	60,762	97.0
Texoma	2,390,914	90.0
Waurika	193,532	95.0
SOUTHWEST		
Altus	7,232	5.4
Fort Cobb	67,387	86.0
Foss	139,371	57.0[2]
Tom Steed	68,608	71.0
EAST CENTRAL		
Eufaula	2,231,094	95.0
Tenkiller	627,500	100.0
Wister	14,648	54.0
Sardis	293,599	97.0
NORTHEAST		
Eucha	77,260	97.0
Grand	1,491,800	100.0
Oologah	544,240	100.0
Hulah	30,594	100.0
Fort Gibson	365,200	100.0
Heyburn	6,355	96.0
Birch	18,748	98.0
Hudson	200,300	100.0
Spavinaw	30,000	100.0
Copan	43,400	100.0
Skiatook	—	— [1]
NORTH CENTRAL		
Kaw	427,622	99.7
Keystone	616,000	100.0
NORTHWEST		
Canton	71,790	74.0
Optima	3,000	— [1]
Fort Supply	12,380	89.0
Great Salt Plains	31,400	100.0
STATE TOTALS	**11,521,548[3]**	**91.2[3]**

1. In initial filling stage
2. Temporarily lowered for maintenance
3. Conservation storage for Lake Optima not included in state total

Data courtesy of U.S. Army Corps of Engineers, Bureau of Reclamation, Oklahoma City Water Resources Department, and City of Tulsa Water Superintendent's Office.

Board Schedules 10 Workshops to Instruct in Loan Application

A series of workshops is scheduled this month to explain the OWRB's financial assistance program and to show mayors, planners and other officials of Oklahoma communities and rural water and sewer districts how to fill out the applications that will make their communities eligible.

Walid Maher, Planning and Development Division chief who oversees the loan and grant program, said beginning mid-month, the Board will conduct workshops throughout the state, with sponsorship shared by South Western Oklahoma Development Authority, Southern Oklahoma Development Association, Eastern Oklahoma Development District, Northeastern Counties of Oklahoma, Indian Nations Council of Governments, Central Oklahoma Economic Development District, Northern Oklahoma Development Association and Oklahoma Economic Development Association.

As a result of the closing of the OWRB bond sale in New York recently, loans for sewer and water improvements are available at an interest rate of 8.94 percent for a maximum term of 25 years. Maher recounted that although designers of the state financial assistance effort conceived it as a two-fold program that would offer loans and emergency grants to troubled sewer and water systems, questions concerning the validity of state-assisted loans had delayed implementation of the loan phase.

Finally in 1984, passage of State Question 581 amended the Oklahoma Constitution and established the state loan program as a legitimate companion to the grant feature. Maher pointed out that since 1979, 66 communities have received emergency grants totaling $4.32 million.

OWRB FINANCIAL ASSISTANCE WORKSHOPS

McALESTER Sept. 17 10 a.m.-12	First National Bank Mall 200 East Choctaw Information: (918) 426-5435
HUGO Sept. 18 10 a.m.-12	Choctaw Electric Cooperative Highway 93, one mile north of Highway 70 Information: (918) 426-5435
MUSKOGEE Sept. 19 10 a.m.-12	Federal Building 3rd Fl. Conference Room Information: (918) 581-2925
VINITA Sept. 20 10 a.m.-12	Rural Electric Cooperative Highway 66 Information: (918) 581-2925
CLINTON Sept. 24 10 a.m.-12	City Hall Council Chambers 415 Gary Freeway Information: (405) 248-7762
ALTUS Sept. 25 10:15 a.m.-12	Altus Public Library 421 North Hudson Information: (405) 248-7762
PAULS VALLEY Sept. 26 1-3 p.m.	Nora Sparks Warren Library 210 North Willow Information: (405) 248-7762
WOODWARD Oct. 1 1:30-3:30 p.m.	County Fair Building 108 Temple Dr. Information: (405) 271-2573
ENID Oct. 2 10 a.m.-12	City Council Chambers 401 W. Owen Garriott Rd. Information: (405) 271-2573
STILLWATER Oct. 4 10 a.m.-12	Indian Meridian Vo-Tech 1312 South Sangre Rd. Information: (405) 271-2573

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