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OKLAHOMA
ANNUAL REPORT
WATER RESOURCES BOARD
1975

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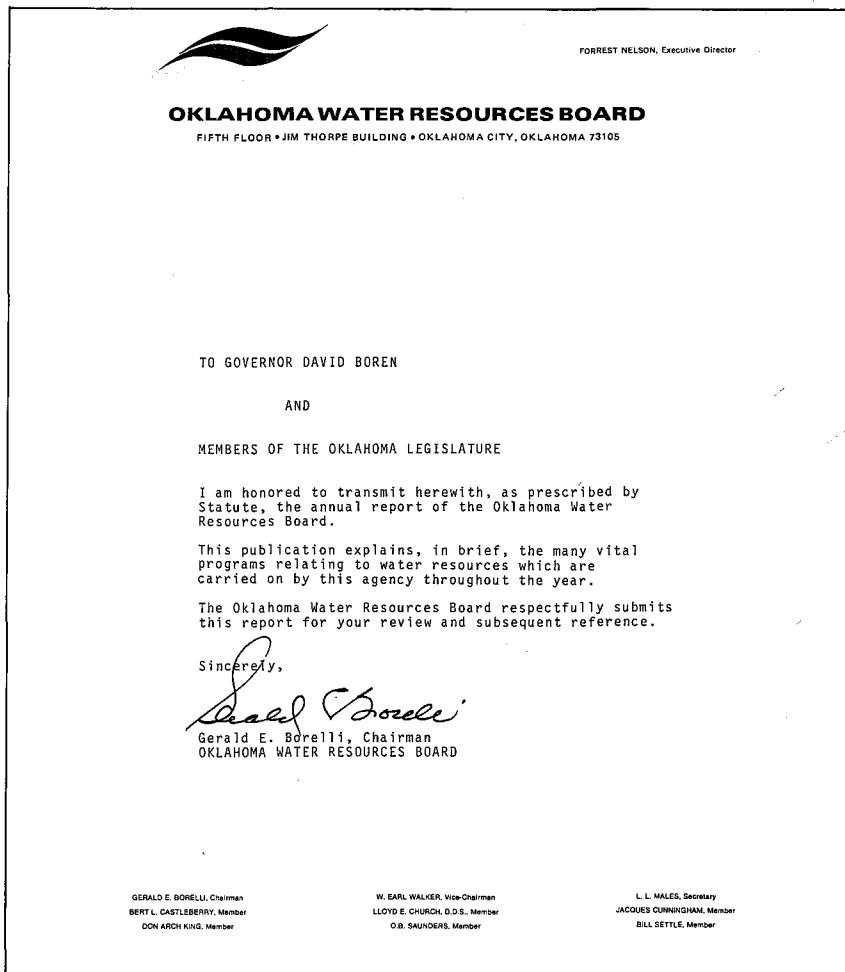
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Annual Report

TO GOVERNOR DAVID BOREN AND MEMBERS OF THE 1ST SESSION OF THE 35 TH LEGISLATURE OF THE STATE OF OKLAHOMA

Publication 59
January 1975



This publication, printed by Times Journal Publishing Co., is issued by Oklahoma Water Resources Board as authorized by Forrest Nelson, Executive Director. Five hundred copies have been prepared at a cost to the taxpayers of the State of Oklahoma of: \$395.00 printing expenses, \$1,059.00 salaries, materials, and miscellaneous expenses and \$448.00 typesetting expenses, totaling \$1,902.00.

Financial Statement

| BUDGET FUNDING | FY 73 ACTUAL | FY 74 ACTUAL | FY 75 APPROPRIATED | FY 76 REQUESTED |
|-------------------------------|-----------------|-----------------|-----------------------|--------------------|
| Appropriated-General Revenue | 413,804.00 | 434,511.00 | 455,143.00 | 685,425.00 |
| Appropriated-(S.B. 510 & 670) | -0- | -0- | 100,000.00 | 200,000.00 |
| Non-appropriated-Special | 40,559.00 | 36,591.00 | 46,435.00 | 39,615.00 |
| Water Quality Fund | 11,293.00 | 16,633.00 | 19,267.00 | 4,733.00 |
| Reimbursement Fund | 314.00 | 2,652.00 | 19,728.00 | -0- |
| Federal Grants | 197,241.00 | 313,865.00 | 185,109.00 | 123,440.00 |
| Miscellaneous | -0- | 1,220.00 | 315.00 | -0- |
| TOTAL | 663,211.00 | 805,472.00 | 825,997.00 | 1,053,213.00 |

EXPENDITURES BY ACTIVITY

| | Number of Employees Budgeted | 39 | 48 | 48 | 65 |
|----------------------------------|---------------------------------|------------|------------|--------------|----|
| 100 General Administration | 142,956.00 | 181,885.00 | 207,545.00 | 188,967.00 | |
| 200 Water Quality | 132,296.00 | 202,071.00 | 173,333.00 | 244,943.00 | |
| 300 Planning | 85,307.00 | 85,683.00 | 58,000.00 | 64,075.00 | |
| 400 Ground Water Administration | 35,857.00 | 44,458.00 | 61,976.00 | 84,168.00 | |
| 500 Surface Water Administration | 53,264.00 | 58,118.00 | 89,706.00 | 145,546.00 | |
| 900 Office of Saline Water | 12,450.00 | 5,192.00 | -0- | -0- | |
| 1000 Cimarron Terrace | 48,515.00 | 31,613.00 | -0- | -0- | |
| 1100 U.S.G.S. Contracts | 136,364.00 | 120,388.00 | 118,248.00 | 111,459.00 | |
| 1200 Safety of Dams | -0- | 51,520.00 | -0- | -0- | |
| 2000 Okla. Com. Water Plan | -0- | -0- | 80,465.00 | 167,375.00 | |
| 8800 Data Processing | 16,202.00 | 24,544.00 | 36,724.00 | 46,680.00 | |
| TOTAL | 663,211.00 | 805,472.00 | 825,997.00 | 1,053,213.00 | |

Water—the absence or overabundance of it—has always been a major concern of Oklahomans. Recurring periods of flooding and drought magnified the need for a regulatory authority. Water management, water rights regulation and water storage and supply development have passed through several agencies throughout state history.

The Constitution of the State of Oklahoma (Article 16, Section 3) gives the legislature power to provide for levees, drains, ditches and irrigation in the state. The Eighth Legislative Assembly of Oklahoma Territory enacted the first water law in 1905, outlining the procedure for acquiring water rights, regulating the use of water and creating the post of territorial engineer.

The engineer was in charge of administering the new law. Upon granting of statehood in 1907, these duties were delegated to the state engineer. Many sections of the Original law are still in effect, and have been expanded to include not only irrigation, but also municipal and industrial water supply, stream-flow regulation, water resources planning and data collection. Most of Oklahoma's early water laws were patterned after the water legislation of South Dakota.

Rapid population growth followed Oklahoma's statehood. In the 1920's, the conservation commission was created to deal with the increasing numbers of water users and their accompanying problems.

The Planning and Resources Board was formed in the 1930's. Parks, forestry and water resources were included in the jurisdiction of the council.

In 1955, House Joint Resolution 520 provided for a water study committee. Composed of state legislators and citizen representatives of agriculture, industry, municipalities and recreation and wildlife, the committee reviewed Oklahoma's water problems and recommended the establishment of a separate authority. This agency would be responsible for the administration of water rights,

OKLAHOMA WATER RESOURCES BOARD HISTORY

negotiation of federal contracts and development of state and local projects to assure the most effective use of the state's water resources. In 1957, the Twenty-Sixth Oklahoma Legislature, under Senate Bill 138, created the Oklahoma Water Resources Board.

Under Title 82, Section 1071 of the Oklahoma Statutes, the Oklahoma Water Resources Board would be composed "of seven members, selected from each of the 1950 Congressional districts and one at-large."

"Each shall serve seven years, one appointed each year. The Board shall have represented on it at least one member well-versed in each of the following major types of water use: recreational, industrial, municipal, agricultural and soil conservation work. . ."

The first meeting of the board took place on June 14, 1957. Original board members included Joe Sykora, Stroud; George R. Benz, Bartlesville; John R. Curry, Antlers; Glade R. Kirkpatrick, Tulsa; Dr. Lloyd E. Church, Wilburton; L. L. Males, Cheyenne and Guy James, Oklahoma City.

James served as the first chairman.

In 1972, under Title 82, Section 1085.1 of the Oklahoma Statutes, two additional at-large seats were added to the board, bringing the board's number to nine. Current members are Bert L. Castleberry, Oklahoma City; Dr. Lloyd E. Church, Wilburton; Jacques Cunningham, Tulsa; Don Arch King, Guymon; L. L. Males, Cheyenne; O. B. Saunders, Altus; Bill Settle, Muskogee; Earl Walker, Okemah and chairman Gerald Borelli, Kingfisher.

The first executive director of the water board was Francis J. Borelli of Okarche. Borelli served from the board's inception until 1959. He is the uncle of the present board chairman.

Frank Raab took over the directorship in September, 1959, and held that post until 1967. Raab was assistant director of the Planning and Resources Board, the predecessor of the Oklahoma Water Resources Board, from 1955-1957.

Forrest Nelson, the present director, was named to the job in 1968, after serving as assistant director under Raab.

STATE & FEDERAL AGENCIES

The Oklahoma Water Resources Board's job of water development, regulation, administration and management is a multi-faceted one and the Board could not continue to operate efficiently without assistance from numerous state and federal water-related agencies.

State

The Board cooperates with other state commissions, boards and offices in a variety of ways.

The attorney general's office examines the legal aspects of the Board's actions and serves as legal support in disputes.

The Oklahoma Geological Survey assists the Board in data collection and hydrologic and geologic studies.

The Oklahoma Wildlife Department works closely with the Board in fish and game protection in state lakes and rivers.

In the area of water quality control, the board aids the Corporation Commission in industrial water pollution control and the Department of Health in municipal waste disposal and water quality monitoring. The Board also works closely with the Department of Pollution Control in monitoring, enforcement and investigation procedures.

The board consults the Department of Parks, Tourism and Recreation on new projects in order to provide sufficient recreational facilities.

The Board assists the state's only river authority, the Grand River Dam Authority, in collection of measurement data.

Federal

Federal water-related agencies

play a significant role in Board functions.

The Water Resources Council, created by the Water Resources Planning Act of 1965, provides Title III funds for state planning projects.

Principal construction agencies are the Corps of Engineers in the Department of the Army, the Bureau of Reclamation in the

Department of the Interior and the Soil Conservation Service in the Department of Agriculture.

The U.S. Geological Survey assists the Board in geologic and hydrologic surveys and data collection.

The Environmental Protection Agency works with the Board in pollution control enforcement and water quality monitoring.

FUNCTIONS & ORGANIZATION

The Oklahoma Water Resources Board has the overall responsibility for coordinating and developing the water resources of the state.

It is the responsibility of the Board, under Title 82, Oklahoma Statutes:

1. To record and administer all water rights;

2. To approve the design and engineering of all water works, except those built by the Federal Government or any of its agencies, which are exempt from such approval;

3. To make hydrologic surveys and investigations of each stream system and sources of water supply in the state;

4. To compile and index all available data concerning the water resources of the state;

5. To negotiate contracts and agreements with the Federal Government for the development of water resources and for the

storage and distribution for beneficial purposes, and to negotiate compacts concerning interstate streams;

6. To develop state-wide and local plans to assure the best and most effective use and control of water to meet both the current and long-range needs of the people of Oklahoma, and to cooperate in such planning with any public or private agency, entity or person interested in water development;

7. To coordinate its activities with all other agencies, local, state or federal, in the use and development of our water resources;

8. To administer the pollution laws of the state in order to safeguard our streams and ground water supplies and to cooperate with all other agencies who have responsibilities under the law for pollution control;

9. To adopt, modify or repeal and promulgate standards of quality of the waters of the state

and classify such waters according to their best uses in the interest of the public under such conditions as the Board may prescribe for the prevention, control and abatement of pollution;

10. To inspect any works used for storage, diversion or carriage of water to insure their safety and to require necessary changes.

Another responsibility of the Board under Title 2, O.S. Supp. 1972, is to administer the licensing and permits required under the Weather Modification Act, establish standards governing research projects in weather modification and control, and assist and cooperate in the formation of weather modification districts within the state;

In April, 1974, the Oklahoma Water Resources Board received specific authority, through Senate Bill 510, to prepare a comprehensive water plan for the state. Further discussion of the plan, its background, make-up and current progress will be presented in subsequent sections of this publication.

The Board also functions as the Oklahoma Water Conservation Storage Commission. This group was created to provide for review of Federal reservoir projects and to enter into contracts with the Federal government for construction of reservoirs and with water users to pay for storage costs. The commission is composed of members of the Oklahoma Water Resources Board and Board officers also serve as officers of the commission. The commission meets upon call of the chairman.

The Board is the coordinating agency between communities and the Federal government on the Federal Flood Insurance program. This program provides insurance for residents and businesses in flood-prone areas who would otherwise be unable to obtain insurance.

The Oklahoma Water Resources Board participates in several interstate stream compacts, which were created for the equal distribution

of waters in the states drained by the stream system. The Arkansas River Commission, involving Arkansas and Oklahoma; the Canadian River Commission, involving New Mexico, Texas and Oklahoma and the Kansas-Oklahoma Arkansas River Commission have received Congressional approval and have been ratified by all participating states. The Red River Compact Committee, involving Arkansas, Louisiana, Texas and Oklahoma, has received Congressional authorization and has been under negotiation since 1956.

The Oklahoma Water Resources Board also represents the state on the Arkansas-White-Red Basins Inter-Agency Committee (AWRBIAC). This committee was created to provide facilities and procedures for the coordination of water and land resource investigation, planning, construction, operation and maintenance. The states of Arkansas, Colorado, Kansas, Louisiana, Missouri, New Mexico, Oklahoma and Texas; the Federal Power Commission and the Departments of Agriculture; Army; Commerce; Health, Education and Welfare; Housing and Urban Development; Interior; Labor and Transportation are members of AWRBIAC.

In addition to statutory responsibilities, the Oklahoma Water Resources Board also performs a number of implied functions in conjunction with its legal requirements. These include cooperative stream gaging programs, national disaster damage surveys, limnology (fresh water chemistry and biology) research, mapping and data processing.

Organization

The organizational structure of the Oklahoma Water Resources Board is designed to carry out most effectively the duties and responsibilities assigned by law.

The Oklahoma Water Resources Board is divided into four divisions: ground water, planning, stream water and water quality.

There is a division chief in charge of coordinating and overseeing the programs and functions of the respective units. Each division chief is directly responsible to the executive director. As of January 1, 1975, the Board staff included 51 employees.

Board

The agency is headed by a nine-member board, meeting monthly, to carry out its duties. Board members are appointed by the Governor and approved by the Senate for seven-year terms, with one member coming up for appointment each year.

Board members are selected from the six Congressional districts and three from the public at large. By statute, members must represent recreational, industrial, irrigational, municipal, agricultural and soil conservation fields, with not more than two representing each interest.

A chairman, vice-chairman and secretary are elected from Board membership and serve for one year.

Administration

The Board employs an Executive Director who directs all administrative affairs of the agency. The executive director, by statute, shall have at least six years of practical and administrative experience in water resource management.

The administrative unit also consists of an assistant director, executive secretary, accounting and public information personnel. The library, completed in 1973, is also part of the administrative division.

Ground Water

The ground water division is responsible for the issuance of ground water rights, water well drillers licensing, data collection and hydrogeologic studies. The division also supervises the computer processing unit.

Planning

The planning division handles several different functions. Currently, the division's main responsibility is preparation of the Oklahoma Comprehensive Water Plan; however, the drafting department, publications and mapping are part of the planning division.

Stream Water

This section is in charge of issuing stream water rights, hydrology research and water impoundment structure review. The stream water division is also responsible for weather modification programs, interstate compacts and flood insurance.

Water Quality

The major functions of the water quality division include issuing industrial waste disposal permits, water quality monitoring and sampling, pollution control studies and enforcement, data collection, adoption and modification of water quality standards and limnological research.

Organization

DAVID BOREN Governor

LLOYD E. CHURCH, D.D.S., Member
DON ARCH KING, Member
BERT L. CASTLEBERRY, Member

GERALD E. BORELLI, Chairman
W. EARL WALKER, Vice-Chairman
L. L. MALES, Secretary

JACQUES CUNNINGHAM, Member
COY MORROW ~~BILL SETTLE~~, Member
O. B. SAUNDERS, Member

FORREST NELSON, Executive Director
BRUCE COX Assistant Director

PLANNING DIVISION

Oklahoma Comprehensive Water Plan
Arkansas Basin Hydrologic Study
Economic Impact Analysis
Federal and State Plan Review
Mapping and Drafting

GROUND WATER DIVISION

Hydrologic Studies
Well Drillers
Well Monitoring
Computer Services

STREAM WATER DIVISION

Irrigation Districts
Stream Gaging
Construction Plan Review
Dam Safety
Disaster Damage Surveys
Flood Insurance
Interstate Compacts
Weather Modification

WATER QUALITY DIVISION

Waste Discharge Permits & Monitoring
Laboratory Certification
Enforcement
Water Quality Standards Development
Bioassay Monitoring
Limnological Laboratory
Limnological Studies

Oklahoma Comprehensive Water Plan

In compliance with the legislative directive, the Oklahoma Water Resources Board is preparing a comprehensive water plan for the state.

The Board received general statutory authority to develop long-range water need studies under Title 82, Section 1085.2 of the Oklahoma Statutes, revised in 1972:

...to develop statewide and local plans to assure the best and most effective use and control of water to meet both the current and long-range needs of the people of Oklahoma..."

In April, 1974, Senate Bill 510 gave the Oklahoma Water Resources Board the power:

...to prepare a comprehensive state water plan...including feasibility and cost studies on designated projects within the plan... such comprehensive state water plan shall be submitted in final and completed form not later than September 1, 1975 and shall include a definition of "excess and surplus water of this state" and a recommended procedure for determining "excess and surplus water of this state," which definition and procedure are to be developed to insure that the area of origin will never be made water deficient..."

The bill calls for a feasibility level study of the southern 33 counties of the state and a reconnaissance level study for the remaining 44 counties, to be submitted to the legislature September 1, 1977. The Grand River Dam Authority is specifically exempt from provisions of this act.

This feasibility study shall include findings and conclusions about the economic and engineering possibilities or development of the water, land and related

PROGRAMS

resources.

This first, or Phase I report, is to be submitted to the legislature by September, 1975 and will consist of four sections, as shown in Figure 9.1. Section 1 is a summary of the plan, Section 2 is an inventory of statewide resources; Section 3 is an inventory of statewide uses and requirements and Section 4 is an inventory of regional resources, requirements and portions of the plan pertaining to each region.

The report will contain input from the Bureau of Reclamation studies, the Corps of Engineers studies, the Soil Conservation Service reports, the Oklahoma

Water Resources Board appraisal reports and local, state and federal agencies, as well as interested individuals. Plan preparation is currently on schedule, as well as an on-going public information program, consisting of statewide and regional newspaper releases to inform citizens about the plan.

A series of public meetings seeking public input on the plan were held in October and November. Questionnaires were distributed, inviting comments and suggestions.

As shown in Figure 10.1, the proposed master planning schedule, the Phase I report will not be

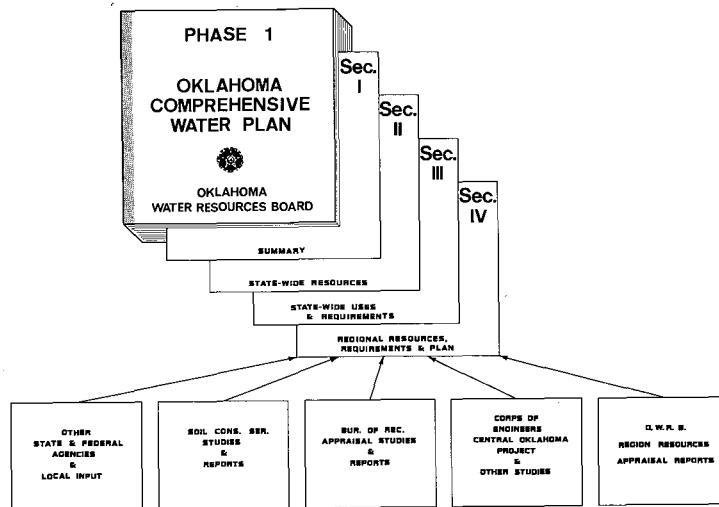


FIGURE 9.1 PHASE 1 REPORT MAKE-UP
OKLAHOMA COMPREHENSIVE WATER PLAN

reviewed until the second session of the 35th Legislature, which convenes in January, 1976. Since detailed hydrologic and economic studies must be done for the northern 44 counties before Phase II can commence, the first session will be asked to appropriate funds for that purpose in Fiscal 1976. The Phase II report, if then authorized by the legislature, would commence in fiscal 1976, and would be completed and submitted to the legislature by September, 1977.

Upon legislative authorization of Phase I, the state of Oklahoma must begin financing and construction programs geared toward putting the plan into action. Funding and personnel levels must be maintained to accomplish this goal. The Federal Government will seek authorization for elements of the plan which fall within their construction authorities. The state of Oklahoma must be prepared to set up organizations to administer repayment requirements of the Federal Government. In cases where projects cannot be federally constructed, the state must begin financing and construction programs toward that end.

Arkansas Basin Hydrologic Survey

This would consist of a detailed hydrologic survey of surface waters in the Arkansas River Basin. This survey would consider a system operation of all existing and authorized flood control, hydropower, water supply and navigation projects for both high-flow and low-flow conditions. The system operation would include expected future hydropower load conditions, withdrawal requirements for in-basin municipal, industrial and irrigation needs, observing interstate compact provisions. The studies are needed to accurately determine the quantity and location of surplus flows, and they must be

PROPOSED MASTER PLANNING SCHEDULE OKLAHOMA COMPREHENSIVE WATER PLAN

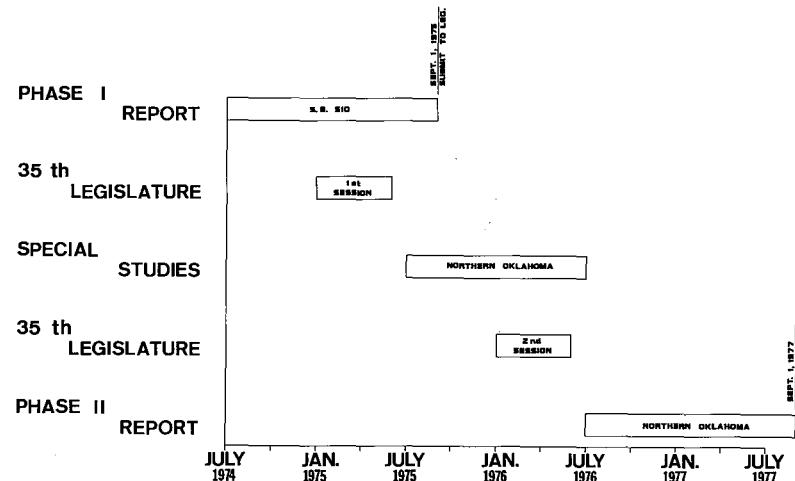


FIGURE 10.1 MASTER PLANNING SCHEDULE

done before studies can proceed on Phase II of the Comprehensive State Water Plan.

Economic Impact Analysis

This analysis is needed to identify and measure, in quantitative terms, the economic effects expected to result from the public investment in the construction and operation of water impoundments and distribution facilities proposed in the Oklahoma Comprehensive Water Plan. The primary study area will be within the boundaries of the State of Oklahoma. Economic effects of such public investment, however, can be expected to reach beyond such boundaries. The study would be done jointly by the Board, the Bureau of Reclamation, the Corps of Engineers and the Soil Conservation Service with appropriate funding to be supplied by each commensurate with study participation. The Board would provide overall guidance and cooperation with the other agencies.

Some of the major work items would involve a review and updating of water demands, analysis of present and future cropping patterns, farm budget evaluations, forecast of economic structure of Oklahoma with and without project conditions and analysis of structural changes in the economy as a function of water availability.

Federal & State Plan Review

All proposed Federal water development projects must be reviewed and approved to insure that their construction would be in the best interest of the State and would result in an efficient and wise use of State Resources. After approval of a State Water Plan by the Legislature, all proposed water resource development projects will be reviewed to insure conformity with the State Water Plan.

In addition, all proposed Federal and State highways, oil, gas or water pipelines or local development projects must be reviewed to assure that they do not interfere with future develop-

ment of the State's water resources. During 1974, approximately 600 plans and environmental statements were reviewed by the Oklahoma Water Resources Board staff. This activity has doubled during the past year and is expected to increase in the future after adoption of an official State Water Plan.

Mapping & Drafting

The drafting department provides maps, upon request, for all functions of the Board's divisions, as well as artwork and layout for various forms, applications and publications.

The department is currently preparing all maps, charts and graphs for the Phase I report of the Oklahoma Comprehensive Water Plan. These will illustrate the state's water needs and resources.

Plotting and updating of stream and ground water rights is done by the department on large, detailed maps. These are necessary for reference and proper allocation on new rights and permits.

The department enters into contracts for mapping with other state and federal agencies and also handles all drafting projects for the Department of Pollution Control.

Ground Water Administration

Ground water is one of Oklahoma's most valuable natural resources. It supplies over 80 percent of the state's irrigation water and municipal and industrial supplies for 300 cities and towns. Over half of Oklahoma's population relies on ground water for drinking and domestic purposes.

One of the primary responsibilities of the ground water division is the administration of ground water rights. Three hundred twelve applications were approved by the

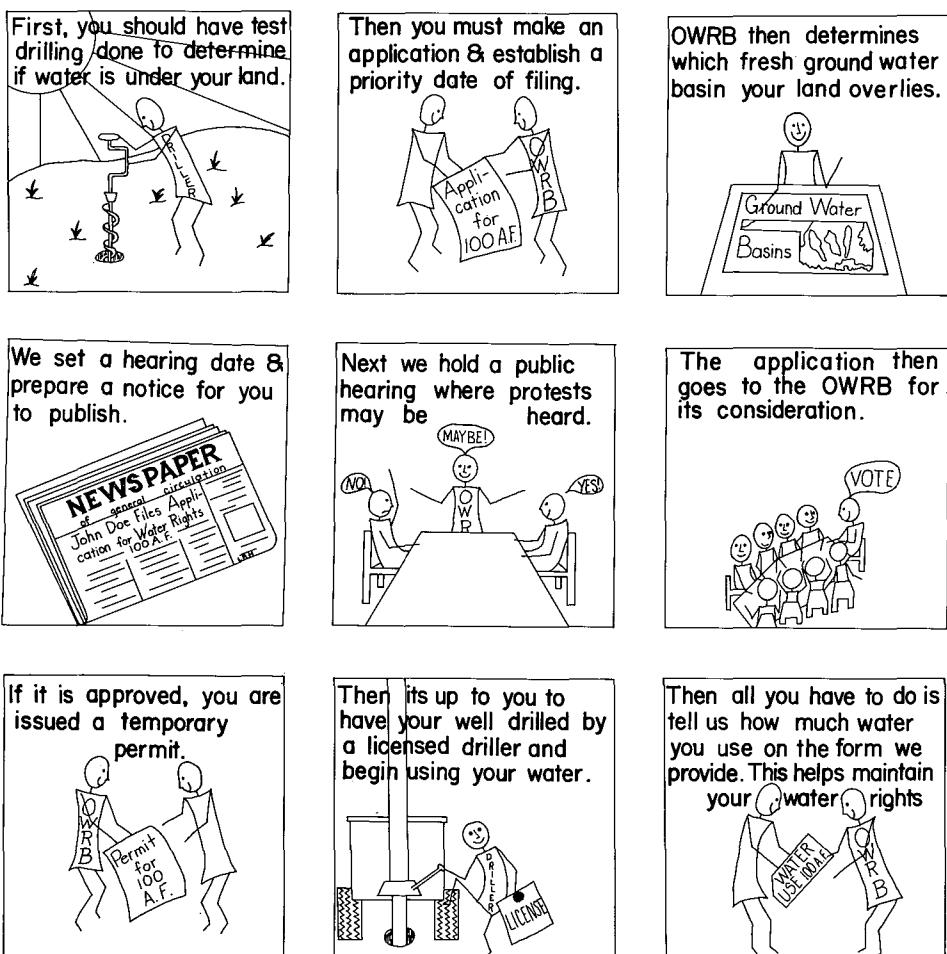


FIGURE 11.1 HOW TO OBTAIN A GROUND WATER PERMIT

Board in 1974, with 7000 applications on file. Approximately 500 requests are expected to be filed in 1975.

A new ground water law went into effect in July, 1973. Some important provisions of the new law included the allowance of two acre-feet of water per calendar year for each acre of owned or leased land that overlies the fresh ground water basin, removal of filing and protest fees, notification of adjacent landowners, and the formation of ground water irrigation districts.

The new law, however, has created new problems and duties. The removal of filing and protest fees has resulted in additional and often unnecessary protests. The requiring of completed hydrogeologic surveys before issuance of permanent permits has resulted in the issuance of temporary permits, which must be renewed

each year. This has increased the workload of the division and the Board, while decreasing their operational effectiveness.

In order to remedy these problems, additional personnel will be needed to continue field investigations on applications and hydrologic surveys. Additional legislation is also needed to correct current problems and provide for future protection.

Hydrologic Studies

Ground Water

In accordance with Title 82 O.S., Supplement 1972, Section 1020.4, the Oklahoma Water Resources Board "shall make hydrologic surveys and investigations of each fresh ground water

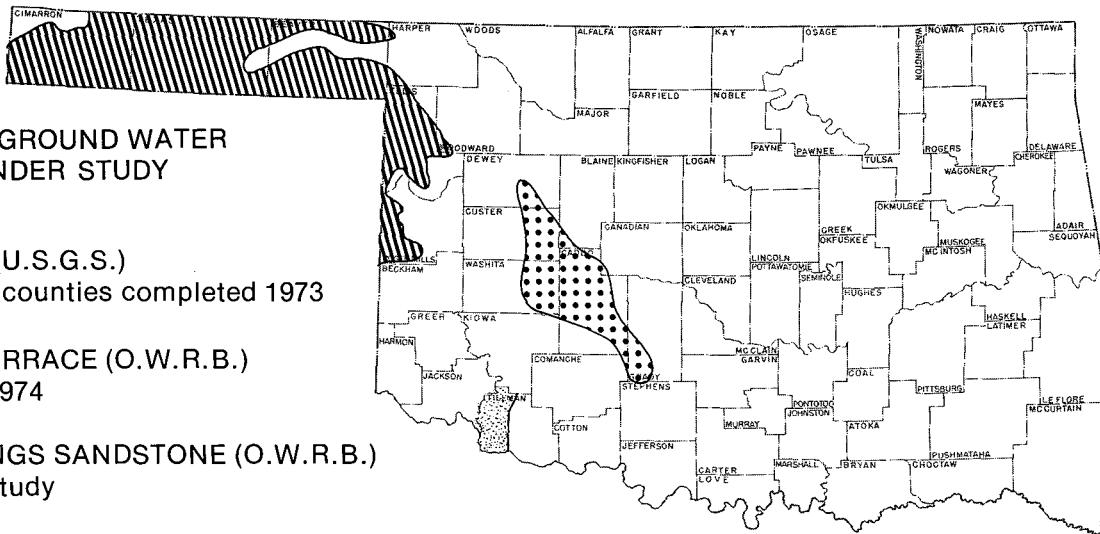


FIGURE 12.1 GROUND WATER BASINS UNDER STUDY

- OGALLALA (U.S.G.S.)
3 Panhandle counties completed 1973
- TILLMAN TERRACE (O.W.R.B.)
Completed 1974
- RUSH SPRINGS SANDSTONE (O.W.R.B.)
Now under study

basin or sub-basin...at least every ten years the Board shall update the hydrologic surveys."

The division's staff collects data on aquifer size, chemical quality of the water, well withdrawal levels and effects and storage estimates for inclusion in these surveys. These serve as planning documents for efficient ground water development and management.

The three-part study on the Ogallala Formation, completed in 1973, covered Beaver, Cimarron and Texas counties. It was a cooperative project with the U.S. Geological Survey and financed with state and matching federal funds. Currently, a computer model of the aquifer in Texas County is being made. Upon completion in 1975, it will be used to predict future water levels and remaining aquifer storage amounts. This model will be expanded to include Beaver and Cimarron counties if funding becomes available.

The Tillman Terrace study, covering Tillman County, was recently completed and financed through state funds. Currently, it is in the process of being published.

The Rush Springs Sandstone study, covering Caddo County, is currently under way, funded with

state monies. The project is in the preliminary stages, with well data being collected and maps being planned. However, progress is slow because information on many wells within the study area is not readily available. More well measuring and monitoring would be beneficial to enhance the report. This will require additional personnel and funding for more extensive field investigations.

A study of the Garber-Wellington Formation in Cleveland and Oklahoma counties is of immediate importance as water shortages occur in central Oklahoma and cities wish to tap this aquifer to meet their water needs.

Additional hydrogeologic data must also be collected on the Vamoosa Formation in east central Oklahoma, the Arbuckle Group in south central Oklahoma and the Antlers Sand in southern Oklahoma as these are sources of potential ground water supplies. To accomplish this, funds and personnel will also be needed to begin investigation and evaluation programs.

Stream Water

Systematic hydrology studies of each stream system within the state must be made in order to determine the availability of

stream water for appropriation. Such studies require tabulating, mapping and quantifying stream water depletions and stream yields as well as identifying time, locations and recurrence probabilities of deficient and surplus stream flows.

Preliminary hydrologic studies on some of the most critical stream systems, generally those with water right lawsuits pending or imminent, have been made. These studies cover an 8.4 million acre area in western Oklahoma wherein all of the stream water has been allocated and no additional supplies can be developed. There is another area of approximately 3.1 million acres of land where restrictions are applicable to any allocations of stream water. These restrictions specify that water can only be captured or diverted during periods of high flow. Those areas in Oklahoma where it has been determined by hydrology studies that the water is fully appropriated or restricted are shown in Figure 12.1.

All stream systems need to be surveyed with the Red River Basin taking first priority as there is little or no water available for appropriation. Lack of funds and personnel has limited these hydrology studies.

Well Drillers

The Board regulates the licensing of water well drillers under Title 82 O.S., Supplement 1974, Section 1020.16. This legislation was enacted for public protection, pollution prevention and ground water conservation.

All drillers must have at least two years experience and must document this when applying. In conjunction with the Water Well Drillers Association, the Board is preparing a written examination which, after July 1, 1975, all new applicants will be required to pass before a license is granted.

A future project of the division is the establishment of minimum well standards. These standards are essential to public protection and ground water preservation since no regulations currently exist.

Well Monitoring

In cooperation with the U.S. Geological Survey and under Title 82 O.S., Supplement 1972, Section 1024.4, the Board maintains a continuing well monitoring program. Currently, 1500 wells are measured, either monthly or annually, to indicate water level increases or decreases.

However, many wells in Oklahoma are not monitored and the program should be expanded to include all areas of the state. If this is done, the Board can be more accurate in its investigations and evaluations.

Computer Services

The Board maintains computer services at a comparatively small cost by using the computer facilities at the Highway Department.

Current computer uses include file maintenance of 10,600 water

rights, permits and well drillers licenses; water use reporting card data collection, as required by Title 82, O.S., Supplement 1974, Section 1020.12 and computer reference reports, such as the annual water use report and comparative use studies.

Industry-related water quality data is maintained for computer reports to statistically reflect any pollution variations in Oklahoma rivers and streams.

These programs are inter-related with the computer programs of many Federal agencies. Federal grants are received from many of these agencies for use in the Board's computer programs. Because of computer format variations between agencies, verification of data is required to insure compatibility and accuracy.

Future computer programs include determination of ground water development through underground aquifer studies; determi-

nation of future stream water availability through comparison of current water rights; insurance of accuracy in legal descriptions and avoidance of duplicate allocation of water rights; scheduling of industrial inspections related to pollution control and evaluation of structural adequacy of dams to prevent downstream hazards due to structural failure.

Stream Water Administration

The Oklahoma Water Resources Board has the overall responsibility of coordinating stream water resource development. It has the obligation to allocate available water supplies in accordance with the Statutes and in a manner which will serve the immediate and long-range interests in the state.

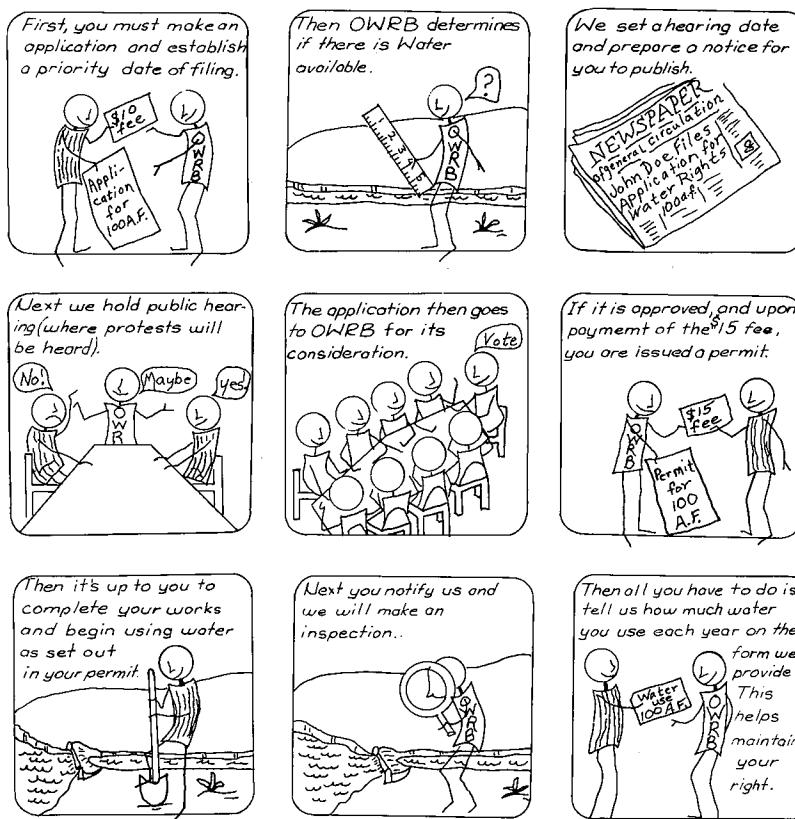


FIGURE 13.1 HOW TO OBTAIN A STREAM WATER PERMIT

After receiving a permit for stream water, an applicant has seven years to put the full amount applied for to use. That water not used in any seven-year period is lost from abandonment and reverts to the public.

Prior to 1963, this function was largely a matter of accepting applications for filing only, because generally enough water was available for appropriation in most areas of the state. Subsequently, as the needs and demands for water increased, the allocation of stream water became much more complicated. More and better data was needed, not only in the allocation of available supplies, but in formulation of the state's comprehensive water plan.

Oklahoma Statutes provide that any person, firm, corporation, state or federal government agency, intending to acquire the right to the beneficial use of water other than for domestic purposes, shall make application to the Board for the use of such water. A total of 129 applications for stream water permits were processed during 1974, allowing the use of 230,266 acre-feet of water. The largest amount of this water, 202,458 acre-feet, was appropriated for municipal and industrial purposes, and 27,808 acre-feet allocated for irrigation of 17,677 acres of land. Approximately one-fifth of the water allocated for industrial use was used in the generation of electricity.

Oklahoma Statutes further provide that when a party entitled to the use of water commences such use, but thereafter fails to use all or part of the water for which a right has been vested for a period of seven continuous years, the unused water becomes public water available for appropriation. This seven-year period ended June 28, 1972 on all vested rights determined and permits issued prior to June 28, 1965.

Thus, in addition to processing new applications, it is now necessary that the Board review approximately 1,500 vested rights and permits, cancelling rights which have been lost in whole or in part. This procedure involves giving notice by certified mail or newspaper publication and holding a hearing on the loss of rights. Loss of right determinations are long overdue and must be undertaken within the 1975 calendar year.

Irrigation Districts

Under the 1973 Irrigation District Act, whenever ten or more electors desire to provide for irrigation of irrigable land, they may petition the Board to organize an irrigation district and levy assessments on the land after formation. The Board may either approve or deny the petition. If the district's organization is approved, the Board issues its order, naming the district and describing its boundaries.

A petition, consisting of 2,531 names, was filed in 1974, embracing all of Texas County with the exception of municipalities. Upon receipt of the petition, hearings were held and certified notice sent to all those listed in the petition. Notice was also published in newspapers within the county. Two hearings were held, giving ample opportunity for the filing of statements supporting or opposing the district. The votes are being tabulated and the boundaries of the district are being mapped. Approval of the petition is expected in early 1975.

The formation of an irrigation district located in south central Oklahoma has also been proposed. Several informational meetings have been held, but a petition has not yet been filed.

Presently, only one irrigation district, Lugert-Altus, exists in Oklahoma. This was formed under the old irrigation district law. The new law is a simplification of the old law and it is anticipated that a number of such irrigation districts will be formed within the state.

Stream Gaging

Stream gaging devices are placed on streams, rivers and lakes to measure and record the amount of water flowing past.

The present stream gaging network in Oklahoma provides a continuous inventory at 138 streamflow sites, as well as 15 reservoir sites and 2 periodic low flow stations. These stations are

cooperatively operated with the U.S. Geological Survey. The federal agency conducts the technical activities related to the collection, computation and publication of appropriate basic records, and the state aids in planning, coordinating and financing the program.

Data collected by stream gages is useful in many phases of stream water management. For example, it can be developed into a runoff map showing the amounts and locations of water runoff which occur in a year's time. The wide extremes of .2 inch to 20 inches is indicative of the water management problems that occur as a result of Oklahoma's annual 120 million acre-feet of precipitation.

Construction Plan Review

All impoundment structures that are 25 feet or more in height or impound 50 acre-feet or more of water, with the exception of structures constructed by the Corps of Engineers or the Bureau of Reclamation, require statutory review by the Oklahoma Water Resources Board. In 1974, there were 51 such construction plans reviewed for feasibility and plan safety before recommendations were made to the Board for approval. These construction plans are also coordinated with five other state and federal agencies for possible conflicts with other improvements.

Impoundment structure review also involves the determination of water to be allocated where joint or multiple ownership of a body of water occurs. This determination often becomes necessary when two or more owners have occasion to know exactly how much water each has in storage available for beneficial use.

Dam Safety

Under Title 82 O.S., Section 54, dam inspection and repair responsibilities have been placed upon

the Board, and are coordinated by the stream water division.

Under a recently completed Inventory of Dams Contract with the U.S. Army Corps of Engineers, 2,466 dams in 77 counties were inventoried. These dams were 25 feet in height or impounded 50 acre-feet or more of water, and excluded large, federally constructed reservoirs.

The report showed many dams impounding sizeable amounts of water upstream from water-deficient communities. A number of older, neglected dams were found in very poor condition, enhancing the possibility of failure. Because of urban development, still others were found to be no longer adequate.

Hazardous conditions, however, can usually be avoided if detected in time. For the physical safety and protection of property of all Oklahomans, a continuing safety inspection and notification program must be instituted as soon as possible. At the present time, the division cannot properly administer this program due to

insufficient funding and the subsequent lack of qualified personnel.

Disaster Damage Surveys

In times of disaster, such as flooding or prolonged heavy rainfall, the Board coordinates with the State Civil Defense and other agencies in furnishing assistance to the Federal government. Field teams composed of Corps of Engineers, Soil Conservation Service, Civil Defense and Board personnel visit damage sites to develop damage estimates for use in reconstruction sites and grants.

As of December 1, 1974, two disasters requiring Board assistance had occurred, compared to four in 1973. Because of recurring natural disasters, this program should be adequately funded to insure our continued participation.

Flood Insurance

In 1967, Congress enacted a Federal Flood Insurance law and added a Federal Flood Insurance Administration branch to the Department of Housing and Urban Development. This new agency was developed for the purpose of devising a Federally subsidized insurance for persons who reside or have a business in a riverine or coastal flood plain.

The Oklahoma Water Resources Board has been designated as the coordinating agency between communities and the Federal Government in implementing the flood insurance program. There are 242 communities in Oklahoma with identifiable flood problems and of these, 27 communities and one county, Rogers, are presently eligible for the sale of flood insurance. (See Figure 15.1)

Recently enacted Federal legislation regarding flood insurance (PL 93-234) makes it mandatory after July 1, 1975, that flood prone communities have Federal Flood

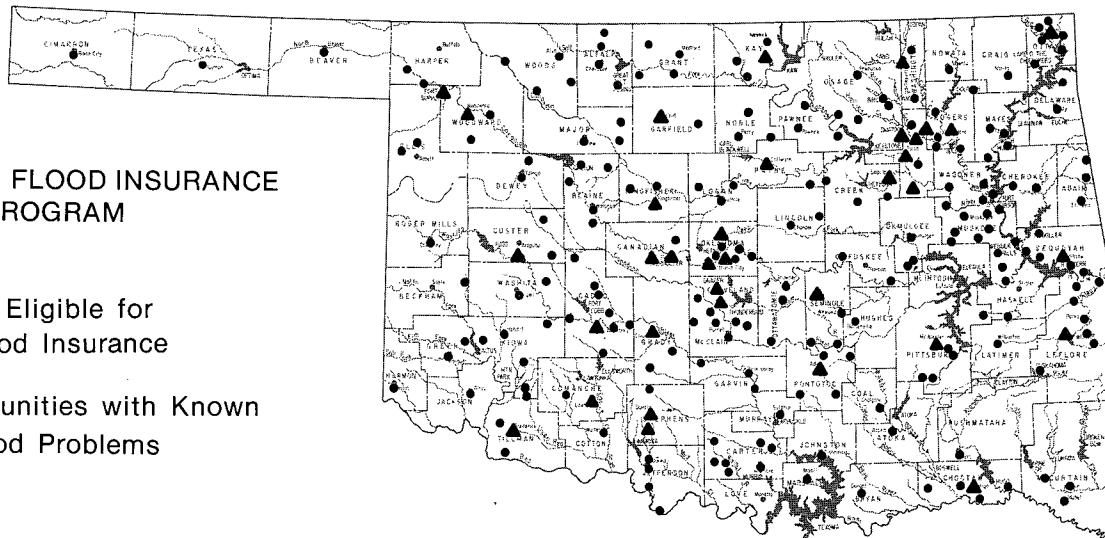


FIGURE 15.1 FLOOD INSURANCE PROGRAM

- ▲ Areas Eligible for Flood Insurance
- Communities with Known Flood Problems

Insurance in order to qualify for any Federally insured loan or grant. The Oklahoma Water Resources Board assists these communities by visiting the local officials to explain the program and furnishing flood insurance application forms. The Board also provides information to insurance and loan companies and directs them to central sources of information concerning the sale of flood insurance.

The entire program is expected to accelerate during the next year as the July 1, 1975 deadline approaches. Proper administration will require more time and personnel participating in the overall effort. Additional coordination is needed with the local planning districts and councils of government throughout the state to assure that the program receives adequate attention at the field level. Additional effort is also needed to properly identify other flood-prone areas not presently included in the program.

At present, it is estimated that two to three persons should be assigned full time to this program. In the future, depending on how

far this program expands, additional personnel will be required to properly administer this important program. At present, there are no Federal funds available to assist in this effort at the state level.

Interstate Compacts

All of the states bordering Oklahoma have an interest in the use of stream waters that originate within or flow through Oklahoma. In order to prevent costly litigation over these waters and allow each state to reserve its proportionate share of the waters for development, Congress has given consent for the involved states to enter into compacts for the apportionment of these waters.

According to Congressional requirements, at least one meeting must be held annually by compact commissioners, and a complete report of all compact activities must be made each year to the President of the United

States and Congress. Oklahoma commissioners are appointed by the Governor to act on behalf of the state in river basin compacts with surrounding states.

The Arkansas River Basin has been compacted by major tributaries and a brief status of each compact is discussed below.

The Canadian River Compact was ratified by Congress in 1951 and covers both the Canadian and North Canadian River basins; the states of Oklahoma, Texas and New Mexico are involved in the compact.

The Arkansas River Compact between the states of Oklahoma and Kansas was ratified by Congress in 1966 and covers the river basins of the Cimarron River, the Salt Fork Arkansas River, the Arkansas River from its confluence with the Grand-Neosho to the Little Arkansas River in Kansas, the Verdigris River and the Grand-Neosho River.

The Arkansas River Compact between Oklahoma and Arkansas was ratified by the 93rd Congress on November 13, 1973 and involved the Arkansas River and all its tributaries from Fort Smith, Arkansas, to its confluence with the Grand-Neosho River at Muskogee.

Although no compact has been made to the waters of the Red River Basin involving the states of Oklahoma, Texas, Louisiana and Arkansas, the Engineering Advisory Committee has made its report to the commission and efforts are continuing to reach an agreement regarding apportionment of these waters.

Weather Modification

Extreme drought conditions existing during the 1930's and 1950's led to efforts to increase rainfall and runoff by artificial "rainmaking" methods and culminated in legislation to regulate weather modification activities in Oklahoma. The Oklahoma Weather Modification Act was passed in 1972.

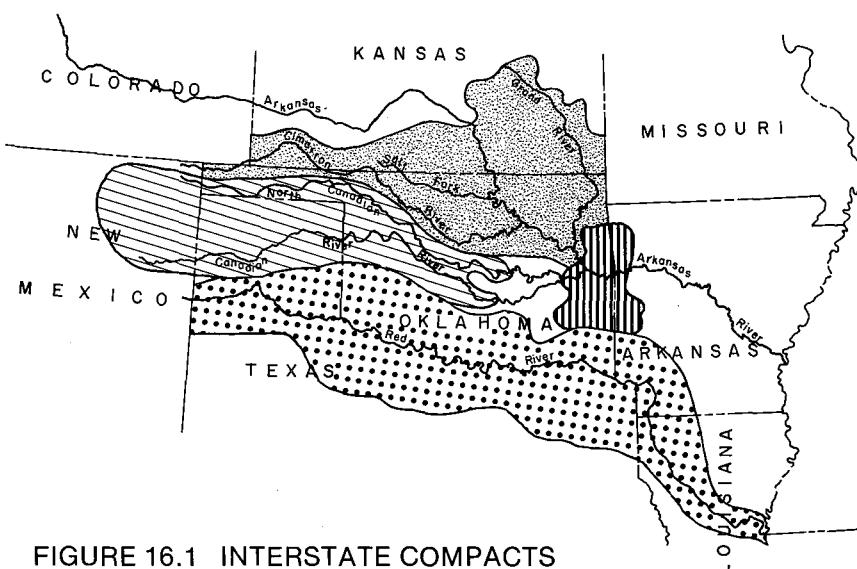


FIGURE 16.1 INTERSTATE COMPACTS

| | | |
|----------------|-------------------------|-------------------|
| Canadian River | N.M., Tex. & Okla. | Ratified 1951 |
| Arkansas River | Kansas & Okla. | Ratified 1966 |
| Arkansas River | Ark. & Okla. | Ratified 1973 |
| Red River | Ark., La., Tex. & Okla. | Under negotiation |

A 1973 amendment delegated to the Oklahoma Water Resources Board the responsibility of administering the Act. This amendment also provided for local entities to hold elections and assess themselves for the cost of contracting for weather modification with the contracts to be filed with and approved by the Board.

Relating to the Act and the Board's Rules and Regulations, "weather modification" or "weather modification and control" means changing or controlling or attempting to change or control by artificial methods the natural development of any or all atmospheric cloud forms or precipitation forms which occur in the troposphere.

A Weather Modification Advisory Committee advises and makes recommendations to the Board concerning legislation, policies, administration, research and other matters. Committee membership now totals 27 interested individuals from all over the state who meet four times annually. The committee voted in September 1974 to curtail rainmaking activities in southwestern Oklahoma to allow harvesting of the state's peanut crop.

Members of the Weather Modification Advisory Committee include J. D. Fleming, Raymond C. Crooks, John Gibson, Gary England, Ken McFall, Jack H. Almond and Patrick J. Ryan, all of Oklahoma City; Jerry Abboud and C. R. Holden, Tulsa; Mike Johnson and Wayne Rowe, Jr., Lawton; Dr. Rex Inman, Norman; Emmett Pybus, Stillwater; Gene Ernest, Alva; Kenneth Hughes, Wetumka; Dick Hamilton, Harmon; Ray Osborn, Chickasha; Robert Shepard, Durant; Leon Russell, Calvin and Henry Joe Von Tungeln, Calumet. Board members Don Arch King and O. B. Saunders serve as chairman and vice-chairman of the committee.

In general, the Act sets forth the powers and duties of the Board and provides for regulation of weather modification operations, procedure for the issuance of licenses and permits and procedures for suspension or revocation

of licenses, penalties and fees. The Board, in cooperation with public or private agencies, is required to exercise its powers to promote the continued conduct of research and development activities in the field of weather modification.

The fee for a license and each annual renewal is \$100 and a \$25 fee for each permit issued thereunder. No money has been funded to the Board for administration of these activities and all fees derived from licenses and permits are deposited in the General Revenue Fund.

Although no research projects were initiated during the current fiscal year, 12 permits were issued covering projects in Oklahoma under one current license, which was renewed for the 1974-1975 fiscal year. Operations under this license consist of rainfall stimulation using ground-based silver iodide generators. There were a total of 85 generators located in Oklahoma, Texas and Kansas covering 12 target areas in Oklahoma. These generators are operated by local residents under

the direction of the licensee as shown in appendix figure 22.1. Monthly operations reports of weather modification activities on each project are submitted to the Board for review by staff members. These reports show generator locations, the date and number of hours operated, modification agent used and type of cloud phenomena modified. The 1974-permitted weather modification projects and ground-based generator locations are shown in Figure 22.1.

Waste Discharge Permits & Monitoring

Pursuant to Title 82 O.S., Supp. 1974, Section 926, the Oklahoma Water Resources Board issues two types of permits aimed at regulating the quality of industrial waste water discharged into state

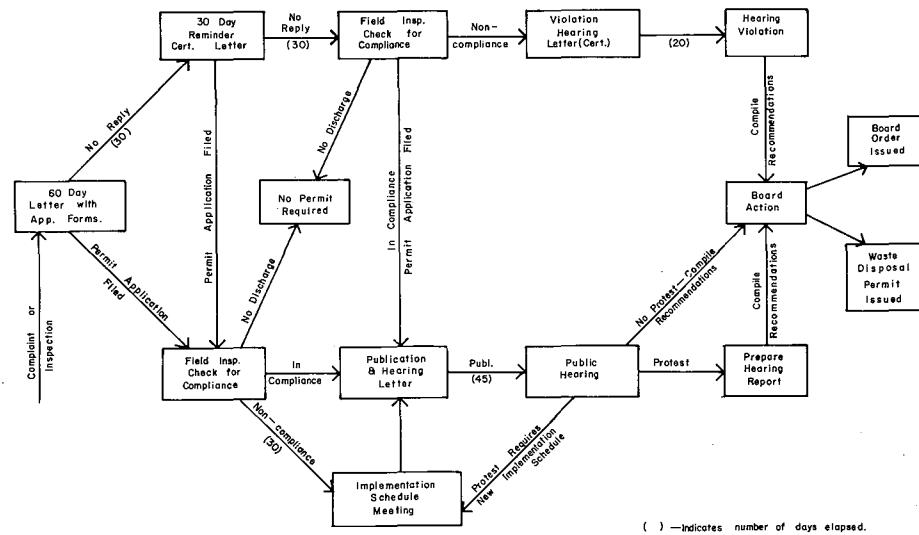


FIGURE 17.1 HOW TO OBTAIN A WASTE DISPOSAL PERMIT

waters—one to industries which discharge waste water and the other to haulers of industrial waste.

This program is accelerating rapidly and additional personnel are needed to perform the monitoring and information-gathering vital to its success. At present the board had granted waste disposal permits to 344 industries. During 1974, 58 additional applications for permits were filed with the board. An even greater number is expected to be filed during 1975.

These permits require industry to monitor their discharge, then submit their data to the board. In addition, the board regularly inspects industries and samples waste discharges for evaluation of the quality of water entering state streams. These data are added to the board's computer files for review of quality standards compliance.

Laboratory Certification

In order to assure that the data submitted by industry is reliable, the board initiated a program to certify laboratories that analyze data for the board. A laboratory seeking certification must meet certain standards established by the board, and must demonstrate their ability to analyze various parameters of unknown samples made available throughout the year. Currently, 37 laboratories are certified or pending certification by the board.

These include B-P Laboratories, Moutrey & Associates, Rockwell International, Williams Brothers Waste Control, McDonnell-Douglas Co., Public Service Co., Reynolds Technical Services, Nalco Chemical Co., Fram Corp., Ozark Mahoning Co., Amoco Production Co., Mapco, Inc., Analytical Services and Badger Meter, Inc., all of Tulsa; Environmental Consultants, Techrad, Oklahoma Testing Laboratories, Southwell Laboratories, Okla-

homa, Gas & Electric, Kerr-McGee Technical Center and Multi-Mode Environmental Laboratory, all of Oklahoma City; Phillips Petroleum and National Zinc Co., Bartlesville; Weyerhaeuser Co., Broken Bow and Valliant; Kerr-McGee Nuclear Corp., Gore; Fansteel, Inc., Muskogee; Nipak, Inc., Pryor; Sonics International, Dallas, Texas; Magal Corp., Arlington, Texas; Wilson and Co., Salina, Kansas; Western Chemical Co., Kansas City, Kansas; Bruce Williams Laboratories, Joplin, Missouri; Escom Laboratories, Fayetteville, Arkansas; Peabody Coal Co., Freeburg, Illinois and Calgon Corp., Pittsburgh, Pennsylvania.

This program is growing on a state basis, and, in addition, the Environmental Protection Agency is expected to establish a national program for laboratory certification, thus requiring additional manpower for inspection and certification.

Enforcement

Enforcement activities of the board center around complaints registered by the public that might involve industrial pollution and around violations of permit requirements and water quality standards by industry. Many of these violations and complaints require extensive investigations.

The Oklahoma Water Resources Board works with industries in violation of state water quality standards to bring them into compliance and to set schedules which allow adequate time for completion of necessary construction of new or modified waste treatment systems. However, the board may order the Attorney General's office to file suit in District Court seeking a cease and desist order when industries fail to comply with board regulations and instructions. Misdemeanor charges also may be sought against violators.

The need for additional personnel and funding to investigate complaints of violations and to help bring violators into compliance is evidenced by the fact that

60 complaints were received and investigated in Fiscal Year 1973, while 71 complaints were received and investigated in Fiscal Year 1974. A similar increase in complaints is anticipated in Fiscal Year 1975.

Water Quality Standards Development

The most recently published Water Quality Standards, the 1973 revision, contain several provisions which will offer significant protection for state waters not contained in the previously published 1968 edition. The list of streams was greatly expanded and all streams were protected for their various beneficial uses. The dissolved oxygen criteria was upgraded for warm and cold water streams and return flow streams, meaning that all streams in Oklahoma have greater protection against oxygen-depleting materials.

The water quality standards were also expanded to include the species diversity index for benthic (bottom dwelling) macroinvertebrate organisms. This initiates protection for the biological communities of the streams.

Development and publication of these standards is essential to protection of the quality of the state's water resources. Revision and publication is necessary in Fiscal Year 1976, thus adequate funding by the legislature will be required.

Bioassay Monitoring

One of the most important programs in obtaining data for upgrading state water quality standards is the bioassay monitoring program.

Bioassays may be used to determine the toxicity of effluents or other materials, allowable efflu-

ent discharge rates, sensitivity of aquatic organisms to environmental stress and effects on toxicity of variables like temperature and acidity.

In conjunction with physical and chemical analyses, bioassays help evaluate the interactions between organisms and their environment.

During the past 18 months, board personnel have begun gathering background bioassay data on metal toxicities in state waters. The board is expanding its bioassays of state waters in order to obtain more data on heavy metals and other toxicants for industrial waste disposal permitting.

The board will also conduct bioassays during its monitoring of 18 state industries granted permits under the National Pollution Discharge Elimination System (NPDES).

The board plans to increase the variety of organisms used in its bioassay program to include members of the benthic community, as well as a broader variety of fish found in Oklahoma's waters. Through this expansion, the understanding of water quality trends will be improved due to a larger perspective of the food chains within the aquatic community.

In order to maintain such a program and keep pace with federal and state regulations on water quality standards, revision, adequate funding and personnel are essential.

Limnological Laboratory

The limnological laboratory is involved in the chemical and biological analysis of the aquatic environment. The intent of this analysis is to determine water quality as related to specific beneficial uses and water quality

standards. The laboratory determines this quality by identifying and quantifying various constituents of water or by evaluating various water quality indicators.

One such indicator entails the examination of benthic communities. This complex of different organisms is referred to as community diversity. Diversity patterns are altered when pollutants are added to a stream. Diversity can be reduced to a mathematical number, which relates to the relative water quality of the stream.

There is considerable on-going research into the effects of various water quality characteristics on benthic organisms. As more knowledge is gained, predictions can be readily made concerning the community structures and diversity patterns expected in different categories of water quality.

The laboratory's present analytical capabilities are sufficient for most monitoring and research needs of the agency, but increasing emphasis on the evaluation of subtle effects of pollutants on the environment will necessitate constant upgrading of laboratory capabilities.

Eutrophication, or the accelerated aging of lakes, is one of the most significant pollution effects. Eutrophication can be minimized, however, if detected early. This will necessitate increases in laboratory capabilities in order to identify the causes of eutrophication. The cost of increasing laboratory capabilities and the maintenance of these facilities will be expensive; however, a decision based on inaccurate data or the failure to recognize an impending environmental problem would be far more costly.

Limnological Studies

Biological parameters are useful

indicators of past and present environmental conditions due to their sensitivity to environmental change and their relative inability to move away from adverse water quality conditions. This, in combination with complete analysis of chemical and physical parameters, provides the foundation for the board's limnological stream and reservoir studies.

Limnology is the study of the biological, chemical and physical aspects of inland water systems. The limnological investigations undertaken by the board are specialized tasks requiring trained professionals. Data analysis and interpretation is necessarily time consuming and requires the talents of proficient limnologists.

RESERVOIR STUDIES

In the past, no systematic or concentrated effort has been made to characterize or assess the existing or historical water quality of the state's reservoirs.

Title 82 O.S., Supp. 1974, Sections 926 and 1085.2 give the board its basic authority "...to develop statewide and local plans to assure the best and most effective use and control of water to meet both the current and long-range needs of the people of Oklahoma..." and "...to encourage, participate in, conduct studies, investigations, research and demonstrations relating to water pollution and causes, prevention and abatement thereof..."

In addition, the 1972 Federal Water Pollution Control Act amendments, PL 92-500, Section 314, requires states to initiate a reservoir surveillance system to determine the eutrophic state (degree of aging) of each state's impoundments. As a result of these requirements, the board is currently engaged in selected reservoir studies.

Lake Konawa

A preliminary study of Lake Konawa in Seminole County, determining the biological, chemical and physical nature of the lake, and the effects of thermal discharges on the aquatic ecosystem, has been completed.

Lake Comanche

The board has been funded by Public Service Company of Oklahoma to conduct a limnological study of Lake Comanche, a cooling reservoir near Lawton. The expanding usage of fresh-water lakes as a source for cooling water has prompted concern about the thermal impact of heated effluents on the aquatic ecosystem. Conclusions derived from the study will assist in evaluating factors of power plant operation that must be considered to preserve healthy aquatic environments.

Ft. Cobb

The board, in conjunction with the Bureau of Reclamation, the Ft. Cobb Master Conservancy District, the State Department of Agriculture and other state agencies, is engaged in a three-year study of Ft. Cobb Reservoir. This study is evaluating the chemical control of a water weed commonly known as Eurasian watermilfoil. The Environmental Protection Agency issued a temporary permit for the use of 2,4-D pesticide and established a temporary tolerance of 0.1 parts per million in the reservoir. This is the first study of its kind to be conducted on a reservoir used for municipal water supplies. Data collected during the study will be used, in part, to help establish full registration for use of 2,4-D in municipal water supplies.

Specific objectives of the board's study are evaluation of pesticide effects on selected biological communities, determination of effects of watermilfoil destruction and decay on the

chemical water quality of the reservoir and description of changes in the reservoir's physical character relating to watermilfoil decay.

The first year's pesticide application and monitoring program has been concluded. Bureau of Reclamation divers have reported excellent kill with the use of 2,4-D. Concentrations of 2,4-D at municipal water supply intakes never exceeded the temporary tolerance level of 0.1 ppm. The second year of the study will commence with the start of the watermilfoil growing season in spring, 1975.

Lake Texoma

In the establishment of Oklahoma's Water Quality Standards, certain questions have arisen concerning the validity of a thermal maximum standard of 90°F for Lake Texoma in southeastern Oklahoma. The Oklahoma Department of Wildlife Conservation, during a public hearing on water quality standards, suggested that Lake Texoma have a temperature limit of 90°F. The Wildlife Department stated that this temperature would provide more protection for the fish than the previously proposed 93°F and that available data does not reflect temperatures in excess of 90°F. Since thermal data on the lake is sparse and not sufficient to draw needed conclusions, the board will conduct a study of Lake Texoma commencing in late June, 1975.

Objectives of the study are collection of meaningful and sufficient data to prescribe a thermal maximum standard for the lake and surveillance of the lake's chemical water quality and physical characteristics. If additional funding is not secured, chemical water quality studies will have to be omitted.

Washita Thermal Aquaculture

The board is presently engaged in a preliminary review of the use and reuse feasibility of industrial

waste water for supplemental food production. Public Service Company of Oklahoma has funded the board to study this.

Power generating plants presently discharge tremendous amounts of energy in the form of waste heat. It is conceivable that this energy can be harnessed and put to more beneficial uses, thereby decreasing amounts of waste heat discharged to state waters. If these techniques prove sound, the principles might be applied to other types of industrial waste water.

The value of these studies is reflected in their individual objectives. It is anticipated that no additional personnel will be required to carry out the aforementioned programs. However, additional programs under federal and state regulations will require additional personnel and equipment.

FUTURE RESERVOIR PROGRAMS

Eutrophication

Eutrophication is the process of nutrient enrichment of lakes which stimulates algae growth, choking shallow areas with rooted plants and impairing the lake as a water resource. This increased plant production depletes oxygen, reduces water clarity, hinders sport fish population growth and destroys aesthetic qualities of the lake.

This process is accelerated by phosphate and nitrate concentrations. Natural land runoff generally provides a sufficient balance of these nutrients, which are necessary for normal fish and plant growth. Technological advances, however, have created an overabundance of these nutrients. Through management, eutrophication accelerated by man can be reversed. A complete study in this area is essential in order to develop the management program necessary to protect new and existing reservoirs from becoming eutrophic.

Trend Reservoir Monitoring

Establishment of a trend reservoir monitoring program, when coupled with the current trend stream monitoring program, would provide a complete picture of the quality of the state's water sources. Such a study would define trends and characterize physical, chemical and biological conditions of the state's surface waters. In addition, the program would establish baselines of water quality, provide for a continuing assessment of water pollution control programs, aid in the identification of new and existing pollution problems, act as a triggering mechanism for introduction of intensive surveys or enforcement proceedings and facilitate the revision of the water quality standards.

STREAM STUDIES

Limnological studies of state streams are important in the detection of problem areas and the establishment of water quality standards. Detailed examinations of aquatic plant, bacteria, plankton, macroinvertebrate and fish populations and their interrelationships, as well as surveys of energy flows through the system are needed for the total discernment of the stream ecology.

Trend Stream Monitoring

In 1972, the board expanded its program of assessing the quality of streams and rivers across the state. Basic objectives of the stream trend program are similar to those outlined earlier under trend reservoir monitoring.

An additional 62 sampling stations were established in mainstream rivers and streams to gather chemical and physical data on quality of the state's water. In order to fully evaluate the state's water resources, biological monitoring will begin at these sites during the next year.

Pesticide Monitoring

The board collects pesticide samples, both water and sediment, at 26 points across the state. This program is a joint effort by the board and the State Department of Agriculture. The program was designed to detect trends in various pesticide concentrations in an effort to define potential problem areas.

Washita River Below Foss

In October, 1974, the Foss Master Conservancy District completed installation of a desalination plant on Foss Reservoir near Clinton. The plant will remove the excess total dissolved solids (salts) from the waters of Foss Reservoir, providing a suitable municipal water supply for the four member communities. The saline wastewater (brine) will be discharged into the Washita River one-half mile below Foss Dam and diluted with released reservoir water.

An extensive two-year, two-phase study was initiated in February, 1973, to determine the effects of the desalination waste on the 30-mile stretch of the river between the dam and Clinton. Study objectives are characterization of biological communities and chemical water quality of the river before and after plant operation commencement and determination of ecological impacts from the discharges.

The first phase of the study was completed prior to operation of the plant. Phase Two of the study will begin in spring, 1975, after the plant is fully operational and will continue for one year.

Mountain Fork River Below Broken Bow

A short-term study was initiated to determine the effects of treated industrial wastes on benthic communities, chemical water quality and certain physical characteristics along a five-mile stretch of Mountain Fork River above and below Weyerhaeuser Company's

Craig plant. This study is being conducted with and funded by Weyerhaeuser Company.

Data analysis and interpretation is nearing completion and will provide beneficial information to assist in the control and understanding of effects on overall stream quality.

Waste Load Allocation Studies

In order to fully study mixing, movement rates and assimilative capacity within streams, the board, in conjunction with the Department of Pollution Control, is involved in waste load allocation studies.

Waste assimilation capacities of streams is determined through the monitoring of the biological oxygen demand (BOD) and the chemical oxygen demand (COD) along a predetermined length of each stream. The collected data aids in establishment of maximum daily effluent loads required by NPDES permits under the 1972 Federal Water Pollution Control Act amendments.

Stream characteristics for 279 streams throughout the state has been collected. This information was and will be used as background data for waste load allocation studies. The board is currently conducting studies on 10 other streams, with Kingfisher, Stillwater and East Cache Creeks and North Canadian River studies already finished.

Studies to be completed during the spring of 1975 will include Horsepen and Cow Creeks, the Washita River and three others to be selected.

Cimarron River near Okeene

This study was made in July and August, 1974, covering a 30 mile stretch of the river. Chemical water quality data and stream flow analysis was obtained at 22 sampling stations. The objectives were to determine the source and distribution of salts in that portion of the river. The project was funded by the Corps of Engineers.

Appendix

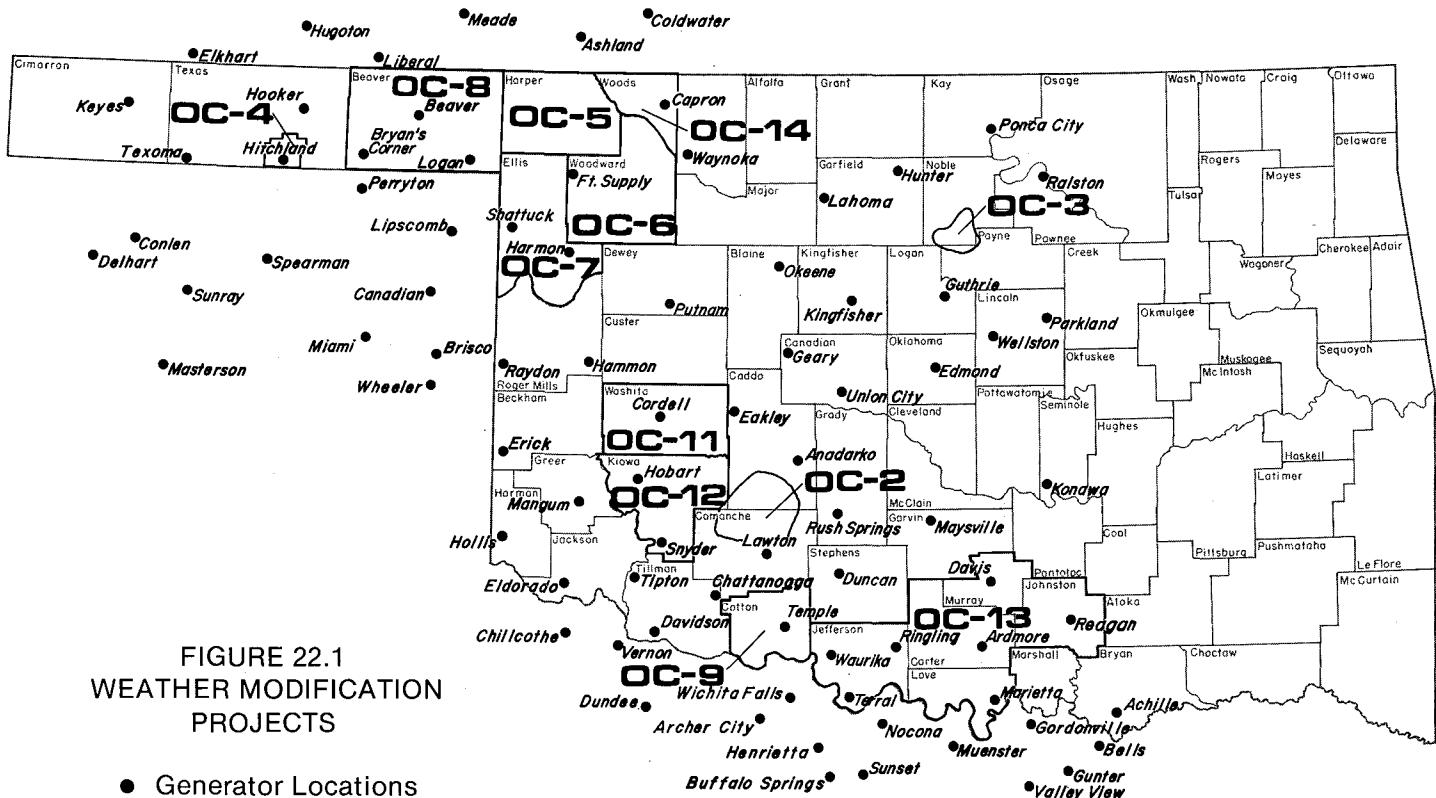


FIGURE 22.1
WEATHER MODIFICATION
PROJECTS

- Generator Locations

PROJECT AREAS

- OC-2 City of Lawton
- OC-3 Oklahoma State University
- OC-4 Hitch Ranch
- OC-5 Harper County
- OC-6 Woodward County
- OC-7 Ellis County
- OC-8 Beaver County
- OC-9 Cotton County
- OC-11 Washita County
- OC-12 Kiowa County
- OC-13 Carter, Love, Murray, Johnston and Jefferson counties
- OC-14 Western part of Woods County (Extension of OC-6, Woodward County)

**FIGURE 23.1 1973 REPORTED WATER USE
(in acre-feet)**

Ground Water
Stream Water

State Totals

**764,276 Ground Water
735,819 Stream Water**

| | | | | | | | | | | | |
|-----------------|----------------|---------------|-----------------|-------------|-------------|------------|------------------|----------------|------------|-------------|------------|
| Cimarron | Texas | Beaver | Harper | Woods | Alfalfa | Grant | Kay | Osage | Nowata | Craig | Ottawa |
| 73,971 4,008 | 234,046 997 | 50,825 774 | 12,631 2,282 | 3,758 13 | 6,344 88 | 1,266 0 | 14,838 59,708 | 3,974 7,943 | 0 1,290 | 30 1,509 | 4,518 0 |

| | | | | | | | | | | | |
|---------------|-------|------------|---------------|--------------|--------------|------------|--------------|--------------|-------------|---------------|----------|
| Custer | Dewey | Ellis | Major | Garfield | Noble | Payne | Payne | Osage | Nowata | Wagoner | Moyes |
| 23,577 922 | 2,052 | 3,171 0 | 22,840 393 | 5,256 182 | 264 5,910 | 917 595 | 7,478 729 | 3,337 349 | 0 1,1374 | 102 78,403 | 124 0 |

| | | | | | | | | | | | |
|---------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Canadian | Oklahoma | Lincoln | Pottawatomie | Seminole | Hughes | Gool | Tulsa | Delaware | Adair | Sequoyah | McCurtain |
| 22,556 433 | 14,279 46,073 | 1,328 46,073 |

| | | | | | | | | | | | |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| McLain | Garvin | Cleveland | Lincoln | Pottawatomie | Seminole | Hughes | Gool | Tulsa | Delaware | Adair | Sequoyah |
| 600 4,510 | 600 2,178 | 600 1,328 |

| | | | | | | | | | | | |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Johnston | Atoka | McLain | Garvin | Johnston | Atoka | McLain | Garvin | Johnston | Atoka | McLain | Garvin |
| 39281 3,314 | 3,218 3,108 |

| | | | | | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Wagoner | McLain | Garvin | Johnston | Atoka | McLain | Garvin | Johnston | Atoka | McLain | Garvin | Johnston |
| 119 0 | 411 0 |

| | | | | | | | | | | | |
|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Cherokee | Adair | Sequoyah | McCurtain |
| 102 0 | 66 39 | 66 39 | 66 39 | 66 39 | 66 39 | 66 39 | 66 39 | 66 39 | 66 39 | 66 39 | 66 39 |

**FIGURE 23.2 1973 REPORTED
IRRIGATION WATER USE
(in acre-feet)**

Ground Water
Stream Water

State Totals

**653,655 Ground Water
106,278 Stream Water**

| | | | | | | | | | | | |
|-----------------|----------------|---------------|----------------|-------------|--------------|----------|------------|------------|--------|--------|--------|
| Cimarron | Texas | Beaver | Harper | Woods | Alfalfa | Grant | Kay | Osage | Nowata | Craig | Ottawa |
| 52,135 2,535 | 164,843 427 | 23,201 230 | 4,683 1,203 | 1,412 40 | 2,198 134 | 450 0 | 274 243 | 828 546 | 0 0 | 0 0 | 6 0 |

| | | | | | | | | | | | |
|--------------|------------|----------------|--------------|------------|------------|------------|-----------|------------|--------|---------|--------|
| Ellis | Dewey | Custer | Major | Garfield | Noble | Payne | Payne | Osage | Nowata | Wagoner | Moyes |
| 6,384 349 | 1,981 0 | 5,068 2,284 | 7,449 196 | 423 101 | 282 326 | 667 120 | 407 39 | 828 546 | 0 0 | 0 0 | 0 0 |

| | | | | | | | | | | | |
|--------------|------------|------------|--------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Canadian | Oklahoma | Lincoln | Pottawatomie | Seminole | Hughes | Gool | Tulsa | Delaware | Adair | Sequoyah | McCurtain |
| 8,694 613 | 770 613 | 770 613 | 770 613 | 770 613 | 770 613 | 770 613 | 770 613 | 770 613 | 770 613 | 770 613 | 770 613 |

| | | | | | | | | | | | |
|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| McLain | Garvin | Cleveland | Lincoln | Pottawatomie | Seminole | Hughes | Gool | Tulsa | Delaware | Adair | Sequoyah |
| 649 4,52 | 649 3,72 | 649 3,72 | 649 3,72 | 649 3,72 | 649 3,72 | 649 3,72 | 649 3,72 | 649 3,72 | 649 3,72 | 649 3,72 | 649 3,72 |

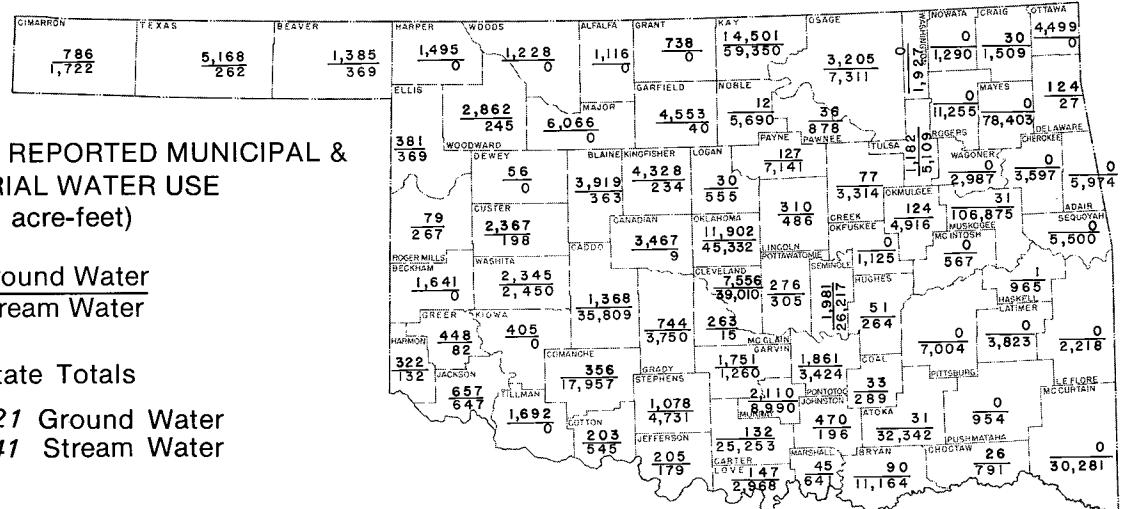
| | | | | | | | | | | | |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Johnston | Atoka | McLain | Garvin | Johnston | Atoka | McLain | Garvin | Johnston | Atoka | McLain | Garvin |
| 345 3,266 |

**FIGURE 23.3 1973 REPORTED
LAND IRRIGATED
(in acres)**

Ground Water
Stream Water

State Totals

**418,445 by Ground Water
105,493 by Stream Water**



**FIGURE 24.1 1973 REPORTED MUNICIPAL &
INDUSTRIAL WATER USE
(in acre-feet)**

Ground Water

State Totals

110,621 Ground Water
629,541 Stream Water

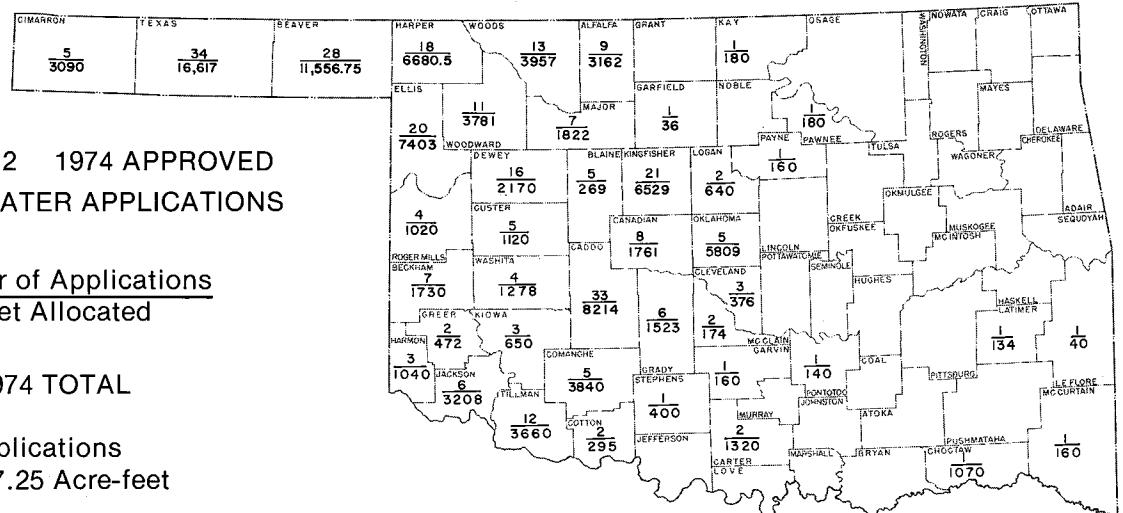


FIGURE 24.2 1974 APPROVED GROUND WATER APPLICATIONS

Number of Applications
Acre-feet Allocated

1974 TOTAL

312 Applications

*107,827.25 Acre-feet

*35,135,617,240 gallons

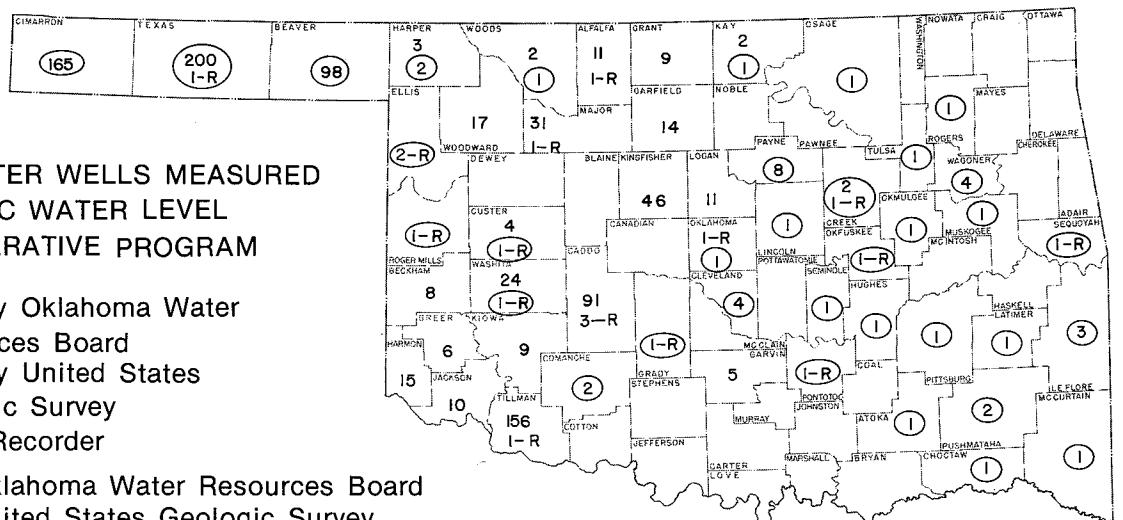


FIGURE 24.3 WATER WELLS MEASURED
FOR STATIC WATER LEVEL
1974 COOPERATIVE PROGRAM

- 2 Measured by Oklahoma Water
Resources Board

③ Measured by United States
Geologic Survey

R Automatic Recorder

481 Total by Oklahoma Water Resources Board

516 Total by United States Geologic Survey

997 Grand Total

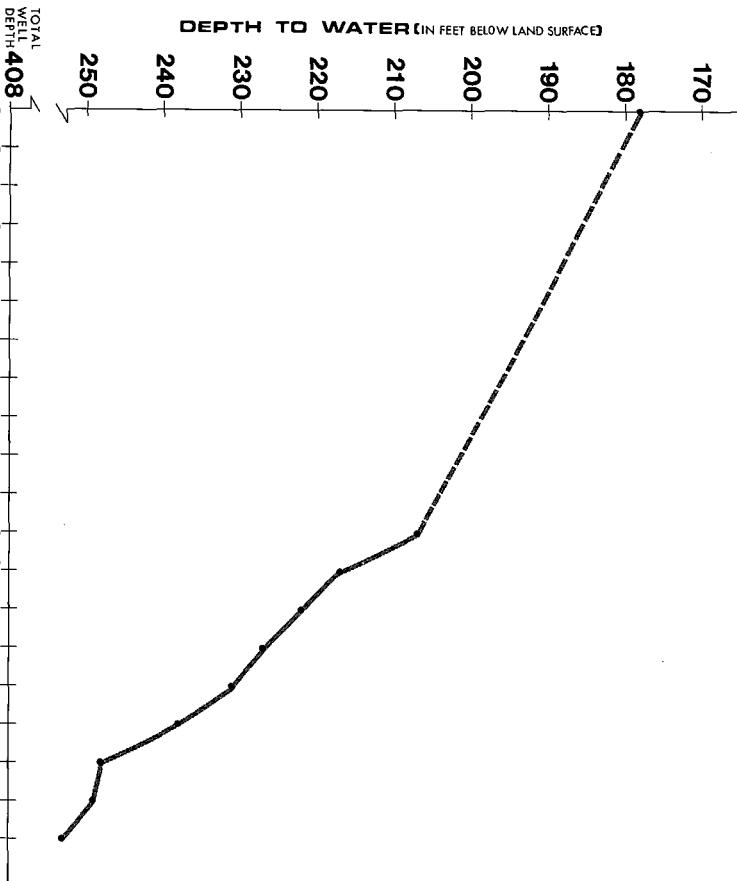


FIGURE 25.1 WELL LEVEL DECLINE TEXAS COUNTY
T2N-R15E-9BCB OGALLALA FORMATION

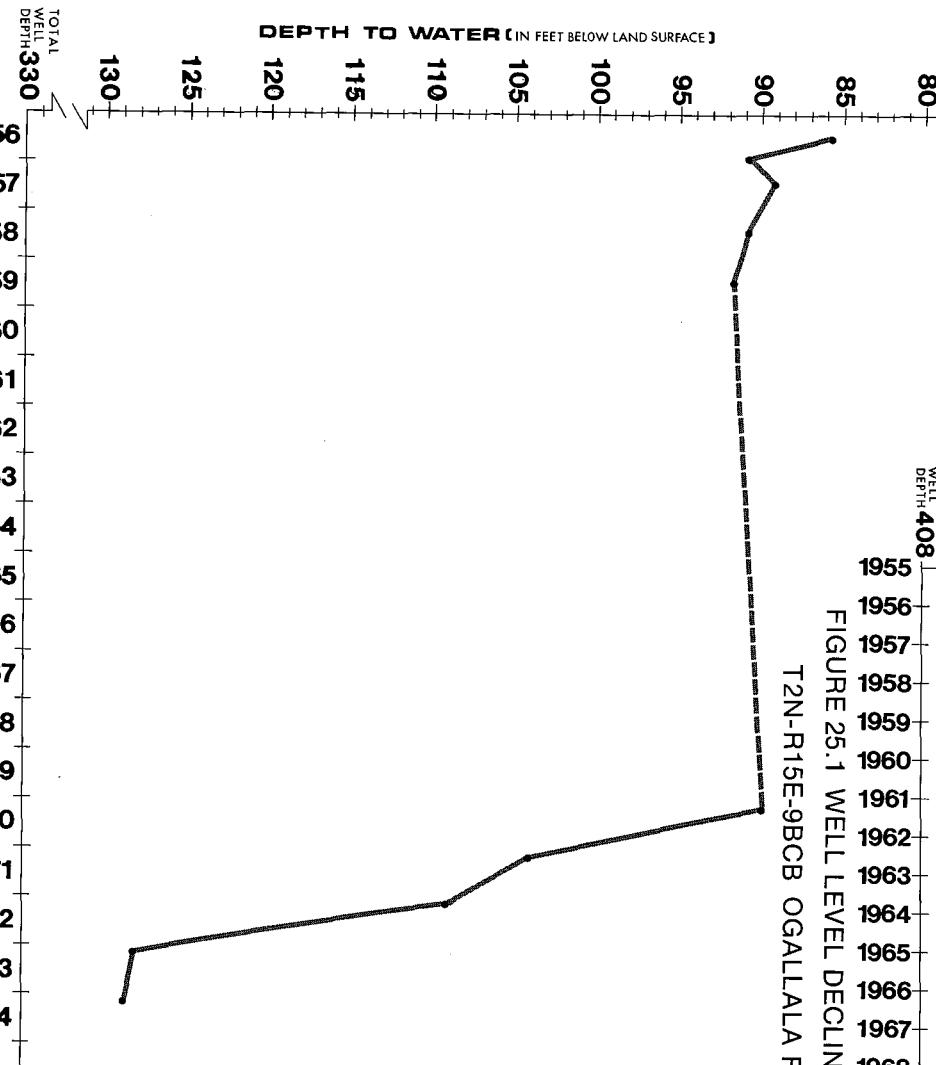


FIGURE 25.2 WELL LEVEL DECLINE CADDO COUNTY
T10N-R12W,3BB RUSH SPRINGS SANDSTONE

**FIGURE 26.1 LICENSED WATER
WELL DRILLERS**
Approved as of January 1, 1975

| | | |
|---|---|---|
| ADAIR COUNTY | H. A. "Bill" Smith Drilling Co. Shattuck | Webber's Drilling Service Ringwood |
| Herbert D. Brown Stilwell | | |
| BECKHAM COUNTY | GARFIELD COUNTY | OKLAHOMA COUNTY |
| Roy Lee Burson Elk City | Campion Water Well Service Waukomis | Bybee Drilling Co. Inc. Bethany |
| F & H Water Well Service Elk City | R. W. Choate Enid | Donald Dean Coyle Oklahoma City |
| Lloid I. Tyson Sayre | V R V Drilling Co. Enid | *Ted L. Jenks Edmond |
| BRYAN COUNTY | Winter Drilling Co. Hillsdale | Poindexter Supply & Drilling Co. Oklahoma City |
| *Buddy's Water Well Drilling Service | GARVIN COUNTY | Sherman Machine & Iron Works Oklahoma City |
| Achille | John Welch Drilling Co. Stratford | Tri-Lab Water Well Drilling Oklahoma City |
| *Curtis Drilling Co. Durant | GRADY COUNTY | OTTAWA COUNTY |
| CADDY COUNTY | Walter Ray Bailey Ninnekah | C. L. Yost Drilling Co. Afton |
| Bell Well Drilling Carnegie | Spears Drilling Co. | PAYNE COUNTY |
| Dewitt Brownback Washita | Ninnekah | R. G. Focht Ripley |
| Glenn Erkenbrack Anadarko | GEEER COUNTY | POTTAWATOMIE COUNTY |
| A. R. Henderson Carnegeie | Houck Drilling & Pump Service Mangum | Moats Drilling Co. Shawnee |
| Earl B. Phillips Binger | HARMON COUNTY | SEMINOLE COUNTY |
| CANADIAN COUNTY | *Faulks & Son Drilling Hollis | McRay Brothers Seminole |
| Orla J. Reese Calumet | John Moore Drilling Co. Hollis | STEPHENS COUNTY |
| CHEROKEE COUNTY | JACKSON COUNTY | H & H Drilling Co. Duncan |
| Rowan & Hood Drilling Co. Tahlequah | H. L. Myatt Altus | TEXAS COUNTY |
| CLEVELAND COUNTY | JOHNSTON COUNTY | K.T.M. Drilling, Inc. Guymon |
| *Meyer Pump Service Norman | *L. R. Browder Milburn | TULSA COUNTY |
| Staats Drilling Co. Moore | KAY COUNTY | Jim Winnek, Inc. Tulsa |
| COMANCHE COUNTY | Robinson Drilling Co. Tonkawa | *Key Drilling Co. Tulsa |
| *Bill Gowan Lawton | KINGFISHER COUNTY | WASHITA COUNTY |
| CUSTER COUNTY | Andrew O. Green Dover | *Stockton's Drilling & Pump Foss |
| *W. L. Myers Drilling Co. Clinton | KIOWA COUNTY | WOODS COUNTY |
| DEWEY COUNTY | Raymond Soukup Mountain Park | Lehl and Son Well Drilling Alva |
| *Squires Drilling & Construction Co. | LINCOLN COUNTY | WOODWARD COUNTY |
| Taloga | Leroy Muzny Prague | Craig Water Well Service Woodward |
| ELLIS COUNTY | McCURTAIN COUNTY | Rogers Drilling Co. Woodward |
| Bud Holt & Sons Fargo | *Morgan Drilling Co. Broken Bow | *Pending |
| | MAJOR COUNTY | |
| | Ewbank, Inc. Fairview | |

FIGURE 27.1 STREAM WATER AVAILABILITY

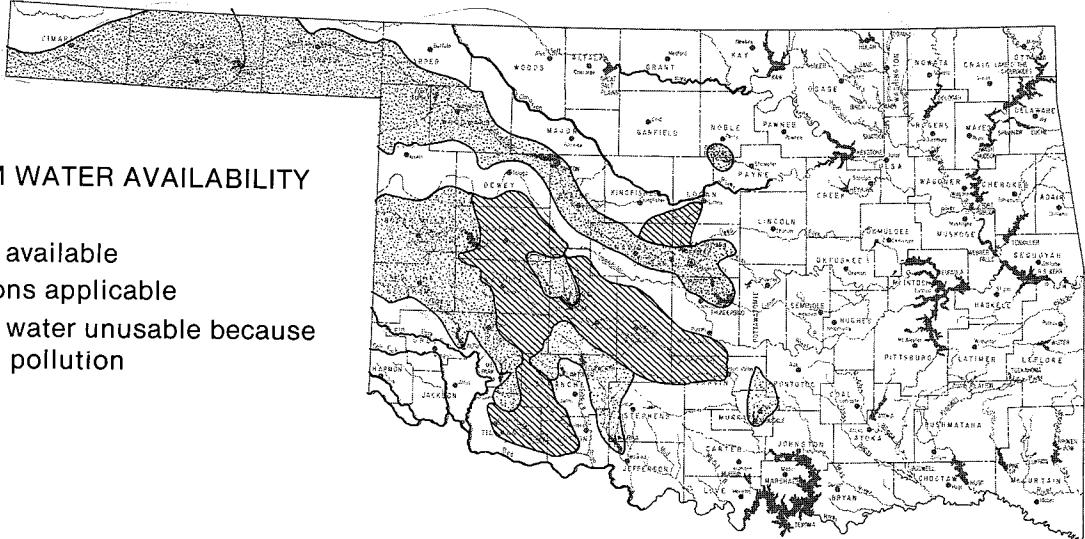
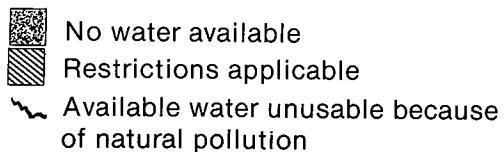


FIGURE 27.2 WASTE DISPOSAL PERMITS (*Issued as of January 1, 1975)

*265 previously issued permits
and new applications are currently
under review for compliance with 1973
edition of Oklahoma's Water Quality Standards

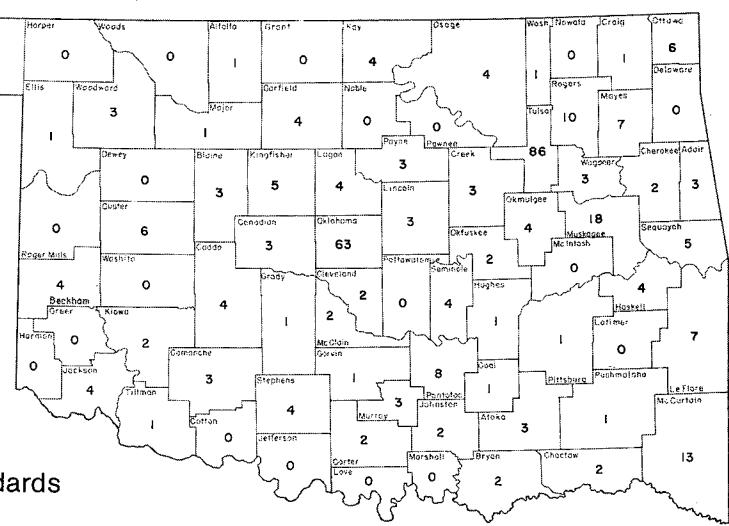
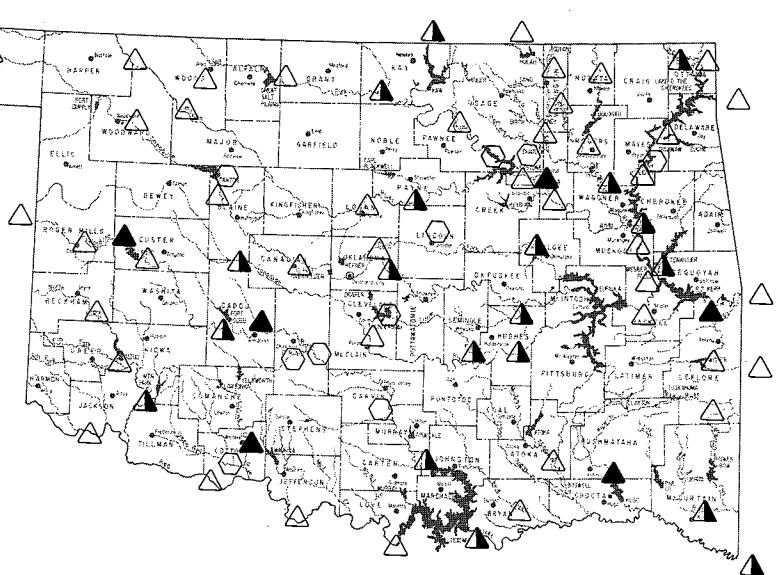


FIGURE 27.3 TREND & PESTICIDE SAMPLING STATIONS



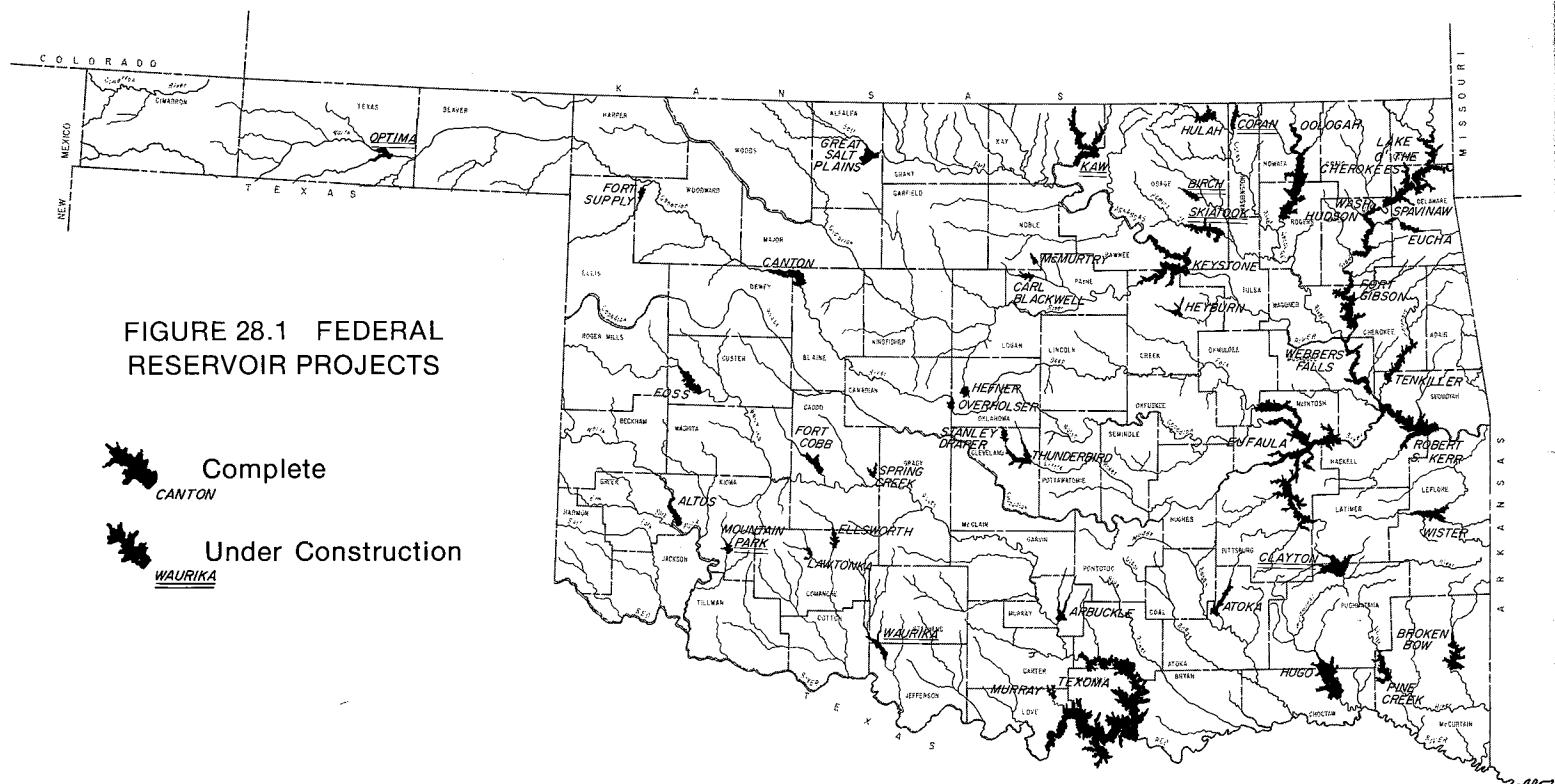


FIGURE 28.1 FEDERAL RESERVOIR PROJECTS

Complete
CANTON

Under Construction
WAURICA

TABLE 28.1 MAJOR RESERVOIRS UNDER CONSTRUCTION
JANUARY 31, 1974

| Reservoir | Water Use | Total Storage Capacity (acre feet) | Estimated Completion Date | Estimated Cost (Dollars) |
|---------------|---------------|---------------------------------------|---------------------------|-----------------------------|
| Birch | FC-WS-WQ-R-FW | 58,200 | December, 1976 | 6,620,000 |
| Copan | FC-WS-WQ-R-FW | 227,700 | June, 1979 | 40,400,000 |
| Kaw | FC-WS-WQ-R-FW | 1,348,000 | January, 1977 | 96,000,000 |
| Mountain Park | FC-WS-R | 115,716 | January, 1975 | 25,734,000 |
| Optima | FC-WS-R-FW | 229,500 | January, 1977 | 27,300,000 |
| Clayton | FC-WS-R-FW | 430,600 | July, 1980 | 14,900,000 |
| Skiatook | FC-WS-WQ-R-FW | 556,600 | September, 1980 | 32,000,000 |
| Waurika | FC-WS-R-WQ-FW | 343,300 | July, 1976 | 42,100,000 |

*Water use abbreviations: FC-Flood Control, WS-Water Supply (municipal & industrial), R-Recreation, WQ-Water Quality, FW-Fish & Wildlife

TABLE 28.2 COMPARATIVE STATISTICS OF LARGER RESERVOIRS

| | Location of Dam (River & County) | Surface Area (acres) | Conservation Storage (acre-feet) | Height of Dam Above Stream Bed (feet) | Shore Line (miles) | Purpose* | Built by | Date Completed |
|----------------|--------------------------------------|----------------------------|--|--|--------------------------|-----------|------------------------------|-------------------|
| ALTUS | North Fork Red; Greer & Kiowa | 6,260 | 134,500 | 94 | 49 | I-WS-FC-R | Bureau of Reclamation | 1943 |
| ARBUCKLE | Rock Creek, Washita; Murray | 2,350 | 72,400 | 142 | 36 | FC-WS-R | Bureau of Reclamation | 1967 |
| BROKEN BOW | Mountain Fork; McCurtain | 14,200 | 918,000 | 225 | 180 | WS-P-R-FC | Corps of Engineers | 1969 |
| CANTON | North Canadian; Blaine | 7,500 | 116,000 | 73 | 45 | FC-I-WS | Corps of Engineers | 1948 |
| CARL BLACKWELL | Stillwater Creek, Cimarron; Payne | 3,264 | 58,752 | 58 | 55 | WC-R-WS | Department of Agriculture | 1940 |
| EUFAULA | Canadian; Haskell & McIntosh | 102,500 | 2,378,000 | 114 | 600 | P-FC-N | Corps of Engineers | 1964 |
| FORT COBB | Cobb Creek, Washita; Caddo | 4,100 | 80,100 | 101 | 45 | I-FC-WS-R | Bureau of Reclamation | 1959 |

CONTINUATION ON PAGE 29

CONTINUATION OF TABLE 28.2

| CONTINUATION OF TABLE 28-2 | | | | | | | | |
|---|--------------------------------------|---------|------------|-----|-------|------------|---------------------------|------|
| FORT GIBSON | Grand (Neosho); Wagoner & Cherokee | 19,000 | 365,200 | 110 | 225 | P-FC | Corps of Engineers | 1953 |
| FORT SUPPLY | Wolf Creek, North Canadian; Woodward | 1,880 | 14,600 | 85 | 26 | FC | Corps of Engineers | 1942 |
| FOSS | Washita; Custer | 8,800 | 256,200 | 134 | 63 | I-WS-FC-R | Bureau of Reclamation | 1961 |
| GRAND LAKE O' THE CHEROKEES (Pensacola) | Grand (Neosho); Mayes | 46,500 | 1,672,000 | 174 | 1,300 | P-FC-R | Grand River Dam Authority | 1941 |
| GREAT SALT PLAINS | Salt Fork Arkansas; Alfalfa | 8,890 | 37,500 | 68 | 41 | FC | Corps of Engineers | 1941 |
| HEYBURN | Polecat Creek Arkansas; Creek | 980 | 8,200 | 89 | 50 | FC-WS | Corps of Engineers | 1950 |
| HUGO | Kiamichi; Choctaw | 13,250 | 126,900 | 101 | na | FC-WS-WQ-R | Corps of Engineers | 1971 |
| HULAH | Caney; Osage | 3,600 | 34,700 | 94 | 62 | FC-WS | Corps of Engineers | 1951 |
| WASH HUDSON (Markham Ferry) | Grand (Neosho); Mayes | 10,900 | 200,300 | 90 | 200 | P-FC-R | Grand River Dam Authority | 1964 |
| KEYSTONE | Arkansas & Cimarron; Tulsa | 26,300 | 663,000 | 121 | 240 | FC-P | Corps of Engineers | 1964 |
| OOLAGAH | Verdigris; Rogers | 5,850 | 58,000 | 129 | 75 | FC-P-N-WS | Corps of Engineers | 1963 |
| PINE CREEK | Little; McCurtain | 3,750 | 53,800 | 124 | 74 | FC-WS | Corps of Engineers | 1969 |
| ROBERT S. KERR | Arkansas; LeFlore | 42,000 | 493,600 | 75 | 250 | N-P-R | Corps of Engineers | 1970 |
| TENKILLER | Illinois; Sequoyah | 12,650 | 641,000 | 197 | 130 | FC-P-WS | Corps of Engineers | 1953 |
| TEXOMA (Denison) | Red; Bryan | 89,000 | 2,722,000 | 165 | 580 | FC-P | Corps of Engineers | 1944 |
| THUNDERBIRD (Norman) | Little; Cleveland | 6,070 | 119,600 | 101 | 86 | FC-WS-R | Bureau of Reclamation | 1965 |
| WEBBERS FALLS | Arkansas; Muskogee | 10,900 | 165,200 | 84 | 175 | N-P-R | Corps of Engineers | 1970 |
| WISTER | Poteau; LeFlore | 4,000 | 30,000 | 99 | 115 | FC | Corps of Engineers | 1949 |
| TOTAL | | 454,494 | 11,419,552 | | 4,702 | | | |

*P-Power, FC-Flood Control, WS-Water Supply (Municipal and Industrial), R-Recreation, N-Navigation, I-Irrigation, WC-Water Conservation

TABLE 29.1 MUNICIPAL, INDUSTRIAL AND RECREATIONAL LAKES
 (Capacity: 1,000 acre-feet or more)

| Name | Location | Use | Area (acres) | Capacity (acre-feet) |
|------|----------|-----|-----------------|-------------------------|
|------|----------|-----|-----------------|-------------------------|

CONTINUATION OF TABLE 29.1

| COAL COUNTY | | | | | LEFLORE COUNTY | | | | |
|------------------------|--------------|-----|-------|--------|--------------------|-----------------------|-----|-------|---------|
| Coalgate | | | | | Spiro | 1-8N-25E | M-R | 445 | 2,200 |
| Caney-Coon Site 2 | 11-1N-10E | M | -- | 3,527 | Cedar | 29-4N-25E | R | 93 | 1,488 |
| COMANCHE COUNTY | | | | | LINCOLN COUNTY | | | | |
| Ellsworth | 28&29-4N-11W | M-R | 5,600 | 50,000 | Chandler | 32-15N-4E | M-R | -- | 2,500 |
| Elmer Thomas | 13-3N-13W | M-R | 472 | 14,000 | Meeker | 22-12N-3E | M-R | -- | 1,000 |
| Lawtonka | 18-3N-12W | M | 1,868 | 63,240 | Meeker Quapah | | | | |
| Grama | 36-4N-15W | R | 114 | 3,450 | Creek Site 15 | 24-12N-3E | M-R | -- | 2,400 |
| Jed Johnson | 18-3N-13W | R | 58 | 1,350 | | | | | |
| Quanah Parker | 23-3N-14W | R | -- | 2,340 | | | | | |
| Rush | 18-3N-13W | R | -- | 1,155 | Guthrie | 32-16N-2W | M | 184 | 2,246 |
| U.S. Army | 16-2N-11W | R | 300 | 4,500 | Liberty | 1-15N-3W | M-R | 201 | 2,740 |
| | | | | | Paul Kuhn | 1-17N-3W | R | -- | 1,900 |
| COTTON COUNTY | | | | | LOGAN COUNTY | | | | |
| Boyer | 15-2S-11W | M | 156 | 2,620 | | | | | |
| CREEK COUNTY | | | | | Murray | 14-6S-2E | R | 5,728 | 153,250 |
| Mannford | 27-19N-9E | M | -- | 7,652 | | | | | |
| Sahoma | | | | | Purcell | 13-6N-2W | M-R | -- | 1,698 |
| (Rock Creek) | 21-18N-11E | M | 485 | 4,850 | Wiley Post | 36-5N-2W | M-R | -- | 2,124 |
| Stroud | 6-15N-7E | M-R | -- | 9,691 | | | | | |
| DELAWARE COUNTY | | | | | MCCURTAIN COUNTY | | | | |
| Eucha (upper Spavinaw) | 22-22N-22E | M | 2,880 | 79,600 | 1941 Cut Off Ward | 23-9S-24E | R | 300 | 2,000 |
| | | | | | | 32-9S-26E | I-R | 410 | 2,900 |
| ELLIS COUNTY | | | | | MCINTOSH COUNTY | | | | |
| Vincent | 1,12-18N-26W | R | 160 | 2,579 | Checotah | 25-11N-16E | M | 49 | 1,137 |
| GARVIN COUNTY | | | | | | | | | |
| Pauls Valley | 33-4N-1E | M | 750 | 8,500 | Chimney Rock | 6-18N-21E | I | -- | 48,000 |
| | | | | | Spavinaw | 15-22N-21E | M | 1,638 | 30,590 |
| GRADY COUNTY | | | | | Veterans | 9-1S-3E | R | 70 | 1,260 |
| Burtschi | 29-6N-8W | R | 180 | 2,140 | | | | | |
| Rush Creek Site 1 | 10-3N-7W | R | 178 | 2,382 | | | | | |
| Rush Creek Site 15 | 35&36-3N-6W | R | 55 | 1,237 | | | | | |
| HASKELL COUNTY | | | | | MUSKOGEE COUNTY | | | | |
| John Wells | 28-9N-21E | M-R | 213 | 3,000 | Greenleaf | 10-13N-20E | R | 920 | 14,720 |
| Kerr-McGee | 9-8N-21E | I | -- | 1,500 | | | | | |
| HUGHES COUNTY | | | | | NOBLE COUNTY | | | | |
| Holdenville | 4-6N-9E | M | 550 | 11,000 | McMurtry | | | | |
| Wetumka | 3-9N-10E | M | 185 | 2,000 | Stillwater Site 40 | 34&35-20N-1E | M-R | -- | 18,940 |
| | | | | | Perry | 6-20N-1W | M | 338 | 4,137 |
| JACKSON COUNTY | | | | | OKFUSKEE COUNTY | | | | |
| Altus City | 8-2N-20W | M | 183 | 2,745 | Okemah | 14-12N-9E | M | 720 | 10,800 |
| JOHNSTON COUNTY | | | | | | | | | |
| Wapanucka | 22-2S-8E | M-R | -- | 3,500 | Hefner | 2-13N-4W | M | 2,500 | 75,000 |
| | | | | | Hiwassee | 28-14N-1W | R | -- | 1,320 |
| | | | | | Overholser | (See Canadian County) | | | |
| KAY COUNTY | | | | | OKMULGEE COUNTY | | | | |
| Blackwell | 34-29N-2W | M | 300 | 3,600 | Henryetta | 22-11N-13E | M | 616 | 8,624 |
| Ponca | 19-26N-3E | M | 805 | 4,140 | Okmulgee | 8-13N-12E | M-R | 611 | 12,600 |
| KINGFISHER COUNTY | | | | | | | | | |
| Elmer | 18-16N-7W | R | 60 | 1,080 | OSAGE COUNTY | | | | |
| KIOWA COUNTY | | | | | Bluestem | 25&36-26N-8E | M | 800 | 17,000 |
| Snyder | 9-3N-18W | M | 130 | 1,355 | City of Hominy | 2-22N-8E | M | 200 | 5,000 |
| LATIMER COUNTY | | | | | Fairfax | 36-25N-5E | M | 101 | 1,795 |
| Carl Albert | 35-4N-21E | M-R | -- | 2,894 | Hudson | 20-27N-12E | M | 335 | 4,800 |
| Dr. Lloyd E. Church | 30-5N-19E | M | 160 | 3,120 | Pawhuska | 12-25N-8E | M | 95 | 2,850 |
| Fourche Maline | | | | | Phillips | 10-26N-6E | I | 70 | 1,224 |
| Site 5 | 13-6N-18E | R | 94 | 1,987 | Shell Creek | 30-20N-11E | I | 640 | 15,300 |
| Wayne Wallace | 12&13-6N-19E | R | 94 | 1,746 | Waxhoma | 15-24N-11E | M | 140 | 2,000 |

CONTINUATION ON PAGE 31

| Name | Location | Use | Area (Acres) | Capacity (acre-feet) |
|------|----------|-----|-----------------|-------------------------|
|------|----------|-----|-----------------|-------------------------|

CONTINUATION OF TABLE 29.1
SEMINOLE COUNTY

PAWNEE COUNTY

| | | | | |
|-----------|-----------|---|-----|-------|
| Cleveland | 20-21N-7E | M | 64 | 2,212 |
| Pawnee | 30-22N-5E | M | 257 | 3,855 |

PAYNE COUNTY

| | | | | |
|---------|-----------|---|-----|-------|
| Cushing | 28-18N-4E | M | 440 | 5,470 |
| Boomer | 2-19N-2E | M | 260 | 2,486 |

PITTSBURG COUNTY

| | | | | |
|-----------------|-----------|-------|-------|--------|
| Brown (USNAD) | 8-4N-10E | M-I-R | 550 | 4,000 |
| McAlester | 2-6N-14E | M-R | 2,100 | 45,475 |
| Talawanda No. 1 | 23-6N-14E | M | 124 | 1,300 |
| No. 2 | 14-6N-14E | M | 244 | 3,300 |

POTTAWATOMIE COUNTY

| | | | | |
|---------------|-----------|---|-------|--------|
| Shawnee No. 1 | 14-10N-2E | M | 1,336 | 22,600 |
| Shawnee No. 2 | 10-10N-2W | M | 1,100 | 11,400 |
| Tecumseh | 35-10N-3E | M | 127 | 1,118 |

PUSHMATAHA COUNTY

| | | | | |
|-------------|-----------|---|-----|-------|
| Clayton | 21-1N-19E | R | 75 | 1,050 |
| Nanah Waiya | 22-2N-19E | R | 131 | 1,064 |

ROGER MILLS COUNTY

| | | | | |
|--------------------------|------------|---|-----|-------|
| Dead Indian Creek Site 2 | 2-14N-23W | R | 110 | 1,148 |
| Sandstone Creek Site 16 | 26-12N-23W | R | 118 | 1,539 |
| Upper Washita Site 57 | 14-13N-25W | R | 99 | 1,061 |

ROGERS COUNTY

| | | | | |
|----------------|-----------|---|-----|-------|
| Claremore City | 1-21N-16E | M | 431 | 3,400 |
|----------------|-----------|---|-----|-------|

| | | | | |
|--------------------|----------|-----|-------|--------|
| Big Wewoka Site 22 | 31-9N-7E | R | -- | 5,349 |
| Konawa | 29-6N-6E | I-R | 1,100 | 23,500 |
| Sportsmans | 34-9N-7E | M-R | 355 | 4,000 |
| Wewoka | 12-8N-7E | R | 200 | 5,000 |

SEQUOYAH COUNTY

| | | | | |
|------------------------|-----------|-----|-----|-------|
| Muldrow City | 9-11N-26E | M-R | 65 | 1,500 |
| Sallisaw Creek Site 29 | 1-12N-23E | M | 227 | 3,513 |

STEPHENS COUNTY

| | | | | |
|-----------------|---------------------|----------|-----|--------|
| Clear Creek | 4-1N-6W | M | 560 | 9,600 |
| Comanche | 24-2S-7W | M-R | 201 | 2,455 |
| Duncan | 34-1N-6W | R | 400 | 7,200 |
| Lewis & Fortner | 36-1S-4E | R | -- | 1,000 |
| Wildhorse | Site 22 (Humphries) | 1-1N-7W | M | 882 |
| Wildhorse | Site 39 (Fuqua) | 36-2N-5W | M-R | 1,500 |
| | | | | 21,600 |

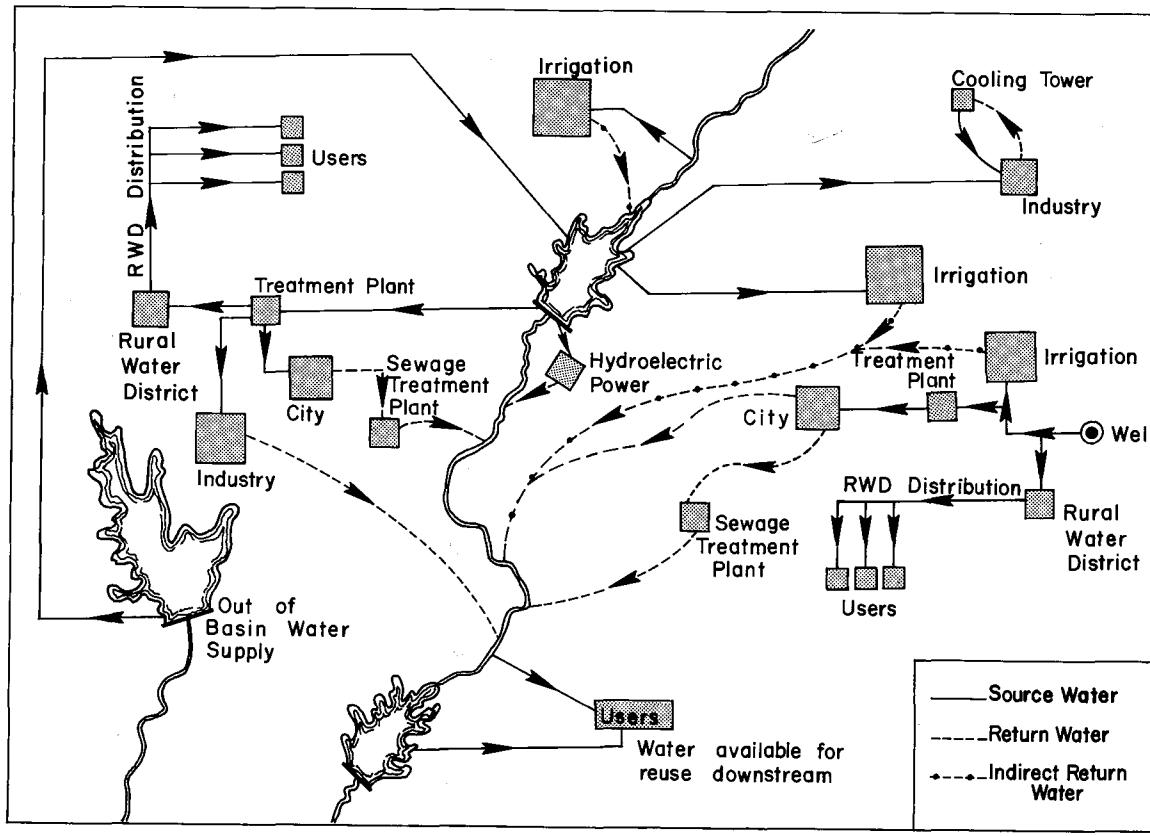
TILLMAN COUNTY

| | | | | |
|-------------------|-----------|---|----|--------|
| City of Frederick | 33-1N-16W | M | -- | 13,900 |
|-------------------|-----------|---|----|--------|

TULSA COUNTY

| | | | | |
|------------|------------|-----|-----|-------|
| Yohola | 16-20N-13E | M | 425 | 7,000 |
| Clinton | 16-11N-19W | M-R | 355 | 1,500 |
| Hobart | 14-8N-18W | M | 450 | 3,600 |
| Vanderwork | 18-8N-15W | R | 135 | 1,578 |
| Oak Site 5 | 18-8N-15W | R | -- | 1,109 |

*Reservoirs built by U.S. Soil Conservation are referred to by site number.





OKLAHOMA WATER RESOURCES BOARD

FIFTH FLOOR JIM THORPE BUILDING OKLAHOMA CITY, OKLAHOMA 73105