Ground Water Management Vital To

COMPREHENSIVE DEVELOPMENT OF RIVER BASIN WATER RESOURCES

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January-February

CER62MWB30

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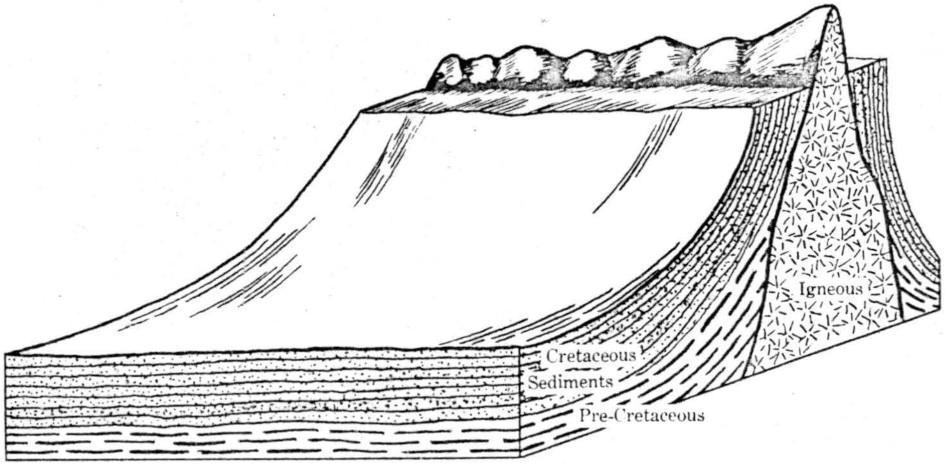
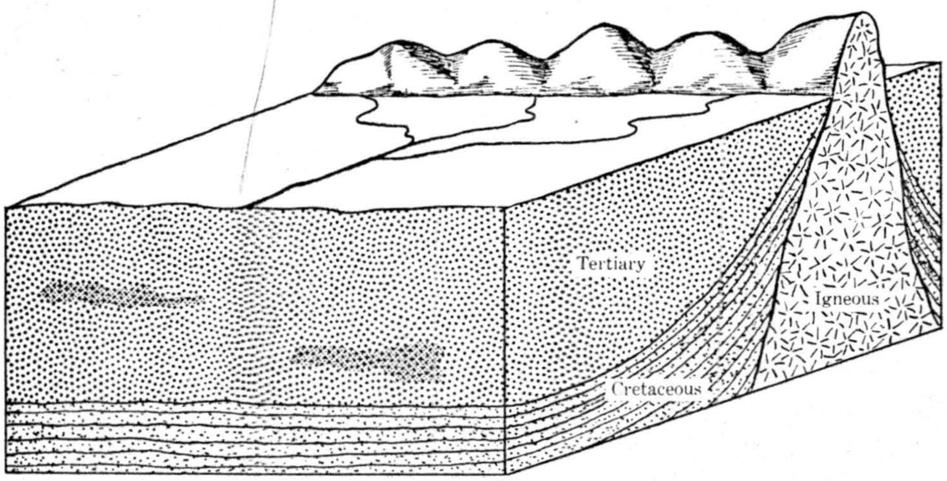
When early settlers of little more than a century ago made their way up the South Platte and Arkansas valleys toward the Rocky Mountains, they found stream systems still largely controlled by nature. They soon learned that although the rivers and their tributaries carried abundant water in the spring, flows often were insufficient in later summer and fall. They also probably noted that both rivers lost water as they proceeded across the dry plains, making the more reliable water supplies available near the mountains.



Uplift of the Rocky Mountains occurred during the late Cretaceous and early Tertiary Periods (about 60 to 80 million years ago). Previous to the uplift, seas covered the area and deposited thousands of feet of fine grained sediments. (Cretaceous).

The natural flow of each stream



Runoff from the newly uplifted mountains began to carry away the Cretaceous sediments early in the Tertiary Period (approx. 70 million years ago). Later in the period, heavy deposition of sediments occurred, resulting in the High Plains extending from the mountain front for hundreds of miles eastward (during last 1-10 million years). Following the heavy Tertiary fill, a general continental uplift occurred causing accelerated erosion and down cutting by streams.

nal drainage. Although the water table rose as much as 50 feet in some areas during the first 20 years of irrigation, water-logging was minor because of rapid internal drainage back to the rivers.

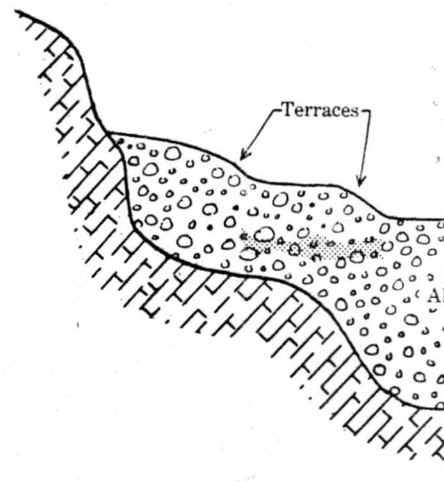
Due to the "return flow," both rivers soon became "gaining," rather than "losing" streams. This tended to make more water available to the lower sections of the rivers during later summer and fall. Today, many water rights on these lower sections depend on the return flow.

Professor L. G. Carpenter, who later became State Engineer began to measure return flow as early as 1889. Ralph Parshall made a study of return flow on the lower South Platte in the 1920's and it has been measured periodically on both streams by the State Engineer since that time. From all indications, return flow for the South Platte reached an equilibrium by 1930 of some 1,000,000 acre-feet per year.

Because of this re-use of water, total diversions by all ditches in the South Platte Basin average more than twice the average annual runoff from the mountain watershed.

Partly out of necessity during the drouth years of the early 30's—and also because of more efficient pumps and the advent of electric power—drilling irrigation wells became big business. Many of these wells merely supplemented ditch water. Others were drilled above canals in areas such as the Beaver Creek and Bijou Creek valleys. Those drilled below canals receive recharge every year, while those above canals draw upon storage which accumulated over many thousands of years.

Today, more than 5,200 irrigation wells tap the alluvial ground-water reservoirs adjacent to the South Platte and its tributaries. About 1,500 wells tap similar deposits along the Arkansas. Most of these wells are below canals and within three miles of the rivers. As much as 1,000,000 acre-feet are pumped from the 5,200 Platte Valley irrigation wells annually. Well water often makes the difference between a mediocre and a good crop and, during drouth years such as 1954 and 1956, it saved both valleys from disastrous crop failure.



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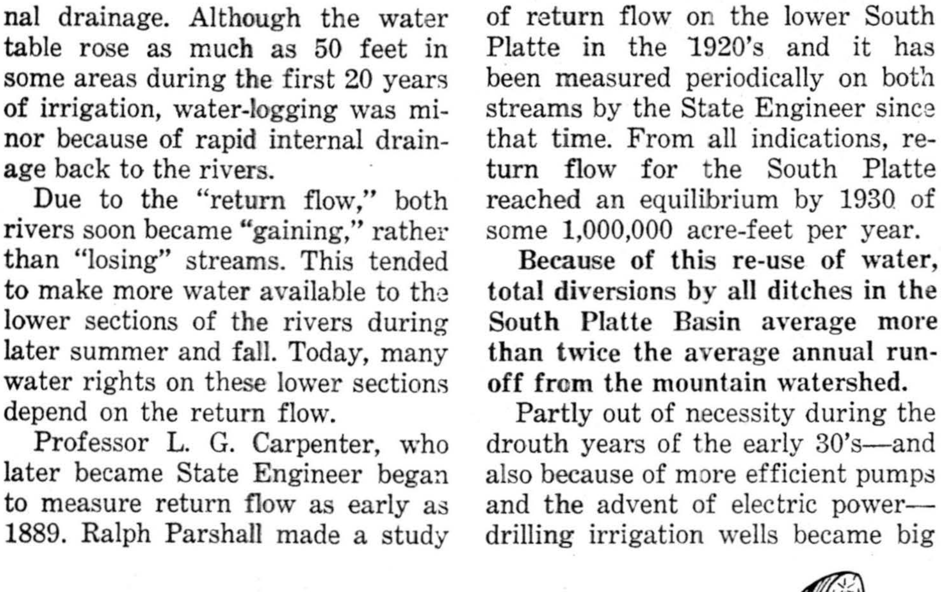
THE WATER PROBLEM

Although intimately interrelated physically, surface water and ground water have been developed separately. Through necessity, surface water was developed by cooperative action and financing by groups and organizations. On the other hand, ground-water supplies have been developed somewhat haphazardly by individual initiative and financing.

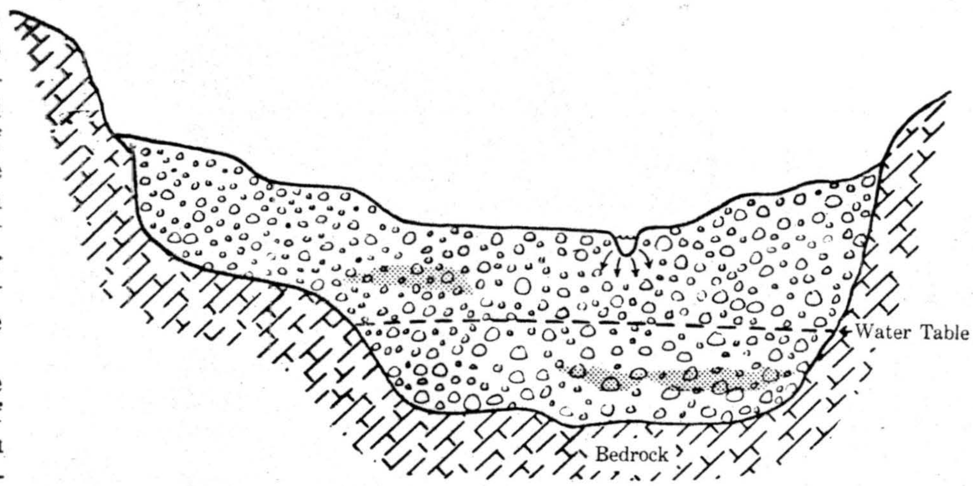
Laws and customs have also developed separately. Therefore, instead of coordinated use of the two related



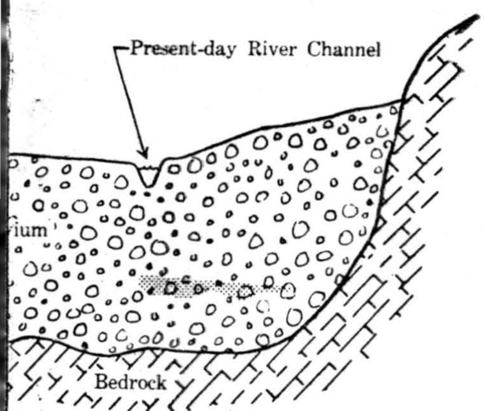
By the beginning of the Quaternary Period (1 million years ago) the drainage patterns of the South Platte and Arkansas Rivers were developed somewhat as we know them today. Most of the Tertiary sediments were removed and deep channels were cut into the bedrock material, such as the Pierre shale.

sources of water, serious conflicts have developed. Those irrigators who cannot obtain wells look unfavorably upon the use of ground water and subsequent reduction of river flow by well pumpers who are 40 to 80 years junior to them in time. But the well owners generally take the philosophy that the water under their land is their property and many are opposed to any degree of control or regulation.

It has been estimated that there is some 25,000,000 acre-feet of ground water storage capacity in the South Platte basin and somewhat less than half that in the Arkansas basin. If only a fifth of this could be used for cyclical storage,



For thousands of years water seeped out of the rivers and streams into the porous materials below. An equilibrium was probably reached between this natural inflow and the natural outflow further downstream where the water table intersected the land surface.



he climate changed, the rivers , sand and gravel in the bedrock oded out, deposited, worked and relatively clean sand and gravel reservoirs of today.

it would add considerably to a total water plan for the two systems.

Because of the immense storage possibilities, the value of the ground water, the impending conflicts of interest and the direct hydraulic connection to surface supplies, conjunctive operation of ground-water reservoirs with surface-water supplies must be considered in any comprehensive development plan. In fact, it is doubtful if comprehensive development can be accomplished without considering the ground-water factor.

Several advantages can be cited for use of ground-water storage—no construction costs, no loss of capacity due to silting, no land flooded, protection from evaporation losses, and protection from contamination such as radioactive fallout.

There are, of course, also a number of problems peculiar to ground-water storage. The boundaries, capacity and operational characteristics are more difficult to determine than for a surface reservoir. Measurement of the amount of water in storage at any time is not generally as simple as reading one gage height. Outflow occurs at many points (wells) rather than at the spillway, thus making administration and control a greater problem.

WHAT RESEARCH IS NEEDED?

To manipulate ground-water storage intelligently, we must know and understand the basic interrelationships of surface and ground water. That is, we must know what effect the use of one will have on the quantity, quality and distribution of the other. Thus, the earlier phases of the CSU-USGS study will be devoted to defining these interrelationships through field investigations and analysis of historical records.

After surface and ground-water interrelationships are determined, an electric analog model probably will be constructed to simulate hydraulic characteristics of at least one and perhaps both river systems. Because of the complexities involved, exact mathematical relationships will be difficult to apply. The electric analog approach offers the best tool for predicting the effects of various

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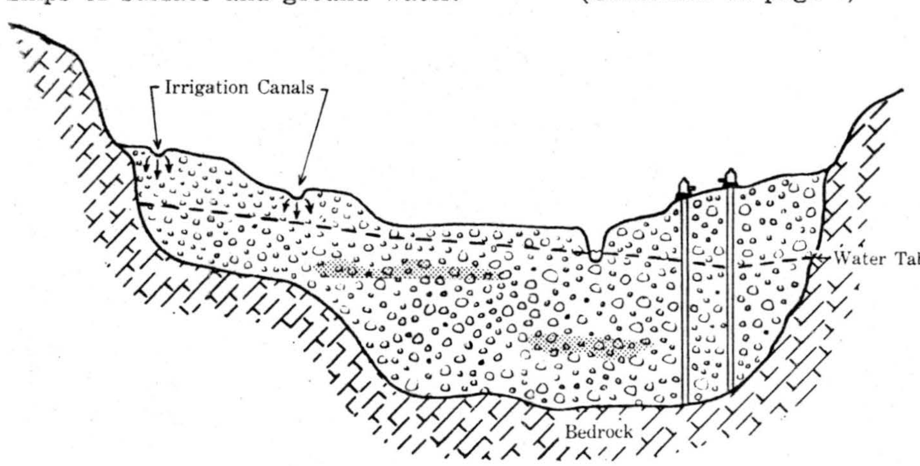

For the last 100 years, man's activities have greatly disturbed the ground-water equilibrium. Water diverted into canals and over fields provides additional recharge to the ground water. Where this has occurred, the water level has risen to elevations higher than the river and thus feeds the river.

Development Of River Basin Water Resources

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water supply use and operational procedures. With this tool, an operational plan for a 100-year period can be tested in a matter of minutes.

A PLAN FOR USE

Planned management and operation of ground-water reservoirs in conjunction with surface-water supplies probably would include: (1) Heavy reliance upon ground water during years of deficient runoff. (2) Artificial recharge facilities to replace pumped ground water during years of favorable runoff. (3) Planned long-term storage in ground water aquifers where geologic conditions make it possible. This may involve transfer of water from surface reservoirs to underground reservoirs during fall and winter months to provide maximum catchment capacity in the spring. (4) Because of the storage manipulations already mentioned, the ground-water reservoirs cannot be kept full and thus will not always provide return flow to the rivers. Thus, many ditches may have to be served by pumps when surface water is not available.

LEGAL AND SOCIAL PROBLEMS

It can be readily seen that a conjunctive-use management plan may be scientifically sound, but quite incompatible with present legal and social customs. These customs resist change, but if it is possible to show that water supplies can be stabilized and increased, and that conflicts can be alleviated, resistance to changes may decrease.

Until now, these legal and social customs evolved in an atmosphere of water-supply development. Since development of more "new" water is becoming difficult, the emphasis must now be shifted to management which will insure for our water resources "the best possible use for the benefit of the most people."