STATE OF WASHINGTON
Daniel J. Evans, Governor

DEPARTMENT OF ECOLOGY
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Water-Supply Bulletin No. 37

# APPRAISAL OF GROUND-WATER AVAILABILITY AND MANAGEMENT PROJECTIONS, WALLA WALLA RIVER BASIN, WASHINGTON AND OREGON

By
R. D. Mac Nish, D. A. Myers, and R. A. Barker

Prepared in cooperation with
UNITED STATES GEOLOGICAL SURVEY
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# APPRAISAL OF GROUND-WATER AVAILABILITY AND MANAGEMENT PROJECTIONS, WALLA WALLA RIVER BASIN, WASHINGTON AND OREGON

By R. D. Mac Nish, D. A. Myers, and R. A. Barker
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## ABSTRACT

The Walla Walla River basin in southeastern Washington and northeastern Oregon covers about 1,750 square miles and is everywhere underlain by a basalt aquifer that yields water to wells at rates ranging from 30 to 3,000 gallons per minute. In the central lowland part of the basin, about 200 square miles of the basalt aquifer is overlain by a gravel aquifer that averages 200 feet in thickness and supplies water to wells at rates ranging from 5 to 900 gallons per minute.

Although agricultural development in the basin started as early as 1850, a sixfold increase in electrical-power consumption by irrigators since 1950 indicates an accelerating rate of development. The decline of water levels in the basalt aquifer at a rate of up to 15 feet per year in areas of heavy pumping is probably due mostly to the increasing rate of ground-water withdrawal from the basalt aquifer, rather than to the permanent removal of large quantities of water from storage. Although withdrawal of ground water from the gravel aquifer is extensive, this aquifer is only lightly stressed and, with efficient management, could greatly increase its present annual yield of 75,000 acre-feet of water. Further withdrawal from the basalt aquifer is possible, although administrative restrictions on further development in the heavily pumped areas are likely.

## INTRODUCTION

### Background and Purpose of the Study

The Walla Walla River basin is in southeastern Washington and northeastern Oregon (fig. 1) and has a drainage area of about 1,750 square miles. Land within the basin has been under cultivation since the 1850's, and has been irrigated much of that time. Shallow wells and surface water supplied most of the early irrigation needs. In the late 1800's and early 1900's several deep wells tapping aquifers in the basalt bedrock were drilled in the vicinity of College Place, Washington. Many of these deep wells had artesian flows, with static water levels higher than 100 feet above land surface. Since that time, more land has come under irrigation and the number of wells has increased accordingly. The pumpage from the deep aquifers has increased and this removal of large quantities of water has reduced the artesian pressure in these aquifers. Today only a few wells in the Walla Walla River basin still have artesian flow at the land surface.

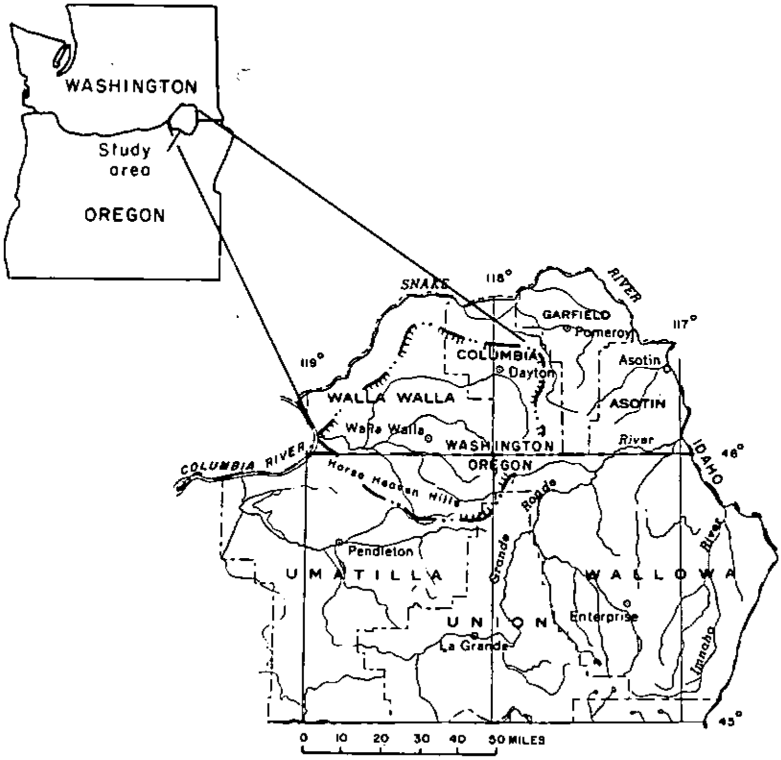


FIGURE 1.–Location of Walla Walla River basin in Washington and Oregon.

Previous work in the basin has been done by Piper and others (1933), and Newcomb (1965). Reports from their studies provide detailed information on the nature and distribution of the aquifers, and information on specific wells. The high degree of water development in the Walla Walla River basin has prompted the present restudy of the area. The purpose of the overall study is to evaluate the total water resource of the basin and to construct a mathematical model that will simulate the actual and somewhat complex hydrologic conditions within the basin. Such a model can then be used as a management tool to guide decisions for conserving, and improving the efficiency of use of, the water in the basin.

### Climate

Most of the Walla Walla River basin has a semiarid climate. The average annual temperature is 52.9°F, with the recorded extremes ranging from -29°F to 113°F. The general movement of air over the basin is from the west and the distribution of precipitation is influenced by the orographic effect of the Blue Mountains that form the eastern part of the basin (fig. 2). Recorded precipitation averages 15.5 inches per year at Walla Walla but is as much as 39.6 inches at the Mill Creek station of the National Weather Service. The total annual precipitation on the basin averages about 1.6 million acre-feet. About 70 percent of this precipitation occurs during the winter months.

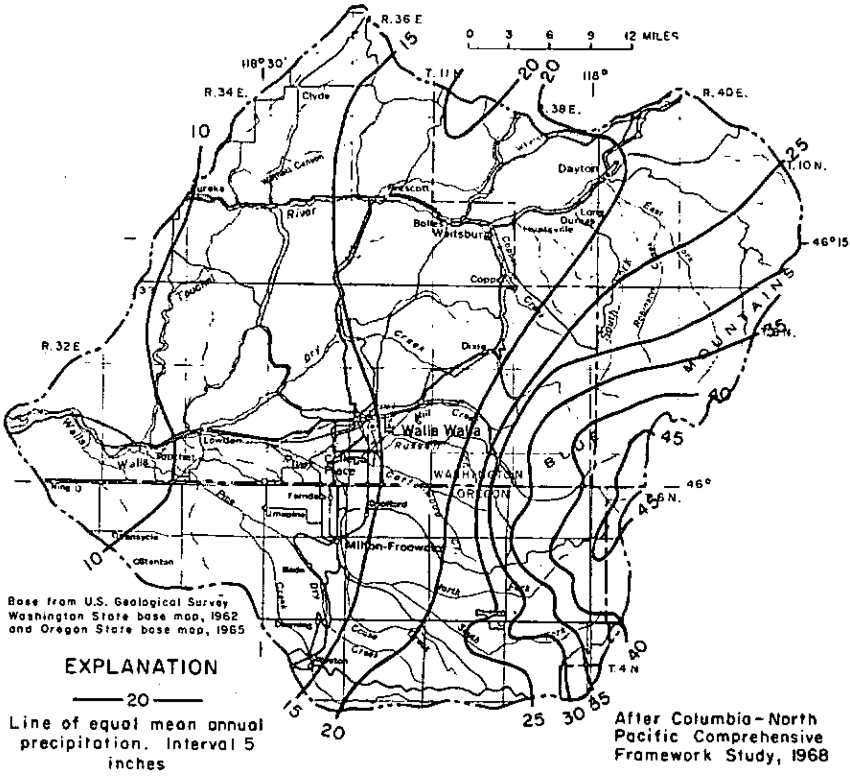
### Streamflow

Major streams in the Walla Walla River basin include Mill Creek and the Walla Walla and Touchet Rivers (fig. 2). Many small streams enter the central lowland of the basin from the bordering highlands to the south and east. Most of these streams flow only during storms or in the winter months. A few streams, such as Dry, Russell, and Blue Creeks in Washington, and Dry, Cottonwood, Birch, Couse, and Pine Creeks in Oregon, flow all year long, although their contribution in the summer months may be little more than a trickle.

The total gaged contribution to the central part of the basin by all the perennial natural streams is shown in figure 3. The quantity of water which annually leaves the Walla Walla River basin as streamflow is 440,000 acre-feet, as measured at a point on the Walla Walla River below Touchet. The seasonal distribution of this flow through the period October 1968-September 1969 is shown in figure 3.

## INFLOW-OUTFLOW RELATIONSHIPS

Precipitation is the primary source of all water in the Walla Walla River basin. The relationship of precipitation to surface-water runoff and recharge of the aquifers (water-bearing earth materials) is the governing factor in water availability in the basin.



Base from U.S. Geological Survey Washington State base map, 1962 and Oregon State base map, 1965

After Columbia-North Pacific Comprehensive Framework Study, 1968

FIGURE 2.—Mean annual precipitation in Walla Walla River basin.

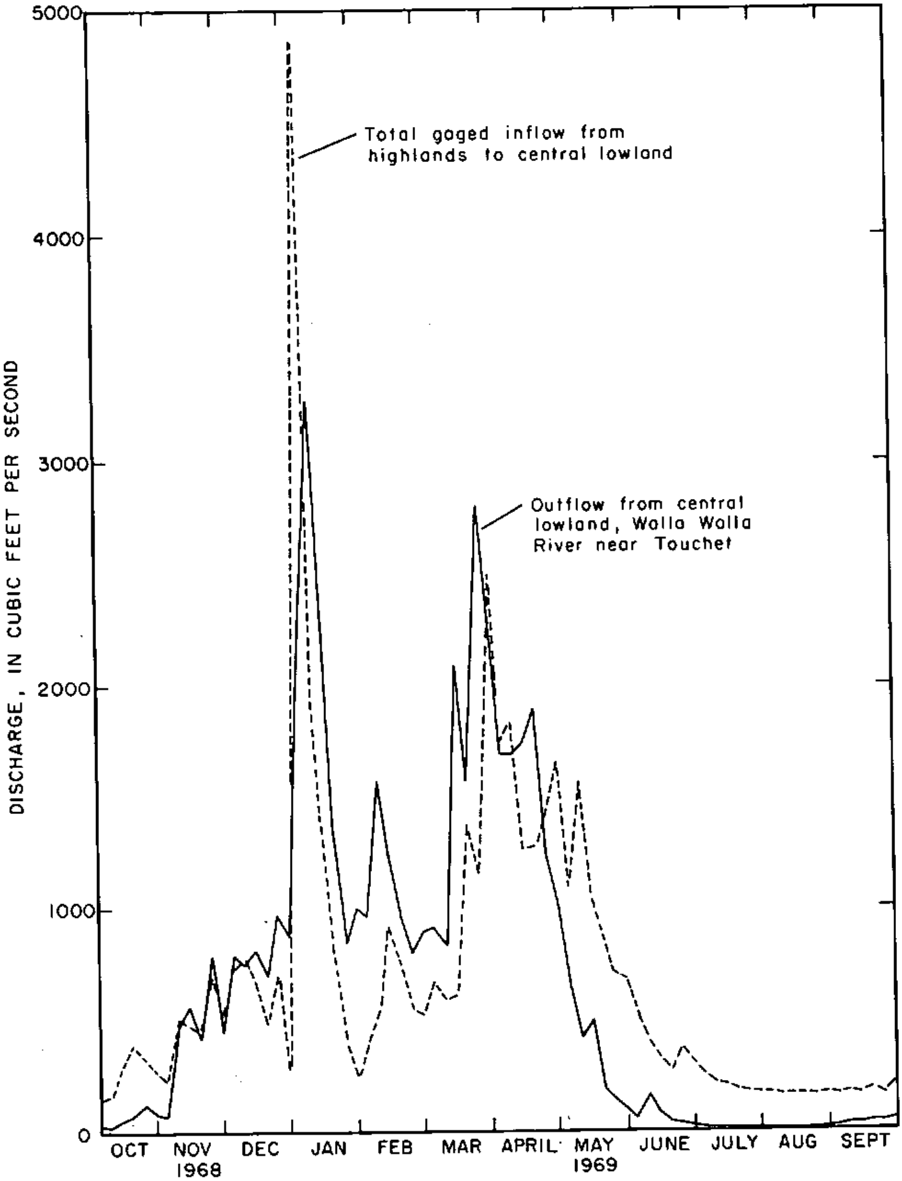


FIGURE 3—Total gaged inflow and outflow, central lowland of Walla Walla River basin, during 1969 water year.

A comparison between the amount of precipitation (1.44 to 1.76 million acre-ft) which enters the basin each year and the outflow (0.44 million acre-ft) from the basin through streams indicates that 1 to 1.32 million acre-feet of water is removed from the basin by other means. Three of the more important means of water discharge from the basin are discussed below.

Plants draw large quantities of water from the soil during the growing season and release most of this water to the atmosphere as water vapor. This process (transpiration) is one of the most important means by which water is removed from the basin. Water also is evaporated directly to the atmosphere from the surfaces of streams and ponds, and from the upper few inches of the soil. Immediately after a rain, or after sprinkler irrigation, water evaporates directly from the soil and wetted surfaces of plants. The two processes, evaporation and transpiration, are commonly considered together and called evapotranspiration. In the Walla Walla River basin evapotranspiration may account for 850,000 to 1,000,000 acre-feet of water discharge per year, or one-half or more of all the water that enters the basin as precipitation.

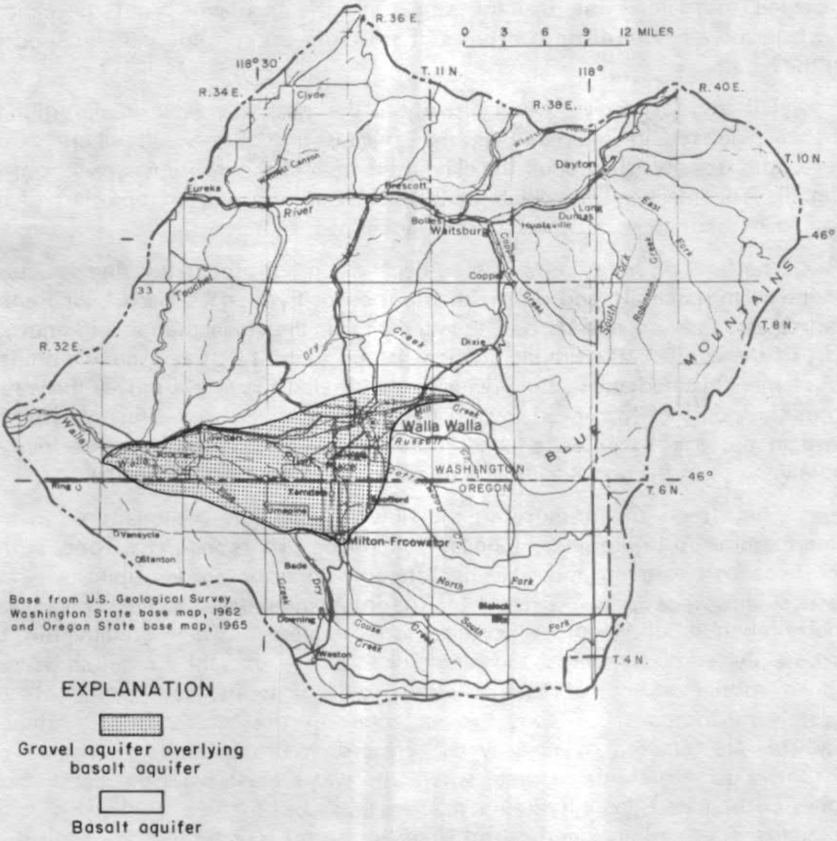
Water also may leave the Walla Walla River basin as ground-water discharge, by flowing slowly through the basalt aquifer and discharging from this aquifer directly into the Columbia and Snake Rivers to the west and north. Although ground water flows very slowly in comparison to surface streams, the large area through which this water discharges (the entire north and west margins of the basin) permits a large volume of water to escape from the basin each year by this means. An estimate of the amount of water leaving the basin as ground water is 140,000 to 300,000 acre-feet per year.

Some additional water is removed from the basin through consumptive use by people and industry. (Consumptive use includes all usage of water where the water used is not returned to the streams or ground-water system.) Water removed from the basin in this manner is probably less than 10,000 acre-feet per year.

## GROUND-WATER AVAILABILITY

### Aquifers

Ground water occurs in water-bearing earth materials called aquifers. In the Walla Walla River basin, ground water is obtained from two geologically distinct aquifers. The most extensive of these is the basalt aquifer which underlies the entire basin. The aquifer is at least 2,000 feet thick in most parts of the basin and wells in this aquifer have yields that range from 30 to 3,000 gpm (gallons per minute). Less extensive, but of great importance, is an aquifer composed of unconsolidated sediments underlying the central lowland part of the Walla Walla River basin (fig. 4). Discussed herein as the gravel aquifer, although it includes some finer grained materials, it is as much as 700 feet thick in the western part of the basin. Yields of wells tapping this aquifer range from 5 to 900 gpm.



Base from U.S. Geological Survey Washington State base map, 1962 and Oregon State base map, 1965

FIGURE 4.—Extent of the basalt and gravel aquifers, Walla Walla River basin.

## Basalt Aquifer

Newcomb (1965, p. 27-32) described the basalt aquifer in the Walla Walla River basin as a succession of tabular broken or porous zones alternating vertically with thicker layers of dense rock. This unit has been warped gently to form broad uplands (the Horse Heaven Hills and the Blue Mountains) which border the central lowland part of the Walla Walla River valley. Newcomb reported that along the margins separating the highlands from the central lowland more highly disruptive types of structure (sharp folds and faults) occur in the basalt.

This aquifer receives water directly in the areas of greater precipitation in the highlands, and indirectly in many areas in the lowland where water percolates downward through the clay at the base of the overlying gravel aquifer (fig. 5). The mechanisms which permit water to move from one part of an aquifer to another, or between aquifers, are explained below.

The flow of water in the ground depends on both the nature and structure of the earth materials, and on the distribution of hydrostatic head.* Where the hydrostatic head in one part of the aquifer is higher than the head in another part of the aquifer, a hydraulic gradient is said to exist between the two points. The larger this gradient is, the greater is the driving force that moves the water from the point of high head toward the point of lower head. Thus, where the head in the gravel aquifer is higher than the head in the basalt, water moves downward from the gravel aquifer through the clay and into the basalt.

The effects of structure on the flow of water are demonstrated in the basalt aquifer in several ways. The layering of the porous and dense zones in the aquifer allows water to move readily laterally along the porous zones, whereas vertical flow is severely restricted by the intervening dense layers. This means that a low hydraulic gradient can move large amounts of water laterally, but, to move water vertically, across the dense zones, a large gradient is required. Where flow-disrupting structures, such as sharp folds or faults, have closed off or severely restricted the porous broken zones in the basalt, large hydraulic gradients are required to move water across such structures. Thus, in areas of disruptive structures, or in areas where the water must cross the dense rock zones in the basalt, large hydraulic gradients may be observed. Evidence of such gradients is seen where significant differences occur in water levels of wells that are relatively near each other. When such wells are of equivalent depth and are at about the same land-surface altitude (as wells B and C in fig. 6), large differences in water level are most likely caused by disruptive structures. When the wells are of different depths (as wells A and B in fig. 6), the difference in water levels is more likely due to vertical flow across the dense layers in the basalt. These phenomena are apparent along the flanks of the Blue Mountains and Horse Heaven Hills. Elsewhere, the ground-water flow is primarily horizontal along the broken zones and there are few disruptive structures, so the hydraulic gradient is low.

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*The water level in a well represents the hydrostatic head in the aquifer tapped by the well.

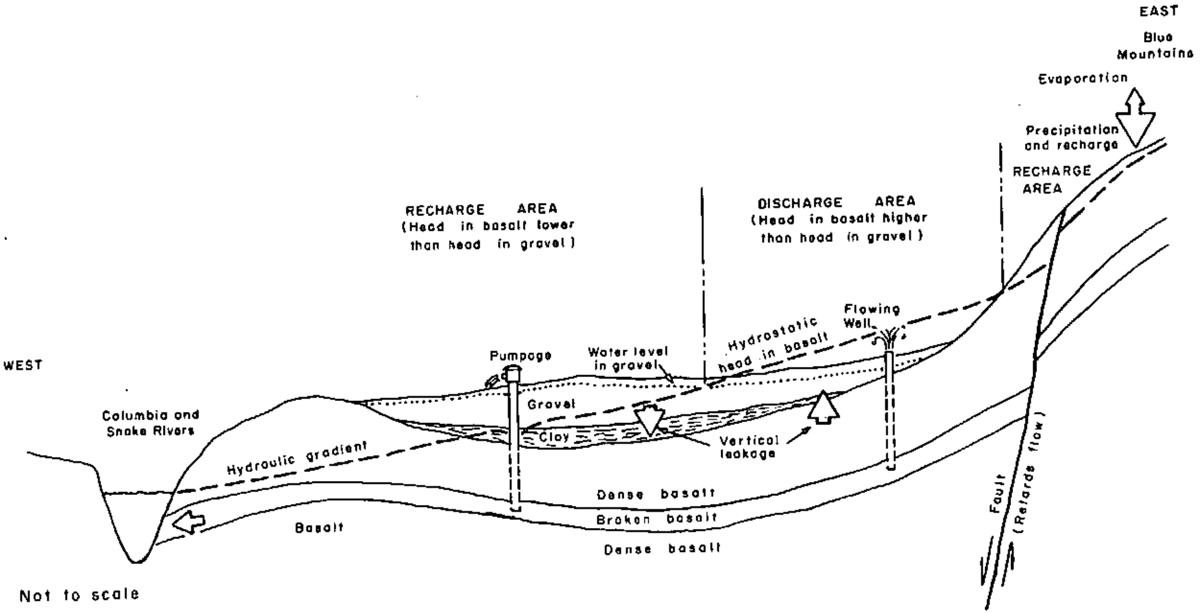


FIGURE 5.—Schematic section showing flow of water through the basalt aquifer.

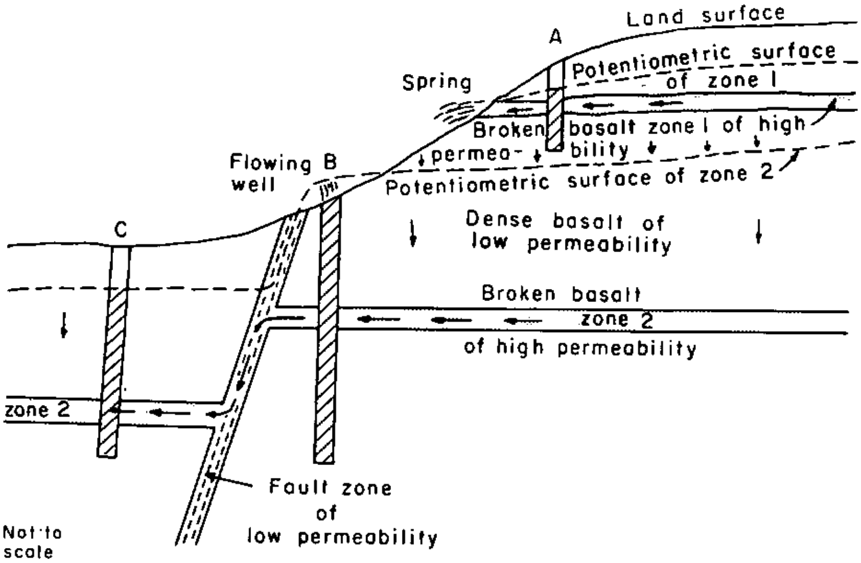


FIGURE 6.—Schematic geologic section, showing the effects of structure on the hydraulic characteristics of aquifers as reflected in water levels observed in wells tapping these aquifers. Arrows indicate direction of ground-water movement.

Discharge from the basalt aquifer varies from one part of the basin to another. In the highlands of the basin discharge occurs directly to streams and is the major factor in maintaining the summer flows of Mill Creek and the Walla Walla River. Also in the highlands, some ground water is lost from the basalt to growing plants (by transpiration), while in the rest of the basin the saturated parts of this aquifer are too far below the land surface for water to escape by either of these means. Within the central lowland part of the Walla Walla River basin, discharge from the basalt aquifer is restricted to pumpage from wells. Beyond the west and northwest margins of the basin the aquifer discharges by underground flow to the Columbia and Snake Rivers.

**Gravel Aquifer**

The gravel aquifer is intimately coupled with the network of streams, canals and ditches that web its surface. Along with recharge from precipitation, the aquifer receives water from stream and canal leakage and infiltration of excess irrigation water. In turn, water from the gravel aquifer discharges to a number of springs and natural streams at lower altitudes, contributes water by downward leakage through underlying clay (fig. 7) to the basalt aquifer, and, where water levels are close to the surface, releases water to growing plants. In addition to these natural discharges, water is drawn from the aquifer by many irrigation and domestic wells.

The movement of water through the gravel aquifer is influenced by the distribution of coarse and fine materials within the aquifer. Beneath the higher areas, north and east of Walla Walla and north and west of Milton-Freewater, the aquifer is composed chiefly of coarse gravels through which water generally moves quite readily; downslope from these two areas, water is transmitted less readily because the materials become finer grained and layers of clay and silt occur locally in the aquifer. Water from the main streams and numerous canals percolates into the gravel aquifer in those areas where the coarse gravels are common. As the water in the aquifer moves to lower altitudes—toward the center of the valley—and encounters the finer materials which cannot transmit water as quickly as the coarse materials supplying them, the water is forced to discharge from the aquifer as springs. The amount of water that flows into and through the aquifer in this manner is about 50,000 acre-feet per year (U.S. Geological Survey, 1970, p. 91). If the pumpage from all the irrigation wells tapping this aquifer is considered with the total spring flow, at least 75,000 acre-feet per year flows through the aquifer under present conditions.

The gravel aquifer may be likened to a large surface reservoir that has been filled with rocks. Between the rocks are gaps or spaces which comprise about 20 percent of the total volume of the gravel aquifer. In the Walla Walla River basin, the gravel aquifer is about 20 miles long, 10 miles wide, and averages more than 200 feet in thickness. Even though this huge reservoir is four-fifths rock materials, the remaining one-fifth will accommodate more than 5 million acre-feet of water. However, the ground-water reservoir's total storage capacity cannot be utilized, owing to practical limitations which prevent removal of all the water from the aquifer. Quantities which more likely approximate the manageable reservoir capacity of the gravel aquifer are perhaps as much as one million acre-feet.

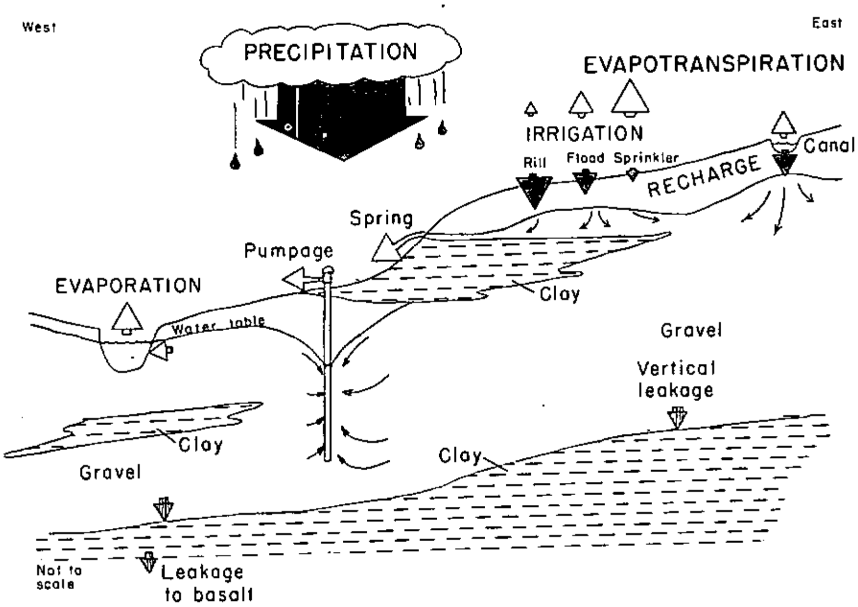


FIGURE 7.–Schematic section showing flow of water through the gravel aquifer.

# PRESENT DEVELOPMENT AND HISTORICAL TRENDS

## General Water Use

The present status of development of the water resources in the Walla Walla River basin is best shown by the distribution of water pumped by installations moving significant quantities of ground and surface water. For the purpose of this study, domestic installations, though numerous, are ignored because the total volume of water pumped is very small, and only installations used for irrigation or for large industrial and municipal water systems are considered.

The rate of increase in power consumption by irrigation pumps has been great in the past 21 years. Figure 8 shows that the total kilowatthours of electrical-power use (as compiled from records of the Pacific Power and Light Co., the major supplier) by irrigation installations has had a sixfold increase over this 20-year period. However, several factors have contributed to this increase, the net effect being that the actual increase in irrigation has been somewhat less than the power-consumption curve would indicate. Perhaps the most important factor has been the change in irrigation practices. Historically, irrigation from streams and canals was by a gravity system, using rill or flood distribution on the irrigated tracts. In recent years, however, irrigation of many such tracts has been converted to application by sprinklers, thus increasing power consumption but not increasing the amount of irrigation from surface-water sources, the areal distribution of which is shown in figure 9. A second factor relating to the increase in kilowatthour consumption is the declining pumping levels in some parts of the basalt aquifer; more electrical energy is required to lift water from the deeper levels. This results in increased power consumption with no increase in the quantity of water pumped. Less than 10 percent of the increased power consumption can be attributed to this factor in the Walla Walla River basin.

## Ground-Water Development

### Basalt Aquifer

The first wells to develop water from the basalt aquifer in the basin were mainly for municipal and industrial supplies, but included a few for irrigation. The total number of wells finished in basalt was about 75 in 1950. In the early 1950's wells were drilled in increasing numbers and most of the wells tapping the basalt in the areas south and east of Walla Walla, around College Place, and in Milton-Freewater were drilled by the mid-1950's. In recent years, more wells were drilled in the western parts of the basin, and by 1971 more than 200 wells obtained water from the basalt. Most of these wells yield between 100 and 3,000 gpm.

Historically, water levels in the basalt aquifer have declined in the areas of intensive pumping. The area where decline has been the greatest (more than 100 feet in some cases) is along the northeastern margins of the Walla Walla River valley, and includes the cities of Walla Walla, College Place, and

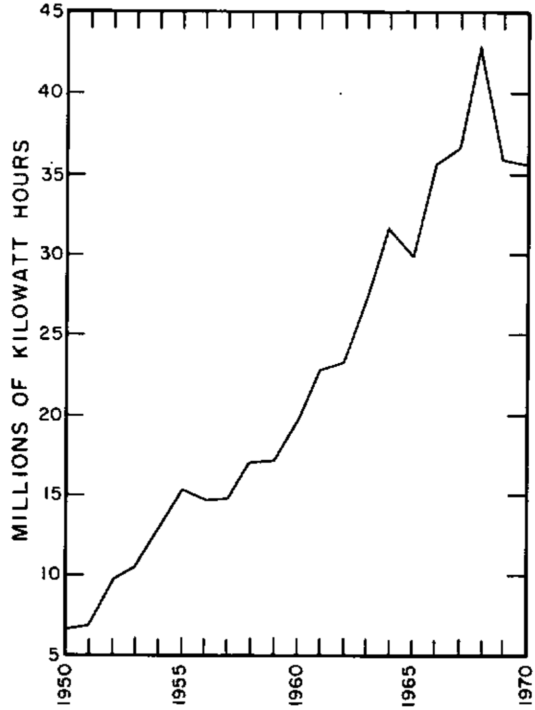
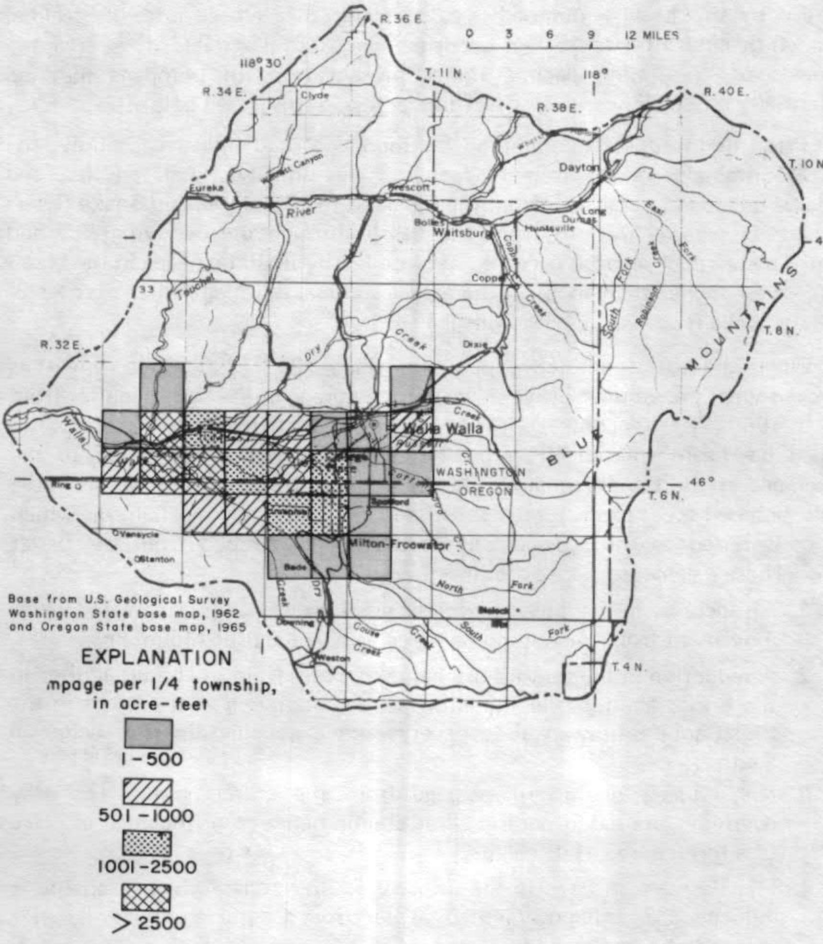


FIGURE 8.—Power consumption for irrigation by well and ditch pumps, Walla Walla River basin, 1950-70. Data from Pacific Power and Light Co., Walla Walla, Wash.



Base from U.S. Geological Survey
Washington State base map, 1962
and Oregon State base map, 1965

FIGURE 9.–Generalized distribution of calculated pumpage from surface-water sources, Walla Walla River basin, 1969. Total calculated pumpage of 25,000 acre-feet does not include water applied by rill and flood irrigation.

Milton-Freewater. Continuing declines in this heavily pumped area could cause substantial increases in the cost of lifting water for irrigation or municipal use. Figure 10 shows the patterns of water-level change over a 2-year period in the basin, with the heavily pumped area showing the largest rate of decline. Although declines of 1 to 15 feet occurred over 20 square miles of the area, the prospects of continuing decline under present rates of pumpage may be substantially reduced by several offsetting factors, as discussed below.

Prior to the onset of pumping for municipal and industrial supply, the Blue Mountains were the primary recharge area for the basalt aquifer, and discharge included lateral flow from the basalt to the Columbia and Snake Rivers and vertical seepage upward from the basalt through the overlying clay and gravel. This vertical seepage occurred because the hydrostatic heads in the basalt aquifer were higher than those in the gravel aquifer, especially in the center of the Walla Walla River valley near College Place.

When the total cumulative pumpage since 1950 (380,000 acre-feet) is compared with the volume of water lost from storage in the basalt aquifer from 1950 to 1969 (27,000 acre-feet), it is apparent that 90 percent of the total water pumped has been replaced either by the capture of natural discharge, or the inducement of additional recharge. The lowering of the static water levels in the heavily pumped areas has actuated three, and possibly four, mechanisms which have contributed to the replacement of the water pumped from the basalt aquifer. These mechanisms are as follows:

1. An increase in the lateral hydraulic gradient, causing an increased water movement from the natural recharge area in the Blue Mountains.
2. A reduction in the upward discharge of water from the basalt aquifer to the gravel aquifer over the entire valley, inasmuch as the heads in the basalt aquifer now are almost everywhere lower than those in the gravel aquifer.
3. An induced downward seepage from the gravel aquifer and clay overlying the basalt aquifer, thus creating an area of recharge in place of a former area of discharge.
4. The decrease in head in the primary aquifer zones, which probably is inducing upward movement of water from deeper aquifer zones not presently being tapped by wells.

The combined effect of these factors is reflected in an unused well at the Veterans Memorial Golf Course in Walla Walla. The history of this well shows a water-level decline typical of many wells in the heavily pumped area mentioned earlier. The record shown graphically in figure 11 covers the period from 1959 to 1970. It is interesting to note that the lines representing the annual recovery of the water level (where the water level rises from the pumping level to the static level) are getting longer, probably due to increased leakage from the overlying gravel aquifer. The lowered water levels in the basalt aquifer have caused an increase in the hydraulic gradient that moves water into this aquifer from the gravel; thus, the greater the pumping stress put on the basalt aquifer, the greater the quantity of water coming in as leakage from the overlying gravel aquifer. This inference suggests that the declines, in large measure, represent

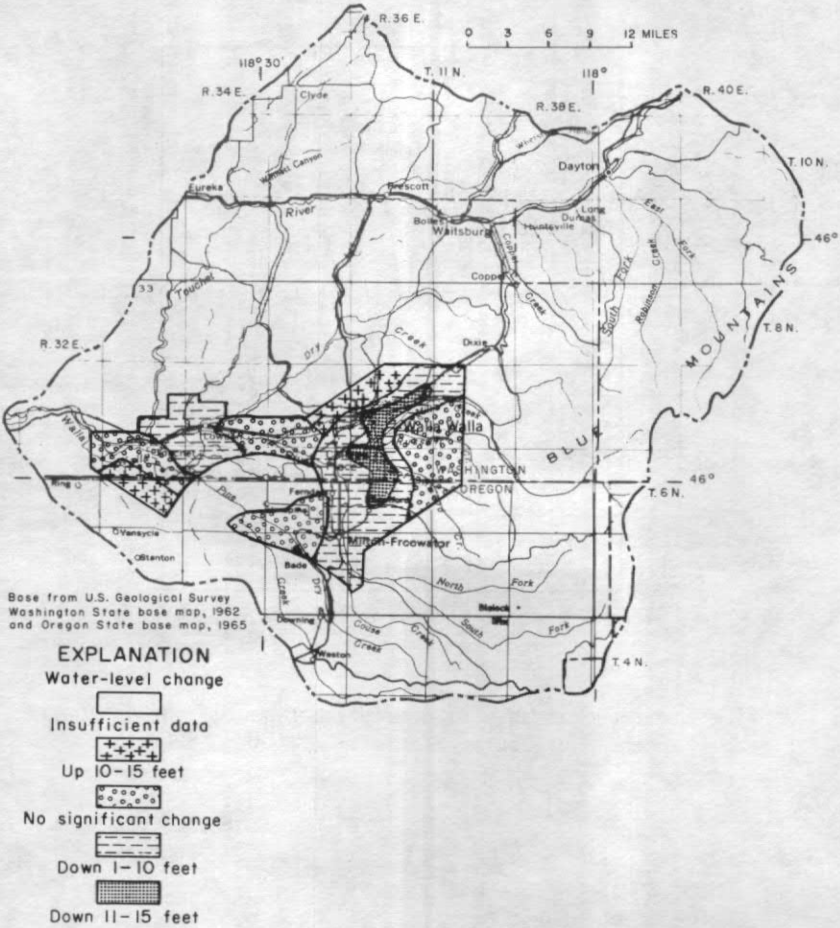


FIGURE 10.–Water-level changes in basalt aquifer during the period January 1969– January 1971.

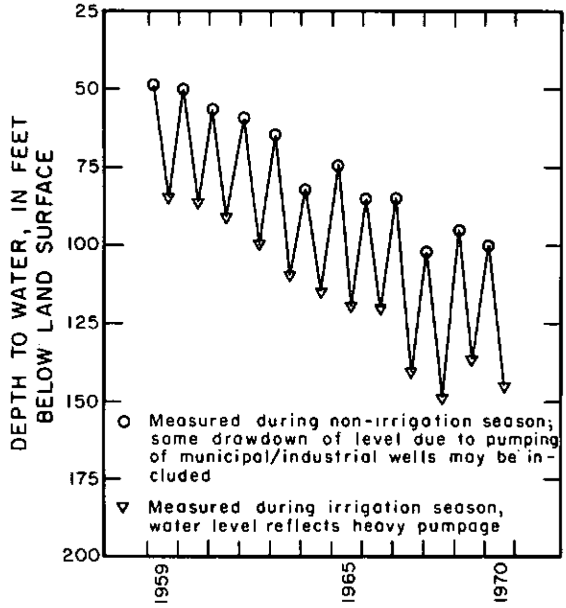


FIGURE 11.– Water-level changes in unused basalt-aquifer well at Veterans Memorial Golf Course, Walla Walla, Wash., 1959-70.

annually increasing rates of pumpage rather than major permanent loss of water in storage in the basalt aquifer. It leads to the hypothesis that, if present rates of pumping (fig. 12) are not increased, the water level in the basalt would tend to stabilize, although at a level somewhat lower than the present level. As noted earlier, the preceding discussion applies only to the heavily pumped areas in the vicinity of Walla Walla, College Place, and Milton-Freewater. In the remainder of the basin, the historic water-level changes are relatively small. This indicates that the natural discharge to the Snake and Columbia Rivers has not been significantly reduced and that there is no serious imbalance between pumpage and recharge over this period.

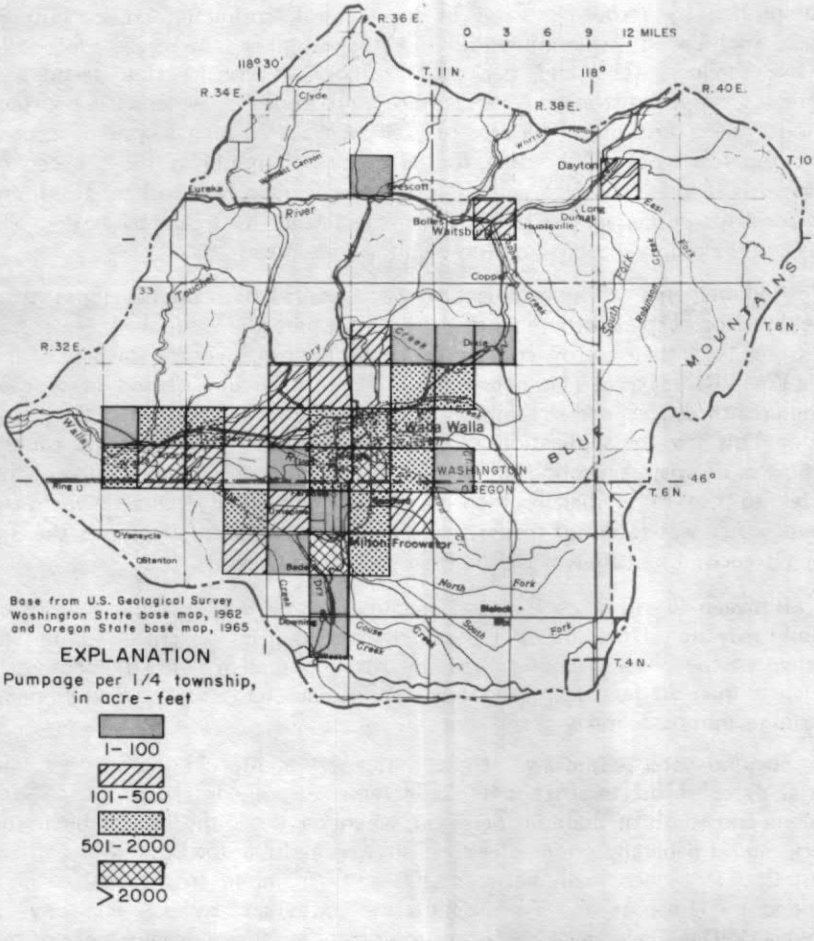


FIGURE 12.—Generalized distribution of the calculated total pumpage from the basalt aquifer during 1969. Total calculated pumpage was 27,000 acre-feet.

### Gravel Aquifer

The earliest settlers in the basin were able to satisfy their water demands by using the basin's springs and by exploiting the shallow ground-water system (gravel aquifer) by means of dug wells. Most of the early irrigation was accomplished by rerouting water in the natural, spring-fed creeks through simple, small canals, while household and stock supplies were served adequately by the shallow wells and backyard springs. As construction techniques progressed, some infiltration galleries were built to deliver water at the surface without having to pump. The city of Walla Walla used such a system, located above the town near Mill Creek, for its municipal supply in 1897. Later, as settlements increased in size and these systems were threatened by pollution, diversions for public supply had to be made farther upstream by both Walla Walla and the old town of Milton (now Milton-Freewater).

Requirements for more irrigation water soon led to the development of large diversion systems beginning at the points where the Walla Walla River and Mill Creek leave their narrow canyons and enter the broad central lowland of the Walla Walla River basin. The increased number of diversions caused an increase in the area of ditches and streambeds where surface water could enter the gravel aquifer. This, and the application of more irrigation water on the ground, caused the flow of downstream springs to increase, and water levels in many parts of the aquifer to rise to artificially high levels. Understandably, this downstream surplus water was soon put to use for irrigation—along such streams as the Big Spring Branch, the Little Walla Walla River, and Mud Creek.

Between World Wars I and II many irrigation wells in the vicinity of Milton-Freewater, Umapine, and Stateline were dug in the gravel aquifer, to supplement the water from the ditch distribution system. Most of these wells were less than 50 feet deep, about 5 feet in diameter, and fitted with small centrifugal pumps, as many in the area still are today.

Ground-water withdrawal from the gravel aquifer in the western and central parts of the basin (fig. 4) has increased sharply in recent years. Near Gardena and south of there into Oregon, where depths to the water table in the gravel aquifer generally are greater than anywhere else in the basin, wells drilled about 250 feet deep yield between 300 and 750 gpm. In the area roughly bounded by Umapine and Ferndale on the south, and by U.S. Highway 12 between College Place and Lowden on the north, extensive development of the gravel aquifer has occurred since the 1940's. Ground-water development in the Milton-Freewater area also has been changing. There, due to expanded development, pumpage has increased, while at the same time there has been a trend toward sprinkler irrigation from ditches, in contrast to the older practice of rill and flood irrigation. As more water is being withdrawn from the area and less water is being recharged due to the change in irrigation practices, water levels in the area are deeper than they were 15 to 20 years ago. As a result, many of the older dug wells on the farms have had to be deepened in the last 20 years. The effects of this change in the balance between recharge and discharge in recent years also may be noted by a reduction in springflow in various places downslope from the areas of changing irrigation practices.

The gravel aquifer has been developed least in the area northeast of Walla Walla. At present (1971) there are few wells in this area and the majority of these are small-capacity domestic wells. Drillers' records indicate a thick, coarse, permeable gravel aquifer in this area; its hydraulic connection to surface streams suggests a potential for further development on a much larger scale in this part of the basin.

Currently there are more than 2,000 wells tapping the gravel aquifer in the Walla Walla River basin. Approximately 25,000 acre-feet of water is now being pumped annually from this aquifer for irrigation. Most of this withdrawal is in the area between Milton-Freewater and the State line, and between the towns of Stateline and Gardena. Figure 13 shows the general distribution of pumpage from the gravel aquifer in 1969. Examination of long-term water-level records for wells tapping the gravel aquifer shows little change between the past and present levels, except as noted in the areas of changing irrigation practices. Most of the wells show the expected seasonal response to pumpage, and to inflow from nearby streams and rainfall; this pattern of seasonal change has remained fairly consistent from one year to the next.

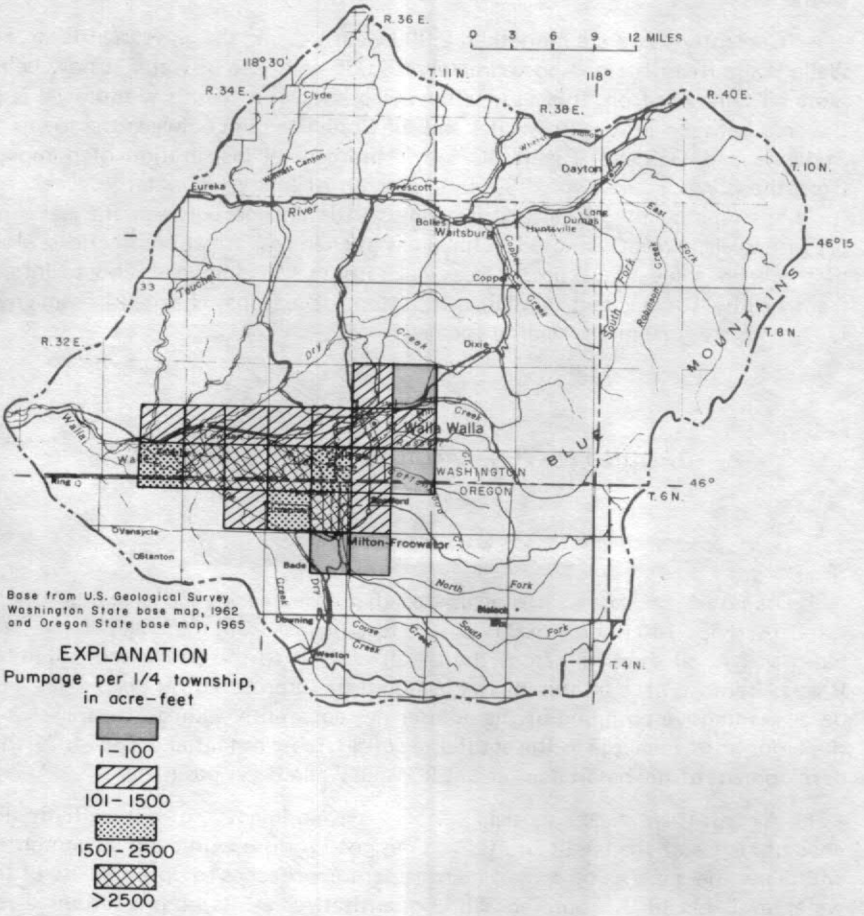
## GROUND-WATER-MANAGEMENT PROJECTIONS

### Basalt Aquifer

As noted on page 6, it is estimated that each year a very large quantity of water (perhaps 140,000 to 300,000 acre-feet) is lost from the Walla Walla River basin as natural discharge from the basalt aquifer to the Snake and Columbia Rivers. Because part of this discharge could be intercepted by deep wells, and because intensive pumping of the aquifer has apparently induced an increase in the amount of recharge to the aquifer, a considerable potential exists for further development of the basalt aquifer in the Walla Walla River basin.

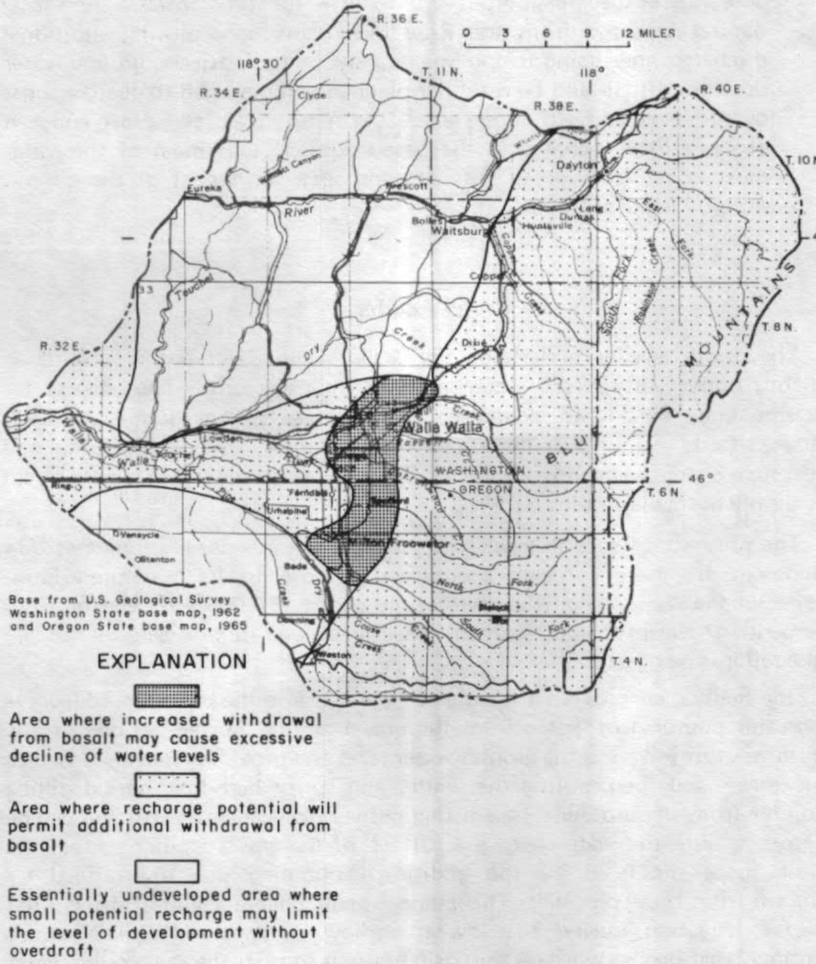
A mathematical model, under development, of the hydraulic characteristics of the basalt aquifer and designed for use with a digital computer, will allow the analysis of several management approaches to optimize use of the water available in this aquifer. While quantitative results or projections await completion of this model, the following general conclusions may be stated, relative to the potential for future ground-water development in various parts of the basin (fig. 14):

1. Increased withdrawal from the basalt aquifer, in the areas where heavy pumpage has already caused water-level declines, will create a still greater decline of the water level. As water levels decline in these areas, the available drawdown—and thus the yields of existing wells—will be reduced. It is in these areas of the Walla Walla River basin that management of the patterns and extent of ground-water development are presently needed to maintain pumping levels within the range of lifts economical for current water uses.



Base from U.S. Geological Survey
Washington State base map, 1962
and Oregon State base map, 1965

FIGURE 13.—Generalized distribution of calculated total pumpage from the gravel aquifer, 1969. Total calculated pumpage was 25,000 acre-feet.



Base from U.S. Geological Survey Washington State base map, 1962 and Oregon State base map, 1965

EXPLANATION

▩ Area where increased withdrawal from basalt may cause excessive decline of water levels

⬚ Area where recharge potential will permit additional withdrawal from basalt

☐ Essentially undeveloped area where small potential recharge may limit the level of development without overdraft

FIGURE 14.–Areas of various potentials for further development of the basalt aquifer.

2. In the areas where there is now very little pumpage from the basalt aquifer, and where there is a potential for increasing the rate of recharge or for capturing a part of the natural discharge, increased ground-water development can occur without causing substantial water-level declines in the near future.
3. In the areas where there is no saturated material overlying the basalt and where the possibilities are remote for substantially increasing natural recharge from the Blue Mountains or capturing additional discharge now going to the Snake and Columbia Rivers, ground-water development should be carefully planned and managed to guard against overdevelopment. In these areas, the natural rainfall is low and can produce little recharge to the basalt aquifer, thus most of the water must come from great distances and such movement of the ground water is relatively slow.

## Gravel Aquifer

The gravel aquifer underlying the Walla Walla River basin presents an excellent opportunity for water-resource management. The tools for management are already in existence: an impressively large number of wells distributed fairly evenly over the extent of the aquifer, an extensive canal and ditch system crisscrossing most of the aquifer, and, most important, an abundant water supply available to the aquifer.

The presence of such extensive irrigation structures usually indicates that development of the local water resources is close to its maximum limit. However, in the Walla Walla River basin only about 150,000 acre-feet (or 10 to 15 percent) of the probable reservoir capacity of one million acre-feet of the gravel aquifer is being utilized.

One method of providing for greater water use in the basin would involve even greater pumping of water from the gravel aquifer during periods of low streamflow—thus lowering the ground-water level and providing more subsurface storage space—and then, during the winter and spring high-flow period, filling the aquifer from streamflow. The existing network of canals and ditches can be used to distribute the water over the surface of the gravel aquifer so that the reservoir space produced by the additional pumping may be refilled by infiltration from these channels. This management scheme would utilize ground water for irrigation during the low-streamflow periods and utilize excess streamflow (that presently leaves the basin unused) to recharge the ground-water reservoir.

Such management of the gravel aquifer would, obviously, require adjustments in the present distribution system. To compensate for the lowering of the level in the ground-water reservoir by increased pumpage, some wells would have to be drilled deeper. Flow from many springs would be reduced, if not completely stopped. Some areas that presently are subirrigated would have to be irrigated artificially. Therefore, these changes, which would make more water available, would involve some additional cost.

A mathematical model of the gravel aquifer and all the interrelated streams, canals, and springs is being constructed to simulate the flow system of this aquifer. When completed, it can be used to test and evaluate various management schemes to develop a plan for increasing the water supply from the gravel aquifer. Present data indicate that about 75,000 acre-feet of water flows through the gravel annually under the present hydrologic conditions. With careful management this figure could be easily increased greatly. Optimum development of the aquifer will require cooperation on the part of the people of the Walla Walla River basin and all the concerned State agencies of Washington and Oregon.

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