SUMMARY OF GROUND-WATER CONDITIONS IN THE BLUE GULCH CRITICAL GROUND WATER AREA EASTERN OWYHEE AND WESTERN TWIN FALLS COUNTIES, IDAHO

by
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INTRODUCTION

History

Development in the Blue Gulch Area began in the 1950's and rapidly increased during the 1960's. The primary development was agriculture which entailed accessing ground water beneath the area, as no surface water is abundantly available. Water level declines in wells were first observed in 1967. From April 1969 to March 1970 water level declines of more than 27 feet were reported for some wells. Based on this, the Idaho Department of Water Administration (now the Idaho Department of Water Resources or IDWR) conducted a study (Chapman and Ralston, 1970) to determine quality, quantity, and occurrence of ground water in the area. Emphasis was placed on the effects of past development and the potential effects of future development.

This report was completed in November 1970 and stated that the area was in overdraft, or in essence, discharge was exceeding recharge. The primary discharge was through wells used for irrigation. The report also concluded that the potential for additional ground water withdrawals was a factor. Applications and approved permits for appropriation of ground water, yet to be developed, totaled more than four times existing well discharge. Recommendations were that the area be declared a "Critical Ground Water Area" (CGWA) which could stop the approval of new applications, although development could continue under previously approved permits. The report recommended that the designation should continue until data were available to show that present or existing water right holders would not be damaged by the approval of new permits. The report also recommended expanding the present monitoring network, and when enough additional data had been collected, a more detailed investigation should be completed.

Based on this report, Director R. Keith Higginson of the IDWR ordered that the Blue Gulch area be declared a CGWA as of December 9, 1970. Since that time the ground water has been monitored by both the IDWR and the U. S. Geological Survey (USGS).

Purpose and Objectives

The purpose of this report was to review hydrogeologic changes and their causes which have occurred since the area was declared a CGWA in 1970. This is the first detailed review since Chapman and Ralston (1970) completed their report.

Description of Area

The subject site is located in western Twin Falls and eastern Owyhee Counties (see Figure 1, "Site Location Map"). The total area is approximately 300 square miles and relief ranges from approximately 3,000 to 4,500 feet above mean sea level over the rolling plain. Annual precipitation is about 9 inches per year based on a precipitation station located in the town of Hollister approximately 20 miles southeast of the area. This amount is reflective of the desert climate.

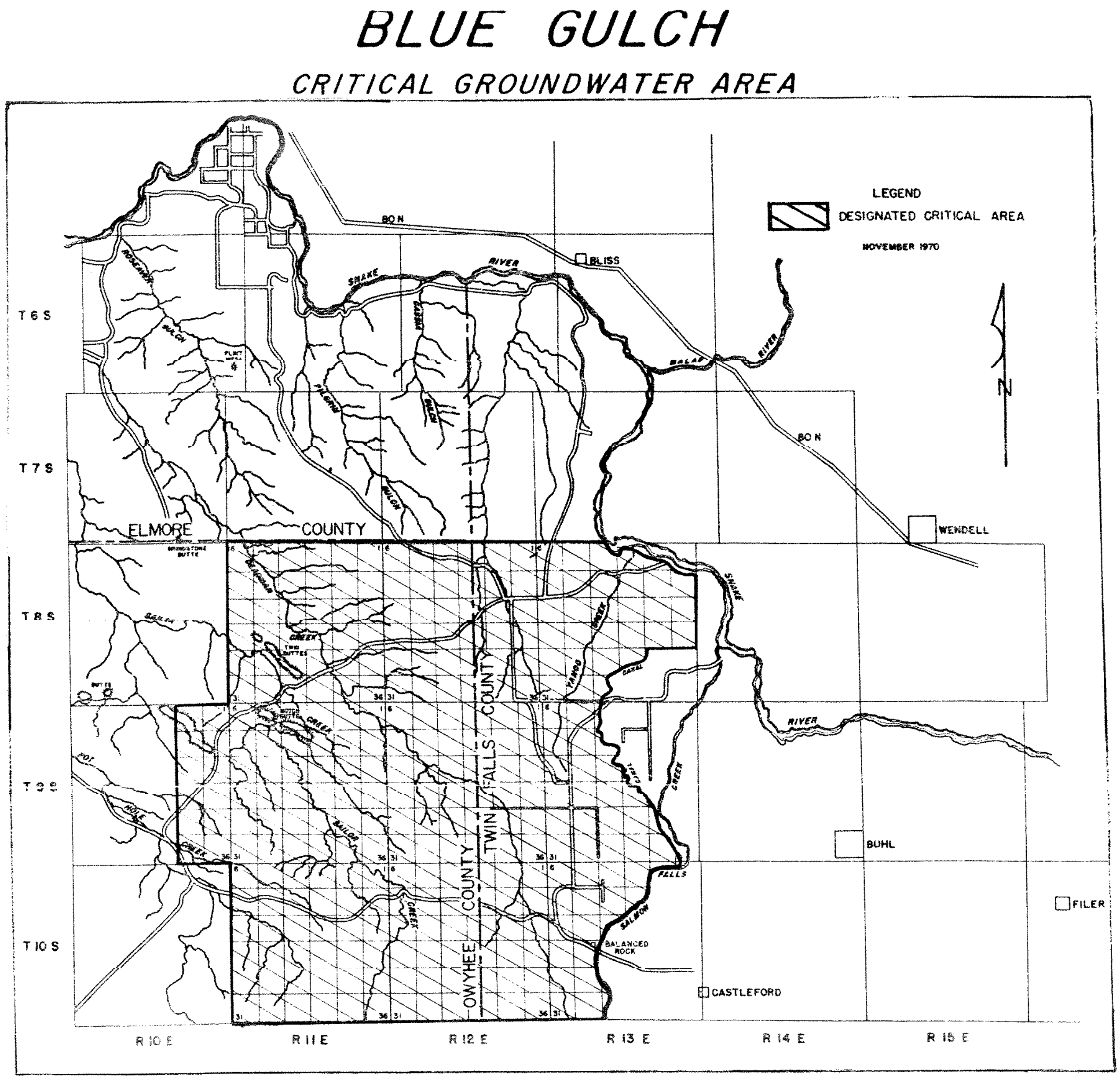
Surface drainage over most of the area is towards the north and northwest into the Snake River. A small part of the area drains eastward into Salmon Falls Creek. Ground water flow appears to follow surface drainage in the area. Streams and creeks are seasonal and are again reflective of the desert climate. Sagebrush and desert grasses are the predominant native vegetative cover.

Farming is the only development in the area. In the middle to late 1970's as much as 20,000 acres was under irrigation. Due to changing economic conditions and government set aside programs, this amount has dwindled to approximately 6,000 to 8,000 acres. The major crops are beans, corn, potatoes, feed and beer (malting) barley, wheat, alfalfa, and pasture. All of these crops require irrigation in the desert climate.

Previous Work

The geology in the area has been studied and presented in a report by Malde and Powers (1962), and in a map published by Malde, Powers, and Marshall (1963). Geologic and hydrologic investigations have been completed by Mundorff and others (1960), and Sumsion (1958, 1959). Crosthwaite (1963), conducted a ground water hydrology study as part of a reconnaissance study of the Sailor Creek area.

By far the most detailed investigation was conducted by Ralston and Chapman (1970). Geology, hydrogeology, and water quality for both surface and ground water, were all addressed. Although no estimate was made for average annual ground water recharge and only partial estimates were made for discharge, conclusions were reached that the area was in overdraft.

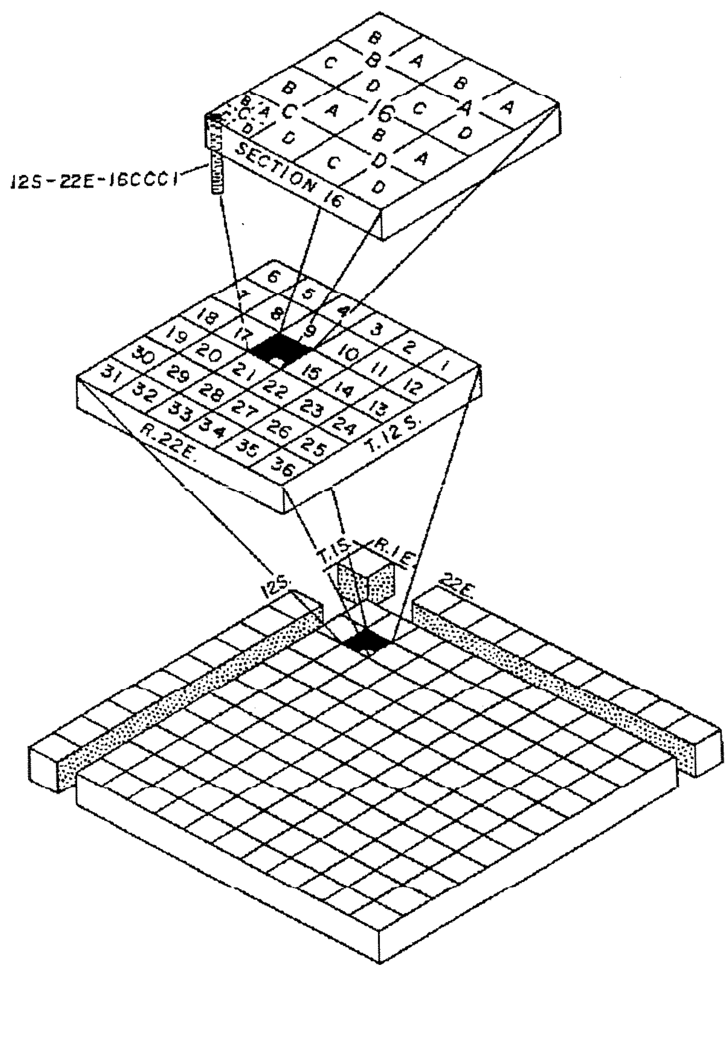


Adapted from Chapman and Ralston, 1970

Figure 1. Site Location Map

Well-Numbering System

The well numbering system used by WELL_LOG is identical to the USGS system. The system is based on the legal descriptions of well locations. The first two segments of the number designate the township and range. The third segment gives the section number, followed by three letters and a number, which indicates the ¼ section (160-acre tract), ¼-¼ section (40-acre tract), ¼-¼-¼ section (10-acre tract), and serial number of the well within the tract. Quarter sections are lettered A, B, C, and D in counterclockwise order from the northeast quarter of each section. Within quarter sections, 40-acre and 10-acre tracts are lettered in the same manner. Well 12S22E-16CCC1 is in the SW¼SW¼SW¼, Section 16, Township 12 South, Range 22 East, and was the first well inventoried in that tract (see below). For wells that are located in government lots, the third segment of the well number uses the following format. First the section number, then the letter L (code for indicating a government lot) and the lot number (1-16), and finally a serial letter. An example of this format is as follows: 16L03A.



GEOLOGIC FRAMEWORK

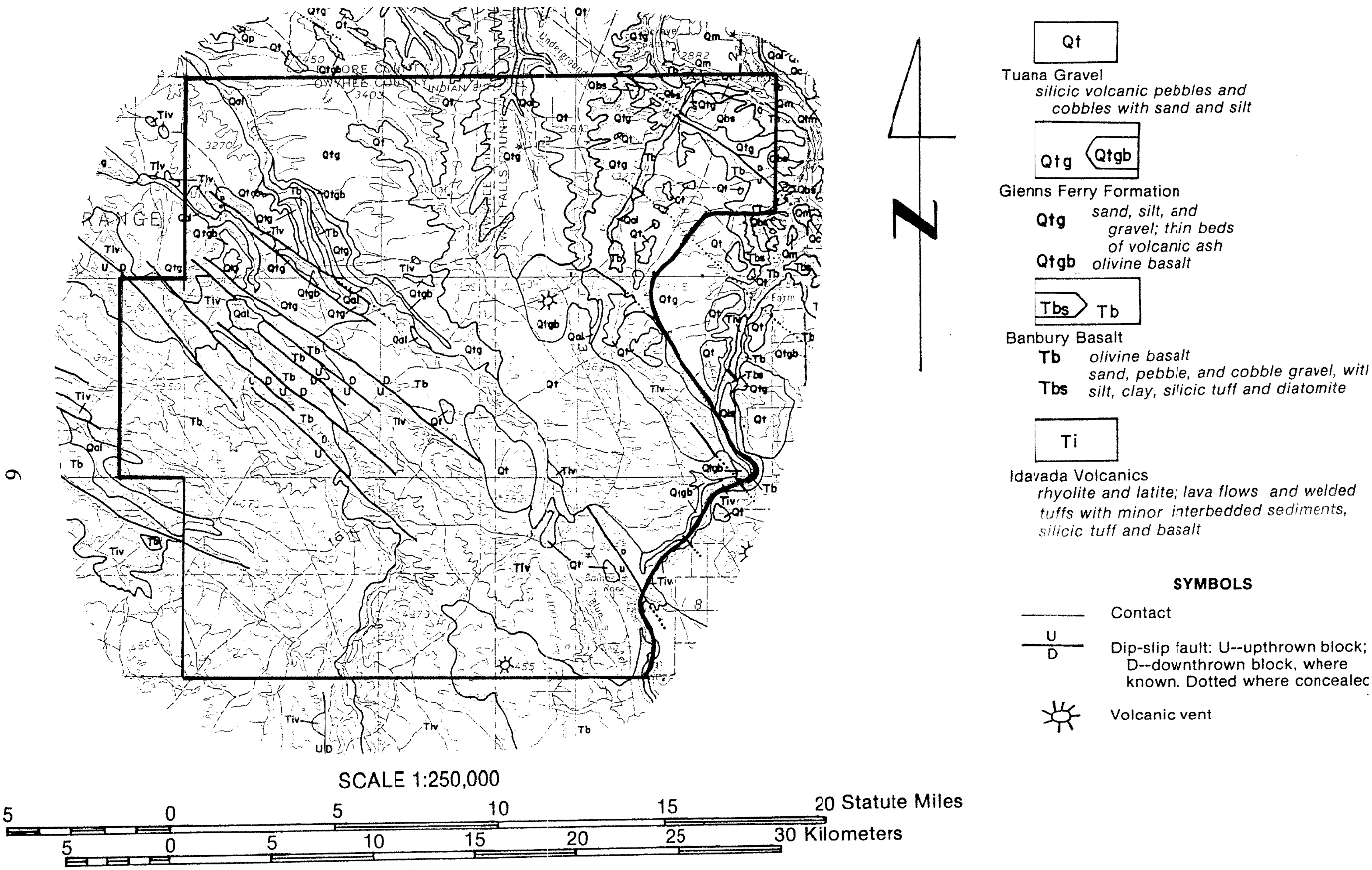
The following is an adaption from work presented by Ralston and Chapman (1970).

While the Blue Gulch area is composed of several geologic formations, only two are important as aquifers: the Idavada Volcanics and the Banbury Basalt. The Idavada Volcanics form the primary aquifer in the area. The unit predominates the surface geology in the southern half of the area (see Figure 2, "Geologic Map") and is composed mainly of silicic, welded ash flows which are brown in color with small white crystals of feldspar.

The Banbury Basalt consists of three members and overlays the Idavada Volcanics. The lower member is composed of several hundred feet of rubbly basalt, which has been altered to such a degree that the vesicles and fractures are filled with alteration products limiting or reducing its porosity. The middle member is a sedimentary unit consisting of a layered sequence of clay, silt, sand, and fine gravel. The thickness is highly variable, ranging from a few feet to approximately 600 feet. The third or upper member consists of several hundred feet of a fresh appearing, gray to black, olivine basalt. Well developed columnar jointing can be observed along with fracturing at contacts between flows and where faulting has traversed the area.

The Glenns Ferry Formation primarily outcrops in the northern part of the study area. It consists of both a basalt and a sedimentary member with the sediments consisting of white, brown, and blue clay along with sand and fine gravel. Neither member is considered an important aquifer in the study area. A thin sequence of clay, silt, sand and pebble gravel named the Tuana Gravel overlies the Glenns Ferry Formation.

Geologic structure in the study area is controlled by the Snake River Downwarp. It is a large structural trough caused by subsidence of the Snake River Plain along with uplift of the mountains to the north and south. Subparallel, northwest trending faults along both sides of the Snake River Plain are evidence of this. Many faults pass through the study area creating highly fractured zones and are considered highly important for their effect on the flow and occurrence of ground water. Wells penetrating these fractured zones have yields considerably higher than those which do not. It is also believed these zones control the vertical movement of ground water and the deep circulation is responsible for warm water encountered at several sites in the study area. Low volcanic domes with a gentle 2 to 3 degrees northward dip are also present within the study area.



Adapted from Rember and Bennett, 1979

Figure 2. Geologic Map

HYDROLOGIC REGIME

Occurrence and Movement of Ground Water

Ground water in the area has been developed for irrigation purposes since the mid 1950's. While some domestic and stock wells are present, they account for only a small percentage of the total pumpage (see Figure 3, "Well Location and Use Map"). Therefore, withdrawal is seasonal and associated with the growing season. Depth to water in the area varies from approximately 50 to 450 feet. It is noted that data are lacking in the western half of the study area and especially in the southwestern portion where no data are available. It is also noted that most of the development of ground water has taken place in the central and eastern portion of the study area where low relief promotes agriculture.

Ground water elevations vary from approximately 3,040 feet at the northwestern portion to almost 3,500 feet at the southeastern portion (see Figure 4, "Ground Water Elevations"). Ground water flow is predominantly from southeast to northwest with a gradient of approximately 11 feet per mile in the southeastern portion increasing to 80 feet per mile in the northwest-central portion. Again, the increased gradient may be held suspect due to the lack of data. In the northeast, the flow or gradient is east into the Snake River and Salmon Falls Creek.

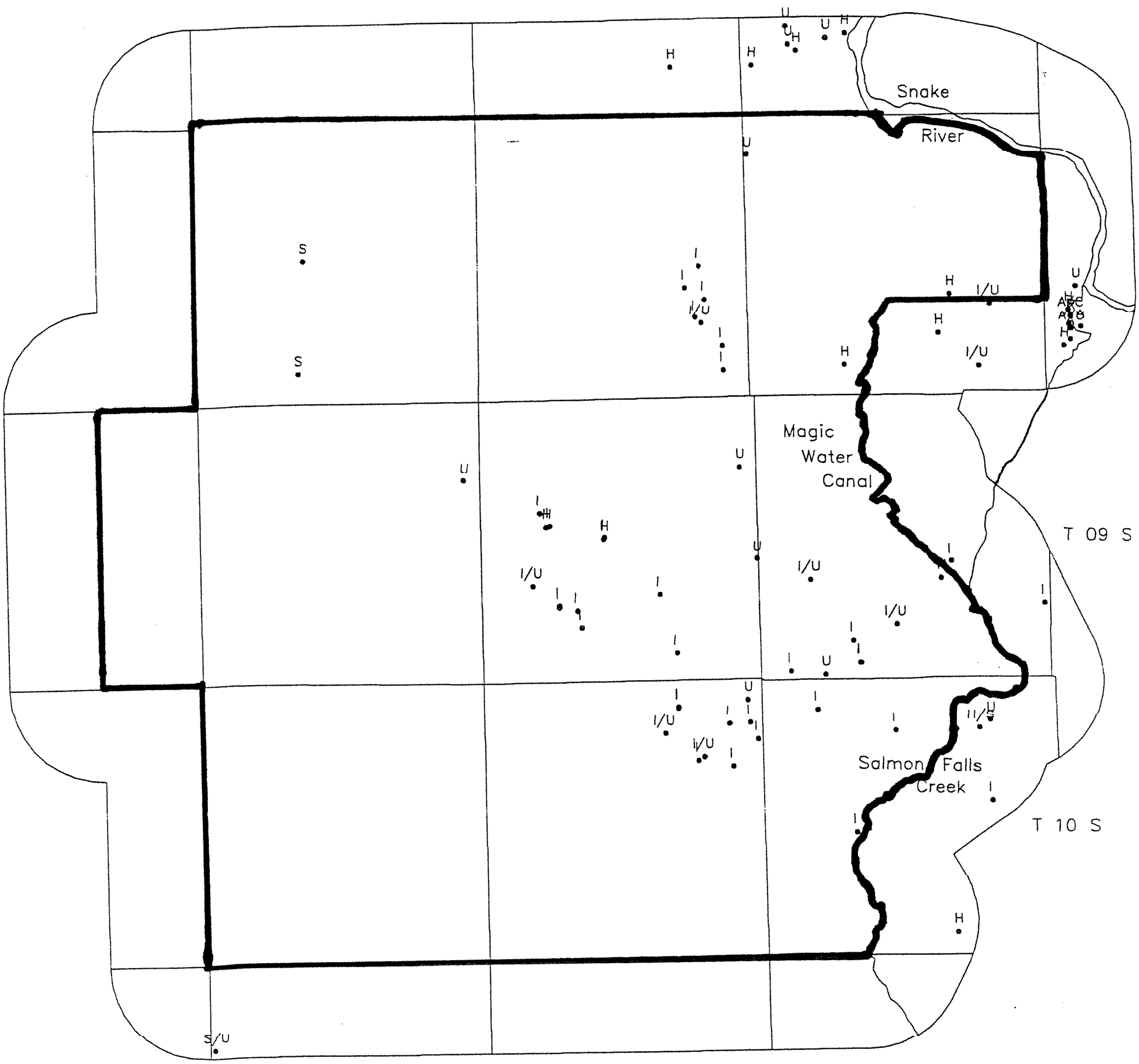
Recharge vs. Discharge

Water levels in selected wells within the area have been measured by IDWR and USGS dating back into the 1960's. While data have been taken sporadically at short intervals of time such as a weekly or monthly basis, most of the data are semi-annual taken in the spring and fall. Figure 5, "Hydrograph Locations" shows the locations of seven wells in the study area for which the hydrographs were chosen for presentation in this report. Table 1, "Selected Wells", presents construction, total depth, elevation, and other basic data about each well. It was decided that these seven wells best represented the area based on their depth and location.

Figure 6 presents hydrographs of two wells located in the northeast portion of the study area. Water level trends for well 08S13E-23CCD1 have been stable and are reflective of its location and shallow depth. It is located next to a canal and in an area which is irrigated with surface water from Salmon Falls Creek. Therefore, the hydrograph fluctuations are probably due to changes in canal flow.

The hydrograph for well 08S12E-24CCC1 typifies ground water changes that have occurred in the Blue Gulch Area. In the late 1960's and early 1970's significant water level declines were observed due to increased ground water withdrawals. Then in the late 1970's a later reduction in usage caused a steady rise in water level.

BLUE GULCH CRITICAL GROUND WATER AREA



LEGEND

H - DOMESTIC   I - IRRIGATION   S - STOCK   U - UNUSED

SCALE 1:200000

5   0   5   10 Miles

Figure 3. Well Location and Use Map

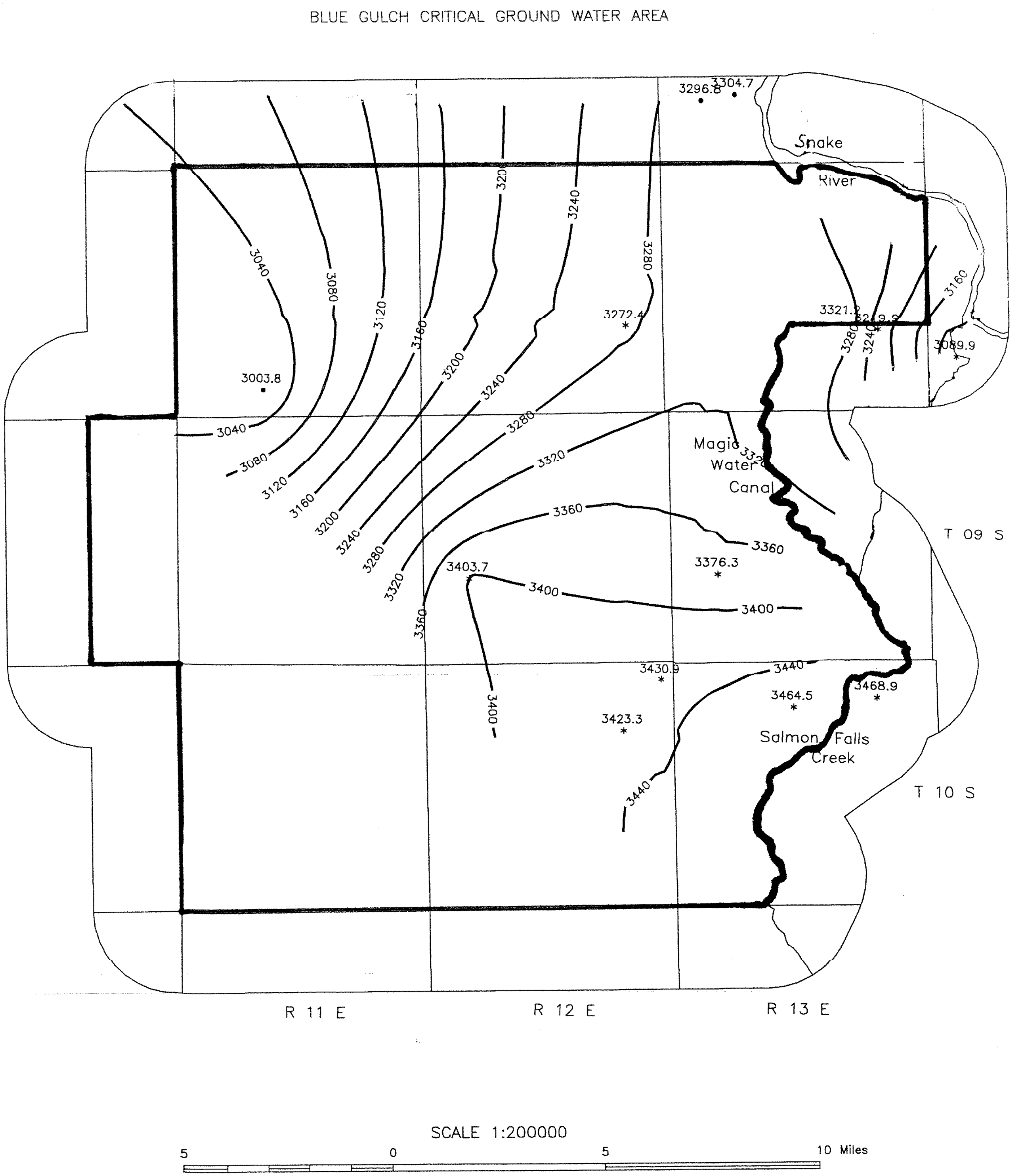


Figure 4. Ground Water Elevations: Spring 1993

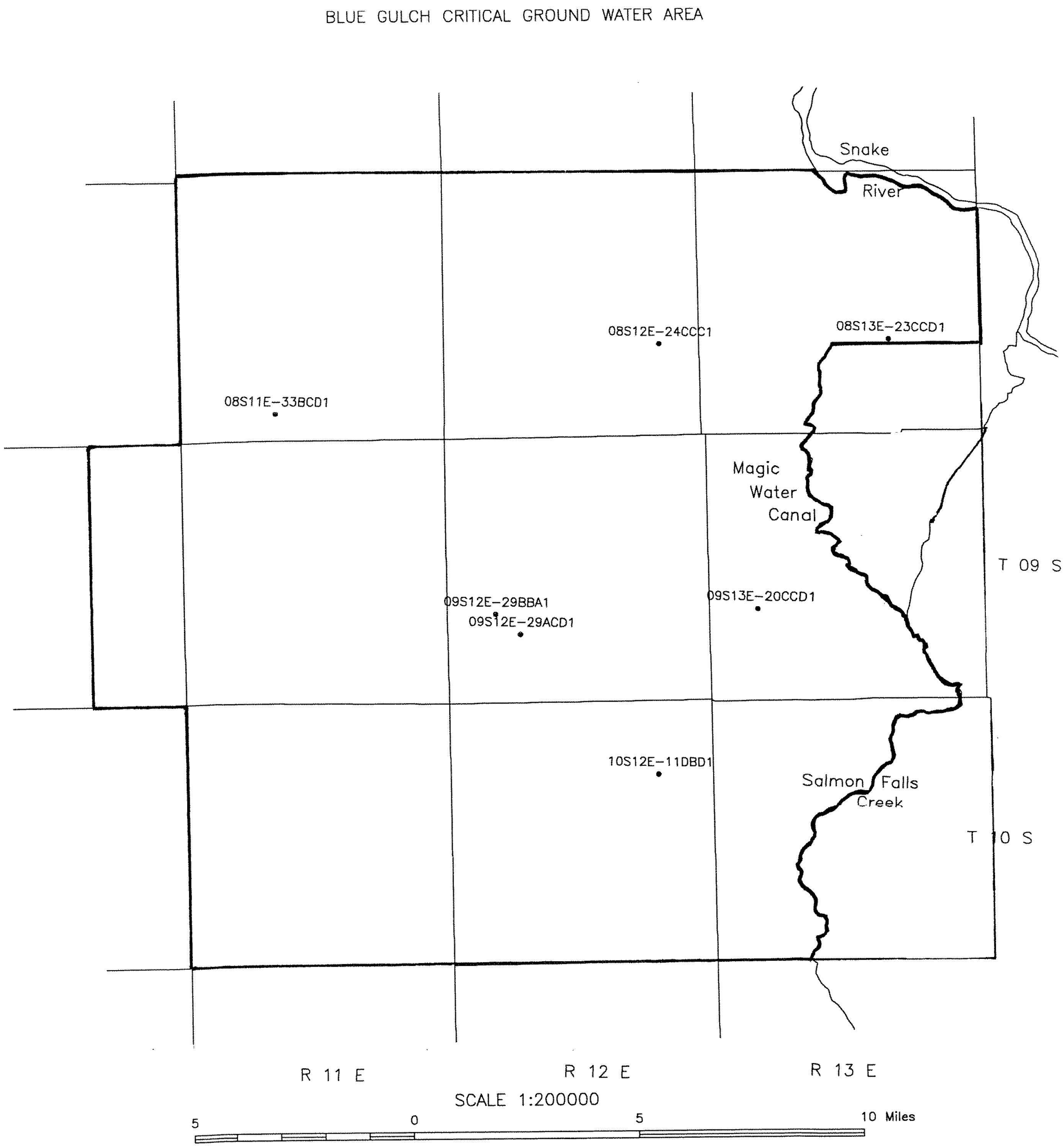


Figure 5. Hydrograph Locations

Table 1. Records of Selected Wells

Elevation of LSD: or land surface datum estimated from USGS topographic maps and field surveys.

Use of water: H - Domestic; I - Irrigation; S - Stock. U - Unused

Depth to water: measured in feet below land surface.

Well number	Elevation of LSD (ft)	Use of water	Well depth (ft)	Depth to first well opening (ft)	Depth to water (ft)	Date measured last
08S13E-23CCD1	3390	H	100	50	69.4	3/23/93
08S12E-24CCC1	3469	I	500	46	196.6	3/23/93
09S13E-20CCD1	3805	I/U	920	165	427.8	3/16/93
10S12E-11DBD1	3761	I/U	700	6	334.4	3/16/93
09S12E-29ACD1	3625	I	530	10	237.7	3/11/82
09S12E-29BBA1	3605	I/U	-	-	198.9	3/16/93
08S11E-33BCD1	3168	S	290	250	164.2	3/23/93

BLUE GULCH CRITICAL GROUND WATER AREA

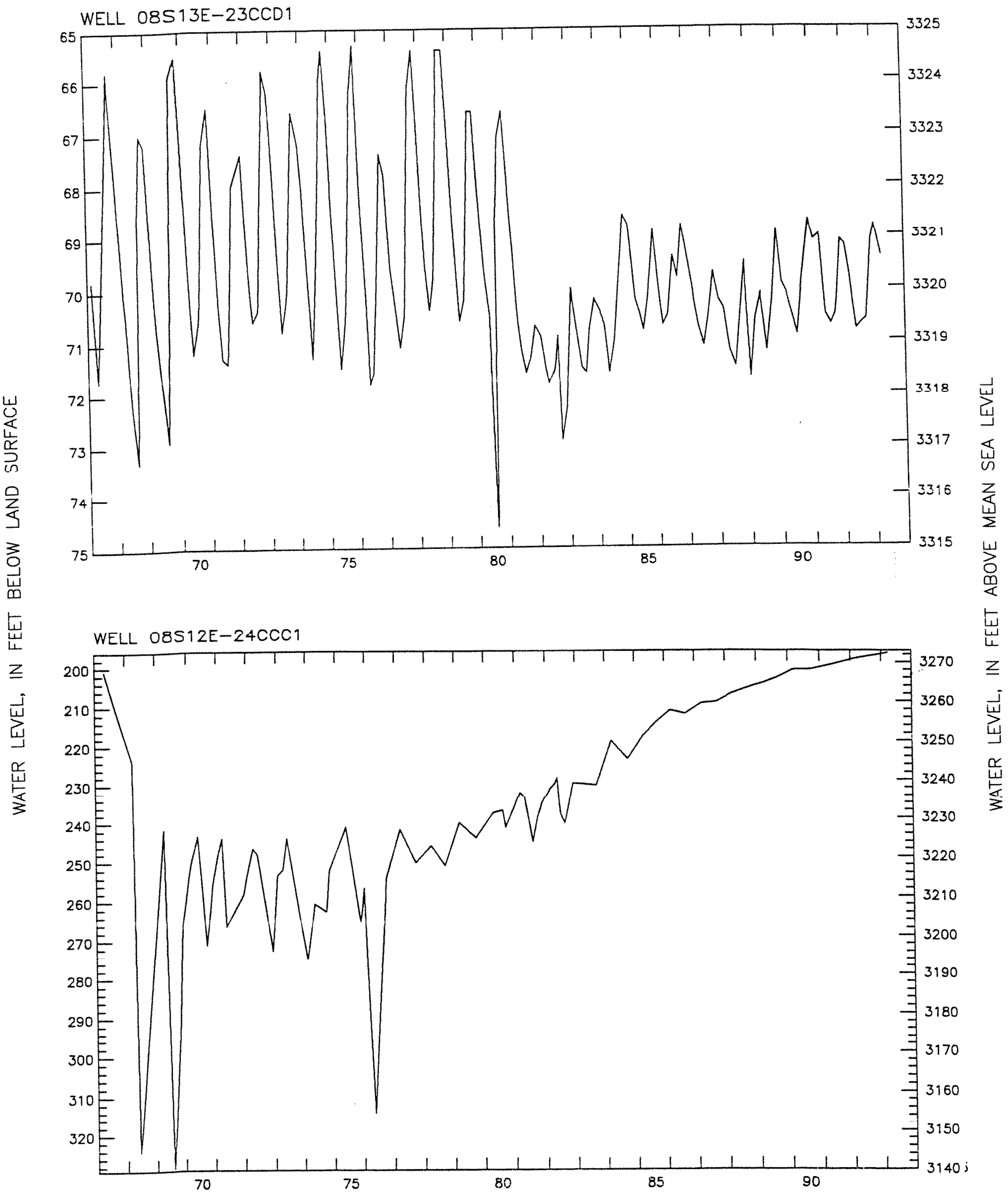


Figure 6. Northeast Hydrographs

Figure 7 presents two hydrographs from wells in the southeastern portion of the study area. Well 10S12E-11DBD1 is again typical. A steady decline occurred throughout the late 1960's with discharge exceeding recharge until approximately 1981. Recharge then exceeded discharge from 1981 until present.

Well 09S13E-20CCD1 is also typical with decreasing water levels until the late 1970's followed by increasing water levels until present. Recharge began to exceed discharge in approximately 1980.

Figure 8 presents the hydrographs from two wells centrally located. Well 09S12E-29ACD1 presents data from the late 1960's until the early 1980's. Well 09S12E-29BBA1, adjacently located, presents data from 1985 until present. While neither of these wells alone show the typical trend, when combined they do. Discharge exceeded recharge until approximately 1980 or later, but by 1985 the water level was rising.

Figure 9 presents a hydrograph from well 08S11E-33BCD1 which is located in the western portion of the area. It is atypical in the sense that it shows recharge exceeding discharge since the late 1960's at a very steady rate even though pumping has been sporadic throughout the years. This possibly could be explained by noting that it is located in a separate drainage basin than the other wells and or that it is a much shallower and is reflective of shallow perched conditions.

None of the hydrographs presented show the recent drought. It is assumed that less discharge is masking the effects of the recent drought. Well hydrographs near the study area do show changes associated with the drought.

Recharge to the area occurs mainly from two sources; underflow entering the area which is the result of precipitation on the uplands south of the area and precipitation directly on the subject site. With the exception of Salmon Falls Creek (which is considered an area of discharge and discussed later in this report), all streams are ephermal, and therefore solely a function of direct precipitation. Imported water is only a factor in the northeastern portion of the area where water is pumped out of Salmon Falls Creek for irrigation. Ground water flow in that area is also east towards the Snake River and Salmon Falls Creek.

Figure 10, "Precipitation Data" presents precipitation data from a station at Hollister located directly east of the area. Precipitation averages approximately 10 inches per year with the recent drought shown by below average precipitation from 1985 to 1992. Precipitation was above average from approximately 1980 to 1984 which is the same time most of the well hydrographs showed ground water levels beginning to rise. Apparently the reason the water levels continued to rise through the recent drought is that the area was in an overdraft condition approximately before, but not after the drought began.

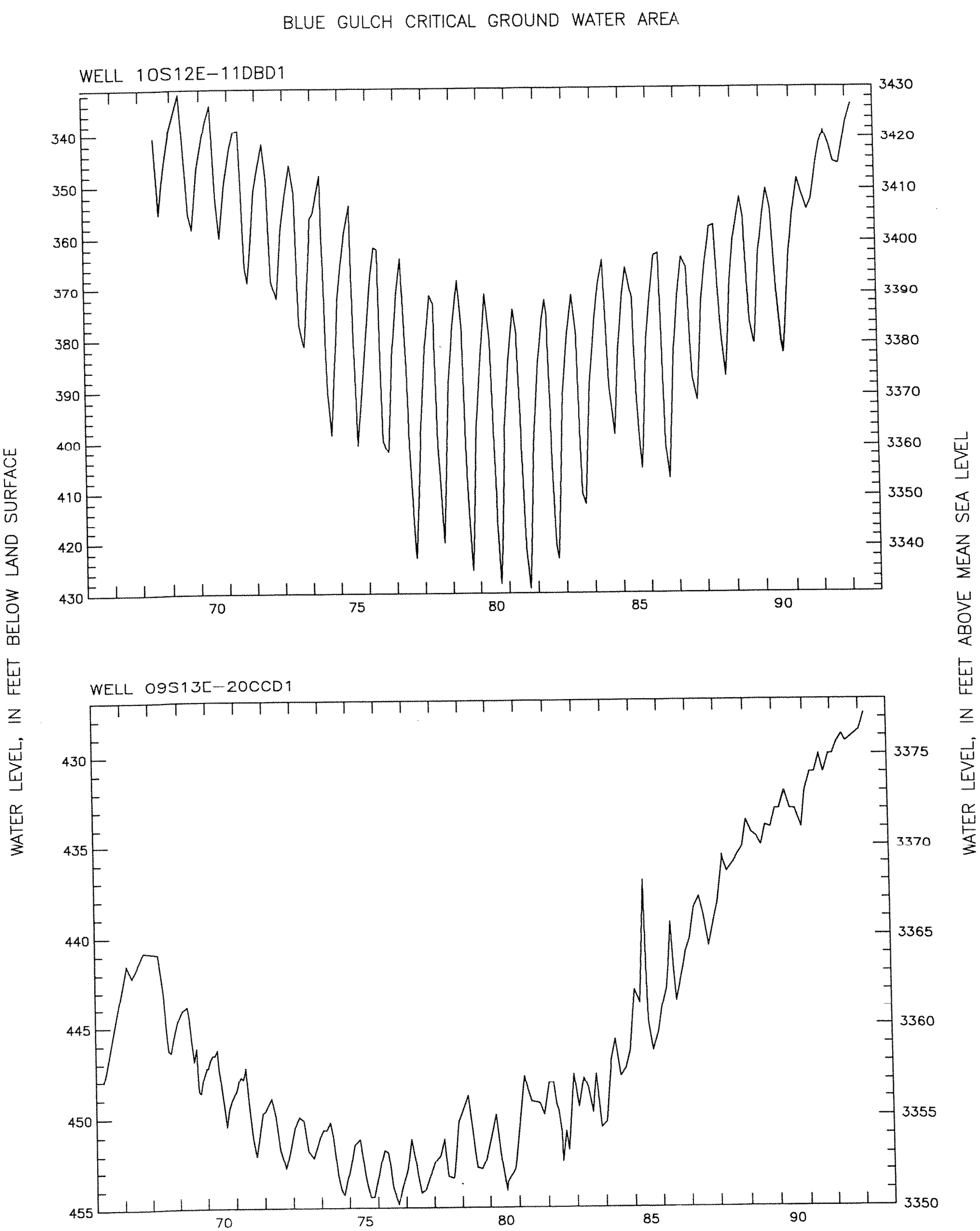


Figure 7. Southeast Hydrographs

BLUE GULCH CRITICAL GROUND WATER AREA

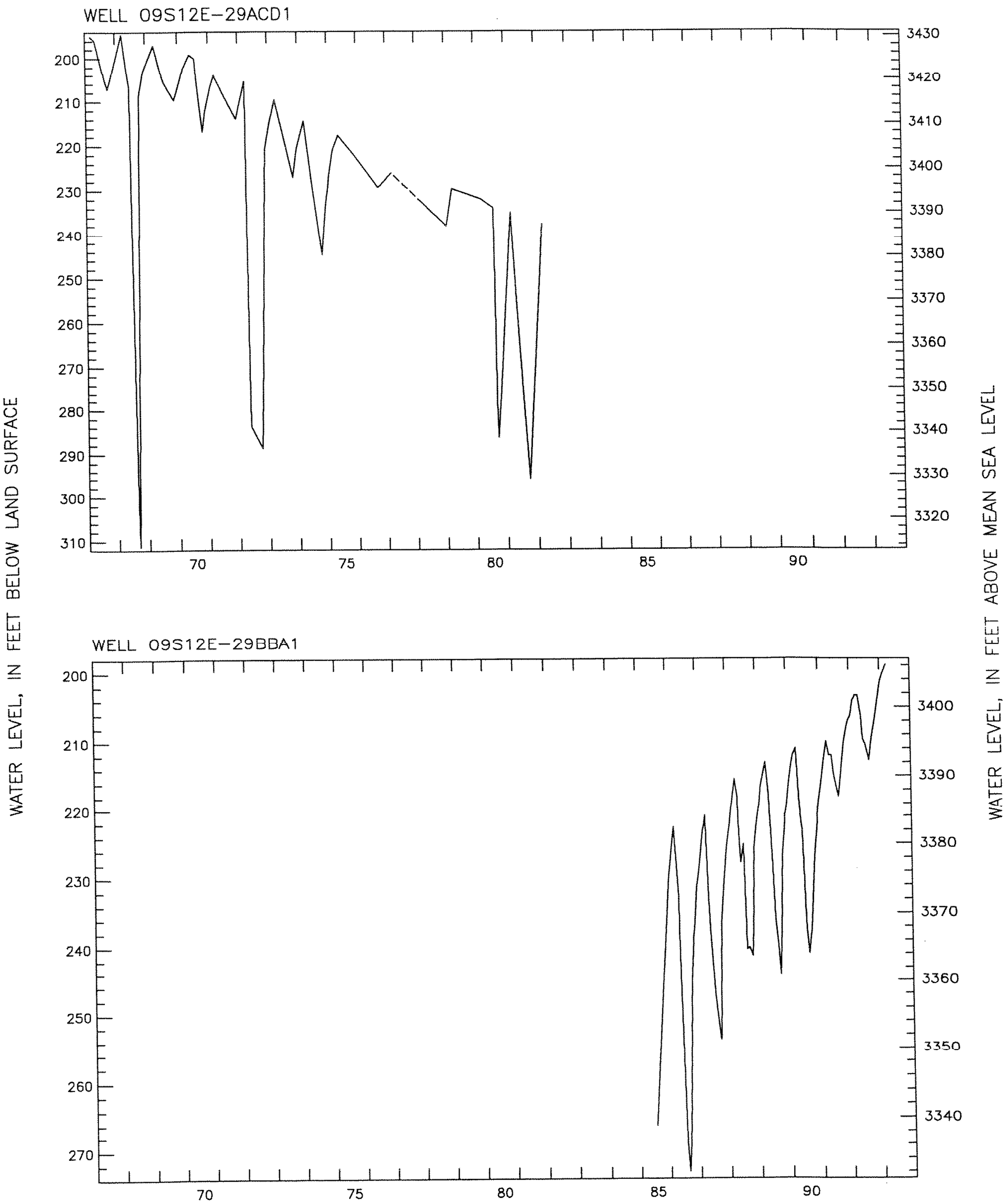


Figure 8. Central Hydrographs

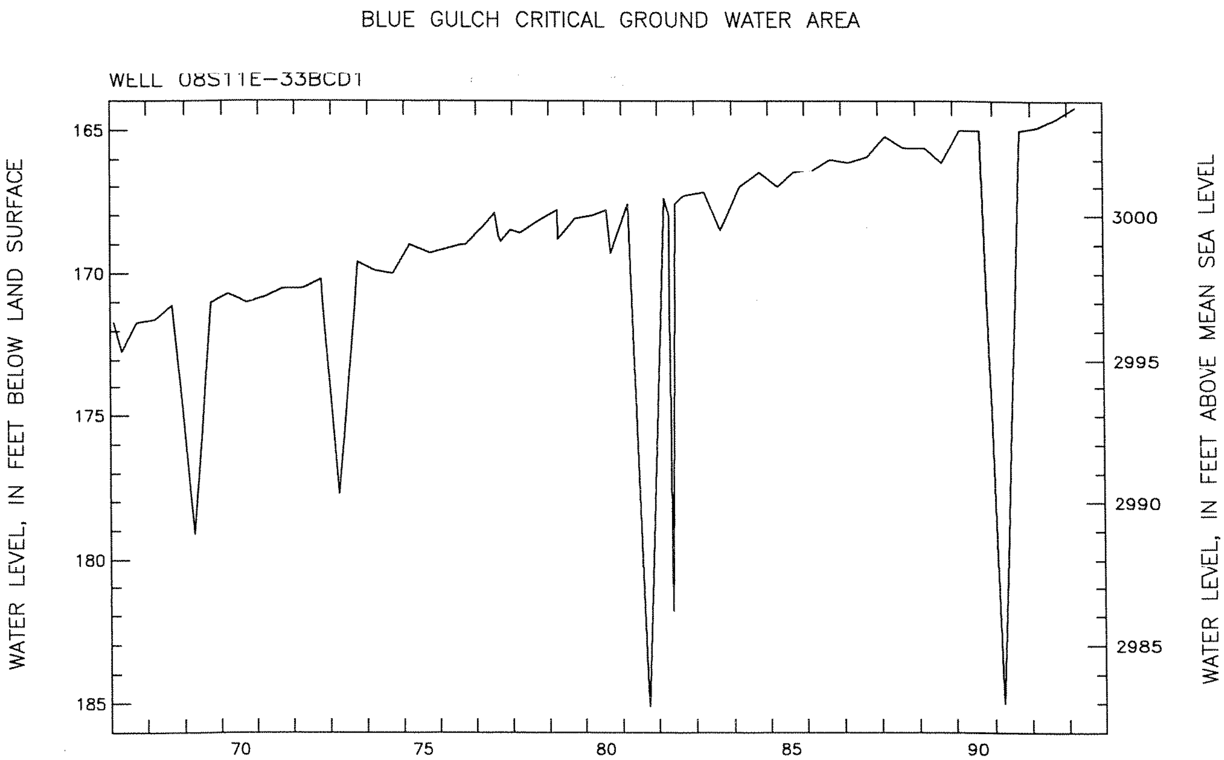


Figure 9. Western Hydrograph

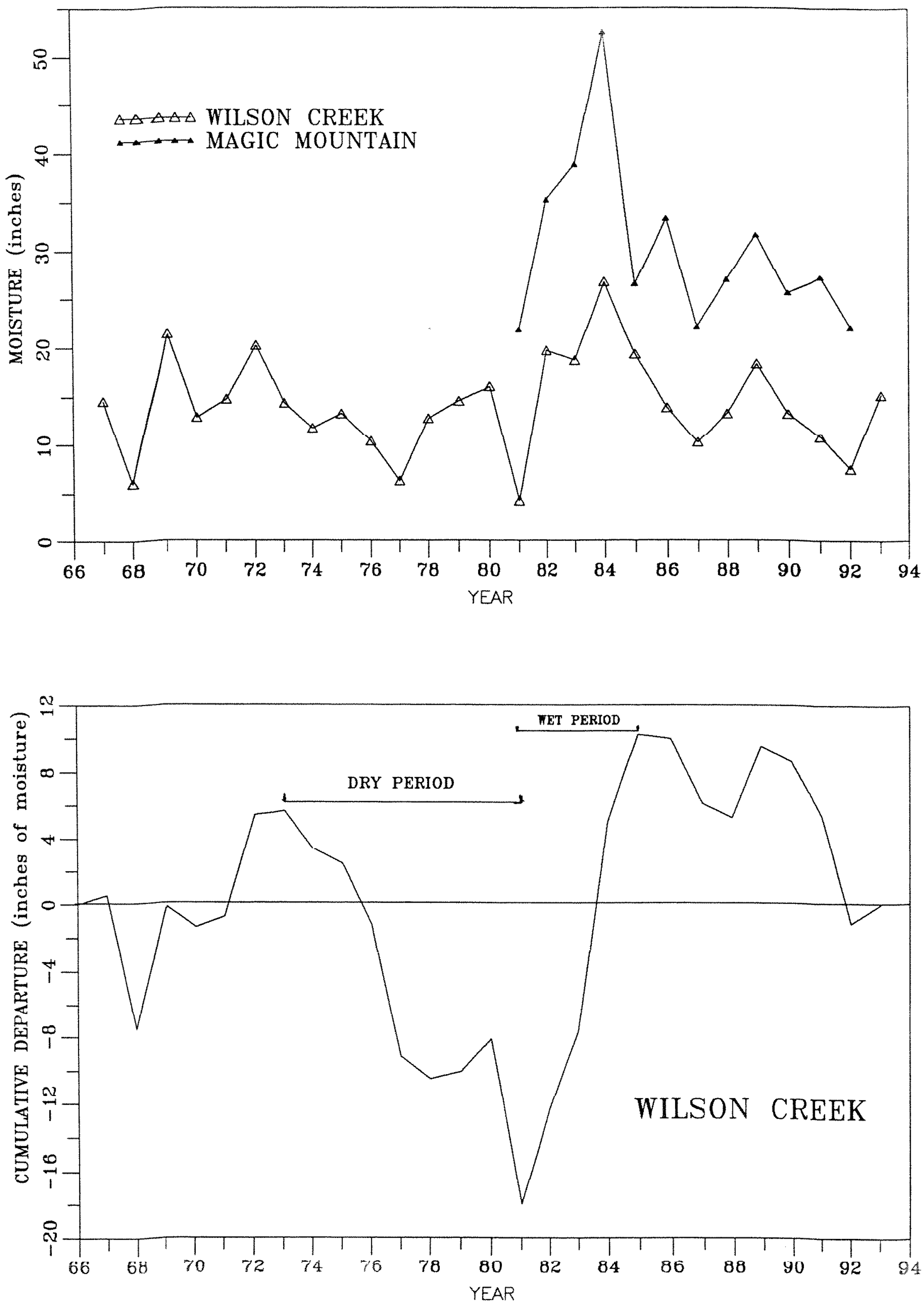


Figure 10. Precipitation Data

While Chapman and Ralston (1970) stated that recharge from direct precipitation was considered minimal to perched aquifers and non-existent to the deeper aquifers, no studies or data are available to confirm this. Their conclusions were based on the high evapotranspiration (ET) rate in the area which is reflective of the semi arid climate. During the spring though, ET rates are well below average and precipitation along with runoff from snow melt is above average. Creek or stream beds must in most of the area, have at some point in their drainage route washed or eroded down to fractured bedrock inducing leakance into the areas aquifers. Therefore direct precipitation could be a significant factor.

Assuming that 5 to as much as 20 percent of direct precipitation infiltrates via the ephermal streams and fracture zones in the area, then 10,000 to 35,000 acre feet per year is recharge. This is a significant amount and when combined with underflow entering the area from the south is the sole source of recharge to the area.

The Magic Water Corporation surface diversions are a source of recharge in the northeastern part of the area, but ground water flow is east into Salmon Falls Creek and the Snake River. Therefore this would be considered return flow and not a significant source of recharge.

Discharge in the area occurs by two mechanisms: pumpage for irrigation and underflow. Underflow leaves the area to the north to northwest and east into Salmon Falls Creek and the Snake River.

Discharge into Salmon Falls Creek was estimated by Chapman and Ralston (1970) at 7300 acre feet per year. Their estimate was based on the difference in water quality between Salmon Falls Creek and underflow entering the creek from the west and east. No current data are available to verify this estimate, but Figure 4 (page 9) does show a gradient into the creek.

Discharge from pumping has also been previously estimated. Ralston and Chapman (1970) estimated an annual pumpage rate of 26,500 acre feet. The estimate was based on water right files, field notes and questionnaires completed during their study, and an annual application rate of 3.5 acre feet per acre over 7,500 acres. While this acreage appears to be within reason, the application rate of 3.5 acre feet per acre per year is considered high. At the time Ralston and Chapman completed their report (1970) accurate data pertaining to agricultural consumptive use in the study area was not available. Allen and Brockway (1983) completed and published a study on consumptive use for crops grown in different areas throughout Idaho. One of the stations used was the Castleford area located adjacent to the Blue Gulch Area. Although data is limited on the exact amount and type of crops grown each year, a 1985 estimate was available for the Blue Gulch Area. The major crops listed in descending order were wheat and barley, alfalfa, beans, potatoes, corn, and pasture. It is noted that based on the economic viability of each of these crops, the percentage grown each year could change dramatically on a yearly basis, but over time it is the author's opinion that these are crops that have been grown in the Twin Falls area for many years and will probably be grown for many more. A weighted average of these crops was then used with data produced by Allen and Brockway (1983) to produce an overall consumptive use rate of 2.5 acre feet per acre per year. While more water must be applied then the consumptive use to prevent excessive salt accumulation in the soil, it is believed the consumptive use of 2.5 acre feet per acre is much closer to the true application rate than the estimate made by Ralston and Chapman (1970). Therefore, Ralston and Chapman's estimate of 26,500 (3.5 acre feet per acre over 7500 acres) acre feet per year is excessive and a value of 18,500 acre feet per year (2.5 acre feet per acre over 7500 acres) is probably more accurate.

Shaff (1979) made estimates of irrigated land in the Blue Gulch area for the years 1970 and 1977 based on areal photographs. His 1970 estimate was approximately 10,000 acres or 3,000 acres above Chapman and Ralston's estimate for the same year. It was assumed that Shaff's estimate included acreage that is irrigated with water diverted out of Salmon Falls Creek in the northeastern part of the area, while Chapman and Ralston's estimate did not. Shaff's 1977 estimate was 17,097 acres excluding any land irrigated with water diverted out of Salmon Falls Creek. It is assumed that the increase in irrigated acreage from 1970 to 1977 was under previously approved permits. Chapman and Ralston (1970) stated that 70 active permits and licenses were on file for appropriation of ground water for the irrigation of 29,140 acres. Therefore a 1977 estimate for ground water discharge by pumping would be 43,000 acre feet based on an consumptive use rate of 2.5 acre feet per acre. These estimates produce an approximate proportional 230 percent increase in total volume pumped from 1970 to 1977.

Based on phone conversations with several of the areas local farmers and an interview with Jim McCaughlin from the Agriculture Stabilization & Conservation Service (ASCS) Twin Falls office, it is estimated that approximately 20,000 acres had been developed for agriculture irrigation. Subtracting the approximate 3,000 acres irrigated from Salmon Falls Creek, produces approximately 17,000 acres of land once under ground water irrigation. This correlates well with a 1977 IDWR estimate of 17,097 acres.

In 1981, the government began programs encouraging farmers to take land out of grain production. No other crops were included. In 1986 ASCS began a new program called the Conservation Recovery Program (CRP). Farmers or landowners could submit a bid to take their land out of production for a minimum of 10 years based on 3 years production of any crop. Bids have ranged from $30 to $50 dollars per acre per year. A farmer can leave the program at any time, but must repay all monies collected from the previous year or years while in the CRP.

A sampling method was used to estimate the amount of land no longer irrigated. Criteria for the sample was the landowner must have ground water rights greater than or equal to 160 acres. Based on this criteria 26 water right claims from 11 different farmers or landowners were reviewed representing approximately 8,500 acres of land or roughly 40 percent of the land developed for irrigation by 1977. Approximately 80 percent of the sample acreage is now in the CRP. This was confirmed by Jim McCaughlin from the Twin Falls ASCS office and Dewayne McAndrew from the Boise U.S. Bureau of Reclamation (USBR) office. The majority had gone out of production in 1987 and 1988, but some not until 1993. Based on the fact that the landowner must repay all monies collected to leave the program before the 10 year obligation is over, it is unlikely that any of the 80 percent out of production will go back into production until the 1997 or 2003 period. It is also noted that more landowners may join the program in 1994 depending on farm economics and whether the program is extended.

The right to divert and use water is not forfeited by reason of not having used the water for 5 or more years if the land is in the CRP or other federal set aside programs. Holders of water rights will be able, under present Idaho Law, to recommence use of water on the withdrawn lands without further review or approval by the IDWR.

In summary, approximately 70 to 80 percent of the approximately 17,000 acres of land irrigated with well or ground water has been out of production since 1987/1988. This produces a proportional reduction in pumpage of the same magnitude. Therefore a dramatic decrease in the discharge of ground water has taken place in the Blue Gulch Area.

CONCLUSIONS

The Blue Gulch Area was in overdraft during the late 1960's and a majority of the 1970's. Causes for the overdraft were from pumpage associated with agricultural irrigation. Water levels in some wells dropped by as much as 30 feet.

In the early 1980's, the government began farm programs which encouraged farmers or landowners to take land out of production which previously grew wheat or other cereal crops. Ground water levels began to rise.

In 1986 the government began the Conservation Recovery Program (CRP) which encouraged landowners to take land out of production regardless of what crops were previously grown. Approximately 80 percent of land once irrigated with ground water in the Blue Gulch Area went out of production in the first two years. Ground water levels continued to rise even though the area was in a drought.

Currently, a minimum of 80 percent of once irrigated land is still out of production, with the earliest time in which some of the area could go back into production is 1997. Ground water levels are still rising and some wells have recovered as much as 40 feet, which is in excess of what some were drawn down in the late 1970's.

In conclusion, the area began recovering in the early 1980's and through the recent drought, and should continue into the foreseeable future.

RECOMMENDATIONS

Since ground water in the area has recovered to possibly pre-overdraft conditions, increasing the present monitoring program to quantitatively assess recharge and discharge is not an immediate priority. The present monitoring program, should, however continue. Information acquired will prove invaluable if and when more land is released from the CRP and ground water discharge through pumpage increases. Future decisions will be more precise and made with a greater degree of confidence.

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