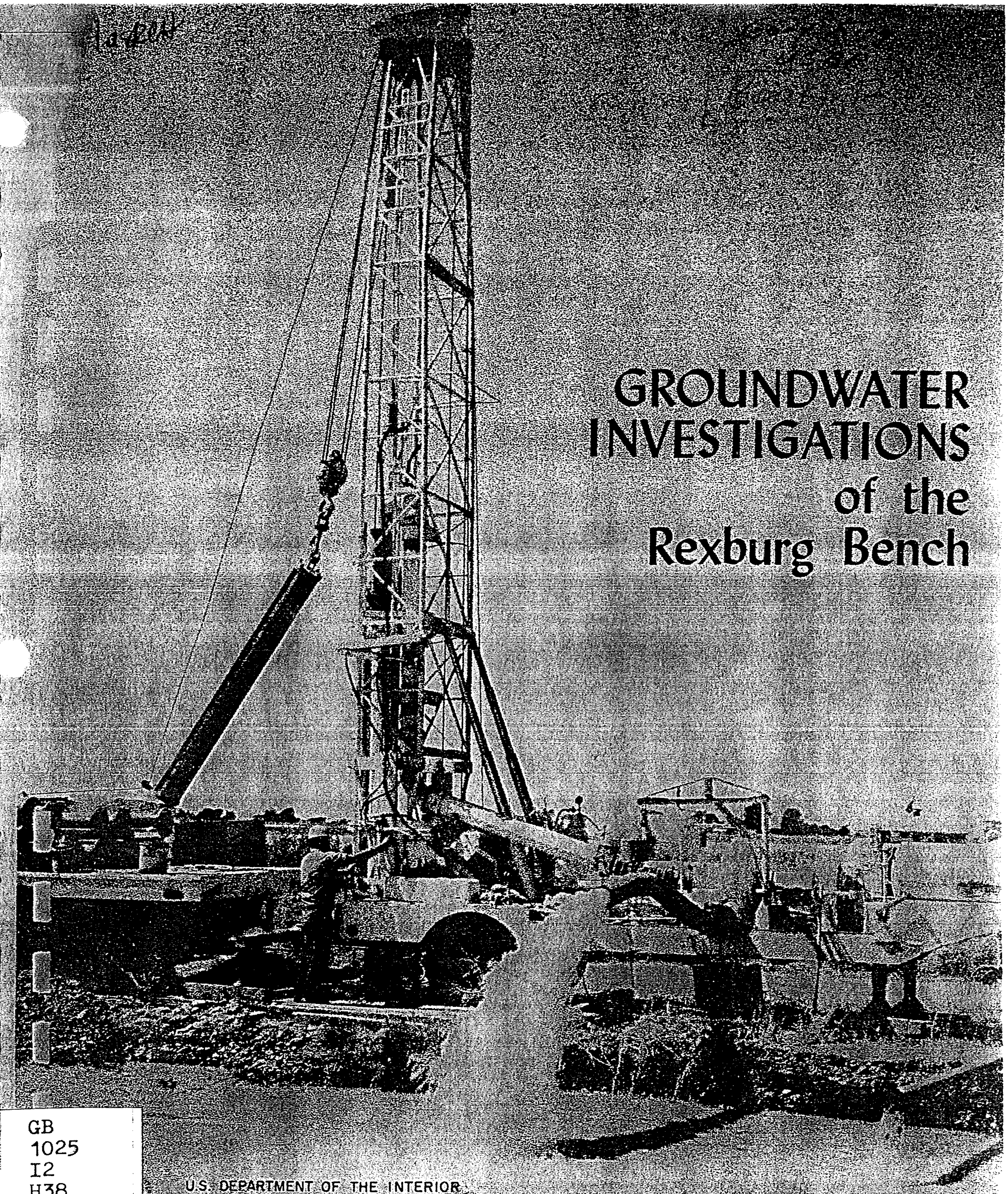

GROUNDWATER INVESTIGATIONS of the Rexburg Bench

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

GROUND-WATER GEOLOGY
OF
REXBURG BENCH

SECOND PHASE, LOWER TETON DIVISION
TETON BASIN PROJECT, IDAHO

By
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Department of the Interior
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Region I
Boise, Idaho

February 1972

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GROUNDWATER GEOLOGY
of
REXBURG BENCH, IDAHO

SETTING

Proposed development of the Teton Basin Project includes a plan for supplying irrigation water to a large part of the Rexburg Bench. Plans outlined in the Special Report, Lower Teton Division, March 1962, proposed delivery of reservoir water by canals to 39,000 acres. At that time, only a few irrigation wells were in production on the Bench. Project development of the Bench lands was considered on the premise that ground-water potential was limited. It was recognized, however, that if a stable economic supply of ground water were developed, other lands could be included in the service area.

By 1961, approximately 7,800 acres of Bench dry land had been converted to ground-water irrigation with an estimated annual pumpage of 16,000 acre-feet of water from 27 wells. Further expansion did not look promising; some wells failed to find adequate water; some pump lifts appeared to be borderline, economically; and it was estimated, on valid assumptions, that annual recharge to Rexburg Bench did not exceed 35,000 acre-feet. When pumpage reached this volume, a declining water table would result in excessive drilling depths and pump lifts.

Ground-water development continued at a steady pace. Annual pumpage in 1962 increased to 25,000 acre-feet and by the 1970 irrigation season, an estimated 40,000 acre-feet was pumped from 87 wells. There is no indication that withdrawals during the present wet cycle are causing a regional water table decline and the water table recovers rapidly following the pumping season.

A study of the Rexburg Bench was begun during the summer of 1970. Data were collected on surface and subsurface geology, well locations and yields, water levels during and after the pumping season, and the approximate distribution and amount of irrigated lands. Unfortunately, there are little historical data on behavior of the water table beneath Rexburg Bench. We are now systematically measuring levels in five wells on the Bench. Continuous recorders have been installed on two of the five. A mass measurement of all accessible wells is planned, before, during, and following the 1971 irrigation season.

LAND FORM

Rexburg Bench is part of a 15-mile wide rectangular structural block trending northwest between the Teton and Snake River Valleys.

Higher elevations of the southeast part of the block comprise the Big Hole Mountains. A broad low-relief apron extends northwest from the mountains to the margin of the Snake River Plain. The apron slopes northwest from an elevation of about 6500 feet at the base of the mountains to about 5,000 feet at its outer margin, near Rexburg. A segment of the block extending from the Snake River Valley near Byrne (T. 4 N., R. 40 E.), north to Teton Damsite on the Teton River and lying generally west of Moody Creek is called the Rexburg Bench.

Most of the land surface of the Bench consists of undulating topography with occasional short steep slopes. A few scattered volcanic cones, partially soil covered, rise above the bench surface. The land surface has a prominent northeast grain formed by strong prevailing winds. A few scattered closed depressions of unknown origin, some up to 1,500 feet in diameter, are present.

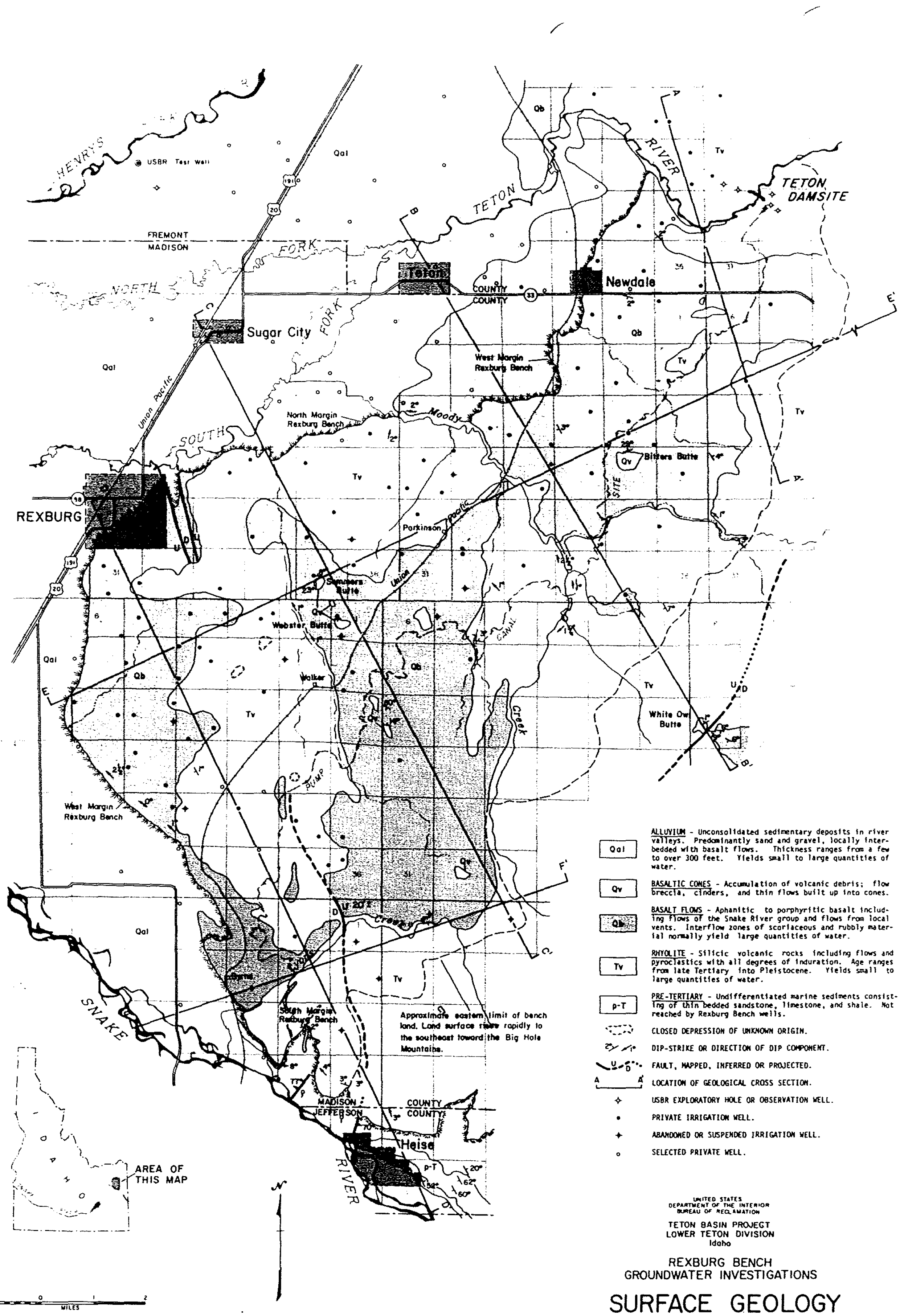
SURFACE GEOLOGY

The soil layer consists of loess ranging from less than 1 up to 40 feet and averaging 6 feet in thickness. Bedrock of rhyolite or basalt crops out in many places along the slopes of major drainage valleys, on the scarp which bounds the bench area, on some steep slopes, and in scattered volcanic cones. The mapped segment of the structural block has been gently tilted. The surface and shallow underlying layers dip 1 to 2° toward the northwest. Bedrock geology is shown on Map No. 549-100-50, Surface Geology, Rexburg Bench.

Faulting

Several faults which are apparent on the Bench surface are shown on the above map. On the east outskirts of Rexburg two near parallel faults form a prominent topographic slot trending about N. 16° W. The faults die out toward the south and are concealed by alluvium north of the Bench margin. Displacement of the block at the north edge of the Bench is about 50 feet.

In the southern part of the Bench, a fault crossing Sec. 1, T. 4 N., R. 40 E., trends about N. 17° W. On the north rim of Lyons Creek Canyon a basalt flow is displaced approximately 20 feet, downthrown to the west. North and south of that point the fault is inferred along a low but continuous topographic scarp.



UNITED STATES
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TETON BASIN PROJECT
LOWER TETON DIVISION
Idaho

REXBURG BENCH
GROUNDWATER INVESTIGATIONS

SURFACE GEOLOGY

AUGUST 1971 549-100-50

Two fault zones are shown on the southwest face of the Bench above the Snake River Valley. In Sec. 25, T. 4 N., R. 40 E., a 10-foot zone of sheared and altered rock trends N. 5° E. In Sec. 23 a major fault zone of over 100 feet of sheared and altered rock containing gouge seams trends N. 32° E. This fault probably accounts for the emergence of Elkhorn Spring. Neither of these faults can be traced northward onto the Bench surface and may represent older faulting, concealed under younger volcanic deposits.

A fault is shown near the east edge of the mapped area trending about N. 32° E. through the northwest corner of T. 5 N., R. 42 E. At White Owl Butte in Sec. 18, a basalt flow which caps the Butte is found approximately 70 feet lower, east of the fault. This fault is inferred to tie with suspected faulting noted in Sec. 32, T. 6 N., R. 42 E., three miles northeast of White Owl Butte.

Stratigraphy

Bedrock outcrops are shown on Map No. 549-100-50. The four different bedrock types shown; pre-Tertiary sediments, rhyolite, basalt, and volcanic vent debris are tentatively subdivided into seven rock units or time events. The seven, beginning with the oldest unit are:

1. Pre-Tertiary sediments - a small patch of steeply dipping marine sediments outcrop near the south edge of the mapped area, in the vicinity of Heise. This unit is not exposed on the Bench but presumably underlies the entire area, below the depth reached in the deepest well. Wells drilled to over 1,400 feet deep have not encountered pre-Tertiary rocks.

2. Rhyolite - consists of massive to slabby outcrops of predominately gray and brown tuff, lightly welded to well indurated. Rhyolite makes up about 35% of the bedrock surface.

3. Basalt (Snake River Group) - a succession of typical Snake River Basalt flows lap onto the west and southwest edges of the Bench with a maximum thickness of about 500 feet in the vicinity of Rexburg. See Cross Section D-D'. In the subsurface, these flows appear to merge or interfinger with those from vents on the Bench - as shown on Cross Section E-E'. (Drawing No. 549-100-55).

4. Basalt (Summers - Webster Butte Vents) - local eruptions from a northwest trending line of vents located four to ten miles east to southeast of Rexburg. Thin flows of black vesicular basalt spread radially from each of the five mapped vents. The more recent

flows influenced the drainage pattern on the Bench, diverting Moody Creek northward and Lyons Creek to the west. Flows from these vents were found along the rims of many canyons but not within.

5. Rhyolite tuff - a 10- to 150-foot layer of semi-indurated tuff mantles much of the bench area. The tuff rests on Snake River Basalts, on other rhyolite, and on all except the most recent basalt flows from local vents. Where this tuff rests on other rhyolite, it has not been separately identified. This unit is considerably younger than the rhyolite discussed under Unit No. 2.

6. Basalt flows (Bitters Butte vent) - thin flows of blocky black basalt cover a large area in the vicinity of Newdale. Early flows in that area, presumably from Bitters Butte are about the same age as some flows from Summers-Webster Buttes. The older flows from Bitters Butte vent influenced the course of the downstream part of Moody Creek and a part of the Teton River below the damsite. Later eruptions produced flows which invaded the bottoms of established drainage channels such as Moody Creek, Teton River and Long Hollow.

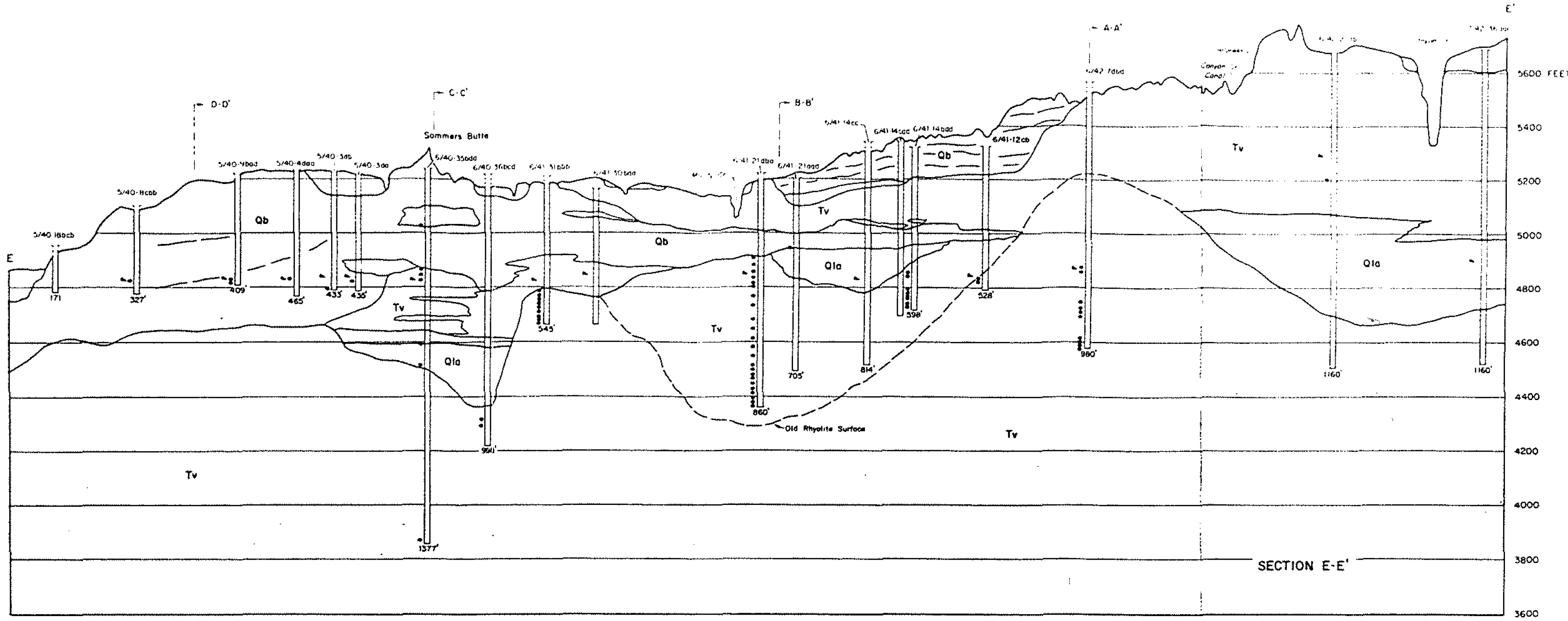
7. Volcanic cones - red cinders, scoria and flow breccia, built up in cones which rise a few feet to over 100 feet above the Bench surface, are evidence of the most recent volcanic activity.

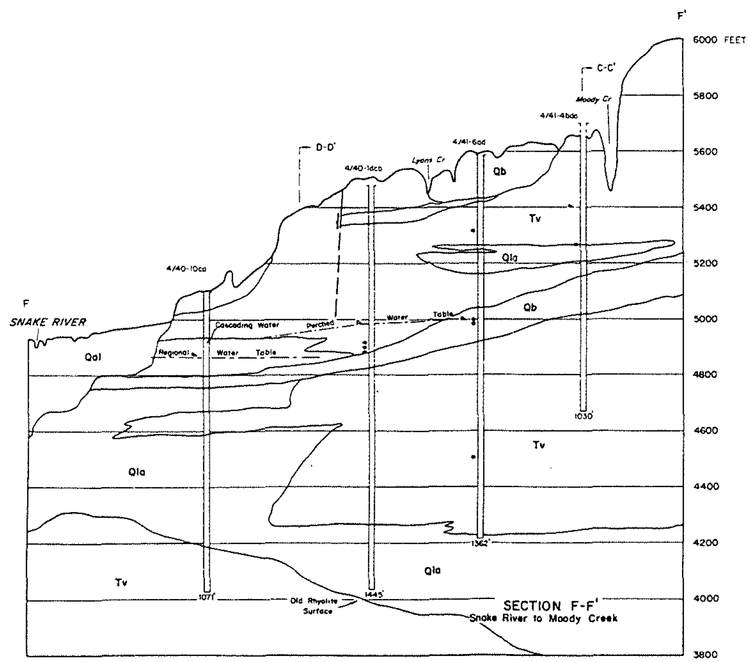
SUBSURFACE GEOLOGY AND GROUND WATER

An inspection of the five geological cross sections (Drawings Nos. 549-100-54 and 55) shows that the subsurface geology of Rexburg Bench is unusually complex. Surface geology may or may not indicate subsurface conditions which lie beneath any particular drill site.

A geological interpretation of the subsurface is shown on Map No. 549-100-51, and on six geological cross sections, A-A' through F-F'. Interpretations are based on surface geology plus data from drillers logs of over 100 wells drilled on the bench. Caution must be used in interpreting the drillers logs. Rhyolite tuffs and flows may be variously logged as rock and clay, shale, "Red Mountain" rock, sandstone, limestone, granite, or just plain rock. Basalt, being more familiar to the drillers, is usually logged correctly. A reasonable geological interpretation can be made only when a sufficient number of logs of adjacent wells are correlated.

Geophysical logs which have recently been run of three accessible wells, are extremely valuable in differentiating the various rock units. A few additional wells should be logged when they become available.





Qal	ALLUVIUM
Qb	BASALT FLOWS
Tv	RHYOLITE
Qla	LAKE AND STREAM DEPOSITS
●	WATER BEARING, REPORTED
▷	PERCHED WATER TABLE, REPORTED DURING DRILLING
◣	WATER LEVEL, REPORTED OR MEASURED

UNITED STATES
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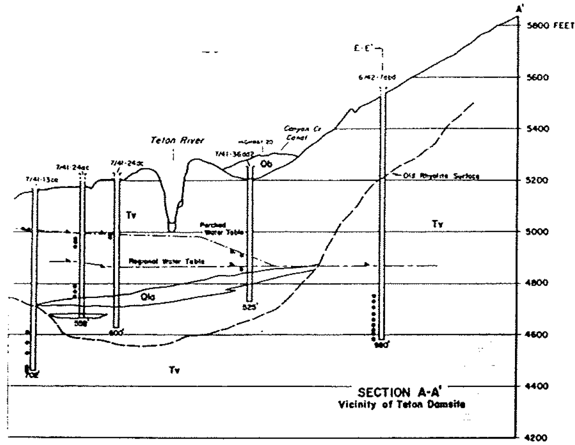
TETON BASIN PROJECT
LOWER TETON DIVISION
Idaho

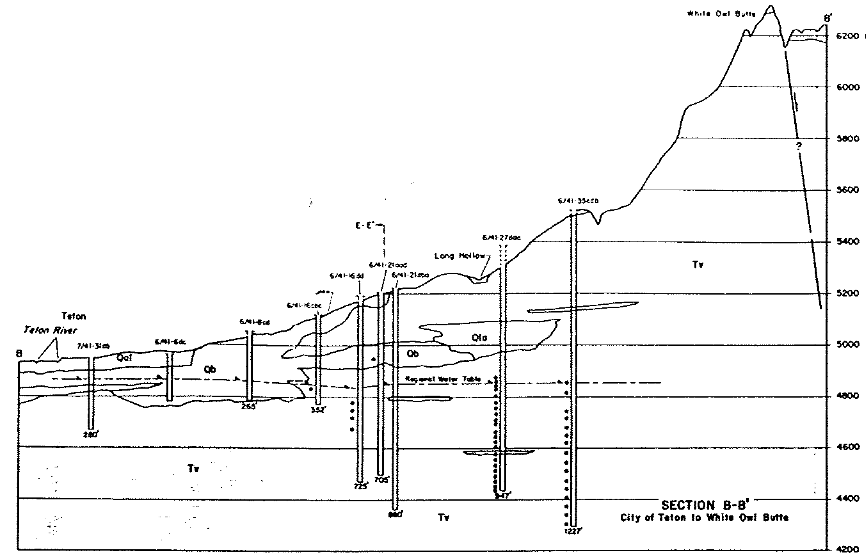
REXBURG BENCH
GROUNDWATER INVESTIGATIONS

GEOLOGIC CROSS SECTIONS

OCTOBER, 1971

549-100-55





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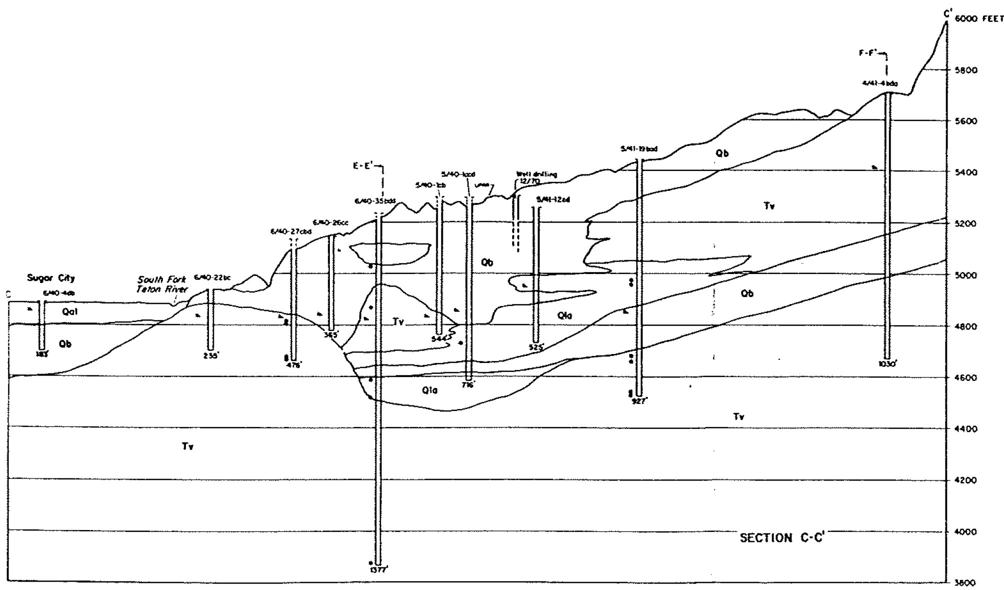
LOWER TETON DIVISION
Idaho

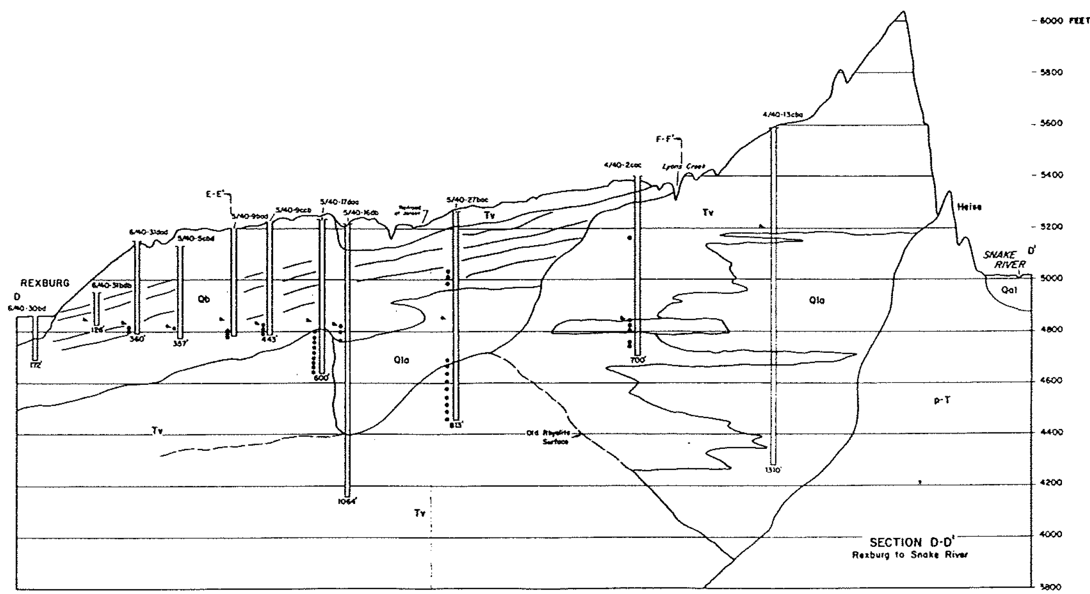
REXBURG BENCH
GROUNDWATER INVESTIGATIONS

GEOLOGIC CROSS SECTIONS

Qal	ALLUVIUM
Qb	BASALT FLOWS
Tv	RHYOLITE
Qla	LAKE AND STREAM DEPOSITS
p-T	PRE-TERTIARY

- ● WATER BEARING, REPORTED
- ▷ PERCHED WATER TABLE, REPORTED DURING DRILLING
- ◣ WATER LEVEL, REPORTED OR MEASURED





OCTOBER, 1971

549-100-

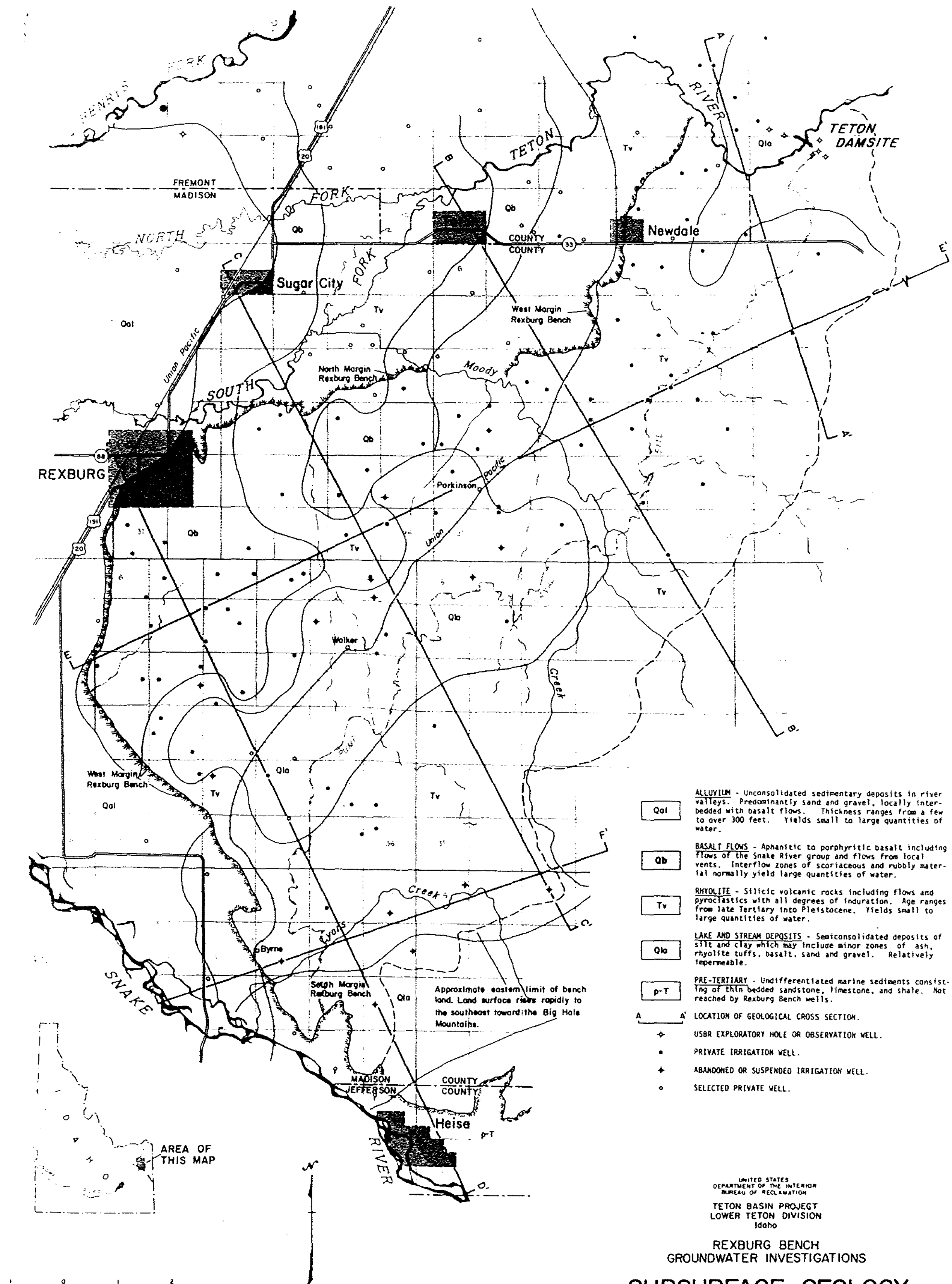
Map No. 549-100-51 displays geological conditions which control ground-water production. The map is a plan geology map at elevation 4800, as though the Bench were planed away to this level. The regional water table under the Bench is approximately 40 to 100 feet above the plane of the map.

The 4800-elevation map suggests a northeast trending pattern of ridges and troughs developed on an old rhyolite surface. Subsequently, the troughs were filled by basalt flows, rhyolite tuffs and clay. The trend of the ridges and troughs is transverse to the regional northwest structural trend and may have been formed by faulting now concealed beneath younger deposits. The abrupt changes in section encountered between wells, drilled less than a mile apart, are indicative of faulting. Note the rapid changes shown on Cross Section D-D' between Wells No. 5N/40E-17daa and No. 5N/40E-16db and on Cross Section E-E' between Wells No. 6N/40E-36bcd and No. 6N/41E-31bbb. (Drawing Nos. 549-100-54 and 55).

Map No. 549-100-51 shows the general distribution of the various rock units: The effective eastern limit of Snake River basalts which lap onto the bench near Rexburg; a basalt filled trough trending north toward the village of Teton; and limits of three clay bodies.

Cross Section E-E' displays the rapid changes in geology which occur from one well to another. Although the elevation of the regional water table changes very little across the bench, drilling depths to penetrate saturated productive rock may range from 200 to over 1200 feet. Wells near Rexburg, the west end of Section E-E', obtain good yields from basalt at 200- 450-foot depths; wells which encounter rhyolite below the water table usually obtain fair production by drilling 500 - 900 feet; wells which encounter the clay fill must be drilled through the clay and into saturated rock beneath, occasionally drilling to over 1200 feet to obtain an adequate supply. Wells located in the basalt tongue which trends northeast from Section 26, T. 5 N., R. 40 E., are excellent producers.

On most of the cross sections, an older rhyolite is shown in some of the wells. The older rhyolite cannot be consistently determined from drillers logs. From drillers descriptions and inspection of a few sample fragments the rock has a predominate reddish cast and tends to be hard and flinty, generally more indurated than rhyolite seen in surface outcrops. This rock apparently forms an old surface. Depressions on this surface were filled by basalt flows, rhyolite tuffs and clays.



UNITED STATES
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BUREAU OF RECLAMATION

TETON BASIN PROJECT
LOWER TETON DIVISION
Idaho

REXBURG BENCH
GROUNDWATER INVESTIGATIONS

SUBSURFACE GEOLOGY
ELEVATION 4800' DATUM

AUGUST 1971 549-100-51

Each of the three major clay areas supports a perched water table whose surface is 100 feet or more above the regional water table. In the clay area near the center of the map there are several shallow wells which obtain a domestic supply from the perched water. Deep irrigation wells which are completed open hole, also tap the perched water.

In the clay area near the south edge of the map the perched aquifer supplies flows issuing at Elkhorn Spring, Sec. 23 and Hawley Spring, Sec. 25, T. 4 N., R. 40 E. Cascading water from above the clay zone occurs in Well No. 4N/40E-10cad.

The clay area centered at Teton Damsite supports a well defined perched water body. Several irrigation wells both north and south of the river obtain an inadequate supply from the perched aquifer. Water levels in scattered wells north and south of the Teton River and east of the mapped area indicate that the perched condition may extend east including most if not all of the proposed reservoir site. Geological conditions in the reservoir area may have considerable significance. Data presently available suggest that at least two hydrogeological conditions may be favorable in regard to reservoir location and leakage. The proposed reservoir appears to be located in a perched aquifer whose water table is tributary to the present stream; in effect limiting the lateral extent of any leakage movement. Permeability tests run in USBR drill holes and the poor yields obtained from private wells near the damsite and to the east, indicate that the rhyolite above the clay is by far the least permeable aquifer in the immediate area.

THE AQUIFERS

Although the various rock types which surround or extend beneath the clay pods act as a common reservoir, the performance of wells varies considerably in different rocks. Table No. 1 is a summary of well performance data showing what can be expected of a typical well in the various rock types. Table No. 2 is a more complete record of available data for 53 wells.

TABLE NO. 1

	Basalt	Rhyolite (Normal)	Rhyolite (Newdale area)	Perched Aquifer (Teton Damsite)
Transmissivity (gpd/ft) 1/	800,000	51,000	no data	4,400
Production per ft. of penetration (gpm/ft)	46	10	40 2/	4
Est. penetration of saturated rock required for 4 cfs well (ft)	50	220	55	450 3/
Est. drawdown for 4 cfs well (ft)	16	60	no data	215 3/

1/ An approximation of transmissivity based on specific capacity. The value shown for the perched aquifer, Teton Damsite, was computed from extended pump-in tests in USBR drill holes.

2/ Several wells in the vicinity of Newdale have unusually high specific capacities for rhyolite. The wells produce hot water. The coincidence may indicate local faulting and associated fracturing.

3/ In the mapped area there is only about 200 feet of saturated rhyolite above the clay zone, limiting production to 1 or 2 cfs.

Basalt

The basalt aquifer is composed of the usual layered sequence of thin flows reaching an aggregate thickness of about 500 feet in the vicinity of Rexburg. Only about 300 feet is below the water table. The basalt rests on a rhyolite surface which rises to the east and southeast wedging out the saturated basalt aquifer. The effective extent of the basalt aquifer is shown on Map No. 549-100-51 and on the various cross sections. A typical basalt flow consists of an upper vesicular to scoriaceous, rubbly or cindery surface, a lower surface which may be vesicular and a dense internal mass that is generally jointed. Productivity of wells in basalt is primarily related to the number of interflow zones open to the well. A typical basalt well on Rexburg Bench produces 2,120 gpm from less than 50 feet of saturated rock. In 14 of the 28 basalt wells on the Bench, for which we have data, yields range from 925 to 3,500 gpm from a penetration of saturated aquifer of 23 to 91 feet.

TABLE NO. 2

SUMMARY OF WELL PERFORMANCE DATA - REXBURG BENCH

Well Number	Depth (Ft)	Diameter (In)	Aquifer 1/	Static Water Level (Ft)	Source of Test Data 2/	Yield (gpm)	Specific Capacity (gpm/ft)	Net Penetration in Saturated Aquifer (Ft)	Production /ft. of Penetration (gpm/ft)
4N/40E-2ca	700	--	R	550	T	1800	--	150	12
5N/40E-3da	435	20	B	391	T	1600	64	36	45
-3db	433	20	B	390	T	2600	1300	43	60
-4ca	425	16	B?	380	T	2500	83	45	56
-6dd	330	20	B	272	T	3500	175	58	60
-9ac	438	16	B	397	P	2800	--	41	68
-9ba	409	12	B	386	T	1500	--	23	65
-16cc	672	16	R	346	P	3200	--	263	12
-17cb	325	--	B	280	P	1700	670	45	38
-18da	300	16	B	248	GS	2500	500	52	48
-18bc	172	--	B	125	P	1720	--	47	37
-20bc	657	16	R	288	T	1300	21	299	4.3
-25cc	783	--	R	585	T	2200	22	198	11
-26dc	910	--	R	555	T	2200	--	355	6.2
-29aa	670	16	R	232	T	2410	86	303	8
-35ad	1069	--	R	628	GS	3000	50	435	6.9
-36ba	1332	20	R	600	T	2200	22	532	4.1
5N/41E-5bc	1003	--	R	453	T	3000	--	450	6.7
-8ab	845	--	R	460	P	2500	--	205	12
-19ba	927	--	R	595	P	3000	60	332	9
6N/40E-23bb	249	16	B	158	?	2400	2000	91	26
-26aa	330	19	B	270	?	1680	2000	60	28
-29cc	363	16	B	285	GS	1700	--	78	22
-31bd	126	14	B	101	GS	925	--	25	37
-33cd	440	--	B	390	T	2650	--	50	53
-35bd	1377	--	R	412	T	2400	27	790	3.0

TABLE NO. 2 (Cont'd)

Well Number	Depth (Ft)	Diameter (In)	Aquifer 1/	Static Water Level (Ft)	Source of Test Data 2/	Yield (gpm)	Specific Capacity (gpm/ft)	Net Penetration in Saturated Aquifer (Ft)	Production /ft. of Penetration (gpm/ft)
6N/41E-1bb	740	18	R	280	GS	900	--	363	2.5
-3ad	260	--	R ?	230	BR	1100	--	30	38 *
-12cb	528	18	R	474	BR	1600	--	54	30
-14bd	598	16	R	450	T	2700	54	133	20
-16cb	471	12	R	268	BR	2200	150	203	11
-19dd	402	--	R	245	T,P	2300	35	157	15
-20bb	393	18	R	247	Log	3500	--	146	24
-21dc	860	12	R	360	T	2400	33	472	5.1
-25bc	895	--	R	525	T	1750	20	370	4.7
-32ba	803	--	R	385	T,P	3100	12	340	9.1
-33bd	920	14	R	420	Log	3200	--	475	6.7
-35cd	1227	20	R	665	T	2175	23	562	3.9
6N/42E-7db	980	--	R	695	Log	3600	--	285	12.5
7N/41E-13ca	702	18	R	158	Log	1120	--	465	2.4
-15aa	452	--	R	67	T	2000	--	385	5.2
-24ac	559	--	R	320	GS	1200	15	200	6
-24dc	600	--	R	367	GS	1100	11	188	58
-25ca	290	--	R	258	T	1800	900 ?	32	56 *
-26dd	283	16	R	225	T	1800	120 ?	58	31 *
-34ad	275	14	R	249	Log	900	--	26	35 *
-34dc	280	--	R	210	T	750	--	70	10.7
-35db	420	16	R	300	BR	1100	--	120	9.2
-36dd	635	--	R	337	T	1320	49	298	4.4

TABLE NO. 2 (Cont'd)

Well Number	Depth (ft)	Diameter (in)	Aquifer 1/	Static Water Level (ft)	Source of Test Data 2/	Yield (gpm)	Specific Capacity (gpm/ft)	Net Penetration in Saturated Aquifer (ft)	Production /ft. of Penetration (gpm/ft)
7N/42E-6ca	835	--	R	225	GS	540	3	610	0.9
-6dd	910	12	R	272	GS	250	1	--	--
					BR	3000	--	638	4.7
-8ca	802	--	R	339	GS	180	2	--	--
					BR	1500	--	463	3.2
-19ca	635	20	R	357	BR	440	5	178	2.5

1/ R = Rhyolite aquifer
B = Basalt aquifer

2/ T = Data from pump testing company
P = Capacity as designed by pump supplier
GS = Data from USGS files, various sources
BR = Data from USBR records, various sources

* Unusually high capacity wells in rhyolite in vicinity of Newdale; coincides with hot water area; possible faulted, fractured rock.

Rhyolite (normal)

Fifty-eight irrigation wells on the Bench produce from the regional water body in rhyolite. For the 29 wells for which we have some data, yields range from 800 to 3600 gpm. A typical rhyolite well produces 2230 gpm from 220 feet of saturated rock.

The rhyolite aquifer which underlies most of Rexburg Bench produces greater volumes of water than is usually obtained from rhyolite wells drilled elsewhere about the Snake Plain. Many rhyolite wells on Rexburg Bench yield from 4 to 8 cfs. Specific capacity values can be greater than for some of the poorer basalt wells. The silicic rocks do exhibit a far more variable permeability. Rhyolite core from exploratory drill holes at Teton Damsite, random drill holes in the Henrys Fork Valley and rhyolite in most surface outcrops is typically dense rock but generally jointed. There must be other variations in the character of the rhyolite to explain the higher permeabilities.

It is suspected that some fragmental tuffs, less indurated than others may form layers of better permeability. In a surface outcrop, in Sec. 31, T. 4 N., R. 41 E., near the south edge of the map, there is a 50-foot zone of fragmental rhyolite tuff that has excellent permeability. Similar zones may extend under the Bench; drillers often report water inflows from specific zones variously reported as sand, cinder or loose rock.

Rhyolite (Newdale Area)

An unusually high yield is obtained from a few rhyolite wells in the Newdale area. Three wells for which data are available, listed in Table No. 2, produce 900 - 1800 gpm from less than 60 feet of saturated rock. A production rate of 40 gpm per foot of penetration is four times that of the usual rhyolite and approaches the value for basalt wells. The coincidence of hot water in this area suggests that the increased permeability may be associated with faulting.

Rhyolite (Perched Aquifer - Teton Damsite Area)

All of the wells shown on Map No. 549-100-51 within the perched aquifer are relatively poor producers. The rock is much less permeable than the rhyolite underlying most of the Rexburg Bench. Well yields are further limited by the available thickness of saturated rhyolite above the perching clay. The average production rate is 4 gpm per foot of penetration, less than one-half the rate for normal Rexburg Bench rhyolite. Wells yield 250 to 1500 gpm with large drawdowns.

GROUND WATER

Map No. 549-100-53 is a contour map of the water table. Water table elevations are from measurements taken by USBR and USGS personnel, from drillers reports, and from pump company records. Where available, the levels are for the fall season, 1970.

Although the water level contour map includes considerable unconfirmed data, drillers reports, logs, etc., it is believed to be basically correct. Additional data which will be obtained during the current year may modify but not greatly change the presented interpretation.

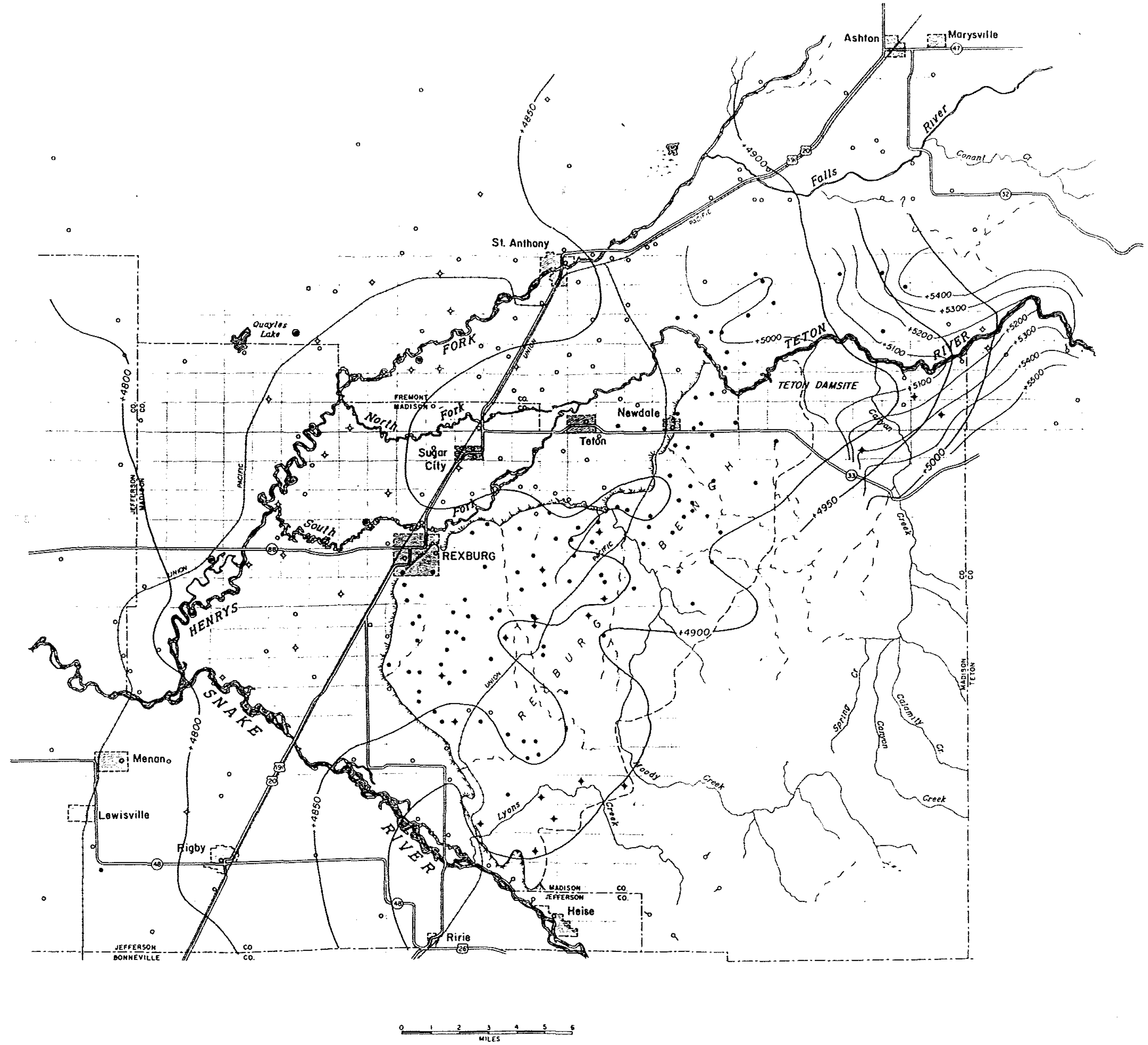
Regionally, the ground-water gradient is in a general west-southwest direction as it is across much of the Snake River Plain. Locally, under the Rexburg Bench the slope is to the northwest at approximately 5-1/2 feet per mile.

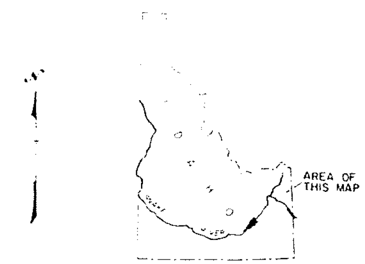
An estimate of annual recharge to the Bench area was made by E. G. Crosthwaite and others in an open file report prepared for the USGS in 1967. It was estimated that maximum recharge from precipitation was 35,000 acre-feet per year. The current annual pumpage is calculated to be 40,000 acre-feet without any apparent decline of the water table. An inspection of the contoured water table map suggests two or three possible sources of additional inflow.

At the extreme north end of the Bench, in the vicinity of Newdale, some water lost from the Teton River reaches the regional water body. Gaging data by the USBR show that the Teton River has no loss in 8- or 10-mile reach above the damsite, but loses up to 50 cfs in the 5-mile reach downstream. The local gradient shows that some of this inflow may reach a few of the northernmost wells.

A second possibility is suggested by the anamolous north and north west directed gradient. Much of the flow of the regional water under Rexburg Bench is from the south and southeast. It would appear that a reach of the Snake River in the vicinity of Heise loses water to the valley alluvium which is in contact with basalts and rhyolite extending under the Bench.

A third possible source is from the alluvium of the Henrys Fork Valley. During the pumping season on the Bench the water table is locally pulled down 6 to 12 feet effecting a potential gradient reversal along the west margin of the Bench. This could allow great quantities of water to move eastward from the saturated alluvium of the Henrys Fork Valley to Rexburg Bench aquifers.





+5000 WATER TABLE CONTOURS

+5100 PERCHED WATER TABLE CONTOURS

AREAS OF PERCHED WATER TABLE

◉ USBR TEST WELL

✧ USBR EXPLORATORY HOLE OR OBSERVATION WELL

• PRIVATE IRRIGATION WELL

✦ ABANDONED OR SUSPENDED IRRIGATION WELL

○ SELECTED PRIVATE WELL

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

TETON BASIN PROJECT
LOWER TETON DIVISION
Idaho

REXBURG BENCH
GROUNDWATER INVESTIGATIONS

WATER TABLE CONTOURS

NOVEMBER, 1971

549-100-53

The temperature range of waters from the many irrigation wells and scattered spring flows might provide clues to ground water occurrence and movement. A check of water from a few scattered wells and springs shows temperature ranging from 50° to over 118°F. A complete temperature survey of all pumping wells will be run during the 1971 season.

A historic record of the ground-water behavior is lacking. USGS personnel have maintained records on a few wells from their completion in about 1960. A mass measurement of water levels which was made by the USBR in 1967 included a few wells on the Bench. During 1970, water level measurements were made in 16 wells during and following the pumping season.

Hydrographs for three wells are shown on Figure No. 1. One is for an abandoned well, No. 5N/40E-11bc, near the center of the Bench, which was monitored from 1961 until plugged and abandoned in 1967; two are from irrigation wells north of Teton Damsite.

Hydrographs for Wells Nos. 7N/42E-6dbc1 and 7N/42E-8caa1 show a slight general decline of the perched water table over the period of record. It would appear that local pumpage is exceeding recharge of the perched aquifer.

Most wells on the Snake Plain show a rise in the water table surface beginning in the early 1960's which correlates with a general increase in precipitation. Figure No. 2 is a 21-year plot of departure-from-normal precipitation at the St. Anthony station. The curve shows an overall positive gain beginning about 1961. The hydrograph for Well No. 5N/40E-11bc1, near the center of Rexburg Bench, shows a responsive rise of the regional water body for its short period of record (1961-67). The rise occurred even though pumpage on the Bench was increasing rapidly during these years.

It should be recognized that behavior of the water table apparent in 1970 might be different during periods of lesser precipitation. It is imperative that a continuing observation program be maintained. When a definite plan report is prepared, the ground-water situation should be re-examined.

IRRIGATION WELLS

There have been 100 large diameter irrigation supply wells drilled on Rexburg Bench. Thirteen have been suspended or abandoned because of inadequate water. Three new wells were being drilled or were in various stages of completion during the 1970-1971 winter season. There are six small diameter domestic wells which yield water from perched aquifers.

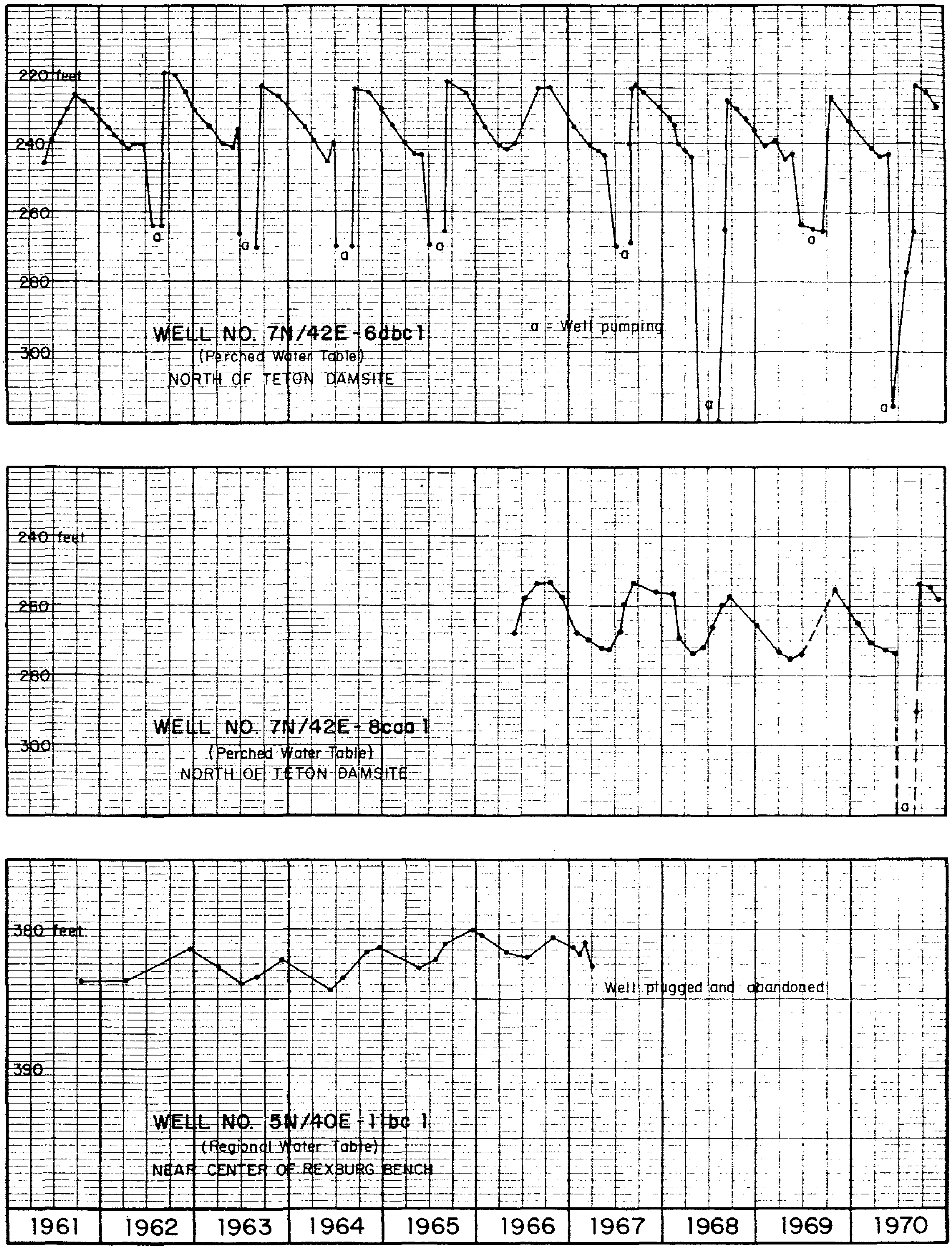


FIGURE 1 Hydrographs, Rexburg Bench Wells

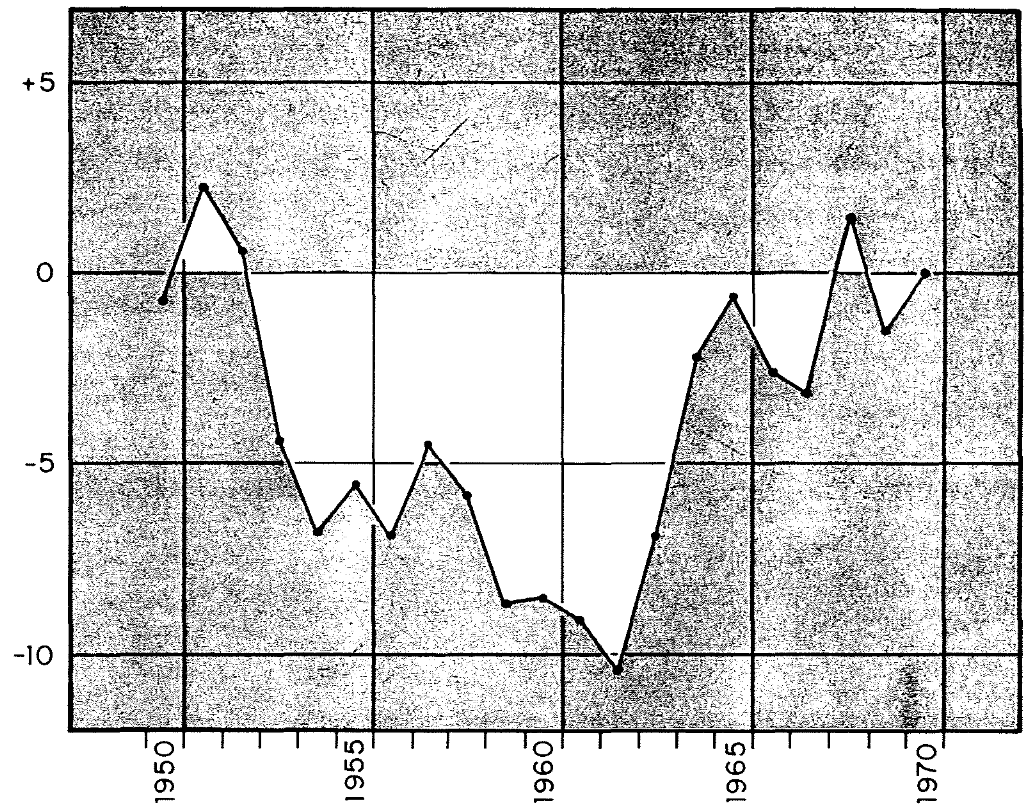
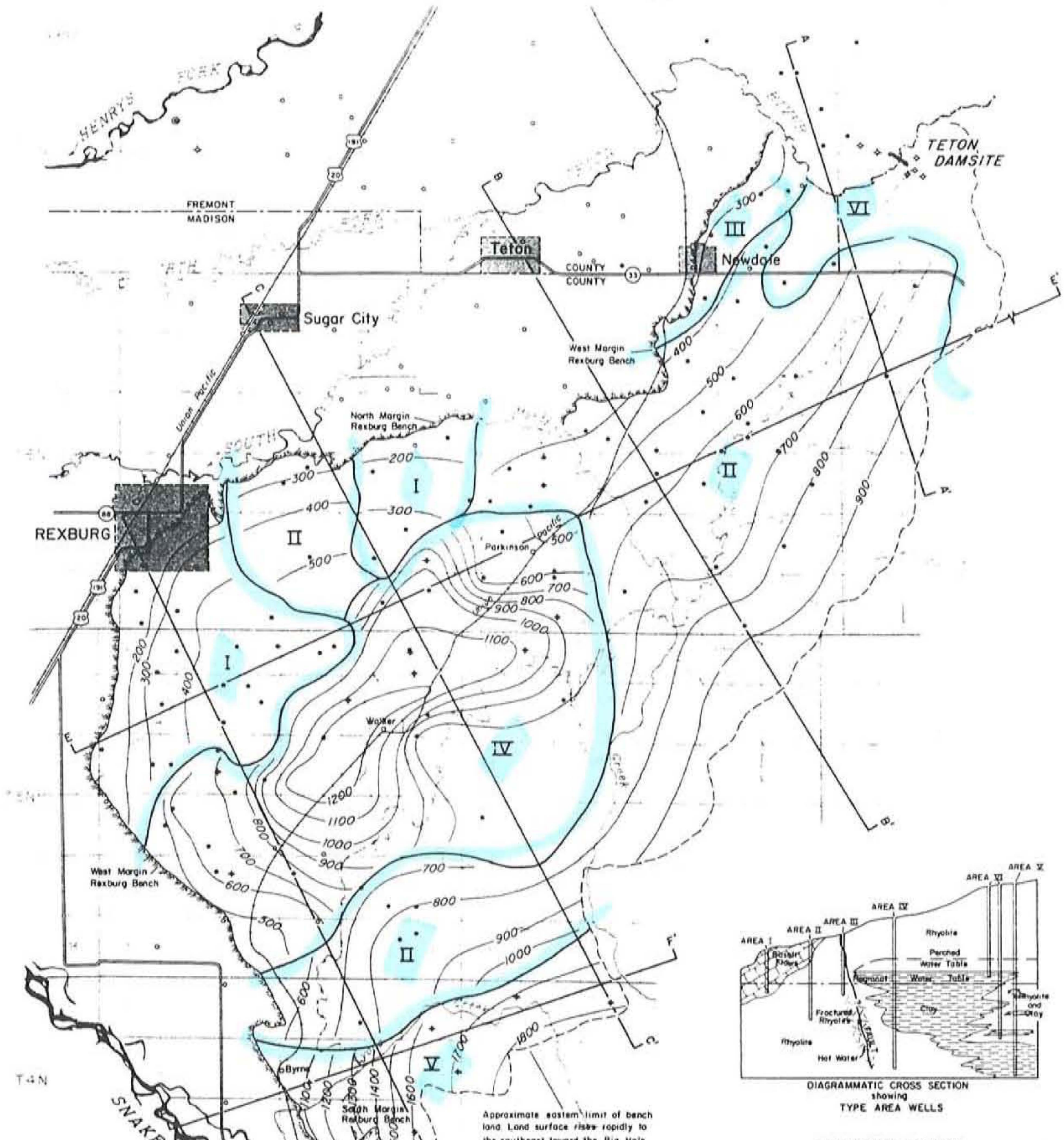


FIGURE 2 Cumulative departure from normal precipitation at St Anthony, Idaho.

A typical irrigation well is drilled, starting with a 20-inch hole at the surface then reducing to 16-inch by total depth. The wells are normally cased only into solid rock unless a clay section is encountered. Then an intermediate casing may be set through the clay. A typical well is completed with a 10-inch pump column and 14-inch bowls. The pumps are powered with 100 to 700 horsepower electric motors. Many well installations utilize booster pumps to supply sprinkler pressure.

Most of the suspended or abandoned irrigation wells are associated with areas of clay. In some cases, more recent wells have been successfully completed nearby, by drilling through the clay and penetrating rhyolite beneath. The following is a resume of the thirteen failures:



ESTIMATED VALUES FOR AQUIFERS

Area No.	Aquifer	Yield/foot of penetration	Penetration saturated rock for 4 c.f.s.
I	Basalt	46 gpm	30 ft.
II	Rhyolite	10	220
III	Rhyolite	40	55
IV	Rhyolite	10	220
V	Rhyolite & Clay	Inadequate	Wells abandoned
VI	Rhyolite (above clay)	4	450
	Rhyolite (below clay)	<4	not obtained by existing wells

600 — Contour of estimated drilling depth for a 4 c.f.s. well based on above values.

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ESTIMATED DRILLING DEPTH
FOR 4 CFS YIELD

AUGUST 1971

549-100-52

Well Number	Total Depth (Ft)	Remarks
4N/40E-1dcb	1445	Drilled clay with thin zones of tight rhyolite
-12daa	1185	Same
-13cba	1310	Same
4N/40E-10cad	1071	Reported as adequate well from 166' of saturated rhyolite below clay; well pumped excessive sand, impellers failed to last one season.
4N/41E-4bda	1030	Drilled clay and tight rock zones
-6ada	1362	Drilled shale and clay in lower 547' of hole
5N/40E-1ccd	716	Abandoned in clay
-11bc	830	Completion problem; drilled thick clay section, well pumped excessive sand
-28bb	426	Drilled only 80' of rhyolite below clay
5N/41E-5bc	1003	Drilled interbedded clay and rock, neighboring wells successful at this depth
6N/40E-25cc	460	Drilled clay with minor rock zones
6N/41E-20bc	650	Reportedly drilled all rock; neighboring wells, successful at even shallower depths
-32ca	460	Abandoned after drilling 277' of clay

DRILLING GUIDE

Map No. 549-100-52 is a drilling-depth map for Rexburg Bench. The Bench is divided into five type areas. Contoured depths are the estimated total depth required for a well to produce 4 cfs. Various factors which determine drill depth include the type of aquifer and its probable performance, taken from Table No. 1; the general rise in topography across the Bench; depth to the water table from Map No. 549-100-53; and thickness of clay, if present. Figure No. 3 is a diagrammatic section showing geological conditions in each of the five areas.

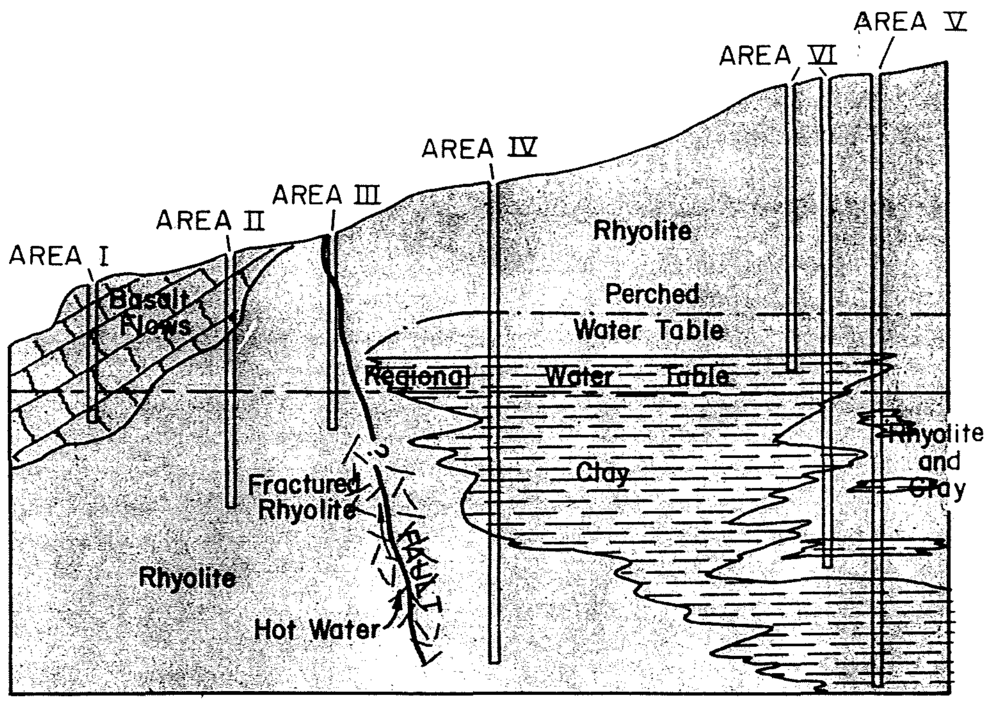

FIGURE 3 Diagrammatic cross section showing type area wells.

Area No. I

Area No. I identifies two separated areas in the vicinity of Rexburg where good yields are obtained from saturated basalt. Adequate wells are from 150 to 450 feet in depth, the depth increasing with the rise in surface elevation. From Table No. 1, a typical well to supply 4 cfs must be drilled 50 feet into saturated basalt.

Area No. II

Wells in Area No. II produce from rhyolite tuffs and flows. Required depth for a 4-cfs well ranges from 300 feet near the edge of the Bench to over 800 feet along the southeast margin. The increase in drilling depth is primarily due to the 700- 800-foot rise in topography across the Bench. A typical well in Area No. II must penetrate 220 feet of saturated rhyolite and will yield 4 cfs with about 60 feet of drawdown.

Area No. III

Area No. III is a small segment of the Bench in the vicinity of Newdale. Wells produce hot water from a rhyolite aquifer at an abnormally high yield per-foot of penetration. A typical well drilled in Area No. III, which penetrates 55 feet of saturated rhyolite, will produce 4 cfs with less than 20 feet of drawdown. Required drilling depths range from 275 to 300 feet.

Area No. IV

Wells in Area No. IV produce from rhyolite tuffs and flows but from beneath an extensive northeast trending clay body. The clay-filled trough is asymetrical with the thickest clay fill along the northwest edge of the trough. Thickness of the clay ranges from a feather edge to over 300 feet.

A successful well must penetrate the clay then drill at least 220 feet of saturated rhyolite beneath. Drilling depths range from 500 to over 1200 feet. Many of the thirteen abandoned wells are located within Area No. IV. Holes were either stopped before penetrating the clay or failed to penetrate sufficient saturated rock beneath.

Area No. V (South end of Rexburg Bench)

Six wells drilled in this segment have all been abandoned. Drillers report numerous clay zones and intervals of rock and clay mixtures with few inflows of water. One exception, Well No. 4N/40E-10cad was drilled through 166 feet of saturated rhyolite beneath 600 feet of clay and interbedded lavas. The well pumped an excessive amount of sand and was abandoned after two seasons. As indicated on Cross Section F-F', (Drawing No. 549-100-55) the productive rhyolite in the above well may be at prohibitive depths (over 1600 feet) to the east. In view of the general northeast structural trend in the Bench, the conditions within Area No. V may be continuous to the northeast and tie with Area No. VI, an area of poor wells in the vicinity of Teton Damsite.

Area No. VI (North end, Rexburg Bench)

Area No. VI combines some geological features found in Areas Nos. IV and V. This is an area of generally poor wells, both from the perched aquifer above a clay zone and from the rhyolite beneath. Some wells have been drilled to over 500 feet and have either penetrated rhyolite beneath the clay or have been on the fringes of the clay body; others have been drilled to over 700 feet in nearly continuous rock and are poor wells. Similarly, scattered wells beyond the mapped area, north and south of the river and up to eight miles east, have inadequate yields.

Wells completed in the perched aquifer are limited by the thickness of saturated rhyolite above the perching clay zone.

DEVELOPMENT, REXBURG BENCH

Past Development

Irrigation development of the Rexburg Bench from ground water has advanced at a steady pace. The first two irrigation wells were drilled on the Bench in 1953; now there are 87 producing wells. Most of the development has occurred since 1960. In 1960, about 2,700 acres were irrigated from ground-water pumping, in 1970, about 17,000 acres, almost entirely in potatoes, were supplied from wells and an additional 15,000 acres of grain received some ground-water application. Pumping of ground water from beneath Rexburg Bench has not caused an apparent decline in water levels. Total pumpage in 1970 is calculated to have been 40,000 acre-feet.

Future Potential

Drilling depths exceeding 1300 feet and pump lifts of over 700 feet have not deterred private development on the Bench. Presumably the Rexburg Bench landowners find even these extremes acceptable. Map No. 549-100-50 shows the extent of Bench lands under the proposed pump canal, which heads at about elevation 5340. Almost 50% of this area now receives a supply of irrigation water from wells. In view of past development it seems likely that private landowners will continue drilling to supply the remaining acreage.

Above the pump canal alignment there is a 1- 4-mile strip of low relief bench land which has a far more questionable ground-water supply. Map No. 549-100-50 shows a boundary line which marks the southeast extent of this strip of bench-type land. Elevations along the boundary range from 5500 to 5700. East of the line, the land surface steepens sharply, rising toward the mountains. There is approximately 30,000 gross acres within the strip, almost entirely without an irrigation water supply.

At the extreme north end of the strip a few hundred acres are supplied from Canyon Creek Canal. In the south part, in the vicinity of several deep abandoned wells approximately 600 acres are supplied by pumping from Snake River. The lift onto bench lands is approximately 950 feet.

Eleven successful wells have been drilled within the strip, most located at lower elevations in the western half. Drilled depths range from 700 to 1332 feet and pump lifts range from 550 to over 700 feet. Of even more significance are the indications that much of the eastern part of the strip is underlain by relatively impermeable rock. At both the north and south ends of the Bench, where well control is available, less than one mile separates adequate wells to the west from inadequate or abandoned wells to the east. Both economic and physical limits may halt further development of ground-water supply to the 30,000-acre strip.

SUMMARY & CONCLUSIONS

Private development of the Rexburg Bench, over the past 10 years, has resulted in an increasing supply of irrigation water from wells. A large part of the Bureau's proposed service area is already supplied from ground water. There are no indications that the present annual withdrawal of 40,000 acre-feet is approaching the recharge volume. It is possible that a stable supply of ground water can be developed for the full service area. However, this cannot be determined from the available short-term data. Neither can the effects of a prolonged dry cycle such as occurred in the 1930's. Meanwhile, landowners seeing the apparent successful ground water development of Bench lands, may accept or reject Bureau plans for delivery of surface water.

If the Bureau plan is rejected, then alternative blocks of land must be considered. For instance, would it be feasible to lift water from the reservoir to a higher elevation on the Bench? A block of approximately 30,000 gross acres of land, located to the east and above the present canal alignment, does not appear to have an economic supply of ground water.

RECOMMENDATIONS

1. Water table observation program

A. Continue the present program which includes two continuous recorder installations plus two mass measurements per year of all accessible wells.

B. Install at least two additional recorders on wells which are now idle.

2. Attempt to get three to four additional geophysical logs of key wells.

3. Complete a water temperature survey of all pumping wells to determine if a pattern of ground-water source and movement can be established.

4. When a definite plan report is required, re-examine the accumulated data toward a better understanding of the ground-water picture.