MEMO ON GROUND WATER FOR STOCK AND DOMESTIC PURPOSES IN THE VICINITY OF TAOS JUNCTION, TRES PIEDRAS, AND NO AGUA, TAOS AND RIO ARRIBA COUNTIES, NEW MEXICO

By

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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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Prepared
in cooperation with
U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
and
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INTRODUCTION

This memorandum was prepared in response to a request from the Forest Service for information concerning the availability of ground water for stock and domestic purposes on lands controlled by the Forest Service in the Taos Junction, Tres Piedras, and No Agua areas, Taos and Rio Arriba Counties. This memorandum, prepared in cooperation with the Forest Service and New Mexico State Engineer, is based on a reconnaissance of the areas by the writer in August 1955, on well information in the files of the Ground Water Branch of the U. S. Geological Survey, and on geologic literature pertaining to the areas discussed. With the exception of the No Agua area, the region examined lies approximately between the Rio Grande Canyon and the Taos-Rio Arriba County line (see enclosed map).

A stock-water supply is needed on the Carson National Forest and Federal lands adjacent to Taos Junction and No Agua, N. Mex. These lands have been cleared and reseeded to crested wheatgrass, but they cannot be opened to grazing until a supply of stock water is obtained.

A permanent supply of well water for domestic purposes is needed at the ranger station in Tres Piedras. The shallow wells at the station go dry in early summer and in late fall, necessitating the hauling of water from Antonito, Colo., 30 miles to the north.

GEOGRAPHY AND GEOLOGY

The three areas examined are located upon a southeastward-sloping basalt-capped plateau which borders the Rio Grande on the west from the Colorado-New Mexico line south to Española, N. Mex. In western Taos County this plateau has a gently undulating surface of little relief and sluggish drainage and rises from an elevation of 7,000 feet, just west of the Rio Grande Canyon opposite Dunn Bridge, to about 8,100 feet (aneroid barometer) at Tres Piedras. Numerous extinct volcanoes (Wind Mountain, Pot Mountain, Ute Mountain, San Antonio Peak, etc.) rise conspicuously above the surface of the plateau; many of these undoubtedly were the sources of the vast basaltic lava flows forming and underlying the plateau.

The rocks of the plateau are locally well-exposed in the Rio Grande Canyon. The rocks exposed are predominately of two types: 1) Basaltic lava flows, known locally as "malpais"; 2) "valley fill," consisting of alternating strata of clay, sand, and gravel. These two rock types underlie large portions of the Rio Grande trough from the north end of San Luis Valley, Colorado, to and beyond El Paso, Texas. They are collectively known as the Santa Fe formation and are of Miocene-Pliocene age. Several of the hills and mountains which rise above the surface of the plateau are composed of rocks much older and of different composition than the Santa Fe formation. Cerro Chiflo and No Agua Mountain are respectively composed of andesite and perlite and are considered to be Cretaceous and/or early Tertiary in age. Blue Hill (approximately 7 miles east of Ojo Caliente) and the hills surrounding the village of Tres Piedras are composed of Precambrian granite. These older rocks have been covered largely by the Santa Fe deposits and crop out on the plateau in limited areas.

In the north-central and northeastern portions of the area canvassed, the basalt flows and associated cinder and ash beds dip gently to the east, and are more than 500 feet thick. In the southern half of the area the basaltic lava flows are interbedded with "valley fill" materials. This interbedding is well exhibited in the Rio Grande Canyon at Dunn Bridge and by logs of wells. The interbedding of the lava and the "valley fill" in the southern half of the area, and the lack of interbedding in the north-central and northeastern part of the area, indicate that during the period of volcanic activity the mountains in the south which bordered the Rio Grande trough were probably higher than the mountains in the northern portion of the area. These mountains contributed much detritus into the southern part of the trough and successive lava flows were buried. However, to the north the volume of detritus from the mountains was not sufficient to bury the individual flows; thus one flow accumulated upon the other.

The basaltic lava flows, in general, permit free movement of ground water. Vesicles (small interconnected cavities formed by escaping gases) and fractures formed during the cooling of these once-molten rocks have rendered them permeable. The vesicles are usually localized in the upper portions of the lava flows while the fractures tend to permeate the entire flow. The fractures thus appear to offer the chief mode of passage for percolating ground waters. The basalt appears to have a relatively high permeability. This is suggested by: 1) The lack of well-defined surface water runoff from large portions of the plateau, and 2) the frequent loss of circulation reported by drillers while penetrating the basalt (see log of Corps of Engineers test hole 9A).

The permeability of the "valley fill" materials ranges greatly due to the range in composition from impervious clays to pervious gravels. The "valley fill" materials are largely detritus derived from the highlands bordering the Rio Grande trough on the east and west. The composition of this detritus, whether predominantly clay, sand, or gravel, depends largely upon the rate of rise of the highlands bordering the depositional trough, the proximity of the detritus to the highlands and the climatic conditions extant during the period of deposition.

Much of the "valley fill" exposed in the Rio Grande Canyon at Dunn Bridge appears sufficiently permeable to furnish a stock-water supply when saturated.

GROUND WATER

Ground water beneath the plateau occurs in two principal ways; as shallow ground water and as basal ground water.

I. Shallow ground water.

In the basalt plateau area many of the arroyos cut into the basalt are floored by relatively thin layers of alluvial sand, gravel, and clay. In areas where the alluvial materials are of sufficient thickness, some shallow wells have been dug. During the summer rainy season and spring snowmelt, the alluvium may become saturated and yield water to these wells. The water is, however, only temporarily available as it gradually percolates downward to lower levels in the porous basalts. With the cessation of the summer rains and spring snowmelt the shallow ground water is no longer replenished and the wells along the arroyos then go dry.

Shallow ground water is also obtained from wells tapping the granitic rocks cropping out at Tres Piedras. These wells are also reported to go dry with the cessation of the summer rains and spring snowmelt, although one well no longer used retains its water throughout the year. The shallow ground water in the Tres Piedras area occurs at depths ranging from 7 feet to 31 feet below the surface.

II. Basal ground water.

Numerous stock wells and test borings by the Corps of Engineers during investigations of the Chiflo damsite have shown the presence of a water table (?)

deep beneath the plateau surface. Over most of the area canvassed the water table lies above the elevation of the Rio Grande and consequently slopes toward the river. The slope of the water table toward the river is much less than the land surface; therefore the depth to water increases westward from the Rio Grande. The basal ground water has been encountered in wells at depths ranging from 297 feet (at well 30.11.22.111) to 640 feet (at well 31.9.10.320) below the surface. Wells tapping this water reportedly have never gone dry.

In the northeast portion of the area under consideration, where the basalt flows exceed 500 feet in thickness, the water table generally lies within the basaltic lava flows although some logs report it within a black sand (cinders?). Very low ground-water gradients, generally less than 2 feet per mile, occur in T. 30 and 31 N., R. 10 and 11 E. These low gradients plus the large spring discharge observable in portions of the Rio Grande Canyon indicate that the lava is very permeable.

In the southern portion of the area canvassed, where the basalt flows are interbedded with the "valley fill" materials, the water table may lie either in the basaltic lava or in the "valley fill" materials. It may also extend laterally from one to the other dependent upon the dip of the rocks and the slope of the water table. Because of the diverse character of the valley fill materials, water-table gradients much greater than 2 feet per mile should be expected when the zone of saturation lies within this rock type.

Several ranchers have reported that the water in their wells rose when the water strata was first penetrated. Several logs also mention this fact (see log of Grazing Service well). The basal ground water thus appears to occur under artesian or semiartesian conditions, at least in places.

The quality of the basal and shallow ground waters does not appear to be a problem in this region. Although no chemical analyses of the ground waters are available for the canvassed area, none of the residents interviewed mentioned that their well water was unfit for domestic or stock use. The chemical analyses of water from a well in Sunshine Valley east of the Canyon (1.73.32.122 Colo. grid) showed a total hardness of 71 parts per million and a specific conductance of 178 micromhos.

Several logs of wells that tap the shallow and basal ground waters have been included with this report. These logs show the character of the subsurface materials and drilling conditions to be expected in the vicinity of each well.

The accompanying map outlines the areas discussed and shows the locations of all deep wells visited during August 1955. Also shown on the map are 9 wells in T. 29, 30, and 31 N., R. 10 and 11 E., which were visited during an investigation of the Sunshine Valley area, east of the the Rio Grande. Although these wells are far removed from the areas under discussion they offer valuable information on the basal water beneath the plateau.

TAOS JUNCTION AREA

The Taos Junction area lies within T. 25 N., R. 10 E. Road and arroyo cuts within the area show the basaltic lava to be at, or just below, the land surface.

There are few wells within the area and all of them are shallow. Information on the basal ground-water aquifer in the Taos Junction area is based upon wells distributed widely on the plateau, all more than three miles from Taos Junction. The data on deep wells canvassed are given on the attached table. Most of the information was obtained either from the owners of the wells or from observations at the well and is considered to be reasonably accurate, but many of the wells listed were found to be caved or filled and the reported data for some of the wells may be erroneous, as for example, the reported depths to water for the two wells at Servilleta.

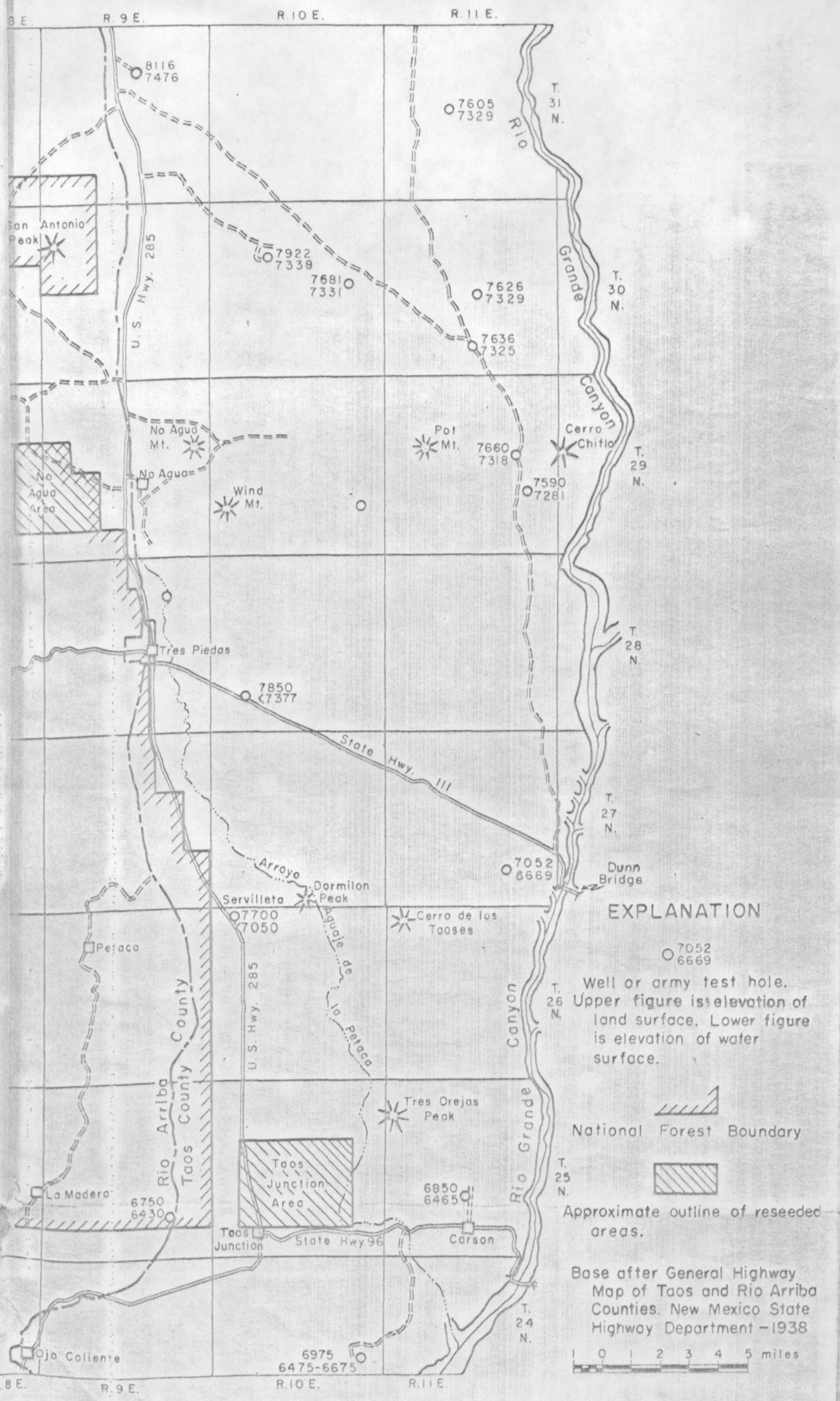
The elevation of the water surface in the three deep wells nearest Taos Junction is approximately 6,400 feet above sea level. The elevation of the land surface in T. 25 N., R. 10 E. ranges from 7,500 feet near the northwest edge of the township to 7,000 feet near the southeast edge of the township. Therefore, the basal ground water should be encountered at depths ranging from approximately 600 or 700 feet in the southeast part of the township to 1,100 or 1,200 feet in the northwestern edge of the township.

TRES PIEDRAS AREA

The village of Tres Piedras lies near the center of T. 28 N., R. 9 E., along U. S. Highway 285. The town is almost encircled by hills of granite which rise conspicuously above the surrounding basalt plateau. The granite is at or near the surface throughout the village, but is encountered at greater depths northward and probably eastward. Two wells on the Foster ranch, 2½ miles north of Tres Piedras, reportedly encountered granite at depths of 297 feet and 337 feet below the surface (see enclosed log), after penetrating basalt and "valley fill" materials. The wells were measured and contained no water. The granite was reportedly not encountered in the 473-foot well at the Franklin ranch, approximately 3 miles southeast of Tres Piedras. This well also penetrated the Santa Fe formation and contained no water when measured.

All the ground water in the village and at the ranger station is derived from shallow wells which have been dug into sands and gravels that fill depressions in the granite surface, and at most locations into the granite itself. Although the granite is fractured and in part is highly weathered, holes dug into it appear to act more as cisterns than as wells. The water in the shallow wells dug into the granite appears to come from the thin veneer of alluvium overlying the granite.

All the shallow wells at Tres Piedras are reported to go dry in early summer and in the late fall or early winter. Recharge from spring snowmelt and summer rains replenishes the water in these dug wells. The granite, however, has little water-storage capacity and a large part of the ground water, after saturating alluvial-filled depressions and wells in the granite,



Map showing location of deep wells in the vicinity of Taos Junction, Tres Piedras, and No Agua, Taos and Rio Arriba Counties, N. M.

probably flows along the surface of this rock to a lower water body in the surrounding basalts. With the cessation of recharge from the spring snowmelt and the summer rains the water slowly drains away and wells are pumped dry.

The replenishment of water to these shallow wells by the summer rains was clearly exhibited in the well drilled by the village in 1953. This well penetrated 58 feet of weathered and fresh granitic rock. The drilling of this well began on May 2, 1953 and the well was completed on June 8, 1953. No water was obtained and the well was abandoned. On August 5, 1955, during the rainy season, this well was measured by the writer and found to contain 28 feet of water. The log of this well is included at the end of the report.

Considering the above discussion, it does not seem probable that a year-round supply of ground water can be obtained at the Tres Piedras Ranger Station where the granite is exposed at the surface. Whether a permanent shallow ground-water supply could be developed elsewhere in the Tres Piedras area, say within a radius of one or two miles of the village, is open to speculation.

As mentioned previously, it is believed that a large part of the ground-water recharge at Tres Piedras moves over the steep surface of the relatively impervious granite to lower levels until it reaches the basal ground-water body in the more permeable rock surrounding the granite. However, if several large buried alluvium-filled troughs should exist upon the granite surface, they might contain sufficient water for a small permanent supply. A detailed geophysical reconnaissance of the bedrock configuration in the vicinity of

the village might possibly show whether such alluvium-filled troughs exist.

The development of a permanent well-water supply for the village from the basal ground-water body underlying the plateau is unlikely. A measurement of the Franklin Ranch well, 3½ miles southeast of Tres Piedras, showed that here the basal ground-water table within the Santa Fe formation is below an elevation of 7,377 feet. Deepening this well 100 to 300 feet would likely suffice to encounter the basal ground-water table, provided granite were not encountered first. The altitude at Tres Piedras, however, is 8,100 feet above sea level and any drilling east, northeast, or southeast of the village is likely to reach granite prior to tapping the basal ground water within the Santa Fe formation.

NO AGUA AREA

The No Agua reseeded area is approximately 7 miles north-northwest of Tres Piedras in T. 29 N., R. 8 and 9 E. The surface and probably the subsurface geology of the plateau in this area is more complex than that in the other areas discussed. No Agua Mountain, which lies to the northeast of the reseeded land, is composed of perlite which is older and of a different texture than the surrounding basalts. A well drilled to a depth of 600 to 700 feet at the village of No Agua reportedly encountered no water. The cuttings from this well were described by older residents as a white sand. This description fits that of crushed perlite. This well has since been buried beneath U. S. Highway 285, and is not available for inspection or measurement.

A northwest-southeast trending hill near the center of the reseeded area (NE¼sec. 24, T. 29 N., R. 8 E.) is composed of a granitic rock similar to that forming the hills at Tres Piedras. Granitic rocks are usually of large horizontal and vertical extent and this hill is probably continuous in the subsurface with the granitic hills at Tres Piedras. The possibility of obtaining a permanent supply of stock water from this rock is small. The land surface between this granitic hill and No Agua Mountain is covered by the plateau basalts.

With the exception of the one shallow dug well at the George Smith home and the buried 600- to 700-foot dry hole there are no other wells in the area. On the basis of present meager information it appears that no water can be obtained in this area. If a decision is made to attempt drilling in this area, it is suggested that the well site chosen be as far as possible from the granitic hill in sec. 24, T. 29 N., R. 8 E.

CONCLUSIONS

I. Stock water should be obtained at depths of 600 to 700 feet in the southeast corner of the Taos Junction reseeded area (T. 25 N., R. 10 E.) and at increasing depths toward the western portion of this area.

II. No permanent supply of well water appears to be available at the ranger station in Tres Piedras where the granite is exposed at the surface.

III. Drilling in the vicinity of the granitic hill in sec. 24, T. 29 N., R. 8 E. of the No Agua reseeded area is not recommended.

Table 1.--Deep wells canvassed in the Tres Piedras, Taos Junction, and No Agua areas, Taos and Rio Arriba Counties, N. Mex.

Location 1/	Depth to water (ft)	Elevation of well (msl)	Remarks
24.10.24.133	300-500	6,975 2/	Old Barnet well. Casing filled with stone.
25.9.26.322	320	6,750 2/	Old Amador well. Little water reported at 75 feet and 125 feet.
25.11.21.440	385	6,850 2/	1 mile north of Carson, Taos Co., N. Mex. Well caved.
26.10.6.200	Dry at 650	7,700 2/	At Servilleta RR Station. Information in Dept. of Agr. Bulletin in 1882. Log enclosed.
26.10.6.200A	225	7,700 2/	At Servilleta RR Station. Well filled.
27.11.26.333	383	7,052 2/	Kirby Cattle Co. Stock well. Water reported to have risen 60 feet when drilled.
28.9.11.200	Dry at 354 3/		Foster Ranch well. Reportedly hit granite at 297 feet. Log enclosed.
28.10.29.333	Dry at 473 3/	7,850 5/	Franklin Ranch well. Owner reports water hit at 440 feet in sand.
29.9.16.200	Dry at 600-700		Buried under U. S. Hwy. 285 at No Agua, N. Mex.
29.10.25.130	320		C. H. Quinlan Ranch.
29.11.14.410	342 (1947)	7,660 4/	Corps of Engr. Chiflo Damsite Test Hole 9A. Log enclosed.
29.11.23.444	309 (1945)	7,590 4/	Corps of Engr. Chiflo Damsite Test Hole 7A.
30.10.8.444	584	7,922 5/	Alire-Duran well.
30.10.14.400	350	7,681 5/	Middlemeist well.
30.11.22.111	297 (1946)	7,626 4/	Corps of Engr. Chiflo Damsite Test Hole R-10.
30.11.27.333	311 3/	7,636 5/	Grazing Service well. See enclosed log.
31.9.10.320	640	8,116 5/	Bagwell-Huffaker well.
31.11.16.333	276 (1946)	7,605 4/	Corps of Engr. Chiflo Damsite Test Hole R-11.

1/ Township, Range, section and fractional part of section.
2/ Interpolated from topographic maps.
3/ Measured by writer; all other depth to water figures reported.
4/ By Corps of Engineers, U. S. Army.
5/ Aneroid barometer.

Table 2.--Driller's logs of wells

Location: 26.10.6.200, at Servilleta, Taos County
Owner: Denver and Rio Grande Railroad
Drilled: 1881 (?)
Source of information: Dept. of Agr. Bull., 1882

Material	Depth (feet)
Clay	0-20
Porous lava rock	20-215
Hard sandstone	215-250
Coarse red sandstone	250-300
Fine yellow and white sand, soft and very friable, so that it had to be cased	300-650

Remarks: Dry hole. Abandoned because inner casing jammed.

Table 2.--Driller's logs of wells--Continued

Location: 28.9.11.200, 2.5 miles north of Tres Piedras
Owner: George Foster
Drilled: March 1955
Source of information: Van Turner Drilling Company, Albuquerque, New Mexico

Material	Depth (feet)
Top soil	0-5
Malpais	5-7
Clay and rock	7-15
Clay and rock	15-35
Malpais	35-80
Red clay	80-100
Sandstone	100-110
Clay, sand and gravel	110-145
Sandstone	145-165
Clay, sand and gravel	165-190
Red clay	190-200
Conglomerate	200-285
Conglomerate	285-297
Hard rock (granite?)	297-359

Remarks: Well cased to 297 feet. 5-inch casing. Well 200 feet west of this well reportedly encountered the hard rock (granite?) at a depth of 337 feet. Well measured on August 1, 1955. Well contained no water although some seep was noted.

Table 2.--Driller's logs of wells--Continued

Location: 28.9.22.420, at Tres Piedras
Owner: Tres Piedras
Drilled: May-June 1953
Source of information: Driller - Glen Izaacson

Material	Depth (feet)
Black dirt	0
Yellow sand	3
Decomposed granite	4
Granite, seep	31
Decomposed granite	39
Granite	40
Granite	61.5
No water, well abandoned.	

Remarks: Well was measured August 5, 1955 and contained 28 feet of water. Depth to water was 30 feet below the surface.

Table 2.--Driller's logs of wells--Continued

Location: 29.11.14.410, about 1 mile west of Cerro Chiflo
Owner:
Drilled: 1946(?) by Corps of Engrs. U. S. Army Chiflo damsite test hole 9A
Source of information: Files, Corps of Engineers, Albuquerque, New Mexico

Material	Depth (feet)
Sand, silt, basalt fragments and caliche	0-7
Basalt, dark gray hard, vesicular 7 feet to 15 feet, dense 15 feet to 37 feet. Lost all drill water at 52 feet. At 61 feet grouted hole and regained drill water.	7-66
Basalt, gray, hard, vuggy. Lost drill water at 167 feet. Partial return at 170 feet.	66-171
Basalt, dark gray, hard, vuggy. Lost water at 177 feet. This formation characterized by lath-like phenocrysts of plagioclase feldspar.	171-205
Basalt, dark gray, dense, hard.	205-210
Basalt, reddish brown to gray, hard, vuggy. Feldspar laths common in this formation. Lost drill water at 211 feet.	210-287
Basalt, dark gray, hard to medium hard.	287-309
Basalt, dark gray to gray, hard, dense, aphanitic. Vesicular to 312 feet. Calcite in joints and a few of the vugs.	309-358
Silt, sand, volcanic ash and basalt fragments, reddish brown, soft.	358-366
Basalt, dark gray, hard, vuggy. Hole blowing at this depth.	366-376
Silt, grayish brown, soft.	376-377
Basalt, dark gray, hard.	377-407
Silt and sand, buff, soft.	407-415
Basalt, dark gray, hard, dense. Several thin sand, silt and ash beds.	415-454
Sand and silt, reddish brown to gray, soft.	454-461
Basalt, dark gray, hard.	461-485
Sand, silt, ash and some fragmental material, medium hard to soft, brownish gray to buff. Lower 25 feet contains fragments of Chiflo andesite.	485-554

Water level 341 feet below surface (1947)

Remarks: This test hole has been equipped with a plunger pump and windmill.

Table 2.--Driller's logs of wells--Continued

Location: 30.11.27.333
Owner: Grazing Service well
Source of information: SCS files, observation

Material	Depth (feet)
Surface soil	0-20
Malpais	20-310
Malpais and red shale mixed	310-330
Water sand, black. Water rose 23 feet.	330-335

Remarks: Well measured on August 16, 1955. Depth to water was 311 feet below land surface.