

Bennett

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M. B. Compton, Engineer, WRD, Santa Fe

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Report entitled "Reconnaissance Investigation of Ground- and Surface-Water Supplies in the Canyon of Largo Creek North of Largo Dam site, Catron County, New Mexico".

Transmitted herewith is the "final edition" of my report on our investigation of ground- and surface-water supplies in the vicinity of the Frank Williams ranch downstream from Largo dam site.

If you should need additional copies of this report, please let me know.

Engineer, Technical Division

SEG*jll

cc: J. C. Yates, Santa Fe
P. D. Akin, Santa Fe
A. T. Watson, Santa Fe

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RECONNAISSANCE INVESTIGATION OF GROUND- AND SURFACE-WATER
SUPPLIES IN THE CANYON OF LARGO CREEK NORTH OF
LARGO DAMSITE, CATRON COUNTY, NEW MEXICO

by

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INTRODUCTION

On November 6, 1968, I traveled from Roswell to Quemado to conduct a reconnaissance investigation of the source and extent of development of ground- and surface-water supplies in the canyon of Largo Creek south of the Village of Quemado in Catron County, New Mexico. This investigation was initiated at the request of the State Engineer following the filing of a protest to an application of the New Mexico Department of Game and Fish (Surface Water File No. 3026) to construct a dam in the canyon of Largo Creek near the one-quarter corner common to Sections 10 and 15, Township 2 South, Range 16 West, NMPM, to impound water for recreational purposes. The protest as filed was based in part on the contention that the construction of a reservoir as proposed by the Department of Game and Fish would adversely effect the flow of Largo Creek and the supply of water available to wells located on lands adjacent to the creek downstream from the damsite. In an attempt to determine the possible validity of this contention the following work was conducted in the field in the company of M. B. Compton

and A. T. Watson of the State Engineer's Santa Fe office during the afternoon of November 6, on November 7, and during the morning of November 8, 1968:

1. Mr. Wayne Orr, of the U. S. Forest Service, was contacted at the Jewett Ranger Station at Quemado to obtain a current map of National Forest lands and information pertaining to the development, dependability, and use of surface- and ground-water supplies on both Federal and patented lands within and adjacent to the canyon of Largo Creek;
2. A relatively complete reconnaissance traverse was made along Largo Creek from the site of the proposed dam to the Village of Quemado;
3. Mr. Frank Williams, the protestant to the application of the Department of Game and Fish and the owner of six (6) wells located on patented lands adjacent to Largo Creek, was contacted at his home to obtain information pertaining to wells located on his ranch, wells located on adjacent ranches, and the availability and dependability of surface flows in Largo Creek; and
4. Seven (7) of the eight (8) known wells in the vicinity of Largo Creek between the site of the proposed dam and the east-west section line bounding the north sides of Sections 20 and 21, Township 1 North, Range 16 West were visited and scheduled.

The discussion of the geology of the area covered by this investigation has been drawn primarily from Part II of "Preliminary Basic Design Report, Largo Creek Dam and Reservoir Site, Catron County, New Mexico"

which was prepared by the writer in December 1963. References pertaining to the general geology of the area are listed in the cited report.

GEOLOGY

The rocks and sediments that relate significantly to the occurrence of existing ground- and surface-water supplies in the vicinity of Largo Creek consist of unconsolidated alluvium, that occupies the floor of the canyon cut by the creek and ranges in thickness from 0 to perhaps as much as 100 feet, and an underlying sequence of consolidated rock that comprises a part of a volcanic sediment facies of the Datil formation of Tertiary age. No specific information is available in regard to the materials comprising the alluvium downstream from the site of the proposed dam. It would appear reasonable to postulate, however, on the basis of investigations conducted at the damsite, that these sediments consist largely of interbedded or intermixed clayey to silty sand and granule- to boulder-sized fragments of volcanic rock. The volcanic sediment facies of the Datil formation that underlies these unconsolidated sediments is believed to consist largely of very fine to medium-grained, quartzose, silty to very silty, calcareous, poorly to fairly well cemented sandstone that contains randomly scattered (and perhaps locally interbedded) angular to subrounded volcanic granules and pebbles up to 2 inches in diameter. The overall permeability of this facies of the Datil formation is believed, on the basis of currently available data, to be considerably less than the overall permeability of the overlying alluvium.

STREAMFLOW

Largo Creek is essentially a "live" stream from a point upstream from

the site of the proposed dam to a point near the east-west section line common to Sections 6 and 7, Township 1 South, Range 16 West. Cursory observations made on November 6 and 7, 1968 suggest that there is an almost continuous gain in the flow of the creek from the point of beginning of flow upstream from the site of the proposed dam to a point in the vicinity of the NE $\frac{1}{4}$ of Section 31, Township 1 South, Range 16 West, and that the flow at the latter point is nearly double the flow at the damsite. An estimated 75 percent of the gain in flow below the site of the proposed dam is attributed to inflow from Sawmill Creek (intercepted near the center of the S $\frac{1}{2}$ of Section 9, Township 2 South, Range 16 West), and the remaining 25 percent is considered to represent the flow of springs and seeps that issue from the alluvial materials into which the present channel of the creek has been incised. About 75 percent of the gain in flow from the latter source appears to occur below the mouth of Sawmill Creek. Beginning in the vicinity of the NE $\frac{1}{4}$ of Section 31 (Township 1 South, Range 16 West), however, there appears to be a progressive decrease in the flow of the creek that continues until the creek channel finally becomes completely dry at a point near the east-west section line common to Sections 6 and 7, Township 1 South, Range 16 West. One short segment within this reach of the creek is also reported to be normally dry. According to Mrs. Frank Williams the perennial flow of the creek continued to a point some distance downstream from the present headquarters of the Williams Ranch (NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ of Section 6, Township 1 South, Range 16 West) when she moved to the ranch 37 years ago.

EXISTING WELLS

The following wells were visited and scheduled during the course of the field work for this investigation. The order in which these wells

are listed corresponds to the sequence in which these wells would normally be encountered when traveling downstream from the site of the proposed dam. The locations of these wells are shown on Figure 1.

Location: Center SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ Section 7, Township 1 South, Range 16 West

Owner: Frank Williams Use: Stock

Topography: Gentle eastward slope on west side of Largo Creek

Year Drilled: 1951 Driller: Jess Heinsohn

Reported Depth: 50 feet Casing: 7-inch steel

Type of Pump: Lift Kind of Power: Wind

Distribution System: 2 $\frac{1}{2}$ -inch discharge pipe to 30 feet in diameter by 4 feet high circular steel tank

Water Level: 18.00 feet below top of casing which is 2.5 feet above land surface Date Measured: November 7, 1968

Miscellaneous: Top of well casing is 16 feet above water surface in incised channel of Largo Creek.

Location: NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ Section 6, Township 1 South, Range 16 West

Owner: Frank Williams Use: Domestic

Topography: Gentle eastward slope on west side of Largo Creek

Year Drilled: 1943 Driller: Les Carter

Reported Depth: About 65 feet Casing: 8-inch steel

Type of Pump: Lift-Jack Kind of Power: Electric

Other Equipment: Windmill head (disconnected when visited)

Distribution System: 2 $\frac{1}{2}$ -inch discharge pipe to elevated steel storage tank

Water Level: No Access Date Visited: November 7, 1968

Miscellaneous: Owner stated well is pumped with windmill during windy season of year. Incised channel of Largo Creek is dry at latitude of this well.

Location: NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ Section 6, Township 1 South, Range 16 West

Owner: Frank Williams

Use: None

Topography: Gentle westward slope on east side of Largo Creek

Year Drilled: About 1946

Driller: Jess Heinsohn

Reported Depth: 40 feet

Casing: 6-inch steel

Type of Pump: None

Kind of Power: None

Water Level: 29.43 feet below top of casing which is 1.0 feet above
land surface

Date Measured: November 7, 1968

Miscellaneous: Owner states well was formerly used to irrigate small orchard. Top of well casing is 17 feet above bottom of incised dry channel of Largo Creek.

Location: NE $\frac{1}{4}$ SW $\frac{1}{4}$ of Lot 16, Section 6, Township 1 South, Range 16 West

Owner: Frank Williams

Use: None

Topography: Gentle eastward slope on west side of Largo Creek

Year Drilled: 1952

Driller: Jess Heinsohn

Reported Depth: 108 feet

Casing: 10-inch steel

Type of Pump: None

Kind of Power: None

Water Level: 31.20 feet below top of casing which is 1.5 feet above
land surface

Date Measured: November 7, 1968

Miscellaneous: Well is reported to have encountered water at depth of 30 feet when drilled. Well was drilled as possible source of irrigation water. Top of well casing is 21 feet above bottom of incised dry channel of Largo Creek.

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ Section 32, Township 1 North, Range 16 West

Owner: D. W. Simpson

Use: Stock

Topography: Gentle westward slope on east side of Largo Creek

Year Drilled: About 1952

Driller: Les Carter & Art Trantham

Reported Depth: 250 feet

Casing: 9-inch steel

Type of Pump: Lift

Kind of Power: Wind

Distribution System: 2 3/4-inch discharge pipe to 15 feet in diameter by 5.25 feet high circular steel tank set on concrete base

Water Level: 17.55 feet below top of wooden column-pipe clamp which is 1.0 feet above land surface Date Measured: November 8, 1968

Miscellaneous: Owner and Mr. Frank Williams both state that although well was drilled to a depth of 250 feet no water was encountered below shallow zone from which water is normally produced in area. Well presently produces water from shallow zone only. Top of wooden column-pipe clamp is 12 feet above bottom of incised dry channel of Largo Creek.

Location: SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ Section 29, Township 1 North, Range 16 West

Owner: Frank Williams

Use: Stock

Topography: Gentle westward slope on east side of Largo Creek

Year Drilled: 1946

Driller: Jess Heinsohn

Reported Depth: 40 feet

Casing: 6-inch steel

Type of Pump: Lift-Jack

Kind of Power: None

Distribution System: 2½-inch discharge pipe to 9 feet in diameter by 7 feet high circular corrugated steel tank

Other Equipment: Windmill head from which "wheel" is missing (disconnected when visited)

Water Level: 27.99 feet below top of casing which is 1.5 feet above land surface Date Measured: November 8, 1968

Miscellaneous: Well is reported to have encountered water at depth of about 25 feet when drilled. Owner jacked up column pipe to provide access for water-level measurement. Top of well casing is 11 feet above bottom of incised dry channel of Largo Creek.

Location: NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ Section 21, Township 1 North, Range 16 West

Owner: Frank Williams

Use: Stock

Topography: Irregular westward slope on east side of Largo Creek

Year Drilled: 1952

Driller: Jess Heinsohn

Reported Depth: 96 feet

Casing: 6-inch steel

Type of Pump: Lift

Power: Wind

Distribution System: 2-inch discharge pipe to an earthen stock tank about 75 feet in diameter

Other Equipment: Auxiliary gasoline-engine powered pump jack (disconnected when visited)

Water Level: 39.20 feet below top of casing which is 1.6 feet above land surface
Date Measured: November 8, 1968

Miscellaneous: Well is reported to have encountered water at depth of 30 feet when drilled. Upper part of zone from which water is produced is reported to be quicksand and bottom part is reported to be gravel. Owner jacked up pump column to provide access for water-level measurement. Top of well casing is 27 feet above bottom of incised dry channel of Largo Creek.

The heretofore listed wells are all located within a few hundred feet of the incised channel of Largo Creek, and except for a reported well, that apparently is located in the vicinity of the SE $\frac{1}{4}$ SW $\frac{1}{4}$ of Section 29, Township 1 North, Range 16 West, are the only known wells that have been drilled in the valley of Largo Creek between the site of the proposed dam and the east-west section line bounding the north sides of Sections 20 and 21, Township 1 North, Range 16 West. The latter well, which is reported to have been drilled to a "depth of several hundred feet" to a "deep zone of water production," was not visited because of adverse weather conditions.

The depths to water in the six (6) wells for which a "Water Level" is listed were measured with a steel tape on the date indicated. The difference in elevation between the bottom of the incised channel of Largo Creek and the water-level measuring point at each of these wells was obtained by hand leveling to the well from the nearest accessible point in the creek channel.

INFERRED RELATIONSHIP BETWEEN GROUND- AND SURFACE-WATER SUPPLIES

It is inferred, both from studies conducted in connection with this

investigation and from previous studies conducted at and upstream from the site of the proposed dam, that the normal flow of the perennial reach of Largo Creek consists largely of water that has percolated downward through the zone of weathering on exposed rocks of the Datil formation or through the mantle of alluvial materials that occupies the canyon floor, and then has moved laterally above relatively impermeable rocks of the Datil formation to points of discharge along the incised channel of the creek. Similar conditions of water movement probably also support the flow of the perennial reaches of Caso Creek and Sawmill Creek that are intercepted by Largo Creek at a point about 0.25 miles upstream and at a point about one (1) mile downstream, respectively, from the site of the proposed dam. It is also inferred that the incidence of flow in the channel of the creek upstream from the site of the proposed dam is due, at least in part, to the constriction of "underflow" in the alluvium at the site of the proposed dam.

The progressive decline in normal flow downstream from the vicinity of the NE $\frac{1}{4}$ of Section 31, Township 1 South, Range 16 West is inferred to be due in part to the consumptive use of water by vegetation -- cottonwood trees and other species of water-loving plants are widely distributed on the floor of the canyon, particularly from a point a short distance downstream from the apparent beginning of loss of flow from the creek to a point at least 1 mile downstream from the headquarters of the Williams Ranch -- and in part to a probable increase in the cross-sectional area of alluvial materials that lie below the level of the bottom of the creek channel. The general departure of the gradient of the water table from the gradient of the bottom of the creek channel in the region of final diminishment and cessation of flow in the creek near the headquarters of the Williams Ranch is shown on Figure 2.

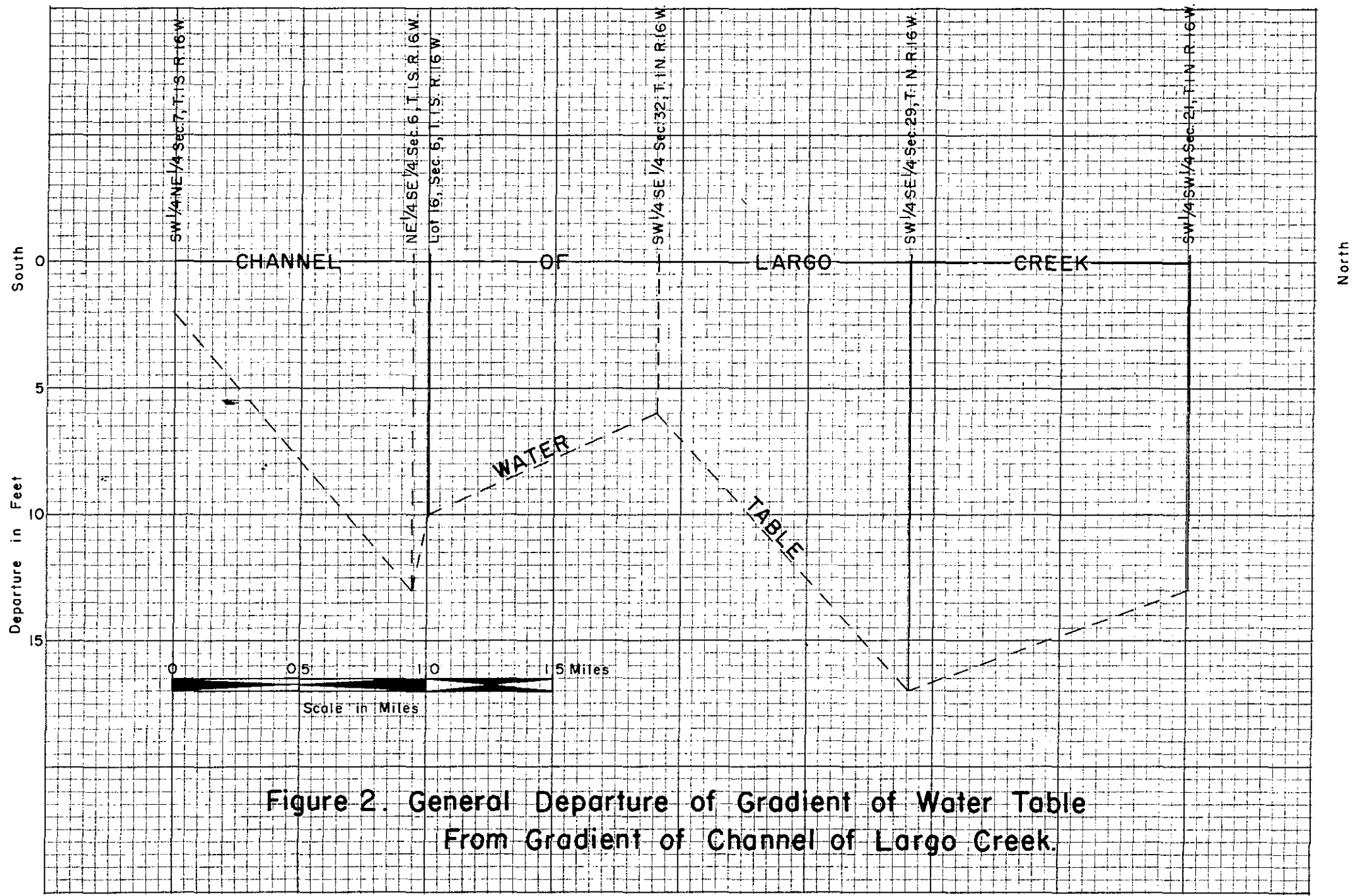


Figure 2. General Departure of Gradient of Water Table From Gradient of Channel of Largo Creek.

No specific data are available in regard to either the depth, the character, or the stratigraphic identity of the aquifer from which the "deep" well that is reported to be located in the vicinity of the SE $\frac{1}{4}$ SW $\frac{1}{4}$ of Section 29, Township 1 North, Range 16 West reportedly produces water. Inasmuch, however, as this well is reported to have been drilled to a "depth of several hundred feet" to a "deep zone of water production," and no water is reported to have been encountered below the usual shallow zone of water production at the site of the scheduled well owned by D. W. Simpson (SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ Section 32, Township 1 North, Range 16 West), it would appear likely that the reported deep zone of water production at this well is separated from the zone of shallow water production normally associated with the valley of Largo Creek by several tens of feet, and perhaps as much as several hundred feet, of relatively impermeable rocks. Mr. Frank Williams, Mr. D. W. Simpson and Mr. Wayne Orr all report that wells drilled in areas immediately adjacent to, but outside, the valley of Largo Creek normally do not encounter sufficient water for either stock or domestic purposes until a depth in excess of 500 feet is reached.

CONCLUSIONS

The writer's conclusions concerning changes in water-supply conditions that are likely to occur in Largo Canyon as the result of anticipated reservoir operations are as follows:

1. The retention of all or part of the water that originates upstream from the site of the dam will ultimately be reflected in a reduction of normal flow throughout the length of the perennial reach of the creek downstream from the dam.

2. The expected reduction of normal flow in the perennial reach of the creek will be accompanied by a corresponding decline of ground-water levels throughout the reach of the canyon in which the protestant's wells are located.

3. The anticipated retention of all waters originating upstream from the dam during the period of "fill up" of the reservoir is expected to result in the greatest decline of ground-water levels that is likely to occur in the subject reach of the canyon in response to reservoir operations. It is further expected that:

(a) The decline of ground-water levels that will occur in response to this phase of reservoir operations will begin a short distance below the site of the dam immediately following the beginning of reservoir filling and then slowly progress at a more or less continuous rate to successive points in the canyon downstream from the dam;

(b) Measurable water-level declines may be evident in some of the protestant's wells within two (2) to five (5) years after the filling of the reservoir begins;

(c) A significant part of the total water-level decline to be experienced at any particular well will occur within a matter of a few months following the initial arrival of the effects of reservoir filling at the site of that well;

(d) The period during which water levels will continue to decline at any particular well will be approximately equal to the period of time required to fill the reservoir; and

(e) The extent to which the water table will decline at any particular well is not expected to exceed two (2) feet.

4. The period during which ground-water levels are expected to decline in response to reservoir filling is expected to be followed by a period during which ground-water levels will at least partially recover in response to the seepage of impounded water through the abutments and foundation of the dam during and following the period of initial "fill up" of the reservoir and the anticipated infiltration of significant quantities of water into permeable alluvium on the floor of the canyon during periods of increased streamflow resulting from the release and/or spilling of excess inflow after the reservoir is filled. It is further expected that ground-water levels will continue to recover until a new state of approximate equilibrium is established between the flow of the creek and the ground-water reservoir in the vicinity of the creek for conditions of normal reservoir operation. A partial recovery of normal perennial creek flow will accompany this expected partial recovery of ground-water levels.

5. The net decline of ground-water levels between the beginning of filling at the proposed reservoir and the time of establishment of a new state of approximate equilibrium between the flow of the creek and the ground-water reservoir in the vicinity of the creek for conditions of normal reservoir operations is not expected to exceed one (1) foot; and

6. It would appear unlikely that the construction and subsequent operation of the proposed reservoir will at any time reduce the inflow of water to the creek channel to the extent that the present perennial

reach of the creek will become dry for more than a few hundred feet upstream from the present point of termination of perennial flow.

Most of the net reduction of ground-water storage and normal perennial creek flow that is expected to occur in the reach of the canyon downstream from the dam in response to continued normal reservoir operations will be attributable to evaporation loss at the reservoir. The average annual loss of water that will be actually experienced in this reach of the canyon in response to reservoir operations, however, will probably be somewhat less than the average annual evaporation from the reservoir because:

1. A small but relatively significant part of the water that will be lost to evaporation at the reservoir will represent water that normally would have been evaporated or transpired from the area that will be occupied by the reservoir -- as much as several tens of acre feet of water per annum is already being evaporated or transpired from this area.
2. At least a part of the evaporation loss from the reservoir will consist of water impounded from flood flows, which, at the time of their occurrence, would have exceeded, either in terms of rate of flow or total volume, the infiltration and/or water-storing capacity of the shallow ground-water reservoir in the vicinity of the creek -- such flows, without the presence of an impoundment facility, would normally have been passed to areas downstream from the subject reach of the canyon without any resulting increase in either the normal perennial flow of the creek or the quantity of ground water in storage in the vicinity of the creek that might eventually become available to pumping at the protestant's wells; and

3. The anticipated reduction of ground-water storage and normal perennial creek flow in the reach of the canyon downstream from the dam in response to the expected net effective loss of water to evaporation at the reservoir will only be effected to the extent to which this loss of water will exceed the seepage loss from the reservoir.

The maximum average annual loss of water that is likely to be experienced in the reach of the canyon downstream from the dam in response to normal reservoir operations is thus expected to be approximately equal to the quantity

$$a - (b + c + d)$$

in which "a" is the expected average annual evaporation loss from the reservoir, "b" is the average annual evapotranspiration loss from the area that will be inundated by water when the reservoir is filled, "c" is that part of the average annual evaporation loss from the reservoir that will consist of water impounded from flood flows such as have been previously described, and "d" is the average annual rate of seepage of impounded water through the abutments and foundation of the dam.

No measurable change in ground-water levels is expected to occur in any deep aquifers of the region in response to either beginning or continuing the operation of the proposed reservoir.