AQUIFER TEST

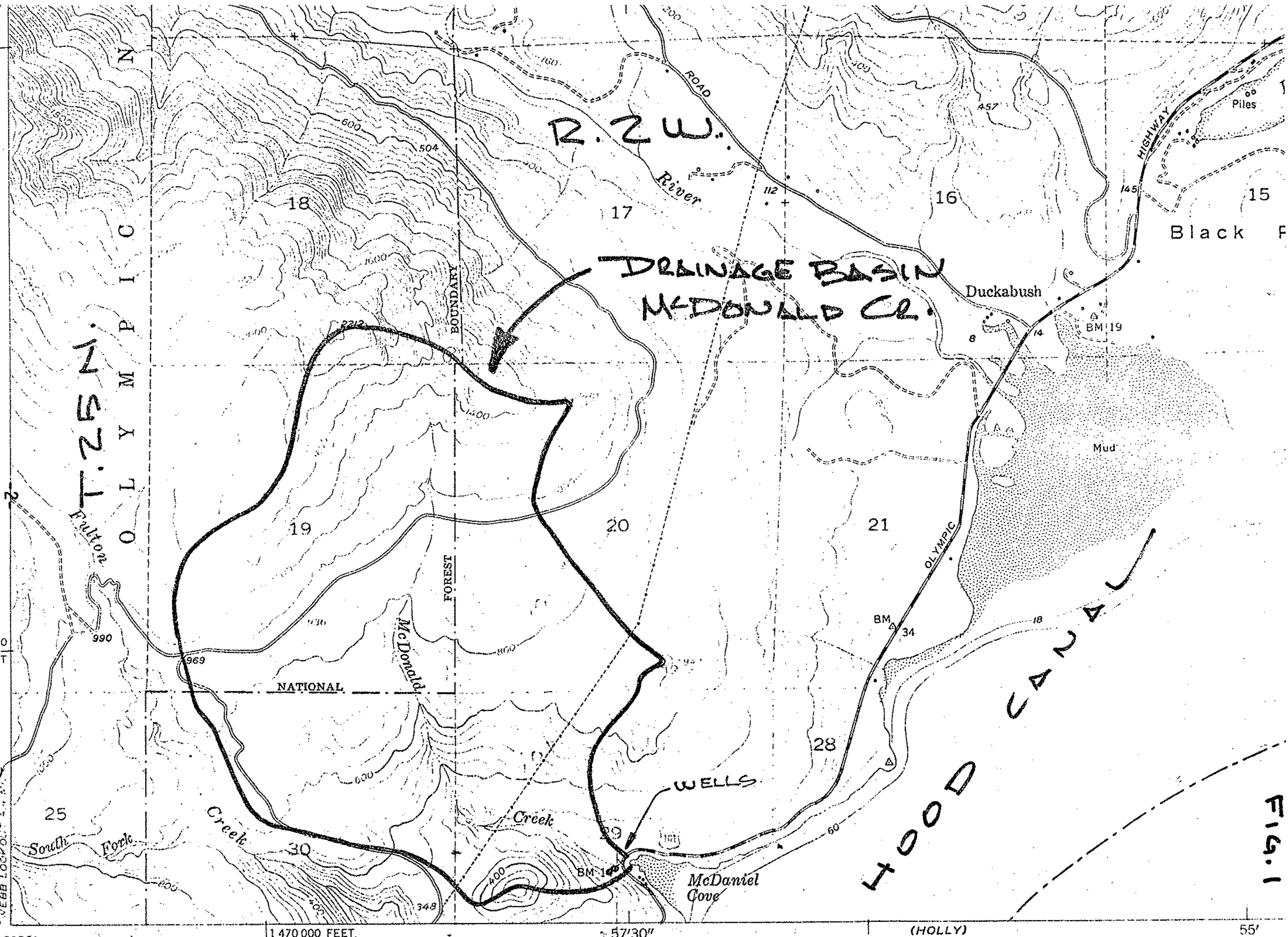
McDONALD CREEK AREA, JEFFERSON COUNTY, WASHINGTON

This test was conducted to satisfy stipulations set forth in Report of Examination, Ground Water Application No. G2-21036, which was prepared by Walter Bergstrom, Southwest Regional Office, Department of Ecology. The purpose of the test was to determine the extent of interference resulting from pumping of the applicant's well upon a nearby well.

The area of interest, which is near Hood Canal, is five miles south of Brinnon in Jefferson County (Figure 1).

Geology - Hydrology

The two wells (Jefferson County Water District No. 2 and Paradise Cove Club, Inc.) were drilled in Quaternary alluvial deposits consisting of sand, pebble to boulder gravels, and, reportedly, lenses of clay. The water in the sediments was believed to be in hydraulic continuity with McDonald Creek which flows in a channel developed in gravels about 50 feet from the two wells. The alluviated stream valley is about 100 to 150 feet wide at the site. The adjacent hills consist of volcanics and rise steeply from the relatively flat valley floor. The volcanics have some permeability because of jointing and fracturing. However, compared to the porous, open-faced gravels overlying them, they are relatively



Mapped, edited, and published by the Geological Survey

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impermeable and are a barrier to the lateral and downward migration of surface waters as well as the ground waters contained in the gravel aquifer.

During some years, the creek bed is dry near the wells but contains water a short distance upstream. The creek is influenced by tidal fluctuations and during high tides the water rises in the streambed beneath the highway bridge which is about 150 feet downstream from the point of the creek nearest the two wells.

Recharge of the gravel aquifer is from precipitation. Some water percolates downward through the soil, some moves along the volcanics soil interface of the aquifer, and some enters the ground-water system via surface-water flow.

Aquifer Testing

The two wells used in the test are 39.2 feet apart. A third well located a few feet east of the Paradise Cove well was not in use 12 hours prior to nor during the test. There are no other wells in the immediate area nor in the aquifer of concern.

The Paradise Cove Club (PCC) well was drilled in May 1956 to a depth of 28 feet. According to the drilling report, sand and gravel with boulders (0 to 10 feet), cemented gravel with clay lenses (10 to 24

feet), and gravel (24 to 28 feet) were encountered. Eight-inch casing was installed without perforations from land surface to 28 feet. There is a five-horsepower centrifugal multistage pump. The Jefferson County Water District No. 2 well (JCWD No. 2) was drilled in 1975 to 26 feet (reported) and a six-inch casing with no perforations was installed to 22 feet. No driller's report is presently available, but a lithology similar to that encountered in PCC was reported. At the time of the test, two 1.5 horsepower centrifugal pumps were installed at the pump site. The well had not been used.

After 12+ hours of no pumping and before the aquifer test was initiated, water levels in the two wells were measured. Subsequently, altitudes of the measuring points of each of the wells and of the water surface in the stream were determined and tied into a bench mark located at the northwestern corner of the highway bridge. The altitudes are: Bench mark - +13.871 feet MSL (mean sea level); PCC well - TC (top of casing) +9.182 feet (MSL); JCWD No. 2 - TC +10.042 feet (MSL); and McDonald Creek at nearest point to wells - surface of water +7.012 feet (MSL). The static water level in the PCC well was 5.04 feet below TC and its altitude was +4.142 feet (MSL). The static water level in the JCWD No. 2 well was 6.01 feet below TC and its altitude was 4.032 feet (MSL).

From the above measurements, it is evident that the water level in the stream is higher than the water level in the two wells and if the stream water and the ground water are interconnected as was suspected, the stream under present conditions recharges the aquifer.

At 1015 hours on October 1, 1975, the pump at JCWD No. 2 was started at a discharge rate of 30 gallons per minute (GPM). This was determined by timing the filling of a container of known volume. An immediate drawdown was noted at the pumped well - 4.02 feet below TC after 30 seconds and 5.11 feet after 3 minutes. In the observation well (PCC) 39.2 feet away, an immediate effect was measured - 0.15 foot after 20 seconds and 0.5 foot after 3.5 minutes. After these levels were reached, no additional drawdown was noted. Because of the low volume of discharge (30 GPM), the pump was shut off after 17 minutes of pumping. The water levels in the wells recovered to the original static level within about 5 minutes.

The five horsepower pump at the PCC well was started at 1120 hours and water was discharged at 46 GPM. The maximum decline as a result of withdrawal at the pumped well (2.08 feet), and the maximum drawdown (1.15 feet) at the observation well (JCWD No. 2) were reached after 100 minutes.

It became apparent after two to three hours of pumping that the tidal fluctuations in Hood Canal were affecting the water levels in the wells. With incoming tides the water in the aquifer and McDonald Creek is dammed by the salt water and the water level in the aquifer, as measured in the wells, rises. During an outgoing tide the damming effect is removed and the water level in the aquifer (wells) drops. This is graphically protrayed in Figure 2.

At 1230 hours on October 2, 1975, 25 hours 10 minutes after the test was begun, the pump was shut off and recovery measurements were made

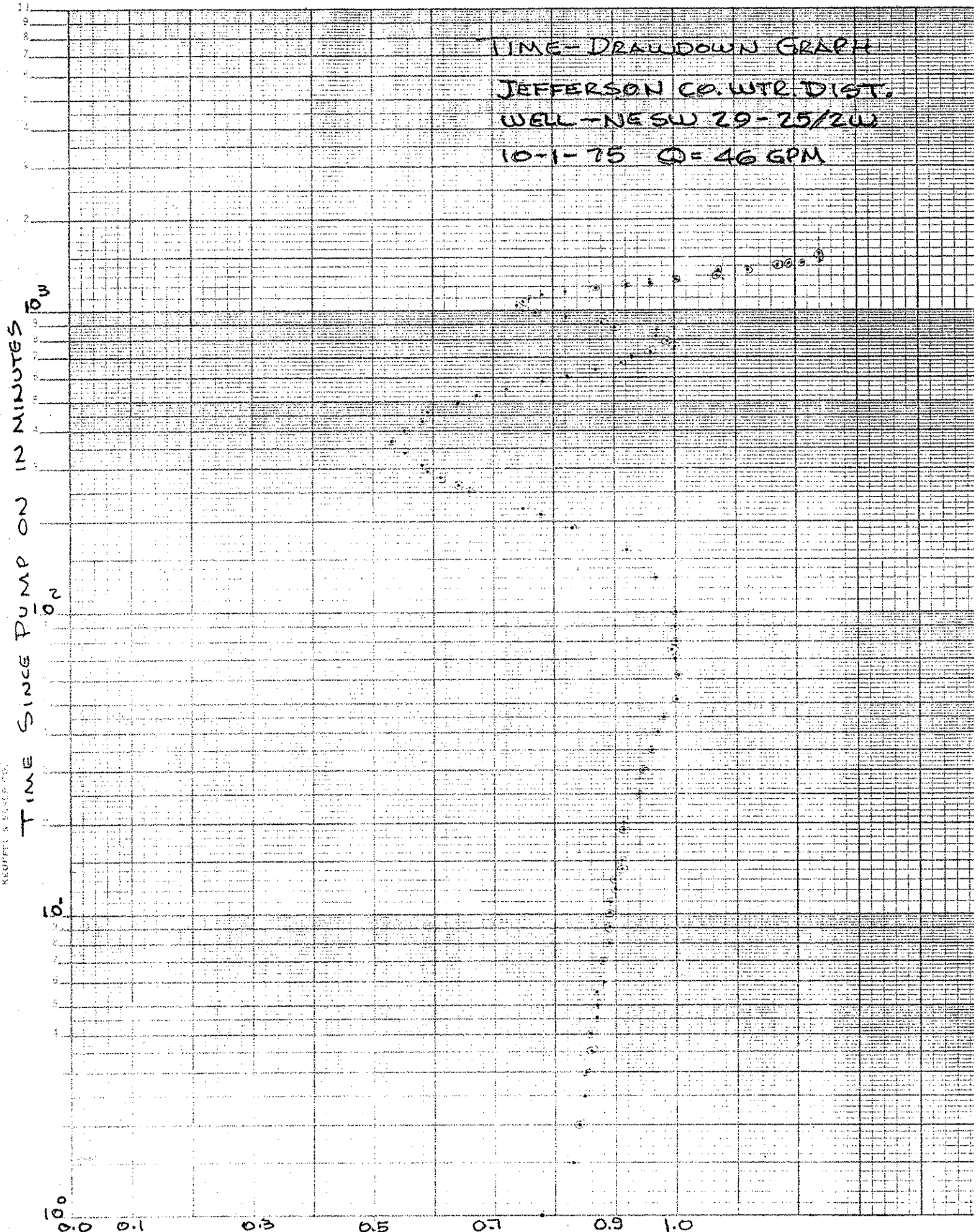
TIME-DRAWDOWN GRAPH
JEFFERSON CO. WTR. DIST.
WELL--NESW 29-2S/2W
10-1-75 Q=46 GPM
TIME SINCE PUMP ON IN MINUTES
10^3
10^2
10
10^0
0.0
0.1
0.3
0.5
0.7
0.9
1.0
DRAWDOWN IN FEET

FIG. 2

for 11.5 hours. Within 0.5 minute, the water level in PCC had recovered 1.78 feet of 2.28 feet of gross drawdown recorded at the cessation of pumping and after 2 minutes the recovery was 2 feet. The water level in JCWD No. 2 was up 0.34 foot after 0.33 minute (gross drawdown was 1.24 feet) and 0.85 foot after 2 minutes. As during the pumping phase, the effects of tides manifested themselves.

The tide charts and fluctuations in water levels in the well during the latter part of the drawdown and recovery periods, when it is believed the water levels were affected solely by tidal movement, were compared. The highs and lows in the wells lag corresponding tides by 2 to 3 hours. A one-foot change in the tide results in a 0.05 foot change in the water levels in the wells.

The time-drawdown graph for the observation well was corrected and a curve was prepared for comparison with the Theis type curve. Values for $T = 5.3 \times 10^{4}$ gallons per day per foot and $S = 7.6 \times 10^{-6}$ which are very approximate and probably conservative, i.e., low were determined and time - distance - drawdown data were calculated. These are probably applicable within the stream valley of McDonald Creek provided the width of the gravels (Quaternary) is the same as at the test site and the stream is in hydraulic continuity with the aquifer.

	TIME (DAYS)	DRAWDOWN (FEET)
One foot	1	2.1
from	10	2.4
pumped	100	2.6
well	1000	2.8
Ten feet	1	1.7
from	10	1.9
pumped	100	2.1
well	1000	2.4
One hundred feet	1	1.2
from	10	1.4
pumped	100	1.6
well	1000	1.9

Because of the superimposition of the effects of the tides on the water level fluctuations resulting solely as a result of pumping, subtleties reflected in the time-drawdown graph such as boundary conditions are masked.

Because of the lack of screens or slots in the casings of the wells (point intake-opening in end of casing), vertical components are induced, the measured drawdown is excessive and is not a true representation of aquifer conditions.

Summary and Conclusions

The two wells are developed in a sand and gravel (alluvial) aquifer which is in hydraulic continuity with the nearby stream, McDonald Creek. The aquifer and stream near the wells are influenced by the rise and fall of the tides in nearby Hood Canal. The static water level in the wells is about 4 feet above mean sea level. The maxi-

mum drawdown in the well which was pumped for 25 hours at 46 gallons per minute was 2 feet. This level was reached after 2 minutes of pumping. The water level in the JCWD No. 2 well, 39.2 feet away, was drawn down 1.2 feet as a result of pumping. This level was reached after 2 hours and remained constant during the remainder of the test.

Prior to this test, the pumping of the Jefferson County Water District well at a rate of 30 GPM resulted in a drawdown of 5.1 feet, and 0.5 foot at the Paradise Cove well. This discrepancy in drawdowns (i.e., greater drawdown (5.1 feet) in the Jefferson County Water District well while pumping at a lower quantity (30 GPM) than the drawdown (2.1 feet) in the Paradise Cove well while pumping at 46 GPM) is probably due to the lack of development of the former well.

Under existing conditions, that is, with the two wells under discussion and a third well, which is used sparingly, there is little chance of sea water encroachment and resultant salt water contamination of the aquifer. However, further exploitation, such as increased pumpage from the existing wells, the establishment of new wells, and/or upstream diversion of McDonald Creek, should be thoroughly analyzed to determine the effects of the additional withdrawal on the fresh water/salt water relationship.