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Dreger Observation Well Near Creston, Washington

December, 1984

State of Washington

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Office Report #ER843

Department of Ecology

Andrea Beatty Riniker
Director

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State of Washington
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Abstract

The 1,233-foot Dreger observation well in Lincoln County was begun in the mid-1970s with irrigation the intended use. Drilling continued intermittently (by the owner) until 1982 when the well was deepened from 780 feet to 1,233 feet by a drilling contractor.

With a static water level of only 548 feet and limited production capability, the well was abandoned in 1983.

Acquisition of the Dreger well is part of the ongoing Department of Ecology and United States Geological Survey program to monitor ground water levels in eastern Washington. The well is on the southeast boundary of the Sinking Creek watershed--an area that has received Department attention recently because of reports of well-to-well and well-to-surface water interference. The well is nine miles south of Creston, Washington.

The well was drilled through the Wanapum and into the Grande Ronde Basalts.

Six piezometers were installed in the Dreger well to measure water levels in six identified aquifers penetrated by the well.

Key words for indexing : basalt, ground water, observation wells

Introduction

The Dreger observation well report provides data on stratigraphy and ground water fluctuations in an area where well interference is reported. Additionally, water withdrawals are said to be interfering with surface water flows (including springs) in the Sinking Creek watershed.

The well is one of 18 test/observation wells in eastern Washington (fig. 1) drilled to identify geologic horizons and aquifers. Some wells are fitted with piezometers for monitoring water-level fluctuations. The test/observation well program is designed to help the Department of Ecology manage Washington's public ground waters.

The program is financed by the United States Geological Survey (USGS) and the Washington State Department of Ecology (WDOE) and is part of a continuing cooperative program to conduct surface and ground water resource investigations in Washington.

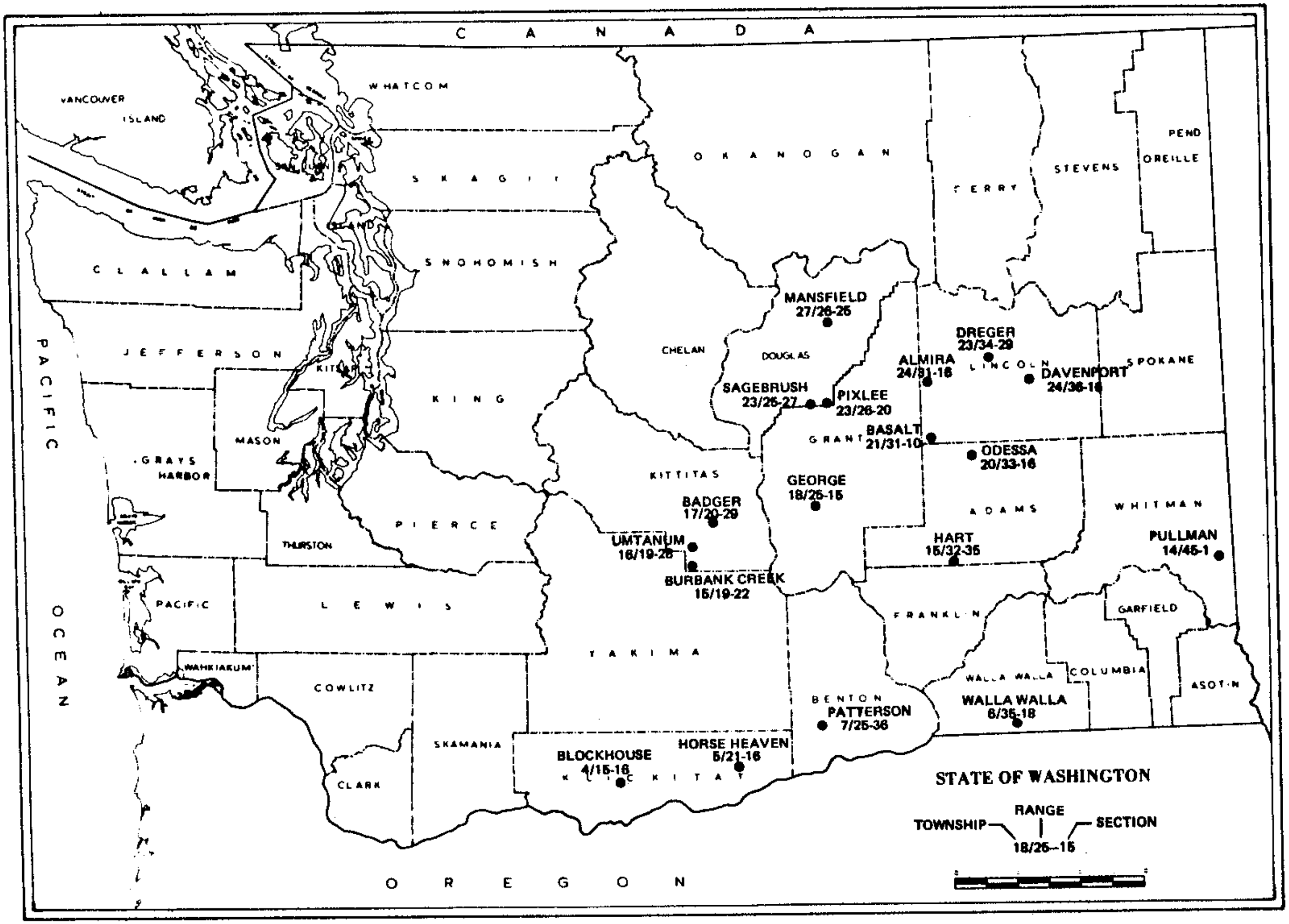

Figure 1. TEST/OBSERVATION WELLS IN EASTERN WASHINGTON.

Background

Major developments for ground water irrigation of cereal grain crops in eastern Washington began in the late 1950s. By mid-1960, ground water used for irrigation had increased dramatically and ground-water levels were decreasing in areas of extensive pumping.

The Department's ground-water level monitoring program includes 500 wells that have been measured periodically since 1967. The program includes monitoring public and private wells, drilling test/observation wells, and obtaining easements for use of abandoned wells.

The USGS designs and contracts the piezometer installation as their portion of the cooperative WDOE/USGS program.

The agreement between Dreger and the USGS for use of his well will last until July 1990, when it can either be extended or ended.

Location of Observation Well

The Dreger observation well is located almost nine miles south of the Town of Creston, WA (Fig. 2). Specific location: 475 feet south, 300 feet west from the east ¼ corner of Section 29 -- within the NE¼NE¼SE¼ of Section 29, T. 25 N., R. 34 E.W.M., Lincoln County. Land surface elevation at the well collar: estimated at 2,285 feet, based upon the USGS Creston Butte 7½-minute quadrangle. Latitude: 47°38'00"; longitude: 118°32'53".

The well is near the southeast boundary of the Sinking Creek Watershed, outside of the boundary. Six other wells are within a 1½-mile radius, northwest and west of the observation well - (four are for stockwater, two for irrigation). Richard Dreger owns all seven wells.

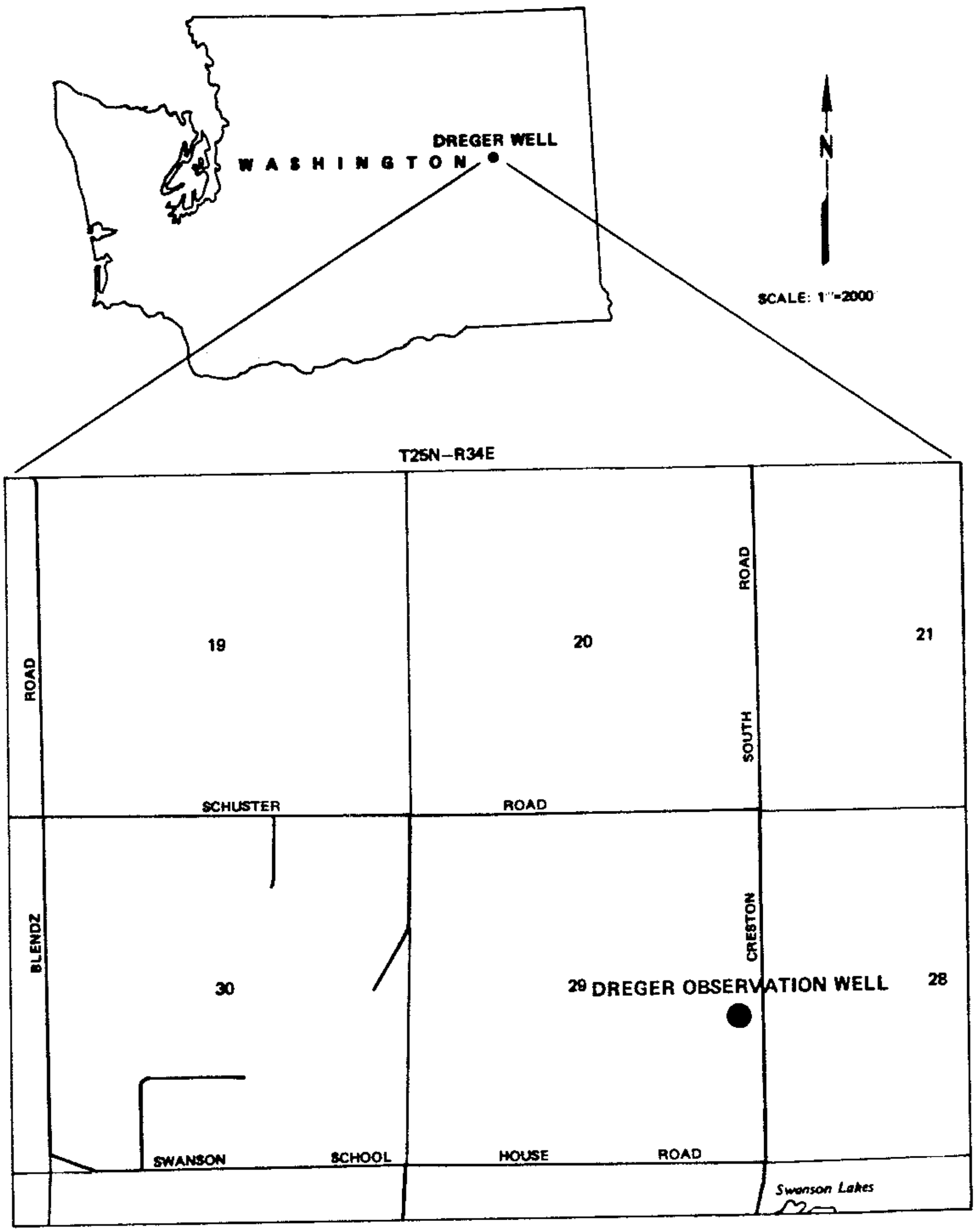

Figure 2. LOCATION OF DREGER OBSERVATION WELL.

Geographic and Climatic Setting

The land surface around the Dreger observation well slopes 2-5 percent to the southwest. Local topography typically is channeled scablands: basalt exposures, and sediment-filled coulees which disect broad gravelly silt plains. Surface geology is wind-blown (eolian) silt deposits, gravel bars and terraces, basalt outcrop, and pre-basalt igneous basement rocks to the north (in the vicinity of Creston).

The climate is semiarid with an average annual precipitation of approximately 13 inches. Almost 50 percent of the precipitation falls from October through January (75 percent from October through March). Total precipitation for the two driest months, July and August, is 6 percent of the annual total (0.79 inches).

Additionally, the Wilbur weather bureau station data indicate a loss of water by evaporation of approximately 40 inches annually from surface water bodies. Potential water loss from the watershed by evapotranspiration is estimated to be 20-25 inches.

The average annual minimum and maximum temperature is 24.5°F in January and 76.6°F in July.

Geologic Setting

The well site is almost 18 miles south of the northern border of the Columbia Basalt Physiographic Province. The northern boundary is the Spokane and Columbia Rivers. Surface soils in the vicinity of the well are classified as Benco cobbly silt loam series and Benge silt loam series--with slopes of 0-15 percent. Soil depths may reach 60 inches, but are generally less. Sand and gravel flood deposits underlie the silt.

Underlying the surface sediments is basalt to an unknown depth. The basalt is made up of an undetermined number of generally horizontal flows, locally separated by interflow zones of broken and/or weathered basalt, and occasional sedimentary deposits of sand and gravel.

Geologic Setting (Continued)

Creston Butte, located 7½ miles north of the well, is pre-Tertiary (Mesozoic) quartzite. The basalt flows make up a normal on-lap contact around the base of the steptoe. The quartzite is believed to underlie the basalt (at an unknown depth) in the area of the Dreger well. However, no wells have penetrated the basalt to the underlying basement rocks.

The regional stratigraphy for the Columbia Plateau (defined by Swanson and others, 1979a) is shown in Figure 3. Studies indicate the Saddle Mountains Formation and Mabton interbed are not present in this area.

Generally water is found and transmitted in the broken, vesicular, or scoriaceious portion of individual flows. Generally the tops of the flows contain vesicles, cinder, and rubble: all as part of the scoria, and jointing, and fractures which are caused by rapid cooling of the rock.

Bottoms of the flows contain baked zones and, where the flow was deposited in water, pillows of basalt occur which have interconnected cracks, joints, and/or broken zones. The centers of the flows are generally massive with vertical jointing caused by the shrinking of the rock during cooling. The jointing provides an interconnection between the tops and the bottoms of flows. Individual flows are from 20-200 feet thick in the area near the test well.

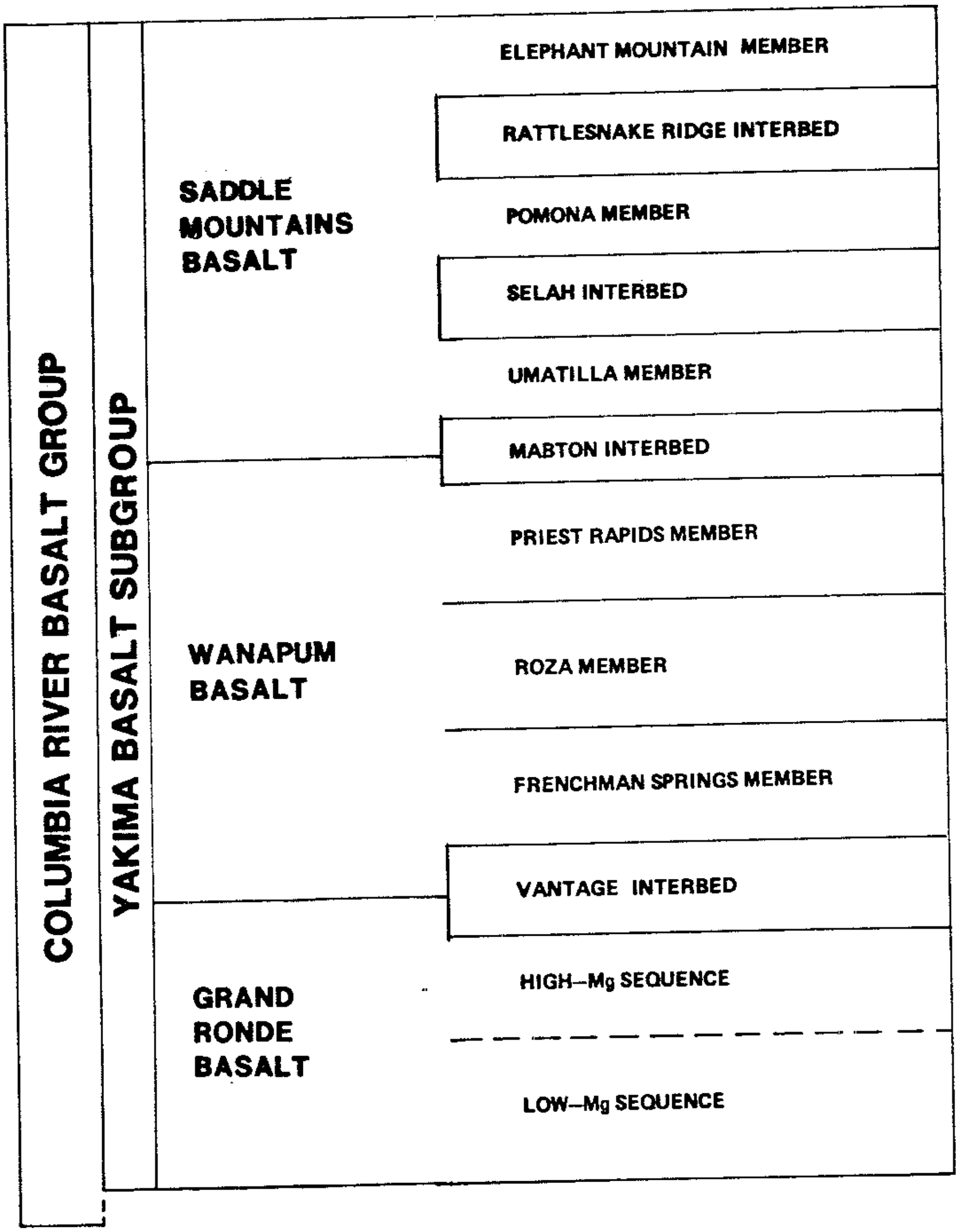

Figure 3. STRATIGRAPHIC TERMINOLOGY (AFTER SWANSON AND OTHERS, 1979a).

Well Construction

The Dreger observation well was drilled as authorized by State Permit No. G3-00914P. The permit authorized 1,230 gallons per minute (454 acre-feet per year) for the irrigation of 123 acres within parts of Sec. 29 and 30, T. 25 N., R. 34 E.W.M.

Drilling was begun in the mid-1970s by Richard Dreger using his own cable tool drill rig. Drilling activities were sporadic until August 1982. (At that time, the well was 780 feet deep.)

Dreger did not keep any records of this drilling activity. He did say that production tests were conducted at depths of 560 feet and 750 feet. The test at 560 feet in September 1977 indicated there was not enough water to fill the pump column. At a depth of 750 feet, a production test in September 1978 indicated approximately 100 gallons per minute. A 10-inch steel liner was installed from 476 to 700 feet.

During August and September 1982, the well was deepened to 1,225 feet by Larry Webley of L&L Drilling, Inc., of Moses Lake, WA.

The water well report submitted by L&L Drilling, appears as Figure 4. The log indicates basalt from 780 feet to the total depth of 1,225 feet, with reported sedimentary interbeds at 1,053 to 1,060 (sand) and 1,090 to 1,093 (clay). At a depth of 1,225 feet, the static water level was 624 feet below land surface.

Because of the deep static water level and limited production capacity, the well was abandoned as a possible irrigation well.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No 10076
Permit No G3-00941P

(1) OWNER: Name Richard Dreger Address Route 1, Box 11 - Creston, WA 99117

(2) LOCATION OF WELL: County Lincoln — NE ¼ SE ¼ Sec 29 T 25 N R 34E W.M.

Bearing and distance from section or subdivision corner 475 ft. south, 300 ft. west from E½ corner of Sec. 29

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ......
New well ☐ Deepened ☒ Reconditioned ☒
Method: Dug ☐ Bored ☐ Cable ☐ Driven ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 9 7/8 inches
Drilled 445 ft. Depth of completed well ...... ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 10 " Diam from ...... ft to ...... ft
Threaded ☐ ...... " Diam from ...... ft to ...... ft
Welded ☐ ...... " Diam. from ...... ft. to ...... ft.

Perforations: Yes ☐ No ☒
Type of perforator used ......
SIZE of perforations ...... in by ...... in
...... perforations from ...... ft to ...... ft.
...... perforations from ...... ft to ...... ft.
...... perforations from ...... ft. to ...... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ......
Type ...... Model No. ......
Diam ...... Slot size ...... from ...... ft to ...... ft
Diam. ...... Slot size ...... from ...... ft. to ...... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: ......
Gravel placed from ...... ft. to ...... ft.

Surface seal: Yes ☐ No ☐ To what depth? ...... ft
Material used in seal ......
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ...... Depth of strata ......
Method of sealing strata off ......

(7) PUMP: Manufacturer's Name ......
Type: ...... H.P. ......

(8) WATER LEVELS: Land-surface elevation above mean sea level. 2285 ft.
Static level ...... ft. below top of well Date ......
Artesian pressure ...... lbs. per square inch Date ......
Artesian water is controlled by ...... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? ......
Yield: ...... gal./min. with ...... ft. drawdown after ...... hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ......
Bailer test ...... gal./min with ...... ft. drawdown after ...... hrs.
Artesian flow ...... g.p.m. Date ......
Temperature of water ...... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Basalt, Gray, med. hard	780	847
Basalt, red, porous	847	850
Basalt, Black	850	875
Basalt, Black, med. hard	875	900
Basalt, Black	900	942
Basalt, broken	942	955
Basalt, Black, med. hard	955	965
Basalt, Black, soft	965	975
Basalt, Black	975	1000
Basalt, Black, med. hard	1000	1040
Basalt, Black, soft, porous	1040	1053
Sand, hard, cemented	1053	1060
Basalt, Black, med. hard	1060	1090
Clay, blue	1090	1093
Basalt, Black, porous	1093	1100
Basalt, Black, med. hard	1100	1138
Basalt, Red, porous	1138	1150
Basalt, Black, porous	1150	1160
Basalt, Black, med. hard	1160	1175
Basalt, Black, med. hard, soft seams	1175	1205
Basalt, Black, med. hard	1205	1225

Note: Owner drilled from 0 to 780 feet. No data available.

Work started 8-24 1982. Completed 9-21 1982

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME I & L Drilling, Inc. (Person, firm, or corporation) (Type or print)

Address Route 4, Box 94B Moses Lake, WA

[Signed] Larry Webley (Well Driller)

License No. 0518 Date 9-24 1982

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Lithology

The detailed lithology of the material from land surface to a depth of 780 feet is not known. Based upon well reports for sites located within a mile, some assumptions can be drawn: Unconsolidated silt, sand and gravel make up the zone from land surface to depths ranging from 35-50 feet. Underlying the sediments is basalt of the Columbia Basalt Physiographic Province.

No wells in the general vicinity are known to have penetrated the basalt and into the pre-Tertiary material.

Based upon an interpretation of the geophysical logs for the well, the Wanapum basalt formation is found to a depth of 468 feet. The Vantage interbed found is from 468-500 feet. Below the Vantage lies the Grande Ronde basalt formation.

Geophysical Logging

Geophysical logging of the well by Washington State University, included the gamma gamma, neutron gamma, neutron neutron, natural gamma, caliper, fluid temperature, fluid resistivity, wall rock resistivity, spontaneous potential, and flow meter logs. The logs discussed in this report are shown on Figure 5. The complete set of logs are available from Washington State University, College of Engineering, Geological Engineering Section in Pullman, Washington 99164-3002.

The Keys-MacCary publication (1971) will provide reference to the interpretation of geophysical logging of water wells.

The logs for the Dreger well were run to a depth of 1,233 feet and reviewed with the following observations:

The caliper log shows significant enlargements of the borehole at depths of 180, 300, 410, 780, and 1,080 feet. Relating these points to the neutron gamma log, it is apparent that these points are the interflow zones separating individual basalt flows. The flowmeter log shows cascading water entered the well bore at the interflow zone at 300 feet. The flowmeter log also shows a downhole movement to about 800 feet, at which point the downhole flow increases. This increase at 800 feet is associated with the interflow zone identified on the neutron gamma log. The downhole flow ends in the area of 1,080 feet -- considered a "thief zone" where water leaves the well bore. Below 1,100 feet there is no flow within the well bore.

A 10-inch steel liner was installed from 476-700 feet. We believe the liner was installed because the walls of the bore hole caved in the area of the Vantage interbed (a sedimentary unit composed of fine-grained material).

In summary, the geophysical logging data indicate several interflow zones that yield ground water. Because of the significant head change with depth, a major downhole flow exists with a thief zone at 1,080 feet. The deep static water level is seen in many wells completed in the Grande Ronde Formation.

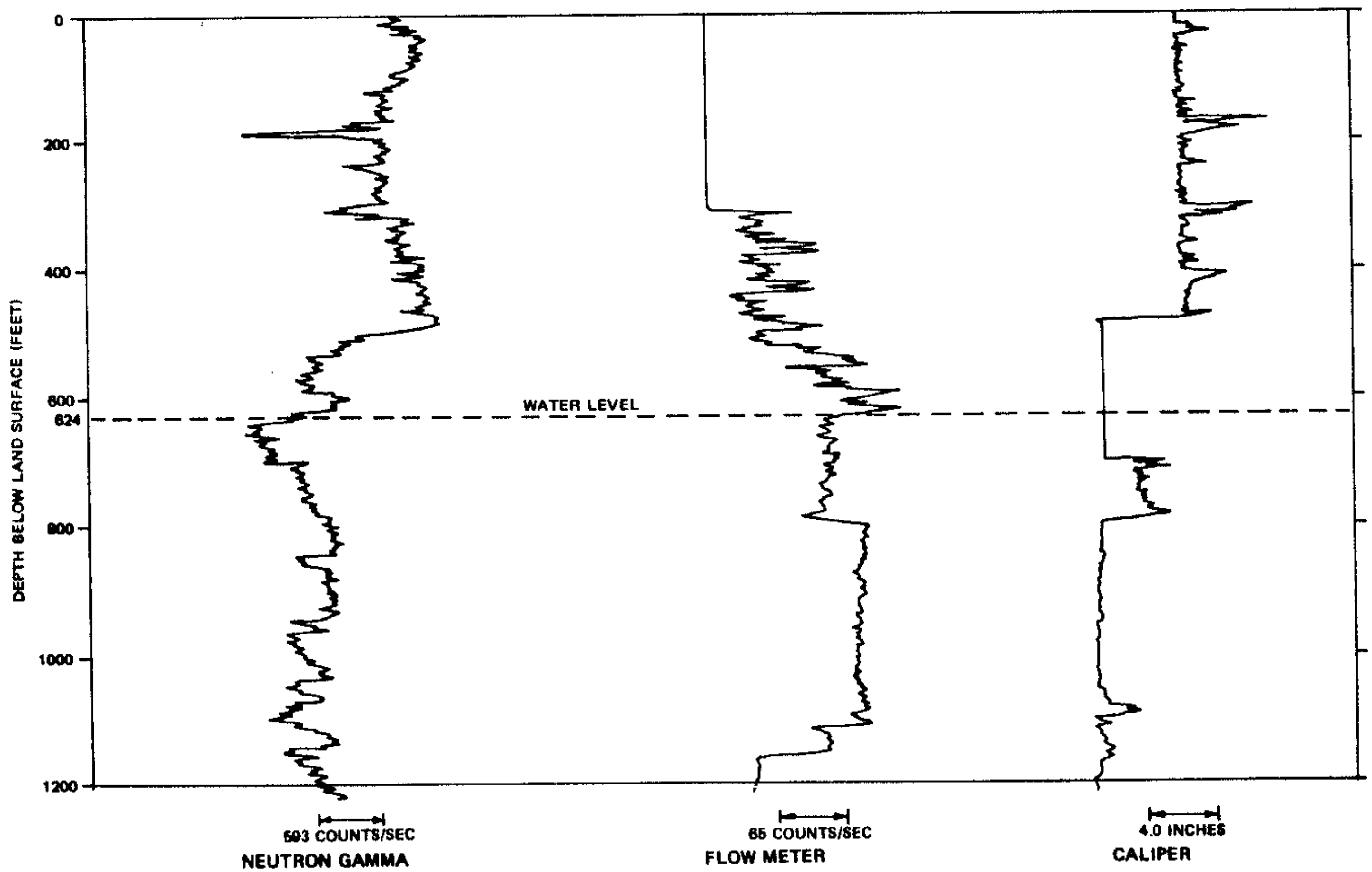

Figure 5. GEOPHYSICAL LOGS.

Piezometers

Piezometers are installed to determine zones of differing head in the multiple aquifers. (A piezometer is a pipe that extends from land surface to a predetermined depth in the well. The lower end of the pipe is open to a water-bearing zone within the borehole and is isolated from water-bearing zones above and below by sealing material.)

Each piezometer allows monitoring of the potentiometric head in the isolated zone. Without piezometers and plugs, the water level in a well represent a composite hydraulic head of all the water-bearing zones open to the well. (Figure 6 shows the installation of the piezometers in the Dreger well.)

The piezometers were installed between September 23 and 29, 1983 by Marlatt Drilling Company of Milton-Freewater, Oregon, under supervision of USGS. The measured depth of the well was 1,233 feet (as compared to a reported total drilled depth of 1,225 feet on the water well report).

Six piezometer pipes were installed using $1\frac{1}{4}$-inch galvanized pipe with a 5-foot stainless steel, wire-wound screen at the bottom of the pipe. Slot size of all screens is 0.060 inch.

Details of the piezometer installation:

Piezometer	Interval Monitored	Plug Depth
J2	1,090 - 1,233	1,080 - 1,090 996 - 1,006
J3	910 - 996	899 - 910 747 - 758
J4*	673 - 747	666 - 673 463 - 478
J5	364 - 463	352 - 364
J6	269 - 352	253 - 259
J7	0 - 253	

* The 5-foot stainless steel screen broke off at 476 feet as the piezometer was being lowered through the 10-inch liner.

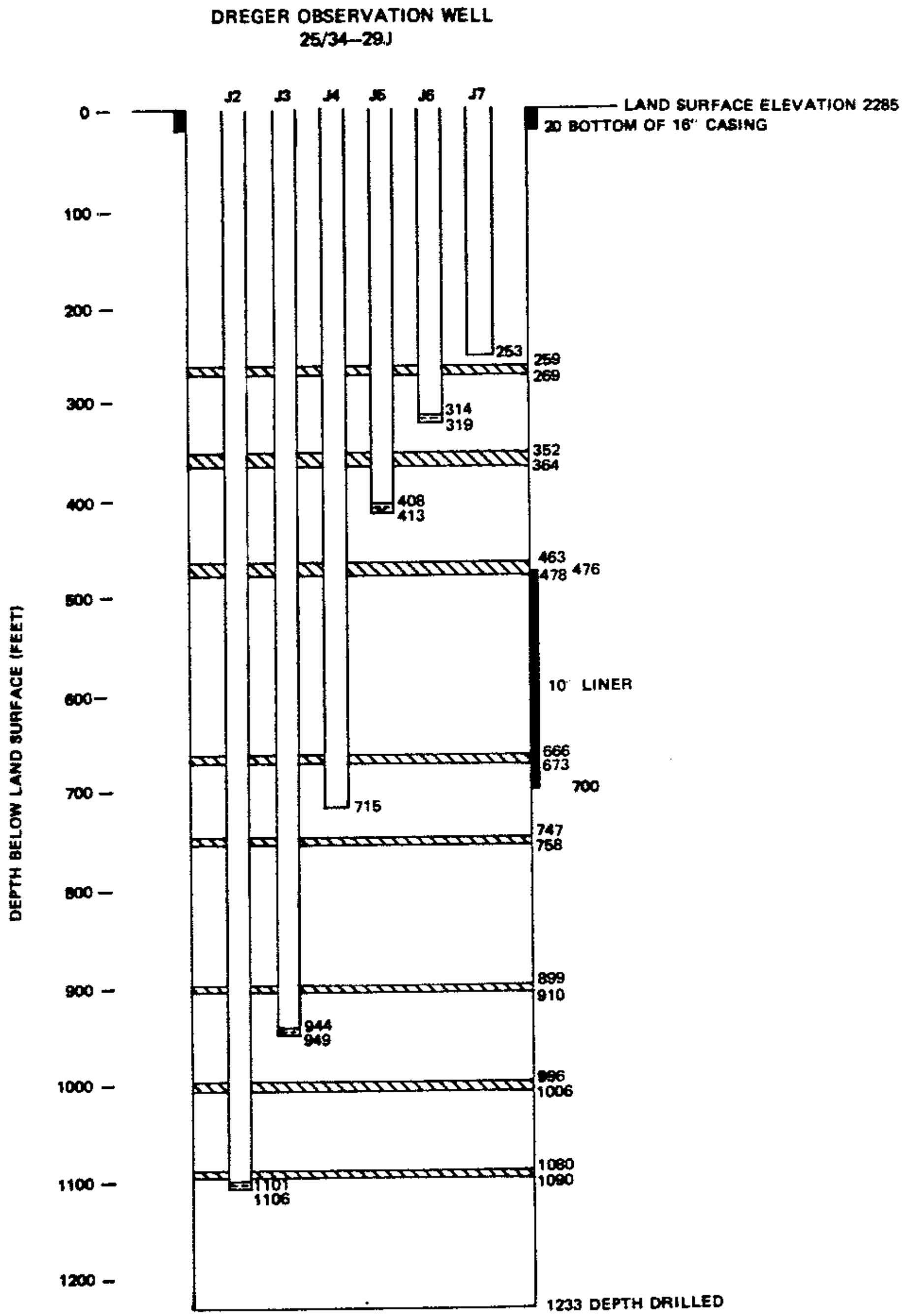

Figure 6. DIAGRAM OF PIEZOMETER INSTALLATION.

Periodic water-level measurements have been made in the piezometers since installation. (See Figure 7)

Water levels in piezometers J2, J3, and J4 were measured until February 1984. In February, for some unknown reason, obtaining additional measurements became impossible. Repeated attempts to obtain measurements have been unsuccessful. Unless the problem can be determined and corrected, future measurements from the three deepest piezometers will not be possible.

These three deepest piezometers reflected little change during the period measurements were obtained. This was as expected since no wells in this depth range closer than four miles.

The intermediate piezometers (J5 and J6) which monitor the zones from 269-463 feet reflect substantial changes during the irrigation season. (The seasonal drawdown exceeds 110 feet between May and September.)

The near-surface piezometer (J7) reflects little seasonal change.

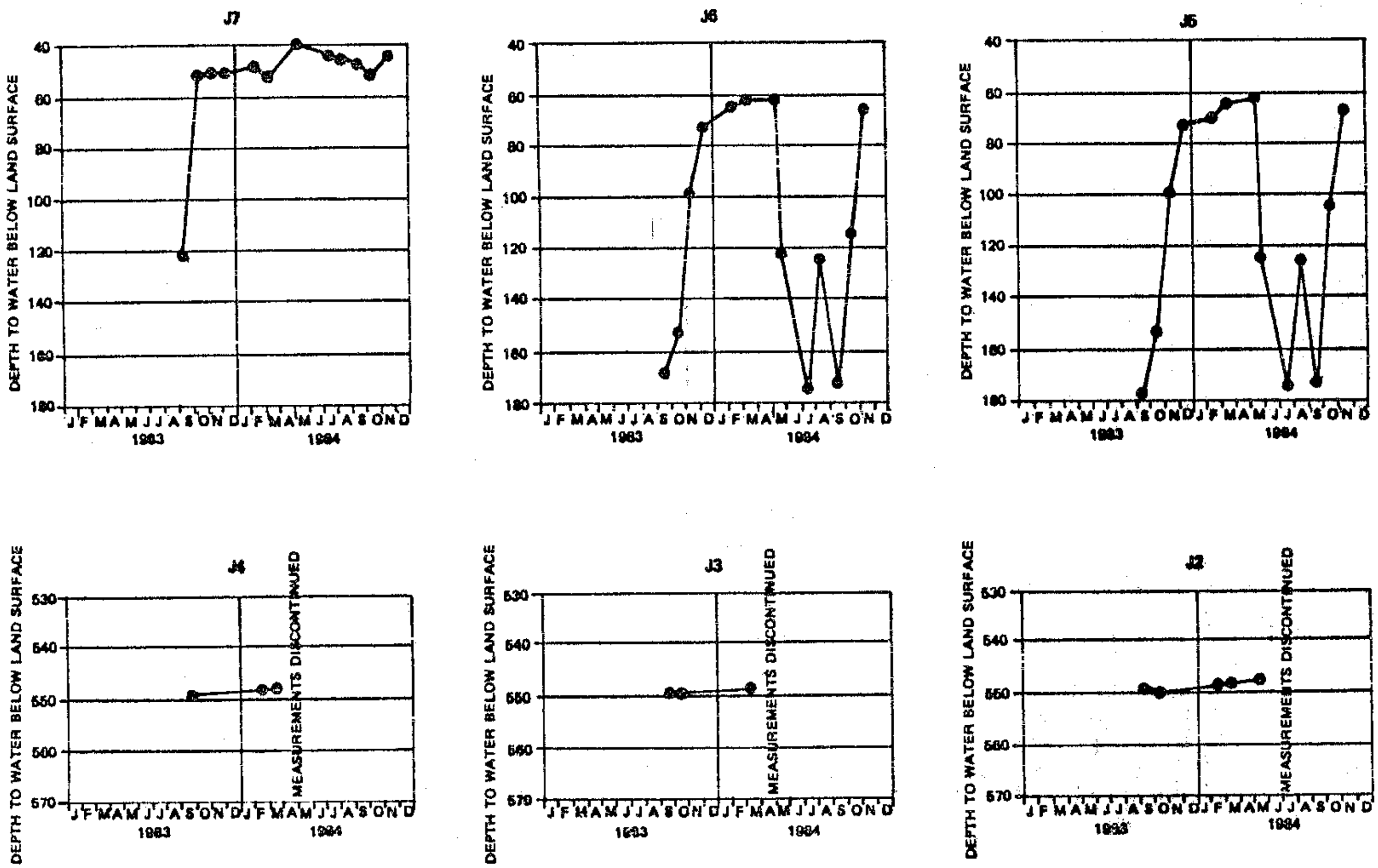

Figure 7. HYDROGRAPHS — PIEZOMETERS 2 THROUGH 7.

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