HYDROGEOLOGY OF THE GREEN BLUFF PLATEAU

SPOKANE COUNTY, WASHINGTON

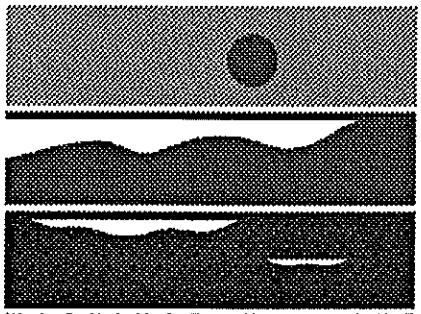
Mark J Ader

March, 1996

OFTR 96-03

SHORELANDS AND WATER RESOURCES PROGRAM

OPEN FILE TECHNICAL REPORT



WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

96190260

HYDROGEOLOGY OF THE GREEN BLUFF PLATEAU SPOKANE COUNTY, WASHINGTON

by

Mark J. Ader

March 1996
OFTR 96-03

This Open-File Technical Report presents the results of a hydrogeologic investigation by the Shorelands and Water Resources Program, Department of Ecology. It is intended as a working document and has received internal Review. This report may be circulated to other Agencies and the Public, but is not a formal Ecology Publication.

Author: _____

Reviewed by: _____

Supervisor: _____

PROPERTY OF STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY LIBRARY

ACKNOWLEDGEMENTS

First and foremost the author wishes to thank Karen Tusa for all her time and effort during the preparation of this document, for without her it would not have been possible. I would like to acknowledge the past project leaders of this study for their hard work. I owe many thanks to John Covert for the time he spent in discussions with me during the course of this project, for his many insightful views and for creation of the final figures. I would also like to thank John Covert and Tom Mackie for their careful review of the manuscript. Finally, I am grateful to Gene Drury and Herman Spangle for their many hours and trips to the field to collect water level and streamflow measurements. Many other Departmental staff have contributed to this study through field work and ideas, to you I say thank you.

ABSTRACT

The Washington State Department of Ecology began a study of the ground water on the Green Bluff Plateau in 1981 based upon complaints of possible ground water declines and well interference. The study determined that one aquifer exists and that it is unconfined and is spatially isolated from sources of regional ground water recharge. Recharge, to the aquifer, is supplied by precipitation on the Green Bluff Plateau. The Green Bluff Aquifer serves as the source for many existing state issued ground water rights. Ground water naturally discharges from the Green Bluff Aquifer to several springs and an unnamed stream which serve as the source waters for several state issued and adjudicated water rights. Natural ground water discharges from the Green Bluff Aquifer also provide baseflow to Deadman Creek, which is closed to further appropriations during the summer (6/1-10/31). On average, ground water levels in the Green Bluff Aquifer declined for the period of record. The declines in the Green Bluff Aquifer are due to the fact that withdrawals and losses from the aquifer exceed recharge.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF APPENDICES

SECTION 1

INTRODUCTION

In the Spring of 1981, in response to complaints of possible ground water declines and well interference problems on the Green Bluff, Spokane County, Washington, the Washington State Department of Ecology (the Department) decided not to make water rights permit decisions until sufficient data was available. A water level monitoring program was initiated on the Green Bluff at this time.

Purpose and Objectives

The purpose of this study is to provide the hydrogeologic and geologic background information necessary to evaluate water rights applications on the Green Bluff Plateau. The objectives are to examine the spatial distribution of the wells and construct a conceptual hydrogeologic model for the Green Bluff Aquifer.

Location and Description of the Study Area

Green Bluff is a localized topographic high located in the northeast portion of the Columbia Basin Physiographic Province (Raisz, 1941). The Green Bluff study area is in northeastern Washington State, located in Spokane County, approximately 15 miles north of Spokane (Figure 1 and Figure 2). The area, which encompasses approximately 4 square miles, is one of several plateaus or bluffs located north of Spokane.

Physiography

The study area is located within the Little Spokane River Watershed (Water Resources Inventory Area (WRIA) 55). Green Bluff is surrounded by Peone Prairie and Deadman Creek on its southern and eastern flanks, Valley Prairie and Little Deep Creek on its northern and western flanks. Mount Spokane (to the northeast of Green Bluff) and Green Bluff are connected by Hay Ridge. Hay Ridge forms a saddle on the northeast side of the bluff in Section 10, T. 27 N., R. 44 E.W.M. Hay Ridge forms the only high ground surrounding the Green Bluff. The Green Bluff plateau rises approximately 400 to 500 feet above the surrounding lowlands and is partially bisected by a perennial stream.

Green Bluff, Spokane County, Wa

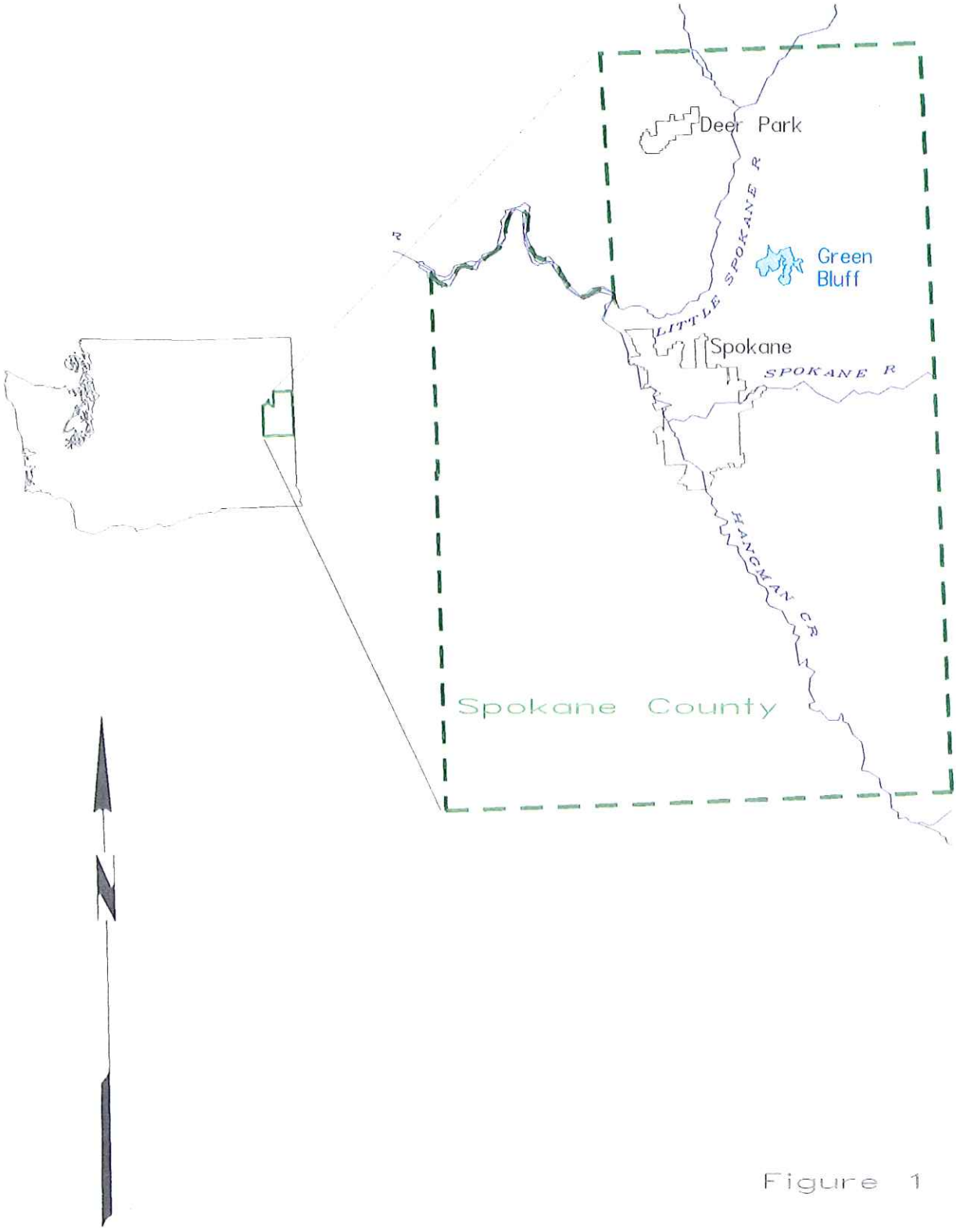
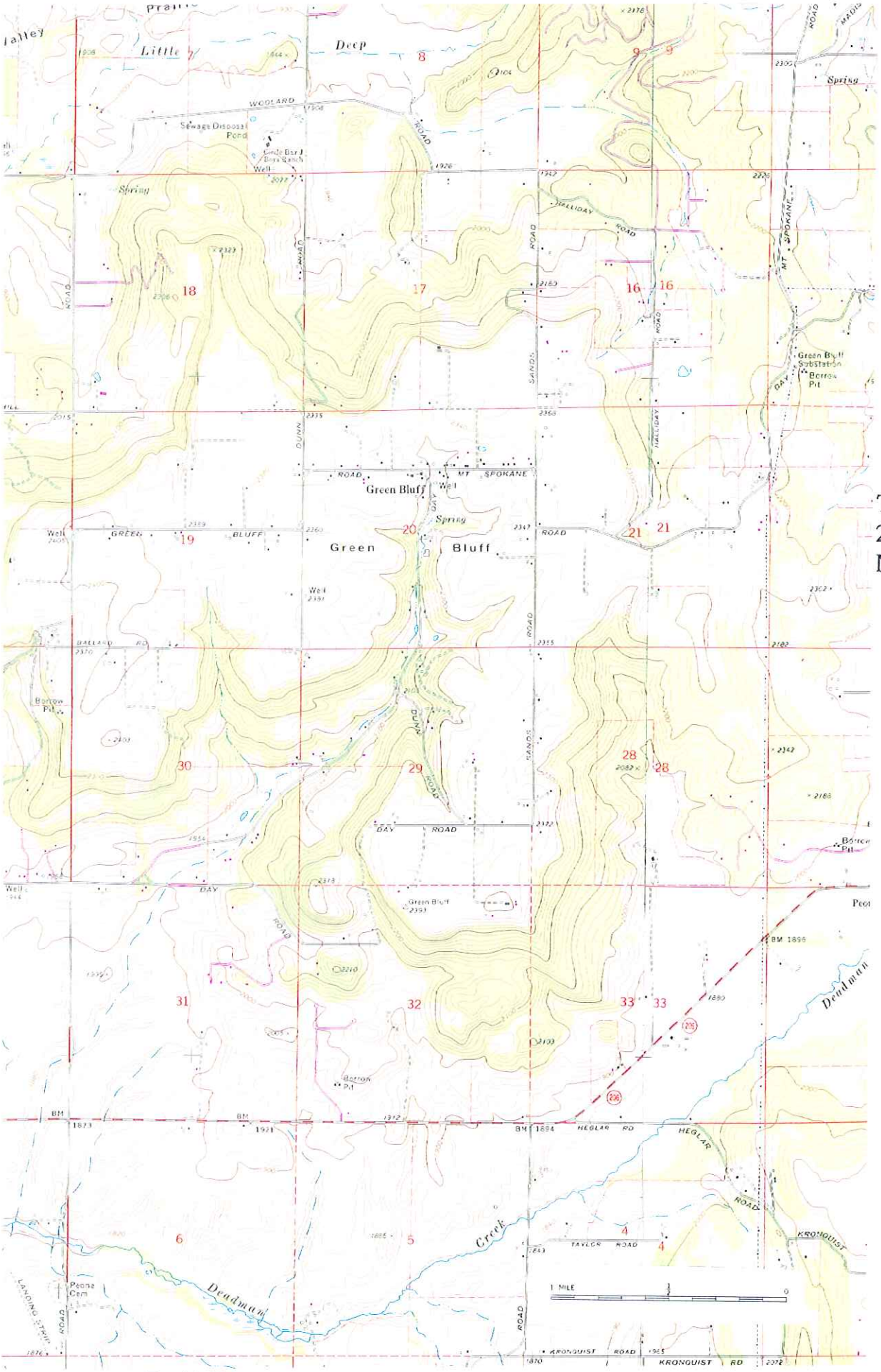


Figure 1



T. 27 N.

R. 44 E.

Figure 2

The stream originates as a spring near the top of a cleft in the south face of the plateau. Above the spring the stream is ephemeral, flowing only during heavy snow melt or runoff events. This stream is tributary to Deadman Creek.

Climate and Precipitation

The climate of the area around the Green Bluff combines the characteristics of a typical mountain/continental climate and a semi-arid climate (Dames and Moore, Inc. et al., 1995). Average yearly precipitation recorded at the Spokane Airport weather station (the closest long term precipitation station) is depicted in figure 3. Average yearly precipitation for the Deer Park weather station during its years of operation is shown in figure 4. Precipitation estimates for the Green Bluff and adjacent areas vary between 16.6 inches at the Spokane Airport (Bauer and Vaccaro, 1990) and 22.9 inches at Deer Park (Hydrosphere, 1994).

Deer Park	22.9	(Hydrosphere, 1994)
Spokane Airport	16.6	(Bauer and Vaccaro, 1990)
Green Bluff	17.5	(Fitzgerald, 1992)
Green Bluff	18	(Bauer and Vaccaro, 1990)
Green Bluff	21	(U. S. D. A., 1968)

General Geology

Green Bluff is composed of Tertiary age sediments that were deposited on pre-Tertiary granitic basement that were in-turn overlain by Tertiary age basalt flow(s) and Pleistocene age loess deposits. The Tertiary age sediments were given the name Latah Formation by Pardee and Bryan (1926) who described the lacustrine and fluvial sediments in the Spokane area. Pardee and Bryan (1926) described the Latah Formation as having been deposited on an irregular surface above granitic and schistose rocks in lakes formed where basalt flows dammed westward flowing drainages. Deposition of the Latah Formation and eruption of the basalt flows of the Columbia River Basalt Group (CRB) occurred contemporaneously as represented by the interfingering and interlayering that is observed along the eastern edges of the Columbia Plateau (Hosterman, 1969; Hosterman et al., 1960). Locally, on the Green Bluff, the Latah Formation is overlain by basalt flow(s) belonging to the Wanapum Formation of the CRB (Drost et al., 1990). The Wanapum Basalts are one of the three formations that comprise the Columbia River Basalt Group (Myers and Price, 1979). According to Myers and Price (1979) the Wanapum Basalts were the second most voluminous of the basalt formations. The Wanapum Basalts erupted from 14.5 to 13.5 million years ago (Reidel and Fecht, 1981) from vents located to the south of the study area, near Lewiston, Idaho. During the Pleistocene the basalt flows were covered by the wind blown silts, or loess, of the Palouse Formation (Easterbrook and Rahm, 1970). Since the deposition of the Palouse Formation, there appears to be no evidence that indicates that Green Bluff has undergone any structural

Spokane Annual Precipitation

Spokane Airport Weather Station

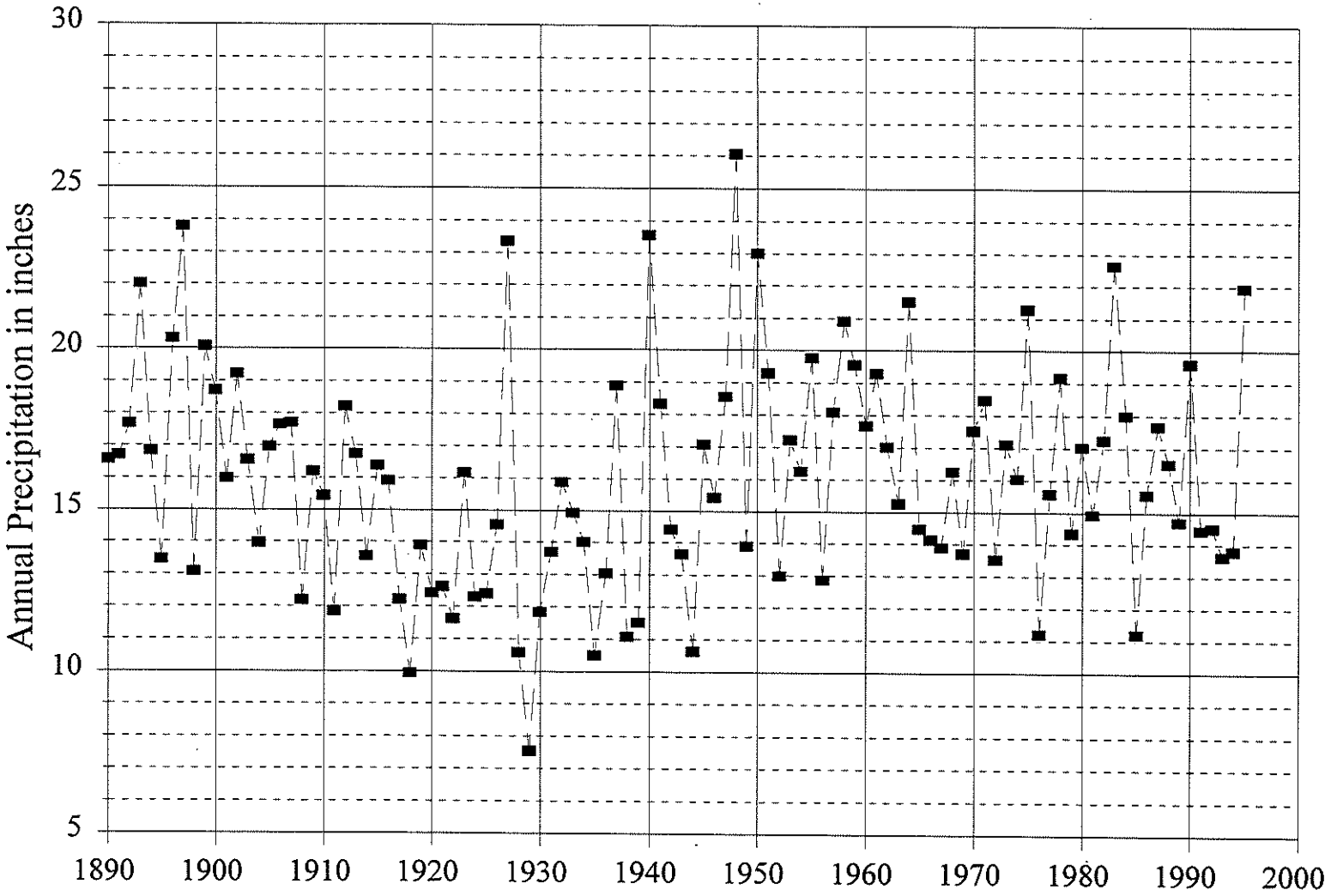


Figure 3

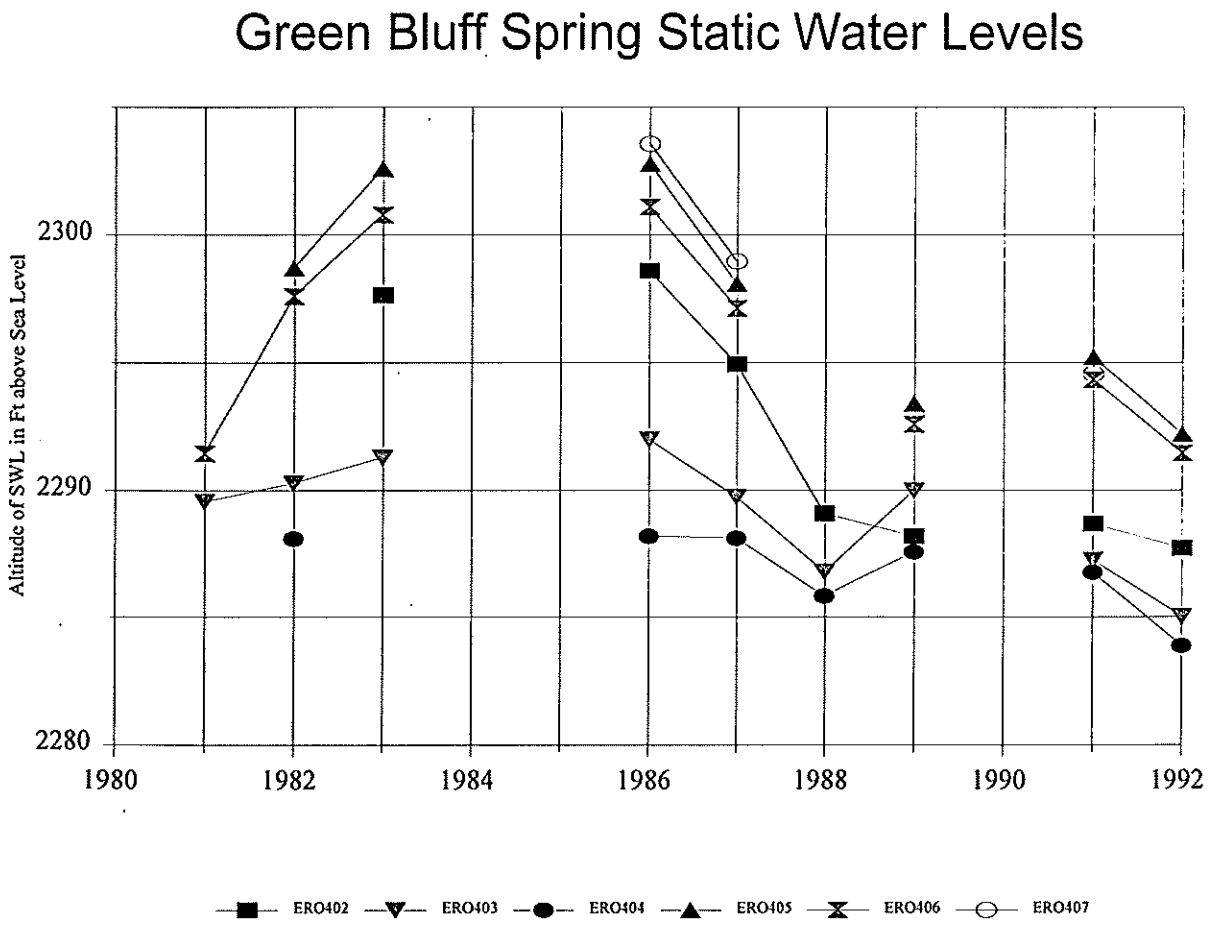

Green Bluff Spring Static Water Levels
Altitude of SWL in Ft above Sea Level
2300
2290
2280
1980
1982
1984
1986
1988
1990
1992
ERO402
ERO403
ERO404
ERO405
ERO406
ERO407

Figure 4

deformation. Today, the individual units are found in much the same place and attitude in which they were deposited. Figure 5 represents a schematic diagram through Green Bluff.

Locally, the surficial sediments overlying the basalt flows of the Wanapum Formation, is the Palouse Formation which is represented by the Green Bluff silt loam (U. S. D. A., 1968). The exact origin of the Palouse Formation has been the subject of debate. The most accepted origin of the Palouse Formation was articulated by Easterbrook and Rahm (1970). According to Easterbrook and Rahm (1970) glacial outwash was deposited behind the Horse Heaven Hills (approximately 160 miles southwest of Green Bluff). The fine grained portion of this deposit was then transported to the northeast by southwesterly winds. This fine grained glacial sediment was probably a major source of successive units of the Palouse Formation during the Pleistocene time (Easterbrook and Rahm, 1970). Hosterman (1969) indicates that volcanic dust from Cascade Range volcanism is a second major source for the sediments of the Palouse Formation. The United States Department of Agriculture, Soil Conservation Service (1968) described the Palouse Formation as being comprised of, "Very deep, medium textured, moderately well drained soils formed from acid igneous glacial till; surface layer contains an admixture of silt and volcanic ash; occur on undulating to rolling upland plateaus."

Green Bluff has been described as one of several basalt-capped plateau erosional remnants in the Spokane area (Griggs, 1976). Although Griggs (1976) did not specifically state that the erosion that formed the Green Bluff and similar structures was due to the Missoula flood episodes as described by Bretz (1959) the author believes this to be the case. Bretz (1959) shows the Spokane area as glaciated and the flood related channels starting at the south and southwest boundaries of the glaciated region. Molenaar (1988), shows the glaciers advancing just to the north of the study area with flood outwash channels in the vicinity of the study area. The outwash channels show that flood type erosion did occur on the paleo-plateau of which Green Bluff, Orchard Bluff, and similar areas exist as remnants. This type of erosion is consistent with that found in the scablands topography described by Bretz (1959). Since the erosion caused by the floods (Bretz, 1959), the Latah Formation has continued to be eroded away, undercutting the more resistant flood basalts. Undercutting of the basalt flows caused large blocks of basalt to become unstable, breakoff, and slide downslope. Basalt blocks, that appear to be out-of-place, can be seen in the present landscape and are apparent in drilling logs. There is no evidence of landslide activity, involving large basalt blocks, in recent time.

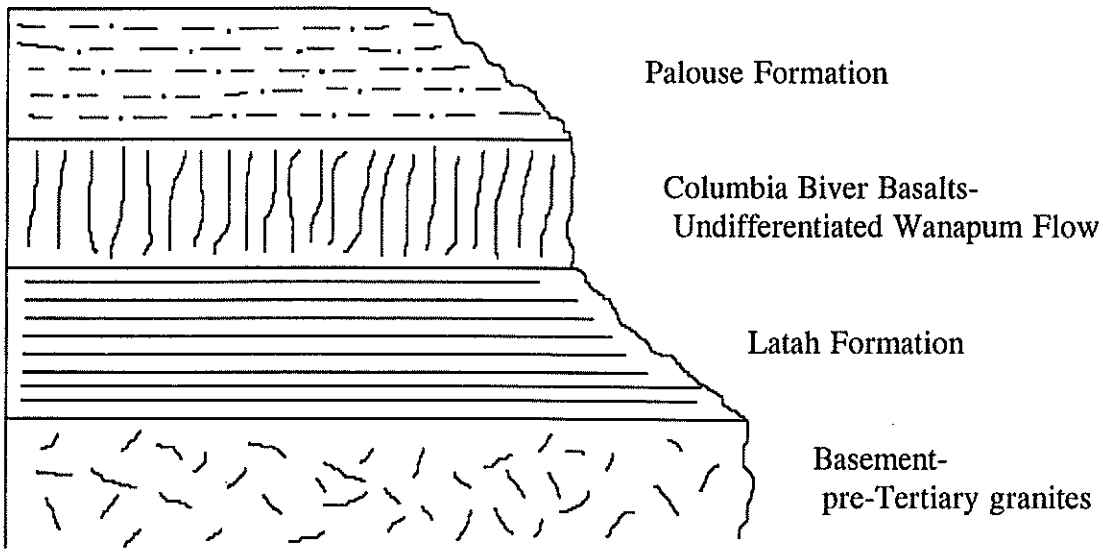

Palouse Formation
Columbia Biver Basalts-
Undifferentiated Wanapum Flow
Latah Formation
Basement-
pre-Tertiary granites

Figure 5

Methods of Investigation

Many different types of data were collected from many different sources and analyzed to study the stratigraphy, the geologic history, the structural geology, and the hydrogeology of the study area. Much of these data pre-date this study. Other data were collected specifically for this investigation. Data types utilized in the study include well reports, well head elevations, water level measurements, streamflow measurements, United States Geological Survey (USGS) maps, and information on local Green Bluff history.

Description of Data

Well Reports - Well reports (well logs) contain a record of well construction including casing installed, perforated or screened intervals, drillers estimation of well production, static water level at the time the well was completed and a log of lithology or rock types that the driller encountered as the well was drilled. Unfortunately, many of the well logs are incomplete, providing only a partial description of the well construction, the geology encountered during drilling, and where water was encountered. Appendix A contains copies of well reports for the wells that were monitored or used in the study if one was available and could be identified.

Well Head Elevations - To assist in correlation of water level elevations, well head elevations had to be determined first. Some of the wells were surveyed-in using the USGS spot elevation at the northeast corner of Section 20, Township 27 N., Range 44 E.W.M. Other well head elevations were determined using a digital altimeter and closed loop circuits. Well head elevations, that were surveyed-in, were recorded to nearest hundredths of a foot. The well heads included in the group measured with the altimeter were recorded to the nearest foot, which was the accuracy of the altimeter. Due to inherent drift problems with the altimeter, the altimeter data were corrected with drift curves (See Appendix B).

Water Level Measurements - Water level measurements were started in some wells in 1981; in 1985, 1986 and 1987 more wells were added to the measurement circuit. Activities that may have had an affect on water levels, in the wells, were also recorded. Activities that may have had an affect are: pump off, well pumping, pumped recently, nearby well pumping, nearby well pumped recently, dry well, and open hole (no pump or pump removed). This information was then entered into the Washington State Department of Ecology (WDOE), Water Resources' Ground Water Data Base. Appendix C contains the hydrographs for the observation wells.

Streamflow Measurements - Streamflow measurements were taken in the perennial stream that originates on Green Bluff in the SW¼SW¼SW¼NE¼ of Section 20, Township 27 N., Range 44 E.W.M. This stream flows to the south, off the Green Bluff, and is tributary

to Deadman Creek. Streamflow measurements were taken from May 24, 1991 until May 6, 1992 on a bi-weekly schedule. Two measurement stations were included in the schedule. The upstream station was in the SE¼SE¼NE¼SW¼ of Section 20, Township 27 N., Range 44 E.W.M. (station 00290A) and the downstream site was located in the NW¼SE¼SE¼ of Section 30, Township 27 N., Range 44 E.W.M (station 00290) (See Figure 6). These flow measurements assist in water budget studies for the Bluff where losses from the aquifer were estimated. Flow measurements were taken with a pygmy flowmeter or by the bucket method, depending on flow quantities and conditions. This information was entered into a WDOE streamflow database. Appendix D is a hydrograph of the streamflow data for stations 00290 and 00290A.

Water Rights and Claims - State issued and adjudicated water rights information was taken from the WDOE Water Rights Information System (WRIS). Claims information was gathered from the WDOE Claims Registry database. Many claims did not specify the amount of water that the claimants were using. For the Green Bluff study, Ecology assigned a quantity for ground water use, Qa (acre-feet per year), for each claim, as follows:

If irrigated acreage is greater than 0 acres: Qa = [# of acres claimed] * 4 acre-feet per year; and
If irrigated acreage is 0 acres: Qa = 2.0 acre-feet per year.

The surface water claims on the Green Bluff were extinguished during the Deadman Creek Adjudication, therefore are not included in this study.

Well-Identification Systems

The wells included in the study were numbered under two separate systems. The primary system used was an alpha-numeric system which began with the three letters ERO which were followed by three sequential numbers. The well numbering sequence started with the ID number ERO 399 and went to ERO 410. The second system used was the standard locational system employed by the United States Geological Survey (Figure 7). The first number identifies the township and the second number indicates the range in which the well is located. The third number indicates the section and the letter designation indicates in which quarter-quarter or 40 acre portion the well is located. A number following the quarter-quarter designator is a sequential number indicating that there is more than one well in that portion of the section and which well it is (may not be present). This sequential number does not necessarily indicate a temporal relation concerning well construction dates.

Green Bluff, Spokane County, Wa

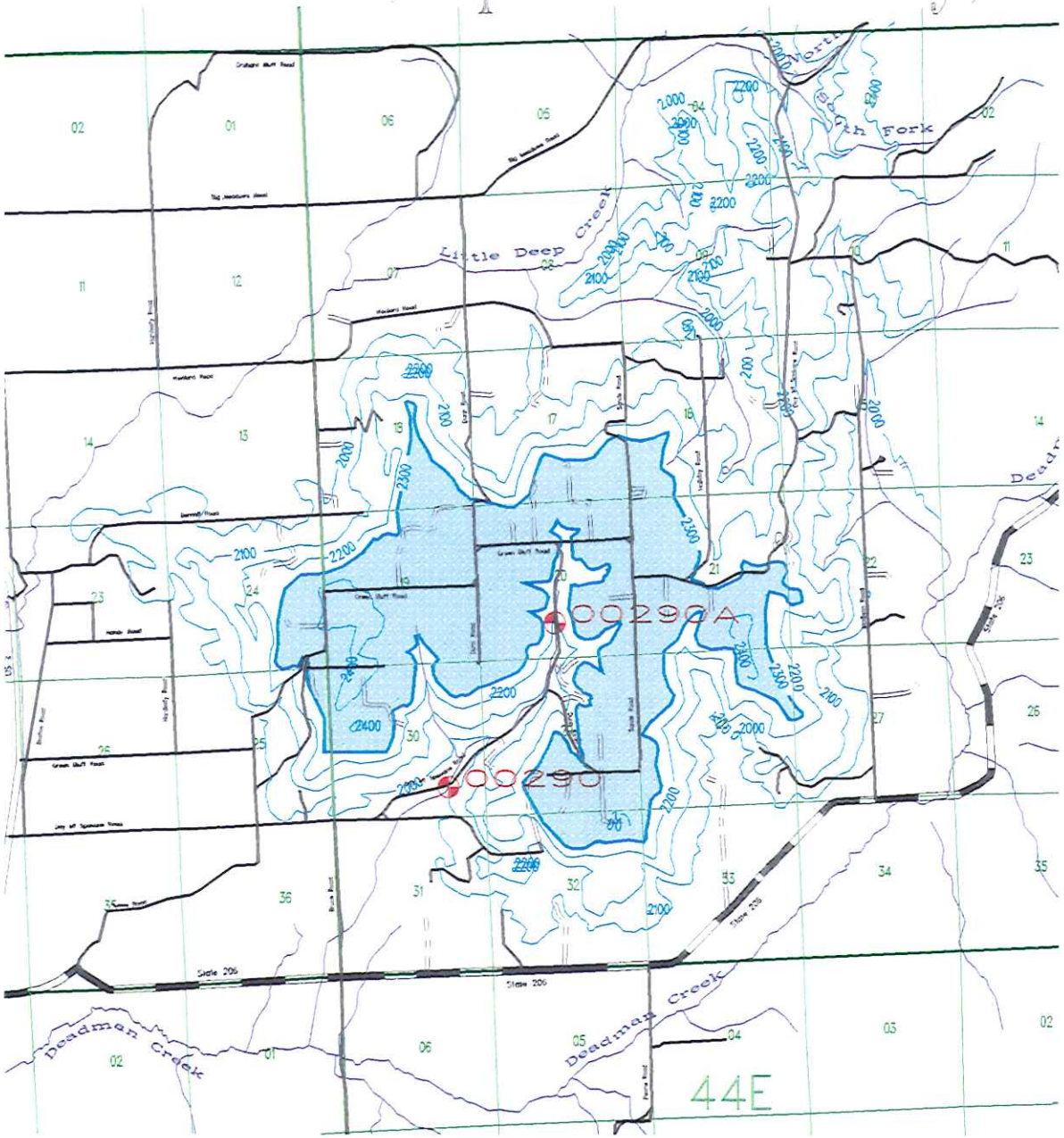


Figure 6

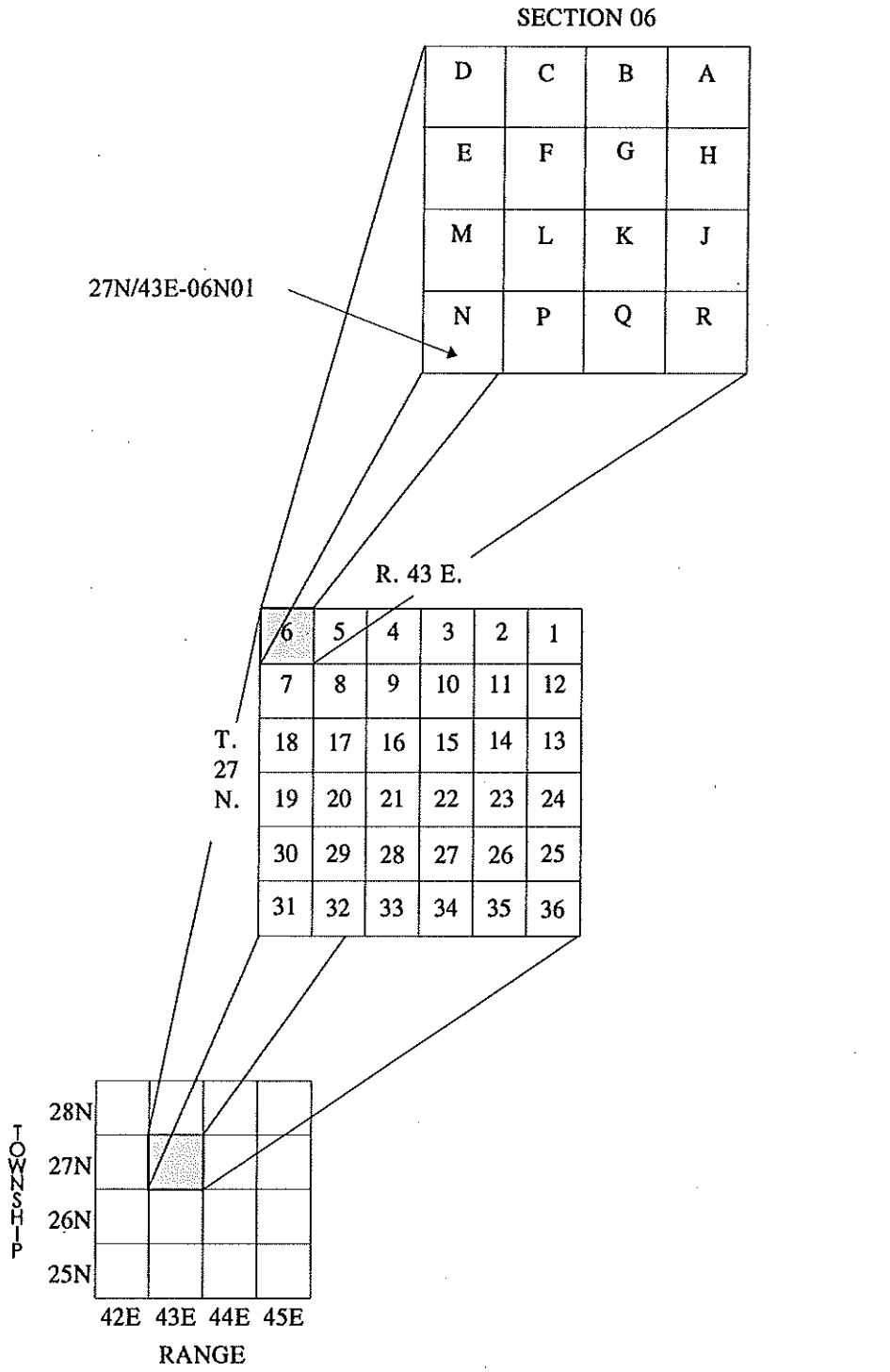

SECTION 06
D C B A
E F G H
M L K J
N P Q R
27N/43E-06N01
R. 43 E.
6 5 4 3 2 1
7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
T. 27 N.
28N
27N
26N
25N
TOWNSHIP
42E 43E 44E 45E
RANGE

Figure 7

SECTION 2

HYDROGEOLOGY

Introduction

An aquifer is defined as a formation [sediment or rock], group of formations, or part of a formation that contains sufficient saturated permeable material to yield economical quantities of water to wells and springs (Driscoll, 1989). Although the granitic basement rock and the Latah Formation, within the Green Bluff are saturated, they are not considered aquifers as defined above, as their bulk permeability is too low. The basalt flow(s) on the Green Bluff Plateau is (are) the formation that forms the Green Bluff Aquifer.

The Green Bluff Aquifer is an unconfined aquifer. The shape of the aquifer's upper surface, or water table, is primarily controlled by topography. The aquifer's lower surface is confined by the relatively impermeable Latah Formation underlying the aquifer. The Latah Formation acts as a confining unit that drastically decreases vertical leakage of water out of the aquifer. Under natural conditions, flow in the aquifer is largely horizontal and controlled by topography. The slope of the unconformable surface between the fractured basalt aquifer and underlying Latah Formation controls the flow of water to a lesser extent.

As illustrated in figure 8, ground water flow directions are mainly controlled by the overlying topography, with water flowing from topographically high areas to the topographically low areas. An analysis of the spatial distribution of wells and the water levels in the wells indicates that the aquifer can be subdivided into three major lobes or areas and one smaller isolated area. These areas are the Main Green Bluff lobe, the North Sand Road lobe, the South Sand Road lobe and the East lobe. The areas of the lobes are approximately 2, 0.9, 0.9 and 0.3 square miles respectively (Figure 8).

Under natural conditions most of the water in the Green Bluff Aquifer moves through the aquifer and discharges to the cleft formed in the south face of the bluff. This cleft forms a major natural ground water discharge point for the Green Bluff Aquifer. Ground water discharging from the aquifer into the cleft maintains the base flow in the unnamed stream that begins as a spring in the SW¼SW¼SW¼NE¼ of Section 20, Township 27N., Range 44 E.W.M. The unnamed stream then supplies baseflow, and is tributary to, Deadman Creek, a stream closed for further appropriation of water under the Little Spokane River Basin Plan (Chapter 173-555 Washington Administrative Code(WAC)).

Water level elevations in wells on the Green Bluff decrease with increasing well depth. Some of the wells have been completed into sand lenses within the Latah Formation or in the granitic basement rock underlying the Latah Formation. These wells have static water

Green Bluff, Spokane County, Wa

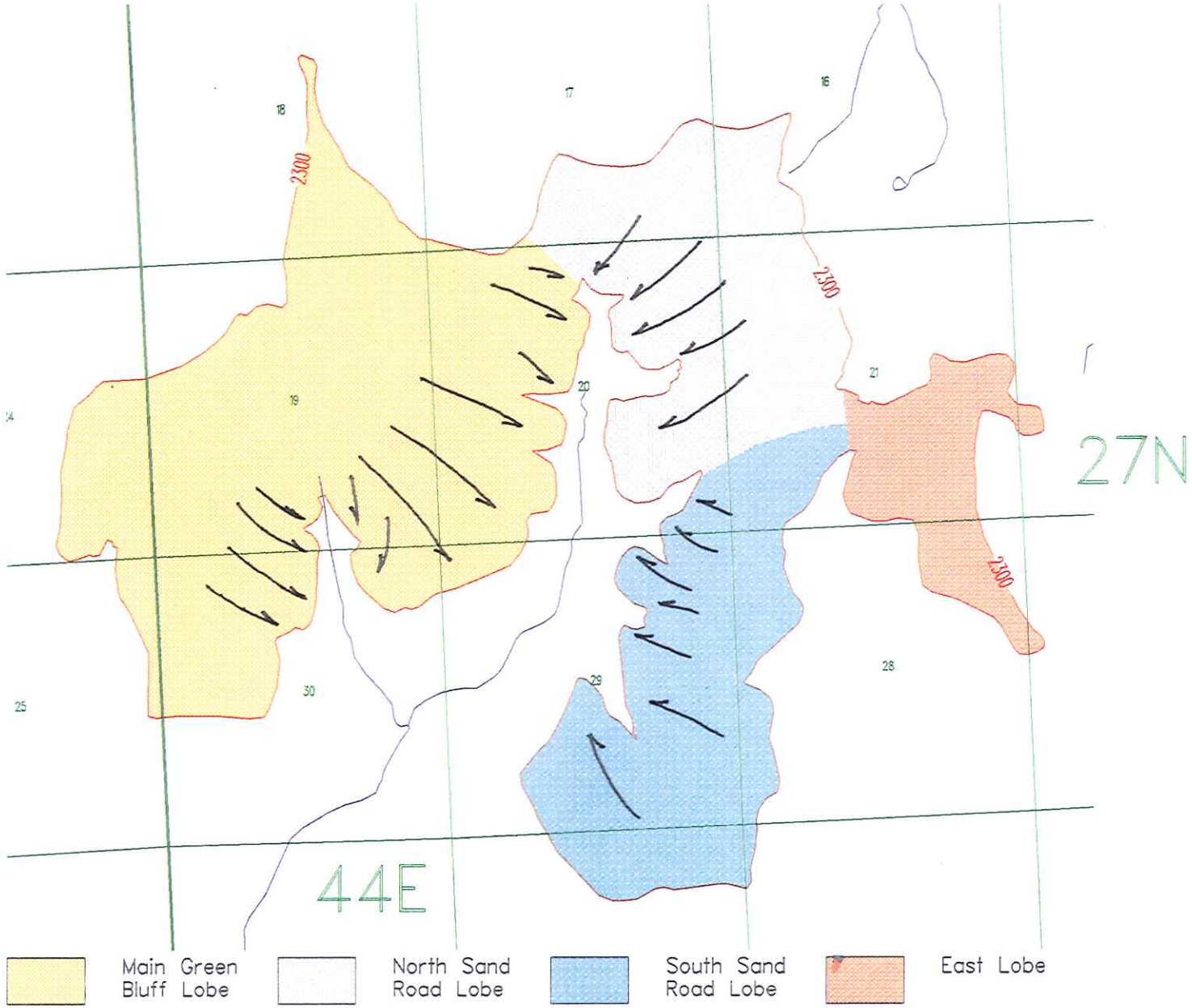


Figure 8

levels that are on the order of 200+ feet lower in elevation than the Green Bluff Aquifer. Well ERO410 (Figure 9) is completed into sand lenses at a depth of 330 to 345 feet below ground surface (bgs). The hydrograph for well number ERO410 (Figure 10) shows an average spring static water level elevation at approximately 2076 feet above mean sea level (msl). The water levels occurring at approximately 1989 to 2025 feet above msl are dynamic or pumping levels recorded during the irrigation season. The Mortenson well (Figure 11), located within 27N/44E-20G, was completed into a cemented sand lense at a depth of 406 to 410 feet below ground surface (bgs) in the Latah Formation. The water level elevation of the Mortenson well is approximately 2060 feet above msl. Another well, constructed for Mr. Smith (Figure 12), located within 27N/44E-20D, was completed into the granite that underlies the Latah Formation. The Smith well withdraws water from 513 to 515 feet bgs. The water level elevation in the Smith well is approximately 1995 feet above msl. These wells indicate that static water level elevation (head) decreases with depth on the Green Bluff Plateau. This relationship between decreasing static water level and increasing well depth indicates that the Green Bluff serves as a recharge area.

Recharge

Water recharging the Green Bluff Aquifer enters through the surface area of the Green Bluff Plateau. The recharge area for the Green Bluff was calculated using the 2300 foot contour line from the USGS 7.5 minute quadrangles (See Figure 8). This elevation marker encompasses the top of the Green Bluff. Below the 2300 foot contour line, the slope is generally too steep to allow for any significant deep percolation of precipitation, and is more likely to be lost in the form of surface runoff. The 2300 foot contour encompasses 4.1 square miles. Given Green Bluff's elevated location, and the fact that hydraulic head decreases with depth, a subsurface contribution of ground water can be eliminated as a source recharge to the aquifer.

To calculate the recharge to the Green Bluff Aquifer, one needs to know the extent of the recharge area and the amount of precipitation that percolates below the root zone. Recharge estimates for the Green Bluff Aquifer can be taken from Chung (1975). Chung (1975) describes recharge to the ground water within the Little Spokane River Basin, of which, Green Bluff is a part. The estimates by Chung (1975) fall within the range used by Bauer and Vaccaro (1990) in their recharge study undertaken as part of the Regional Aquifer System-Analysis (RASA) study. Bauer and Vaccaro (1990) estimated a range of 2-5 inches of annual recharge to the ground water, for the Spokane area. This equates to 12 to 30 percent of annual precipitation as recharge. This was calculated from the 2-5 inches of estimated annual recharge, for the Spokane area, divided by the 16.61 inches/year average precipitation at the Spokane airport weather station. Bauer and Vaccaro (1990) did not estimate the recharge values for the Green Bluff itself. The closest cell area to the Green Bluff to be included in their recharge study was Five Mile Prairie. According to the U.S.D.A. (1968), the Uhlig silt loams, which mantle Five

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
Permit No

(1) OWNER: Name Allan J. Wicklund Address 1813 Hutchsion Apt 27 Spokane, Wn.

(2) LOCATION OF WELL: County Spokane S. ½ — N. ¼ NE ¼ Sec 29 T 27 N., R. 44 WM

Bearing and distance from section or subdivision corner

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

(4) TYPE OF WORK: Owner's number of well (if more than one) 3
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☒ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well ____ inches.
Drilled ____ ft. Depth of completed well ____ ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam. from 0 ft. to 38 ft.
Threaded ☐ 6 " Diam. from plus 2 ft. to 328 ft.
Welded ☐ 4" PVC " Diam. from 325 ft. to 365 ft.

Perforations: Yes ☒ No ☐ Skill Saw
Type of perforator used
SIZE of perforations 1/8" in. by 6"-6 rounc
240 perforations from 325 ft. to 365 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? 18 ft.
Material used in seal cement & bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Grundfoos
Type: S-4 H.P 1-1.2

(8) WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 228 ft. below top of well Date 1.0.87
Artesian pressure none lbs. per square inch Date none
Artesian water is controlled by none (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? Contractor
Yield 8 gal./min. with 76 ft. drawdown after 1 hrs.
" 8 " " 76 " " 2 "
" 8 " " 76 " " 5 "

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
4:40	304	4:41	265	4:42	242
4:45	235	4:50	230	4:55	229
5:00	228				

Date of test
Bailer test 5 gal./min. with 84 ft. drawdown after 3 hrs.
Artesian flow g.p.m. Date
Temperature of water 56 Was a chemical analysis made? Yes ☐ No ☒

1/20/87

(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
Clay white to gray	65	100
Clay brown	100	130
Clay dark brown	130	217
Clay lite brown	217	228
Clay white to gray	228	230
Clay lite brown (some wood)	230	233
Clay green	233	249
Clay dark brown (very fine sand)	248	268
Clay blue (very fine sand)	268	283
Clay green (very fine sand)	283	294
Clay brown (very fine sand)	294	330
Clay to shale brown (with sand lenses) Water Bearing	330	345
Clay lite brown to shale with sand lenses & wood fragments		365
*Water Bearing		

RECEIVED
JAN 20 1987
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

Work started 12/3 86 19 Completed 1.0.87 19

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 C.J. Warren & son Drilling
(Person, firm, or corporation) (Type or print)
Address E. 12005 8th Avenue Spokane Wn. 99206
[Signed] Charles J Warren (Well Driller)
License No. 0515 Date January 12 19 87

(USE ADDITIONAL SHEETS IF NECESSARY)

Figure 9
ERO410

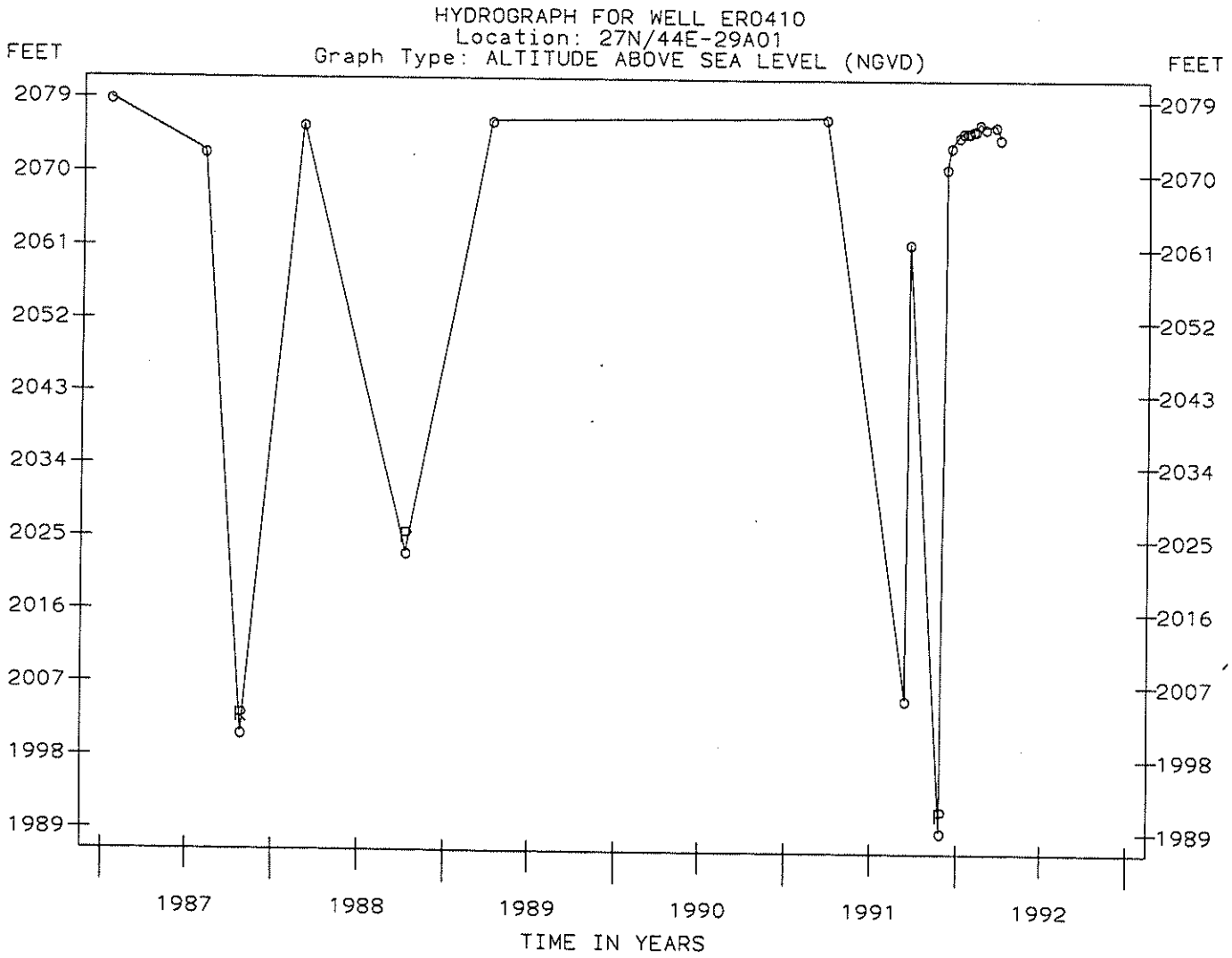

HYDROGRAPH FOR WELL ER0410
Location: 27N/44E-29A01
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2079
2070
2061
2052
2043
2034
2025
2016
2007
1998
1989
1987
1988
1989
1990
1991
1992
TIME IN YEARS

Figure 10

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. G3-27355

Permit No. ....

(1) OWNER: Name Arthur W. Mortensen Address P.O. Box 448, Petaluma, CA 94952

(2) LOCATION OF WELL: County Spokane — SW ¼ NE ¼ Sec. 20 T. 27 N., R 44E W.M.

Bearing and distance from section or subdivision corner

(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 ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 410 ft. Depth of completed well 410 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +1 ft. to 410 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? 18 ft.
Material used in seal Bentonite
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 2300 ft.
Static level 220 ft. below top of well Date 8/17/83
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: 10 gal./min. with ft. drawdown after hrs.
" ESTIMATED AIRLIFT " "
" " " "

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 ☐

8/30/83

(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
Sand & Gravel	0	14
Clay, sandy	14	22
Basalt, rotten	22	35
Clay, orange	35	42
Sand, fine w/water	42	47
Clay, white	47	92
Clay, gray, soft	92	275
Sand	275	302
Sandstone	302	304
Clay, hardpan	304	305
Clay	305	375
Wood	375	376
Clay	376	381
Sand	381	405
Clay, hard	405	406
Sand, cemented w/water	406	410
NO PVC LINER INSTALLED		
6" Drive Shoe Installed		

Work started 8/10, 19 83 Completed 8/17, 19 83

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 PONDEROSA DRILLING & DEVELOPMENT INC.
(Person, firm, or corporation) (Type or print)

Address E. 6010 Broadway, Spokane, WA 99212

[Signed] Jim Doyle
Jim Doyle (Well Driller)

License No. 1287 Date 8/17/ 19 83

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Figure 11

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. .....
Permit No. .....

(1) OWNER: Name Darrell C. Smith Address Rt.3, Box 141, Colbert, Wa. 99015

(2) LOCATION OF WELL: County Spokane — NW ¼ NW ¼ Sec. 20 T. 27 N., R. 44E W.M.
Bearing and distance from section or subdivision corner

(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 ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 515 ft. Depth of completed well 515 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +1 ft. to 513 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? 18 ft.
Material used in seal Bentinite
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.... ft.
Static level 355 ft. below top of well Date 9/8/76
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~~ air test made? Yes ☒ No ☐ If yes, by whom? Driller
Yield: 8 plus gal./min. with 160 ft. drawdown after 1 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
Top soil,drk brn,silty	0'	14'
Clay,brn,moist,firm	14'	21'
Basalt,fract w/brn moist clay	21'	23'
Basalt,fract,blk,m hrd	23'	31'
Basalt,heav fract,blk w/grn sed,m hrd	31'	42'
Clay,brn-gray,dry,firm	42'	48'
Clay,brn,moist,firm	48'	58'
Clay,rusty brn,firm	58'	63'
Clay,wht,moist,seams,firm,gray	63'	66'
Clay,wht,moist,seams,firm,water 2 GPM	66'	87'
Clay,tan,moist,firm	87'	104'
Clay,drk brn,moist,firm	104'	188'
Clay,tan,moist,firm	188'	216'
Clay,drk gray,moist,firm	216'	232'
Clay,yell-brn,dry,firm w/fine sand	232'	284'
Clay,gray,dry,firm,wood chips	284'	288'
Clay,gray-brn,dry,firm	288'	331'
Clay,gray,dry,firm	331'	356'
Clay,brn-gray,dry,firm	356'	366'
Clay,grey,dry & sandy,firm	366'	412'
Clay,brn-gray,dry,firm	412'	470'
Clay,drk gray,dry,firm,fine sand, gray quartz	470'	485'
Coarse quartz sand,clear-light purple-gray clay	485'	493'
Granite,fract,heav,drk gray-wht, m hrd	493	508'
Granite,fract,s&p m hrd	508'	512'
Granite,occas fract,s&p,m hrd	512'	515'

Work started 19 Completed 19

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 ZINKGRAF'S WELL DRILLING CO.
(Person, firm, or corporation) (Type or print)

Address E. 1606 Sharp, Spokane, Wa. 99202

[Signed] James G. Zinkgraf
(Well Driller)

License No. 0544 Date 10/25/76, 19

ECY 050-1-20 11/18/14 (USE ADDITIONAL SHEETS IF NECESSARY)

Figure 12

Mile Prairie, have approximately the same hydrogeologic characteristics as the Green Bluff silt loams so one would expect them to have similar recharge characteristics.

Using the above figures for precipitation and recharge the following calculations can be made:

(1) recharge (inches) = precipitation (inches) x (0.12 to 0.30)

Equation (1) above gives the range of values for the amount (percent) of precipitation that gets past the root zone to recharge the ground water, in our case the Green Bluff Aquifer. If this number is then multiplied by the area of the Green Bluff, the number derived is the volume of recharge to the aquifer in acre-feet.

(2) recharge (ac-ft/yr) = recharge(ft) x 640 ac/mile^2 x 4.1 mile^2

In the evaluation of their work, Bauer and Vaccaro (1990) stated that, "...that a maximum error of about 25 percent can be assumed for most zones presented in this report." Using Bauer and Vaccaro's (1990) range of recharge of 2-5 inches annually in the Five Mile prairie area and incorporating a 25 percent error factor (Bauer, 1995), results in a range of recharge of 1.5-6.25 inches for the Green Bluff (0.13 ft- 0.52ft). Therefore, equation (2) yields a range of recharge from 341 to 1364 acre-feet of recharge available to the aquifer.

If recharge is calculated using the 20 percent recharge (Chung, 1975) figure and the 21 inches of annual precipitation (U. S. D. A., 1968) the following is true:

(3) 0.35 ft x 640 ac/mile^2 x 4.1 mile^2 = 918 ac-ft of (total) recharge

This figure falls within the range of recharge values calculated from the USGS values. The estimates calculated here are estimates of gross recharge as will be seen in the Losses from the Aquifer section.

Losses from the Aquifer

When considering aquifer recharge and water availability, any discharge points or potential losses of water from the aquifer must be taken into account. A water budget analysis, which was beyond the scope of this report, takes into account Evapotranspiration (ET)(evaporation and transpiration from plants), actual consumptive use (pumping) and discharges from the aquifer (to surface waters and ground water). An estimate of one of the losses (discharge to the Latah Formation) was made to gain a partial understanding of the hydrogeologic dynamics of the Green Bluff Aquifer.

A source of loss from the aquifer is to the Latah Formation which forms the confining unit and lower boundary of the aquifer. Clays, such as those that make up the Latah

Formation generally exhibit very low hydraulic conductivities but high porosities. Clay deposits of the Latah Formation located immediately south of Green Bluff had been described as silty clay, clayey silt and silt (Hosterman, 1969). Well logs describe the Latah Formation on the Green Bluff simply as clay. The hydraulic conductivity of the Latah Formation is estimated, based on grain size, at 10^{-2} to 10^{-4} gal/day/ft^2 (Freeze and Cherry, 1979). Losses of ground water from the Green Bluff Aquifer to the Latah Formation are estimated at approximately 120 acre-feet per year (9 to 13 percent of recharge). This leakage flows through the Latah Formation and is discharged to surface water (springs and the unnamed stream) and recharge to the granitic basement rock.

Discharge from the Latah Formation into the unnamed stream is evidenced in the hydrograph of stations 00290 and 00290A (Appendix D). The lower station, 00290, recorded higher flows than the upper station, 00290A, showing that the stream was a gaining stream.

A major discharge point exists in the spring-fed unnamed perennial stream that originates in the cleft on the south face of the bluff. The spring is fed by the Green Bluff Aquifer and acts as a drain.

Ground water pumpage (for irrigation, commercial/industrial, multiple domestic and stock), probably the largest discharge from the aquifer, was not calculated as it was beyond the scope of the study. Actual useage requires flow meters on the wells or other data (power records and well/pump efficiency studies) to calculate pumped quantities. Domestic exempt uses would also need to be calculated. All of these would need to be corrected for consumptive use, a correction for that portion of the pumped water that is returned to the aquifer.

Surface Water/Ground Water Relationships

The Green Bluff Aquifer is in hydraulic continuity with the unnamed stream that flows from the cleft in the south face of the bluff. Hydraulic continuity refers to the hydraulic connection and dynamic interactions between ground water and surface water. According to Garrigues et al. (1993) an aquifer is in hydraulic continuity with lakes, streams, rivers or other surface water bodies whenever it is discharging to, or being recharged by, surface water. Since the Green Bluff Aquifer serves as a source of water, and discharges to the unnamed stream that flows from the cleft in the south face of the Bluff, the aquifer is in hydraulic continuity with the unnamed stream. This stream is in turn tributary to Deadman Creek, which is closed to further appropriations during the summer (6/1-10/31).

Ground Water Levels

Water levels in Green Bluff wells are declining. These declines are based upon the analysis of water level measurements that have been recorded for a number of wells on

Green Bluff over the period of record. The Department has recorded both static water level measurements (early spring-time measurements taken before irrigation season starts to see how the system recharged during the winter) and dynamic water level measurements (taken during the irrigation season to observe well interference) over the period of record. Overall, the water level data shows a declining water table. Without detailed precipitation data, it is difficult to determine how much of this decline is attributable to changes in precipitation and how much is due to groundwater pumping. In the mid-1980s a period of greater recharge (higher static water levels) is reflected in higher water levels in the wells (See Figure 13). This same phenomenon is seen throughout the eastern portion (east of the Columbia River) of the State of Washington (Covert, 1995).

The phenomenon is thought to be caused by higher precipitation which caused a decrease in pumpage for irrigation water and also provided more recharge to the aquifers. In addition to providing more recharge to the aquifers, the higher precipitation decreased demand on ground water (less pumpage) which allowed the aquifers to recover more fully (Covert, 1995).

SECTION 3

WATER RIGHTS

State Issued Water Rights

Ground water rights have been issued for 796 acre-feet/year for the irrigation of 445 acres, as well as commercial/industrial, domestic multiple, single domestic and stock watering uses since 1944.

Several surface water rights exist around the Green Bluff plateau.. Water is appropriated from springs and an unnamed perennial stream in the south cleft of the Green Bluff Plateau. This stream is tributary to Deadman Creek (which is closed to further appropriations during the summer (6/1-10/31) each year). These surface water rights were adjudicated in the 1988 Deadman Creek adjudication which allocated a total of 148 acre-feet per year for consumptive uses.

Claims

The Claims Registration Act (Chapter 90.14 RCW) was enacted to document those uses of surface water in existence prior to the adoption of the State Surface Water Code (Chapter 90.03 RCW), which was adopted in 1917, and those uses of ground water in existence prior to the adoption of the State Ground Water Code (Chapter 90.44 RCW), which was adopted in 1945. The Claims Registration Act established a period to register claims for ground water and surface water use. Documentation was submitted to Ecology

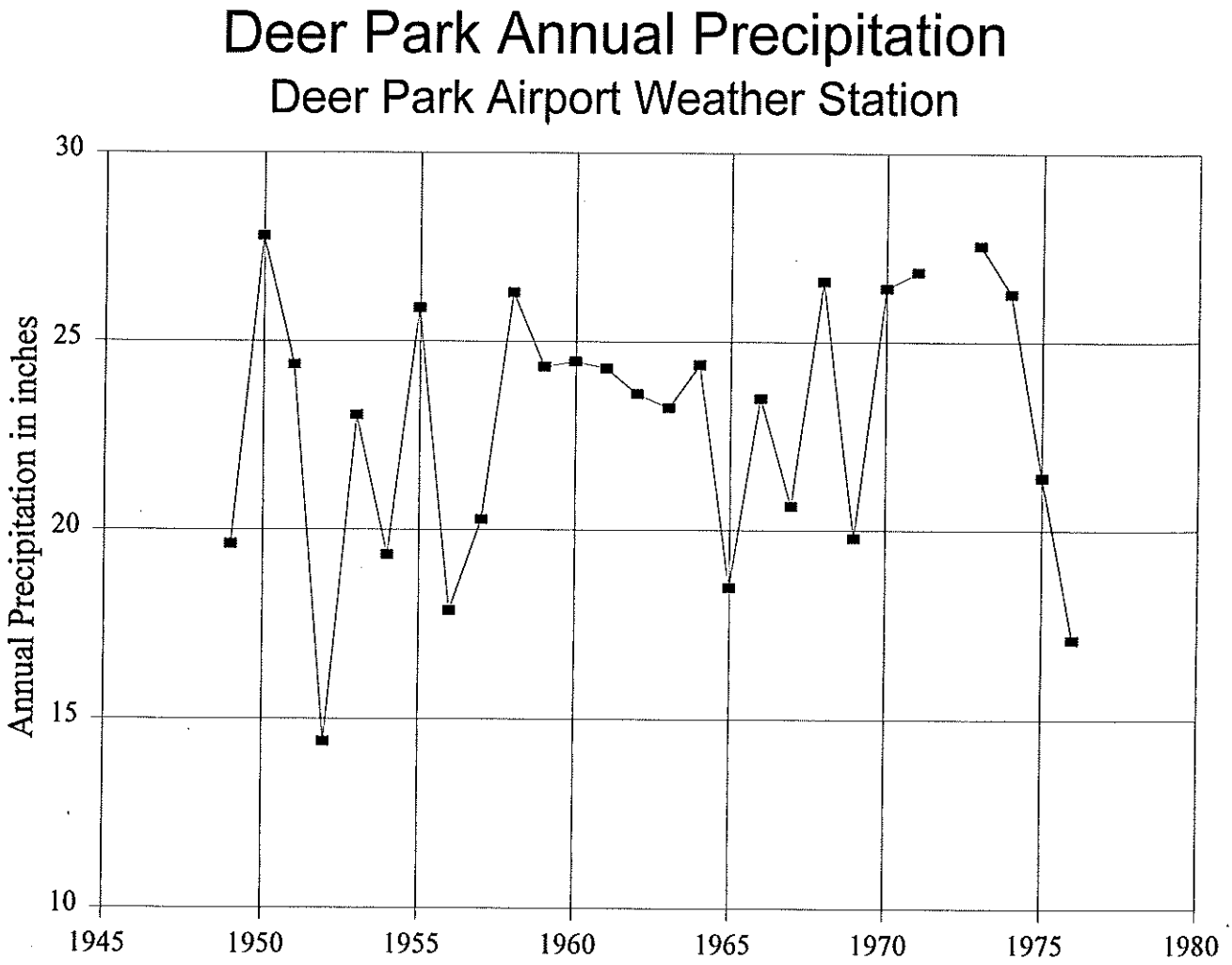

Deer Park Annual Precipitation
Deer Park Airport Weather Station
Annual Precipitation in inches
30
25
20
15
10
1945
1950
1955
1960
1965
1970
1975
1980

Figure 13

on either a long form to claim detailed uses for domestic and irrigation uses or on a short form for a single domestic use with up to one-half acre non-commercial lawn and garden. A total of 87 ground water claims were filed for a total of 416 acre-feet per year.

Sources of Water for Water Rights

Ground water rights and claims and surface water rights on and around the flanks of the Green Bluff Plateau rely on the Green Bluff Aquifer as a source for the appropriation of water. The aquifer is relied upon directly, for ground water rights and claims, where the point of withdrawal (well) is located on the bluff and the well is completed in the Green Bluff Aquifer. Several adjudicated surface water rights depend on ground water discharge (losses) from the Green Bluff Aquifer. These rights were issued from springs on the flanks of the Green Bluff that are fed from leakage out of the Green Bluff Aquifer. The unnamed stream in the cleft in the south face of the bluff, which is fed by springs that discharge water from the Green Bluff Aquifer, also serves as a source for surface water rights.

SECTION 4

CONCLUSIONS

Conceptual Model of Green Bluff Hydrogeology

- The aquifer is an unconfined or water table aquifer.
- The Green Bluff Aquifer is primarily the basalt flow(s) and in some places the overlying Palouse Formation.
- The Aquifer is stratigraphically above and bounded by the Latah Formation, which acts as a confining unit on its lower surface.
- The aquifer is located on a bluff vertically isolated from sources of regional ground water recharge.
- The aquifer's sole source of recharge is precipitation.
- Flow of water through the aquifer is largely controlled by topography.
- Vertical flow is greatly impeded by the fine grained Latah Formation confining unit.
- Ground water naturally discharges from the aquifer as surface water in springs located where the Wanapum/Latah contacts daylight around the perimeter of the Green Bluff.
- A major point of discharge is the unnamed stream in the cleft on the south face of the Bluff.
- On average, ground water levels in the Green Bluff Aquifer have declined for the period of record.
- The Green Bluff Aquifer ground water decline is due to the fact that withdrawals and losses from the aquifer are exceeding recharge.
- The Green Bluff Aquifer serves as the source for ground water rights and claims.
- Discharge from the Green Bluff Aquifer serves as the source for surface water rights.

REFERENCES CITED

Bauer, H. H., and Vaccaro, J. J., 1990, Estimates of Ground-Water Recharge to the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho, for Predevelopment and Current Land-Use Conditions; U. S. Geological Survey Water-Resources Investigations Report 88-4108.

Bauer, H. H., 1995, Personal Communication.

Bretz, J. H., 1959, Washington's Channeled Scabland; Washington State Division of Mines and Geology Bulletin 45.

Chung, S. K., 1975, Water Resources Management Program - Little Spokane River Basin, WRIA 55. Washington State Department of Ecology Policy Section, Water Resources Management Division.

Covert, J., 1995, Personal Communication.

Dames and Moore, Inc. and Cosmopolitan Engineering Group, 1995, Draft Initial Watershed Assessment Water Resources Inventory Area 55, Little Spokane River Watershed, Open-File Technical Report 95-15. Published in cooperation with Washington State Department of Ecology.

Driscoll, F. G., 1989, Groundwater and Wells.

Drost, B. W., Whiteman, K. J., and Gonthier, J. B., 1990, Geologic Framework of the Columbia Plateau Aquifer System, Washington, Oregon, and Idaho; U. S. Geological Survey Water-Resources Investigations Report 87-4238.

Easterbrook, D. J., and Rahm, D. A., 1970, Landforms of Washington, The Geologic Environment; Western Washington State College.

Fitzgerald, T., 1992, Personal Communication.

Freeze, R. A., and Cherry, J. A., 1979, Groundwater.

Garrigues, R. S., Ader, M. J., Hoselton, A., Lehotsky, C., and Liszak, J., 1993, Procedural Guidelines for Hydrogeologic Investigations, Open-File Technical Report 93-6; Water Resources Program, Washington State Department of Ecology.

Griggs, A., B., 1976, The Columbia River Basalt Group in the Spokane Quadrangle, Washington, Idaho, and Montana; U. S. Geological Survey Bulletin 1413.

Hosterman, J. W., 1969, Clay Deposits of Spokane County, Washington; Geological Survey Bulletin 1270.

Hosterman, J. W., Scheid, V. E., Allen, V. T., and Sohn, I.G., 1960, Investigations of Some Clay Deposits in Washington and Idaho; U. S. Geological Survey Bulletin 1091.

Hydrosphere Data Products, Inc., 1994, Climatedata TD 3200 Summary of the Day Cooperative Network CD-ROM; Data from the National Climatic Dat Center.

Lahee, F. H., 1961, Field Geology.

Molenaar, D., 1988, The Spokane Aquifer, Washington: Its Geologic Origin and Water-Bearing and Water-Quality Characteristics; U. S. Geological Survey Water-Supply Paper 2265

Myers, C. W., and Price, S. M., 1979, Geologic Studies of the Columbia Plateau, a Status Report; Rockwell International, Rockwell Hanford Operations RHO-BWI-ST-4.

Pardee, J. T., and Bryan, K., 1926, Geology of the Latah Formation in Relation to the Lavas of the Columbia Plateau near Spokane, Washington; U. S. Geological Survey Prof. Paper 140-A, p. 1-16.

Raisz, E., 1941, Landforms of the Northwestern States (maps), Inst. of Geographical Exploration, Harvard University, Cambridge, Mass.

Reidel, S. P., and Fecht, K. R., 1981, Wanapum and Saddle Mountains Basalts of the Cold Creek Syncline Area; RHO-ST-14, Rockwell Hanford Operations, Richland, Washington.

Revised Code of Washington (RCW) Chapter 90.03, Surface Water Code.

Revised Code of Washington (RCW) Chapter 90.14, Claims Registration Act.

Revised Code of Washington (RCW) Chapter 90.44, Ground Water Code.

U. S. Department of Agriculture, 1968, Soil Survey of Spokane County, Washington; soil survey published by Soil Conservation Service, U. S. Department of Agriculture, in cooperation with Washington Agricultural Experiment Station.

APPENDIX A
Well Reports for Observation Wells or Other Wells Used in the Study

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. .....
Permit No. .....

(1) OWNER: Name Darrell C. Smith Address Rt.3, Box 141, Colbert, Wa. 99015

LOCATION OF WELL: County Spokane — NW ¼ NW ¼ Sec. 20 T. 27 N., R 44E W.M.
Bearing and distance from section or subdivision corner

(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 ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 515 ft. Depth of completed well 515 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +1 ft. to 513 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? 18 ft.
Material used in seal Bentinite
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 .... ft.
Static level 355 ft. below top of well Date 9/8/76
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~~ air test made? Yes ☒ No ☐ If yes, by whom? Driller
Yield: 8 plus gal./min. with 160 ft. drawdown after 1 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
Top soil,drk brn,silty	0'	14'
Clay,brn,moist,firm	14'	21'
Basalt,fract w/brn moist clay	21'	23'
Basalt,fract,blk,m hrd	23'	31'
Basalt,heav fract,blk w/grn sed,m hrd	31'	42'
Clay,brn-gray,dry,firm	42'	48'
Clay,brn,moist,firm	48'	58'
Clay,rusty brn,firm	58'	63'
Clay,wht,moist,seams,firm,gray	63'	66'
Clay,wht,moist,seams,firm,water 2 GPM	66'	87'
Clay,tan,moist,firm	87'	104'
Clay,drk brn,moist,firm	104'	188'
Clay,tan,moist,firm	188'	216'
Clay,drk gray,moist,firm	216'	232'
Clay,yell-brn,dry,firm w/fine sand	232'	284'
Clay,gray,dry,firm,wood chips	284'	288'
Clay,gray-brn,dry,firm	288'	331'
Clay,gray,dry,firm	331'	356'
Clay,brn-gray,dry,firm	356'	366'
Clay,gray,dry & sandy,firm	366'	412'
Clay,brn-gray,dry,firm	412'	470'
Clay,drk gray,dry,firm,fine sand, gray quartz	470'	485'
Coarse quartz sand,clear-light purple-gray clay	485'	493'
Granite,fract,heav,drk gray-wht, m hrd	493	508'
Granite,fract,s&p m hrd	508'	512'
Granite,occas fract,s&p,m hrd	512'	515'

Work started 19 Completed 19

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 ZINKGRAF'S WELL DRILLING CO.
(Person, firm, or corporation) (Type or print)

Address E. 1606 Sharp, Spokane, Wa. 99202

[Signed] James J. Zinkgraf
(Well Driller)

License No. 0544 Date 10/25/76, 19

11/18/76

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

3

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. 63-27355
Permit No. ....

(1) OWNER: Name Arthur W. Mortensen Address P.O. Box 448, Petaluma, CA 94952

(2) LOCATION OF WELL: County Spokane — SW ¼ NE ¼ Sec. 20 T. 27 N., R 44E W.M.
Bearing and distance from section or subdivision corner

(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 ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 410 ft. Depth of completed well 410 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +1 ft. to 410 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? 18 ft.
Material used in seal Bentonite
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 .... 2300 ft.
Static level 220 ft. below top of well Date 8/17/83
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: 10 gal./min. with ft. drawdown after hrs.
" ESTIMATED AIRLIFT " "
" " " "

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 ☐

8/30/83 WC

(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
Sand & Gravel	0	14
Clay, sandy	14	22
Basalt, rotten	22	35
Clay, orange	35	42
Sand, fine w/water	42	47
Clay, white	47	92
Clay, gray, soft	92	275
Sand	275	302
Sandstone	302	304
Clay, hardpan	304	305
Clay	305	375
Wood	375	376
Clay	376	381
Sand	381	405
Clay, hard	405	406
Sand, cemented w/water	406	410
NO PVC LINER INSTALLED		
6" Drive Shoe Installed		

Work started 8/10, 19 83 Completed 8/17, 19 83

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 PONDEROSA DRILLING & DEVELOPMENT INC.
(Person, firm, or corporation) (Type or print)

Address E. 6010 Broadway, Spokane, WA 99212

[Signed] Jim Doyle
(Well Driller)

License No. 1287 Date 8/17/ 19 83

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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. .....
Permit No. .....

(1) OWNER: Name DAN FOSTER Address E. 1518 GORDON SPOKANE WN. 99207

LOCATION OF WELL: County SPOKANE NE¼ SW¼ Sec. 19 T. 27 N., R. 44 W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 100 ft. Depth of completed well 100 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +1 ft. to 99 ft.
Threaded [ ] " Diam. from ..... ft. to ..... ft.
Welded [X] " Diam. from ..... ft. to ..... ft.

Perforations: Yes [X] No [ ]
Type of perforator used TORCH
SIZE of perforations ¼ in. by 12 in.
36 perforations from 60 ft. to 100 ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes [ ] No [X]
Manufacturer's Name .....
Type ..... Model No. .....
Diam. ..... Slot size ..... from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes [ ] No [X] Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? Yes [ ] No [X]
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 .... ft.
Static level 60 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: APPROX. 20-25 GPM gal./min. with BY AIRTEST 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 [ ]

9/15/86

(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
TOPSOIL	0	2
BRN. CLAY-FIRM	2	6
BRN. CLAY & COBBLE	6	8
BRN. CLAY-HARD	8	10
BASALT-HARD W/FRACTS.	10	70
BASALT-FRACT. & CINDERS WATERBEARING	70	75
WHT. CLAY-HARD	75	100

NOTE: 6" - 10" FORMATION
PACKER SET AT 18 ft.

RECEIVED
SEP 15 1986

Work started 8/14 19 86 Completed 8/15 19 86

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 J & J DRILLING, INC. (Person, firm, or corporation) (Type or print)
Address S. 5613 LUKE RD. GREENACRES WN.
[Signed] Benjamin J. Carpenter (Well Driller)
License No. 1278 Date 8/18, 1986

(USE ADDITIONAL SHEETS IF NECESSARY)

ERO399

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. .....
Permit No. ...0326522

(1) OWNER: Name Ron Andrews Address Rt. 2 Box 79A Mead, Wash. 99005

(2) LOCATION OF WELL: County Spokane NW ¼ SW ¼ Sec. 20 T. 27 N., R 44 W.M.
Bearing and distance from section or subdivision corner

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

(4) TYPE OF WORK: Owner's number of well (if more than one) 1
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 90 ft. Depth of completed well 90 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam. from 0 ft. to 22'7" 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? 21 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.... ft.
Static level 51 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 30 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
Topsoil	0	3
Fine Br. sand	3	12
Soft Br. clay	12	14
Rd. dk. br. clay	14	20
Soft basalt & clay mix	20	22
Med. basalt	22	24
Med. hd. basalt	24	48
" soft "	48	51
" hd. "	51	69
soft fractured basalt	69	73
" hd. Basalt	73	89
Soft. Br. clay	89	90

RECEIVED
FEB 2 9 1987
DEPT. OF ECOLOGY

Work started 4/9 19 86 Completed 4/10 19 86

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 SAMS DRILLING
(Person, firm, or corporation) (Type or print)
Address Rt. 2 Box 82 Elk, Washington 99009
[Signed] (Well Driller)
License No. 0494 Date 4/30 19 86

2/23/87

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

ERO400

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. .....
Permit No. G326552

(1) **OWNER:** Name Ron Andrews Address Rt 1 Box 70A Wood Wash. 99005

(2) **LOCATION OF WELL:** County Spokane NW ¼ SW ¼ Sec. 20 T. 27 N., R. 43 W.M.
Bearing and distance from section or subdivision corner 4/4

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

(4) **TYPE OF WORK:** Owner's number of well (if more than one) 2
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 8 inches.
Drilled 97 ft. Depth of completed well 94 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 8 " Diam. from 0 ft. to 25 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? 21 ft.
Material used in seal Cement & bento nite
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 .... ____ ft.
Static level 56 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
Topsoil	0	2
Soft Br. clay	2	5
Fine Br. sand	5	11
Soft Br. clay	11	16
Bl. " "	16	23
Med. soft basalt	23	34
" Bl. "	34	41
" " "	41	77
" " "	77	86
Dk. Br. clay	86	89
Fine silica sand	89	94
Orange clay	94	97
Aquifer	89	94
Permit No. G326552		

FEB 20 1987

Work started 7/24 19 85 Completed 7/24 19 85

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 SAMS DRILLING
(Person, firm, or corporation) (Type or print)
Address Rt. 2 Box 82 Elk, Wash. 99009

[Signed] _____
(Well Driller)
License No. 0494 Date 8/15 19 85

EGY 050-1-20 (USE ADDITIONAL SHEETS IF NECESSARY)

ERO401

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. G3-26555
Permit No. ....

(1) OWNER: Name L.D.S. Church Address N. 11317 Vista Ridge Ct., Spokane WA. 99218

LOCATION OF WELL: County Spokane NW ¼ NE ¼ Sec. 20 T. 27 N., R. 44 W.M.
Bearing and distance from section or subdivision corner

(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 ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 10 inches.
Drilled 90 ft. Depth of completed well 90 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 0 ft. to 90 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used torch cut
SIZE of perforations 1/8 in. by 4 in.
80 perforations from 60 ft. to 80 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: ½ "
Gravel placed from 80 ft. to 55 ft.

Surface seal: Yes ☒ No ☐ To what depth? 25 ft.
Material used in seal Bentonite
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... 2050 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? Coffey
Yield: 44 gal./min. with 20 ft. drawdown after 2½ 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 ☒

12/21/82

(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
clay	0	6
broken basalt w/ clay	6	28
basalt	28	31
broken basalt	31	35
broken basalt w/ clay	35	70
broken basalt w/ water	70	80
gray clay	80	200

DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

Work started 9-6 19 82 Completed 9-9 19 82

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 Coffey Corp. (Person, firm, or corporation) (Type or print)
Address Rt. 4 Box 448 Cheney, Wa. 99004
[Signed] (Well Driller)
License No. 0572 Date 11/4 19 82

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

ERO402

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG

No. Appli. 1087
Cert. 562-A

Date April 21, 19 50

Record by W. C. Reede

Source Driller's Record

Location: State of WASHINGTON

County Spokane

Area

Map

E½W½NW¼ NE¼ sec. 20 T. 27 N., R. 44 E. W.M.

DIAGRAM OF SECTION

Drilling Co. Clyde W. Reede Co., Inc.

Address Mead, Wash.

Method of Drilling Date April 20 1950

Owner Andrews ~~Brothers~~, Lloyd + Fred Andrews

Address Route 1; Colbert

Land surface, datum ft. above / below

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)		
	Sod & clay	3	3
	Sand with clay(approx.60 g.p.m.	16	19
	Basalt rock	3	22
	Decomposed granite (water)	14	36
	~~Brown clay, streaks of mica~~		
	Coarse clean granite broken	2	38
	White Dolomite	12½	50½
	Pump Test:		
	Dim: 50½' x 8"		
	SWL: Surface		
	DD: 14'		
	Yield: 140 g.p.m.		
	Casing: 8" dia. Standard pipe from 0 to 50'6".		
	Perforations: 6 slots ¼" x 6" per ft. from 12 to 38 ft.		

Turn up

Sheet of sheets

ERO404

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. .....
Permit No. .....

(1) OWNER: Name Applewood Farms/Ron Andrews Address RT#1, Box 271, Mead, WA. 99021

(2) LOCATION OF WELL: County Spokane SW¼ NW ¼ NW ¼ Sec. 21 T. 27 N., R. 44E W.M.

Bearing and distance from section or subdivision corner NE 20

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

(4) TYPE OF WORK: Owner's number of well (if more than one) Well #3
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 50' ft. Depth of completed well 50' ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 10" Diam. from 0 ft. to 48 ft.
Threaded ☐ 6" Diam. from 1 ft. to 49 ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used Mills Knife
SIZE of perforations ⅛" in. by 2" in.
1/8" perforations from X ft. to 8 ft.
10" 20' perforations from 19 ft. to 40 ft.
6" 40' perforations from 19 ft. to 47 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: Pea
Gravel placed from 0 ft. to 50 feet ft.

Surface seal: Yes ☒ X No ☐ To what depth? 18 ft.
Material used in seal Bentonite
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 2370 ft.
Static level 5' ft. below top of well Date 8/11/79
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: 15 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 8/11/79
Bailer test X gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

8/15/79 (USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

(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
Overburden	0'	5'
Quicksand (Water)	5'	47'
Clay	47'	50'

RECEIVED
AUG 15 1979
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

Work started 7/17 19 79 Completed 8/11 19 79

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 Ponderosa Drilling & Development, Inc.
(Person, firm, or corporation) (Type or print)

Address 6010 E. Broadway, Spokane, WA. 99206

[Signed] Gage R. Thacker
(Well Driller)

License No. [redacted] #0654 Date August 11 19 79

ERO405 (?)

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. .....

Permit No. .....

(1) OWNER: Name Clayton WELLINGTON Address Rt1 Mead, Washington 99022

(2) LOCATION OF WELL: County Spokane — NW¼ NE¼ Sec 20 T 27 N., R 44E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 50 ft. Depth of completed well 50 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +1 ft. to 40 ft.
Threaded [ ] " Diam. from ft. to ft.
Welded [ ] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
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 [X]
Manufacturer's Name .....
Type ..... Model No .....
Diam. ..... Slot size ..... from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes [ ] No [X] Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes [X] No [ ] To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
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 .....
Static level 9 ft. below top of well Date Aug 6 76
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: 35 gal./min. with ft. drawdown after hrs.
" Est. Air Lift " "
" " " "

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
Top Soil	1	3
Clay	3	30
Broken Basalt	30	35
hard Basalt	35	45
Broken Basalt Clay	45	50

RECEIVED
AUG 11 1976
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

Work started 8-6- 19 76 Completed 8-6- 19 76

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 Caman Development Company
(Person, firm, or corporation) (Type or print)

Address E 6010 Broadway, Spo. Wn. 99206

[Signed] Jonis D Caman
(Well Driller)

License No. 0699 Date 8--9- 19 76

8/13/76

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71)

ERO406

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. G3-27289
Permit No.

(1) OWNER: Name Stan Edburg Address Rt.1 Mead, Washington 99021

(2) LOCATION OF WELL: County Spokane SW¼ of SE ¼ NE ¼ Sec. 20 T. 27 N., R. 44 W.M.
Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 96 ft. Depth of completed well 92 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 0 ft. to 30 ft.
Threaded [ ] " Diam. from ft. to ft.
Welded [X] " 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 [X] No [ ]
Manufacturer's Name
Type PVC Model No.
Diam. 5 Slot size 15 from 82 ft. to 87 ft.
Diam. 5 Slot size 20 from 87 ft. to 92 ft.

Gravel packed: Yes [ ] No [ ] Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 18+ ft.
Material used in seal Cement & bentonite
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 ft.
Static level 57 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 15 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
Topsoil	0	2
Br. Clay	2	8
Broken basalt, sand & clay, mixed	8	14
Light, br. clay	14	25
Sand (no water)	25	27
Dk. br. clay	27	52
Br. clay	52	78
Orange clay	78	81
Silica sand (Aquifer)	81	92
White clay	92	96
PVC Lined		

RECEIVED
APR 9 1986
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

Work started 6/21 19 82 Completed 6/23 19 82

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 SAMS DRILLING
(Person, firm, or corporation) (Type or print)
Address Rt.2 Box 82 Elk, Washington 99009

[Signed] (Well Driller)
License No. 0983 Date 6/28 19 82

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 040-1-20

ERO407

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. .....
Permit No. 83-4[illegible]50

(1) OWNER: Name Wallace Hohack Address Rt.4 Box 749 Newport, Washington 99156

(2) LOCATION OF WELL: County Spokane S½ of NE ¼ NE ¼ Sec. 29 T. 27 N., R. 44 W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 98 ft. Depth of completed well 98 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 30 ft.
Threaded [ ] ..... " Diam. from ..... ft. to ..... ft.
Welded [X] ..... " 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 [X] No [ ] To what depth? 18 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 ... 2300 ft.
Static level 59 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 10 g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? Yes [ ] No [ ]

8/17/84

(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
Topsoil	0	2
Soft clay & fine sand	2	5
Soft Br.clay	5	27
Soft basalt	27	30
Med. basalt	30	33
Hard basalt	33	93
Br. clay	93	95
White clay	95	98
White clay to orange	98	100

Work started 5/3 19 84 Completed 5/4 19 84

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 SAMS DRILLING
(Person, firm, or corporation) (Type or print)
Address Rt.2 Box 82 Elk, Washington 99009
[Signed] Herbert D Sams
(Well Driller)
License No. 0457 Date 7/8 1984, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

ERO409

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. .....
Permit No. .....

(1) OWNER: Name Allan J. Wicklund Address 1813 Hutchsion Apt 27 Spokane, Wn.

(2) LOCATION OF WELL: County Spokane S.½ – N. ¼ NE ¼ Sec. 29 T. 27 N., R. 44 W.M.

Bearing and distance from section or subdivision corner

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

(4) TYPE OF WORK: Owner's number of well (if more than one) 3
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☒ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well ..... inches.
Drilled ..... ft. Depth of completed well ..... ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam. from 0 ft. to 38 ft.
Threaded ☐ 6 " Diam. from plus 2 ft. to 328 ft.
Welded ☐ 4FVC " Diam. from 325 ft. to 365 ft.

Perforations: Yes ☒ No ☐ Still Saw
Type of perforator used 1/8" in. by 6"-6 rounds
SIZE of perforations 240 perforations from 325 ft. to 365 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? 18 ft.
Material used in seal cement & bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ..... Depth of strata .....
Method of sealing strata off .....

(7) PUMP: Manufacturer's Name Grundfoos
Type: SP-4 H.P. 1-1.2

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 228 ft. below top of well Date 1.0.87
Artesian pressure none lbs. per square inch Date none
Artesian water is controlled by none (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? Contractor
Yield 8 gal./min. with 76 ft. drawdown after 1 hrs.
" 8 " 76 " 2 "
" 8 " 76 " 5 "

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
4:40	304	4:41	265	4:42	242
4:45	235	4:50	230	4:55	229
5:00	228				

Date of test 1/3/87
Bailer test ..... gal./min. with 84 ft. drawdown after 3 hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water 56 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
Clay white to gray	65	100
Clay brown	100	130
Clay dark brown	130	217
Clay lite brown	217	228
Clay white to gray	228	230
Clay lite brown (some wood)	230	233
Clay green	233	248
Clay dark brown (very fine sand)	248	268
Clay blue (very fine sand)	268	283
Clay green (very fine sand)	283	294
Clay brown (very fine sand)	294	330
Clay to shale brown (with sand lenses) Water Bearing	330	345
Clay lite brown to shale with sand lenses & wood fragments		365
*Water Bearing		

RECEIVED
JAN 20 1987
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

Work started 12/3/86 19..... Completed 1.9.87 19.....

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 C.J. Warren & son Drilling (Person, firm, or corporation) (Type or print)
Address E. 12005 8th Avenue Spokane Wn. 99206
[Signed] Charles J Warren (Well Driller)
License No. 0515 Date January 12 19 87

1/20/87

(USE ADDITIONAL SHEETS IF NECESSARY)

ERO410

APPENDIX B
Altimeter Drift Curves, Associated Data and Explanations
for Wellhead Elevation Corrections

Wellhead elevations were measured from points of known elevation. A point of known elevation was selected as a benchmark from which a measurement loop was initiated. The loop was then closed to check for drift and allow for correction. Loops were held to 30 minutes to minimize correction problems. The following are the three loops ran to collect wellhead elevations.

Loop 1

Well ID	Time	Pressure millibars	Wellhead Elevation	Drift Correction	Corrected Elevation	At
ERO405	11:06	942.0	2306	0	2306	slab
ERO406	11:10	941.8	2309	0	2309	MP
ERO404	11:14	942.6	2289	0	2289	MP
ERO403	11:17	942.3	2294	0	2294	MP
ERO402	11:20	942.2	2298	0	2298	GS
ERO405	11:26	942.0	2306	0	2306	slab

Loop 2

Well ID	Time	Pressure millibars	Wellhead Elevation	Drift Correction	Corrected Elevation	At
ERO407	11:45	940.6	2342	0	2342	GS
ERO408	11:50	940.5	2344	-1.0	2343	GS*
ERO409	11:57	939.9	2361	-2.35	2359	GS**
ERO410	12:07	941.7	2311	-4.3	2307	MP
ERO407	12:16	940.4	2348	-6.0	2342	GS

*MP = -2.44
** at road +5

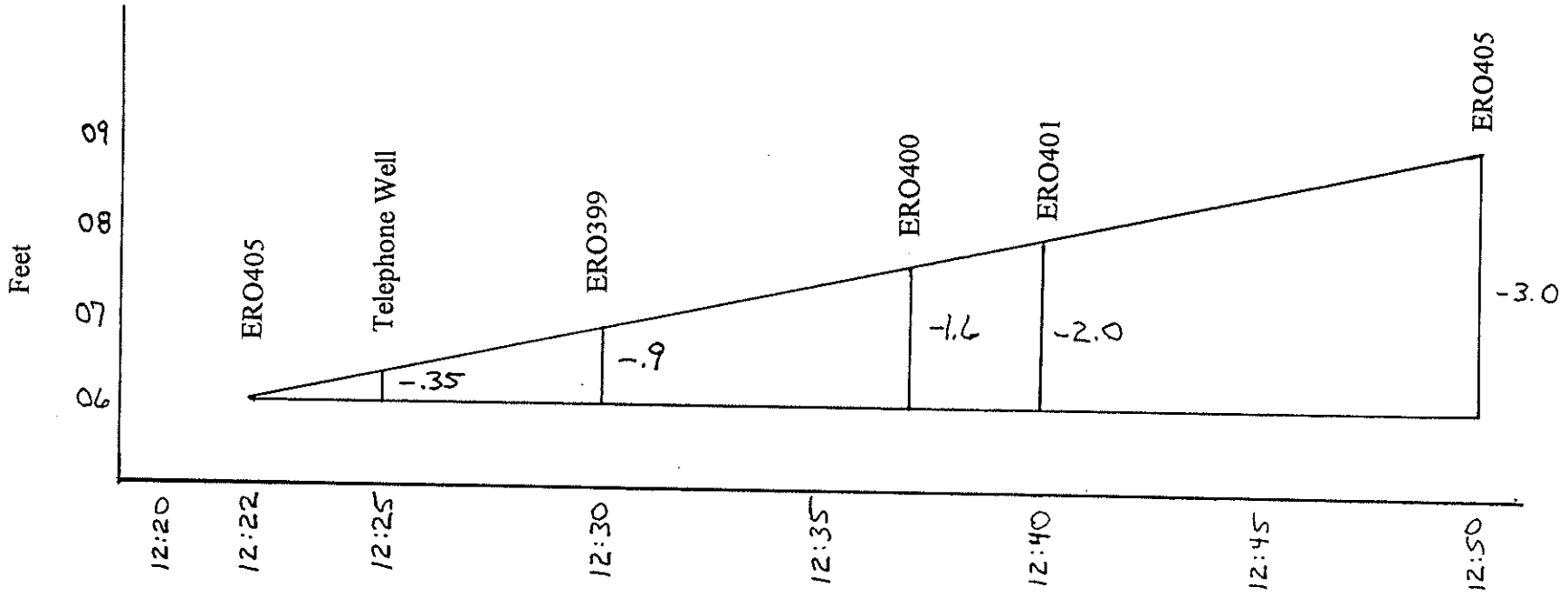
Loop 3

Well ID	Time	Pressure millibars	Wellhead Elevation	Drift Correction	Corrected Elevation	At
ERO405	12:22	941.6	2306	0	2306	slab
Telephone Well	12:25	941.5	2308	-0.35	2308	GS
ERO399	12:30	938.4	2397	-0.9	2396	MP
ERO400	12:37	939.7	2360	-1.6	2358	MP
ERO401	12:40	940.2	2347	-2.0	2345	MP
ERO405	12:50	941.5	2309	-3.0	2306	slab

A Lietz model AIR-HB-1L barometer/altimeter was used to take the readings. The accuracy of this instrument is 1.0 foot according to the manufacturer. Measurements were taken in millibars and elevation in feet. Drift curves were used to correct for instrument drift (Lahee, 1961). The day the measurements were taken there was no wind, the temperature was about 65 degrees, and there were no clouds.

ALTIMETER ELEVATION CORRECTION CURVE

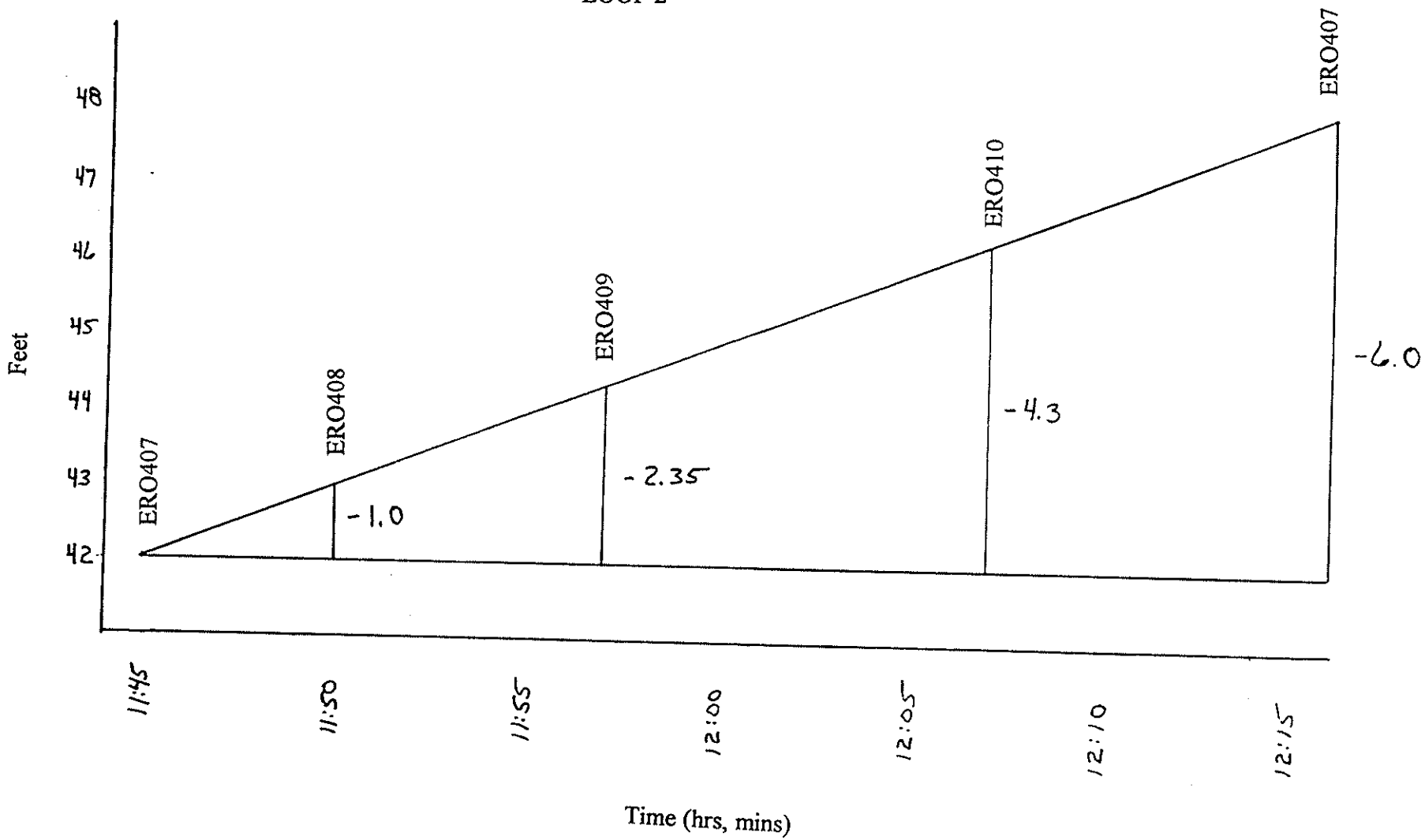
LOOP 3



Time (hrs, mins)

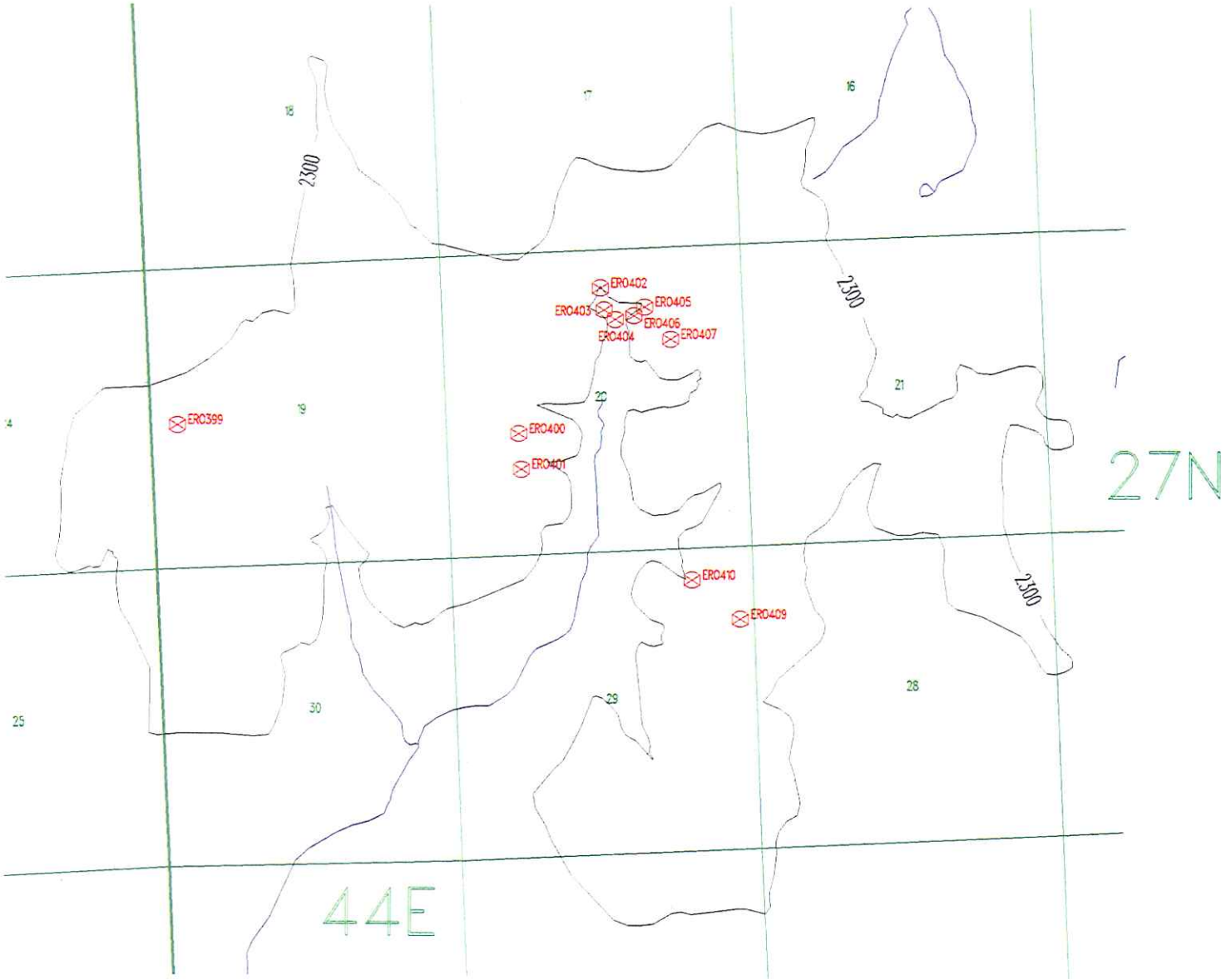
ALTIMETER ELEVATION CORRECTION CURVE

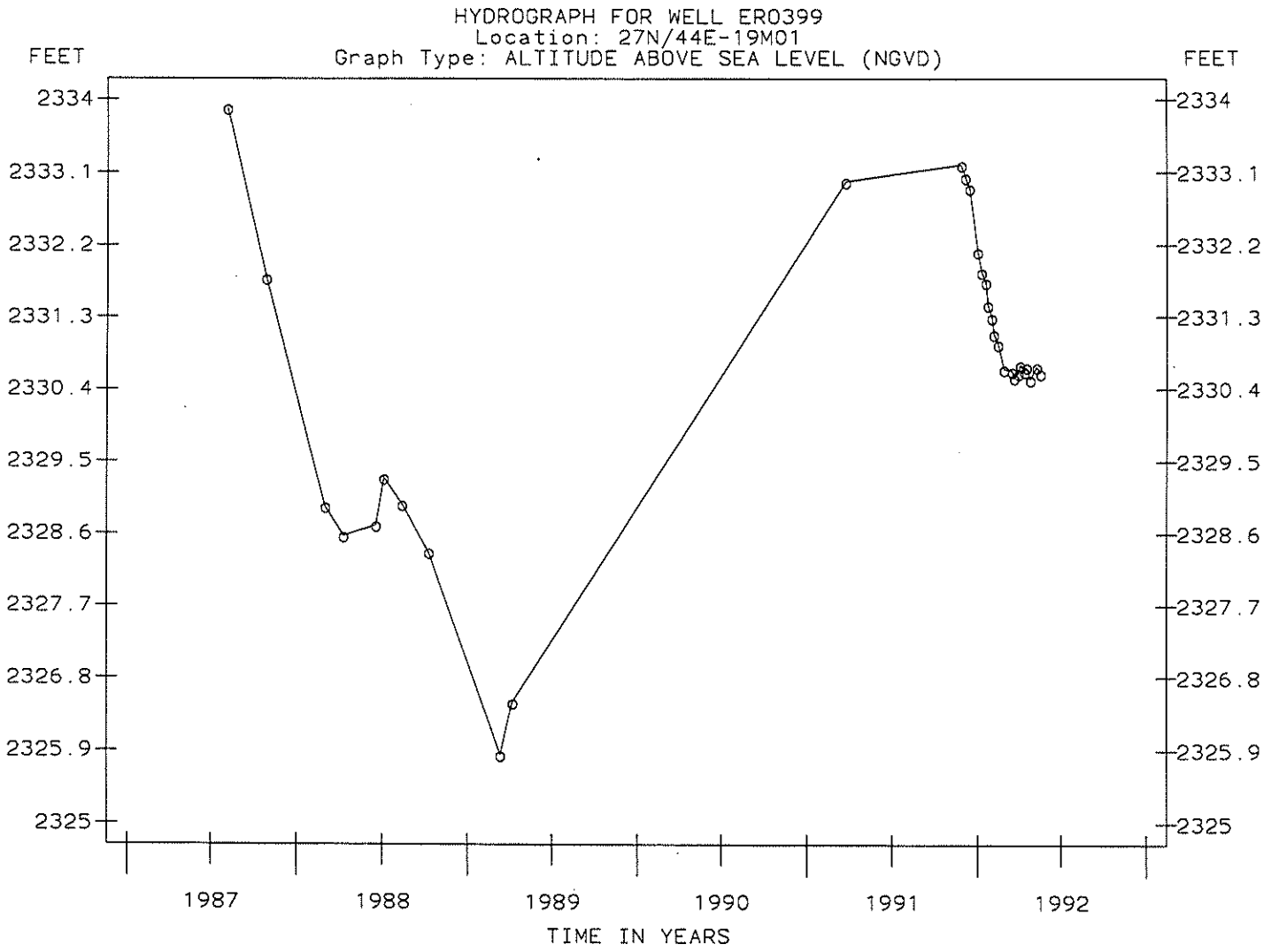
LOOP 2

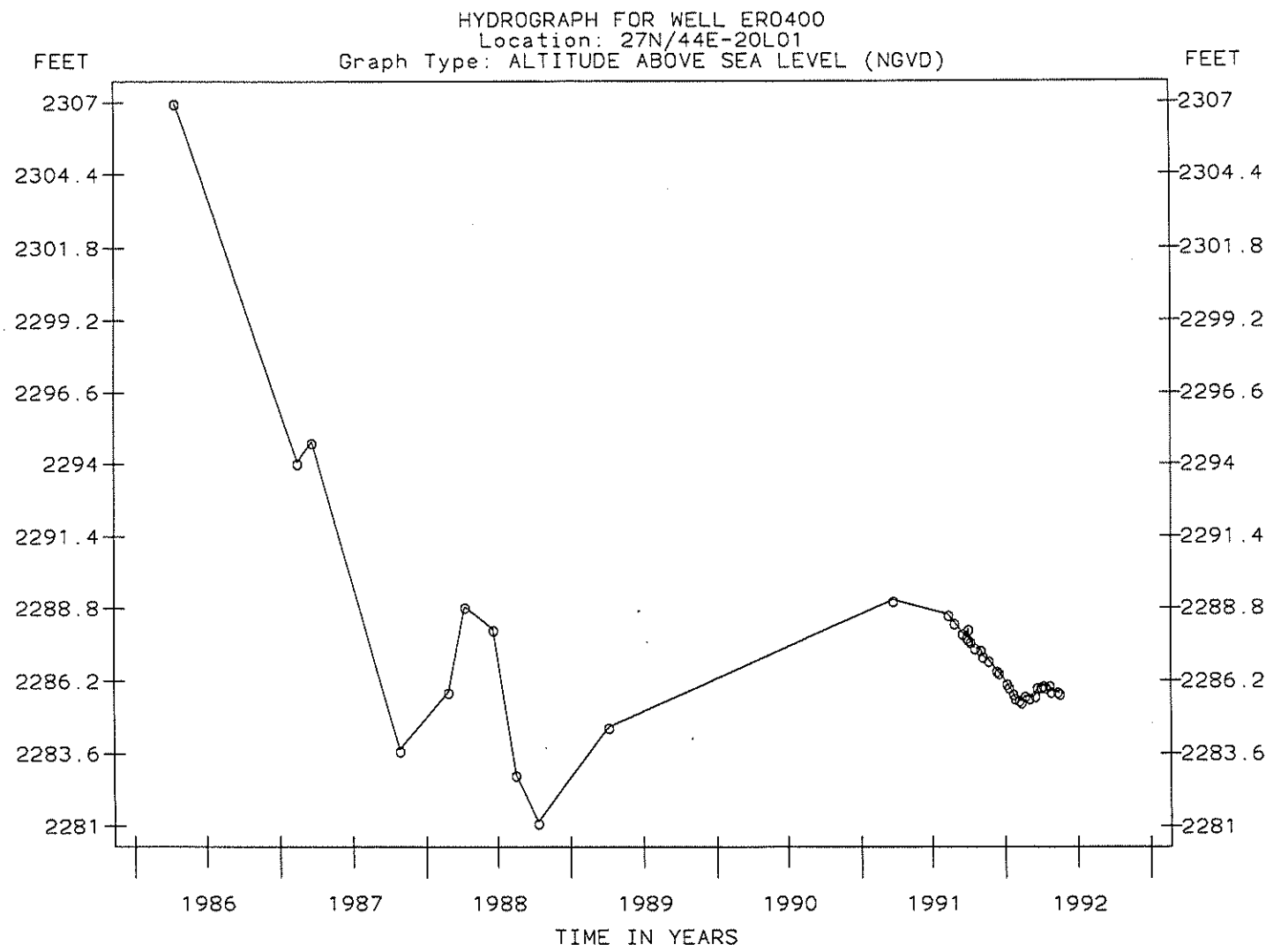


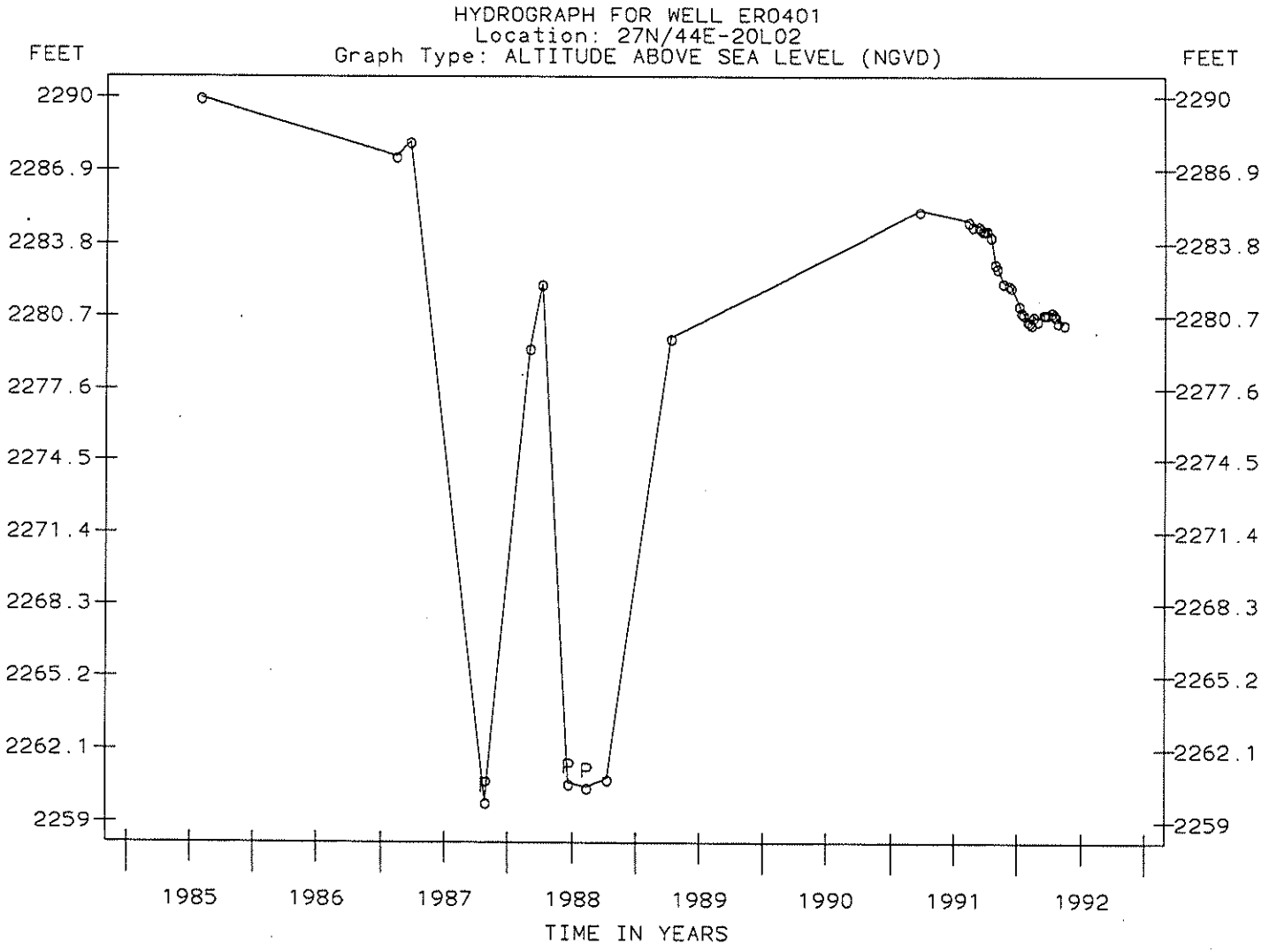
APPENDIX C
Hydrographs for Green Bluff Observation Wells

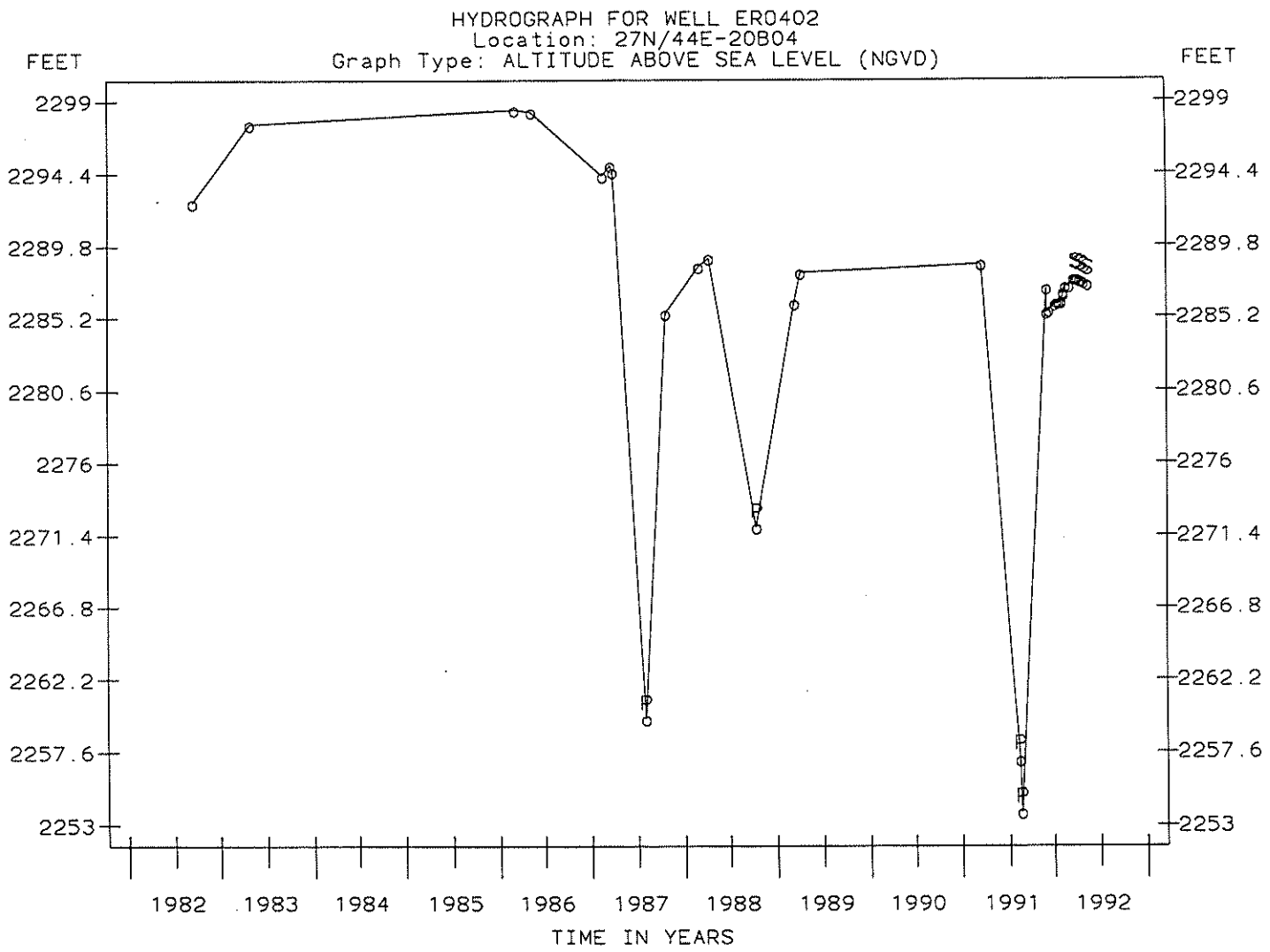
Green Bluff, Spokane County, Wa

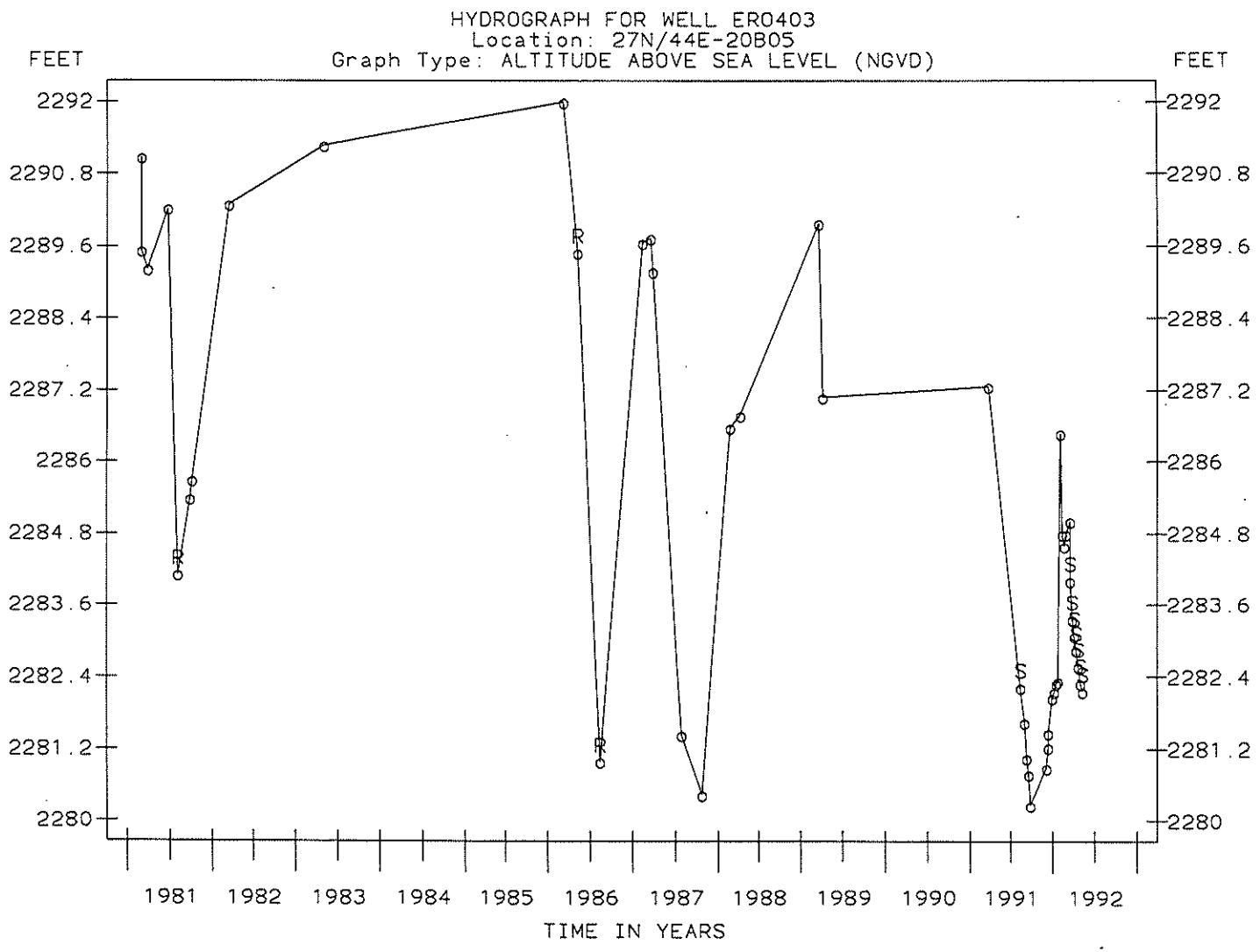


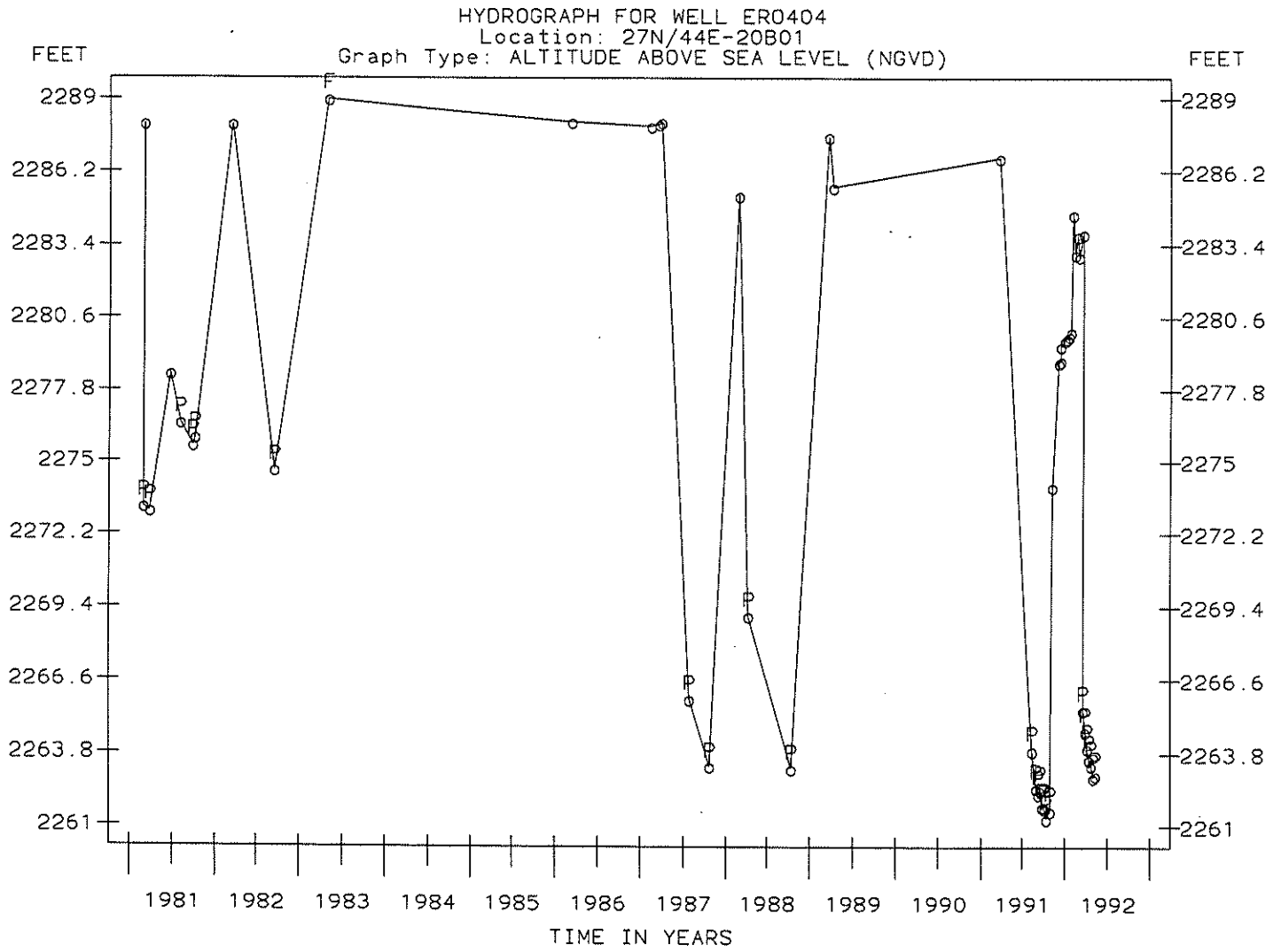

HYDROGRAPH FOR WELL ER0399
Location: 27N/44E-19M01
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2334
2333.1
2332.2
2331.3
2330.4
2329.5
2328.6
2327.7
2326.8
2325.9
2325
1987
1988
1989
1990
1991
1992
TIME IN YEARS

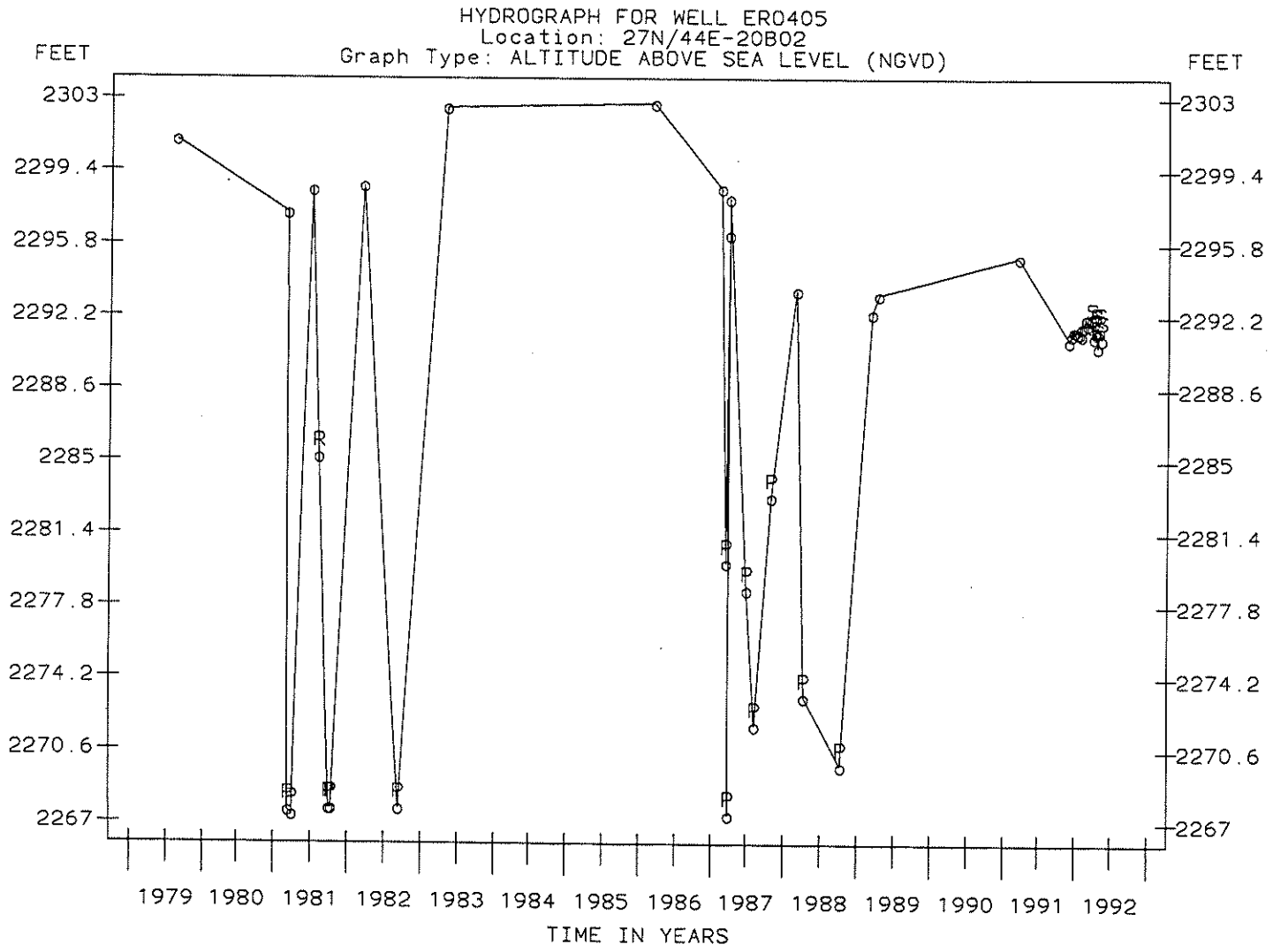

HYDROGRAPH FOR WELL ER0400
Location: 27N/44E-20L01
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2307
2304.4
2301.8
2299.2
2296.6
2294
2291.4
2288.8
2286.2
2283.6
2281
1986
1987
1988
1989
1990
1991
1992
TIME IN YEARS

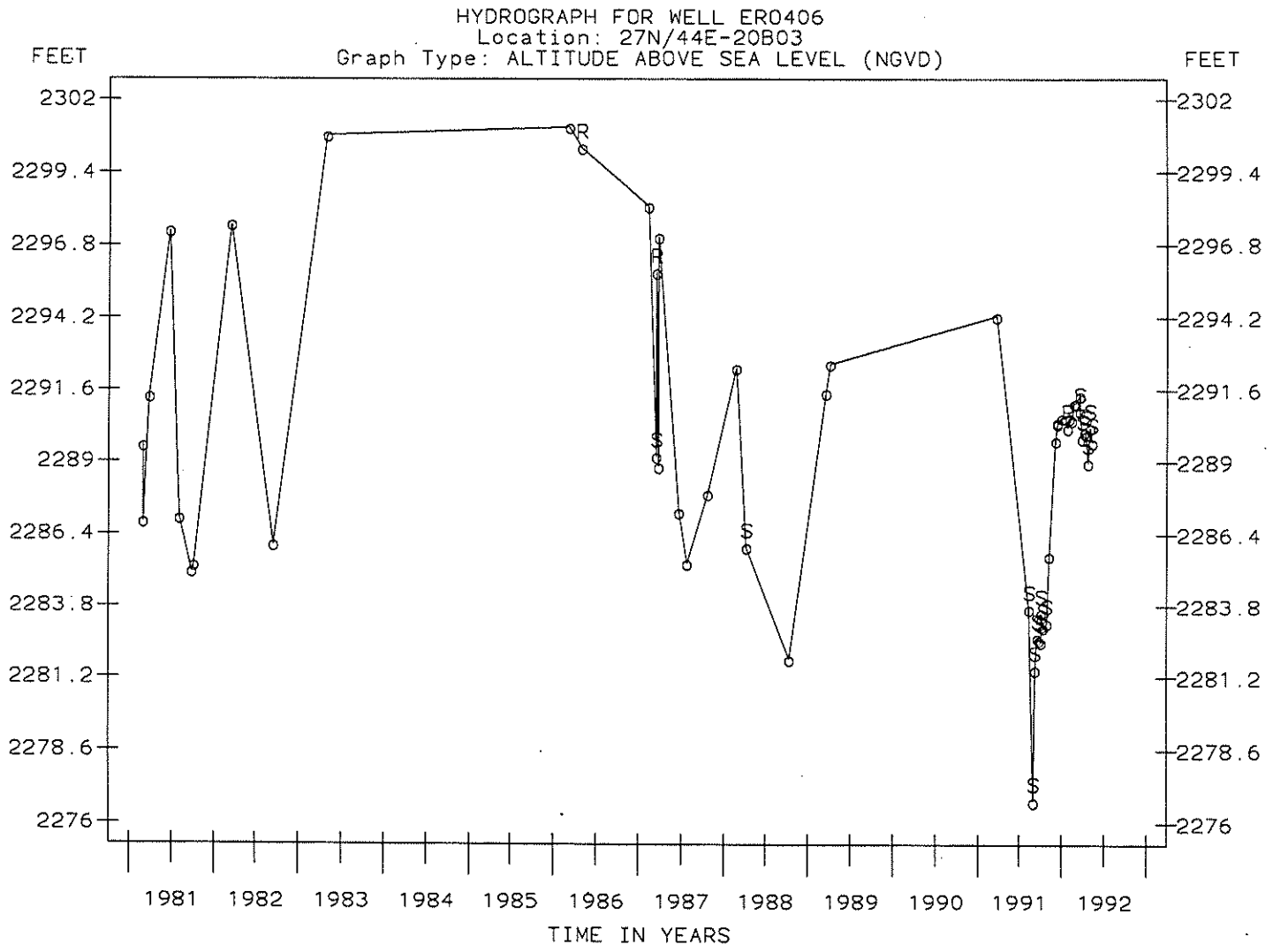

HYDROGRAPH FOR WELL ER0401
Location: 27N/44E-20L02
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2290
2286.9
2283.8
2280.7
2277.6
2274.5
2271.4
2268.3
2265.2
2262.1
2259
1985
1986
1987
1988
1989
1990
1991
1992
TIME IN YEARS

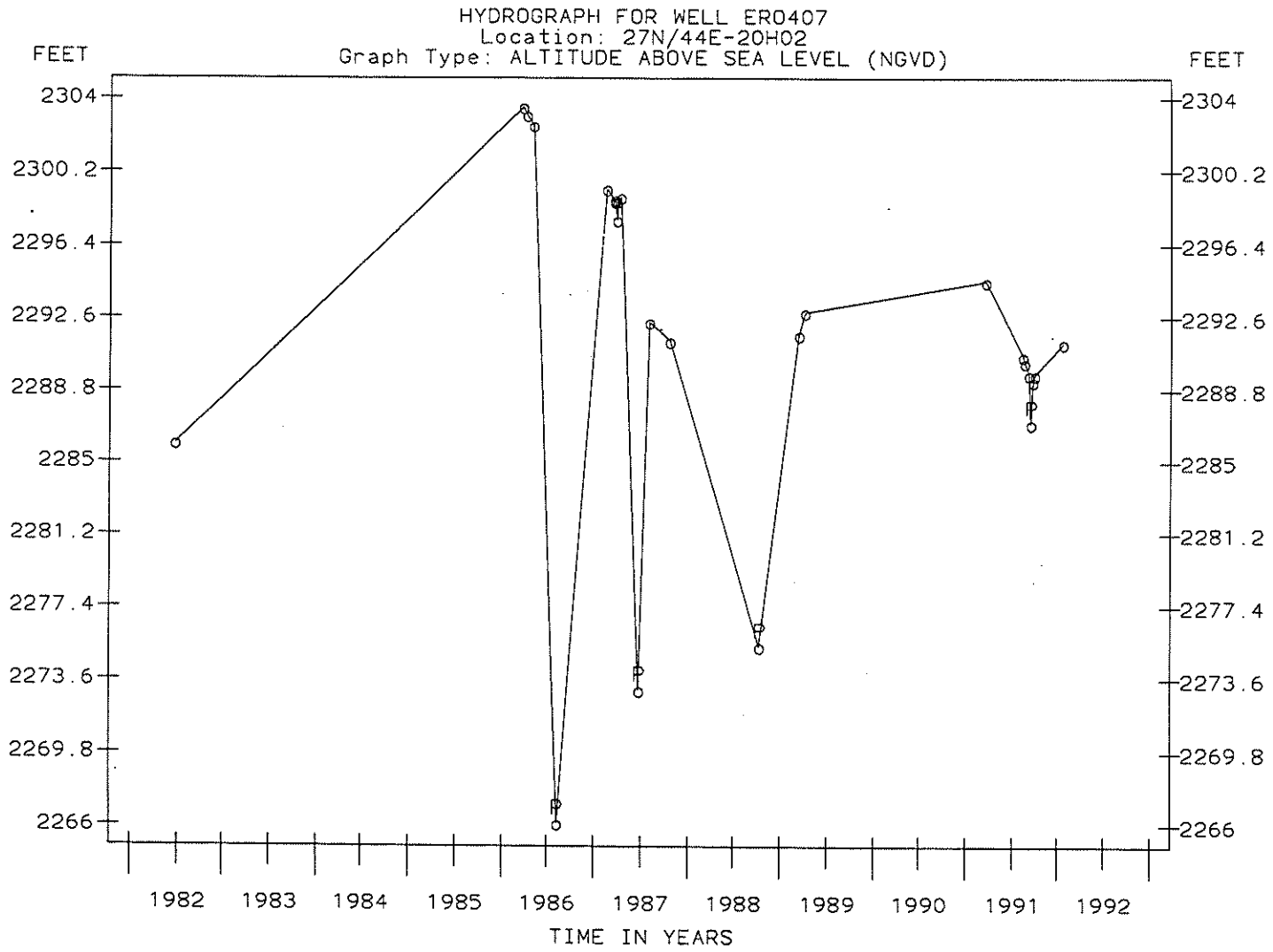

HYDROGRAPH FOR WELL ER0402
Location: 27N/44E-20B04
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2299
2294.4
2289.8
2285.2
2280.6
2276
2271.4
2266.8
2262.2
2257.6
2253
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
TIME IN YEARS

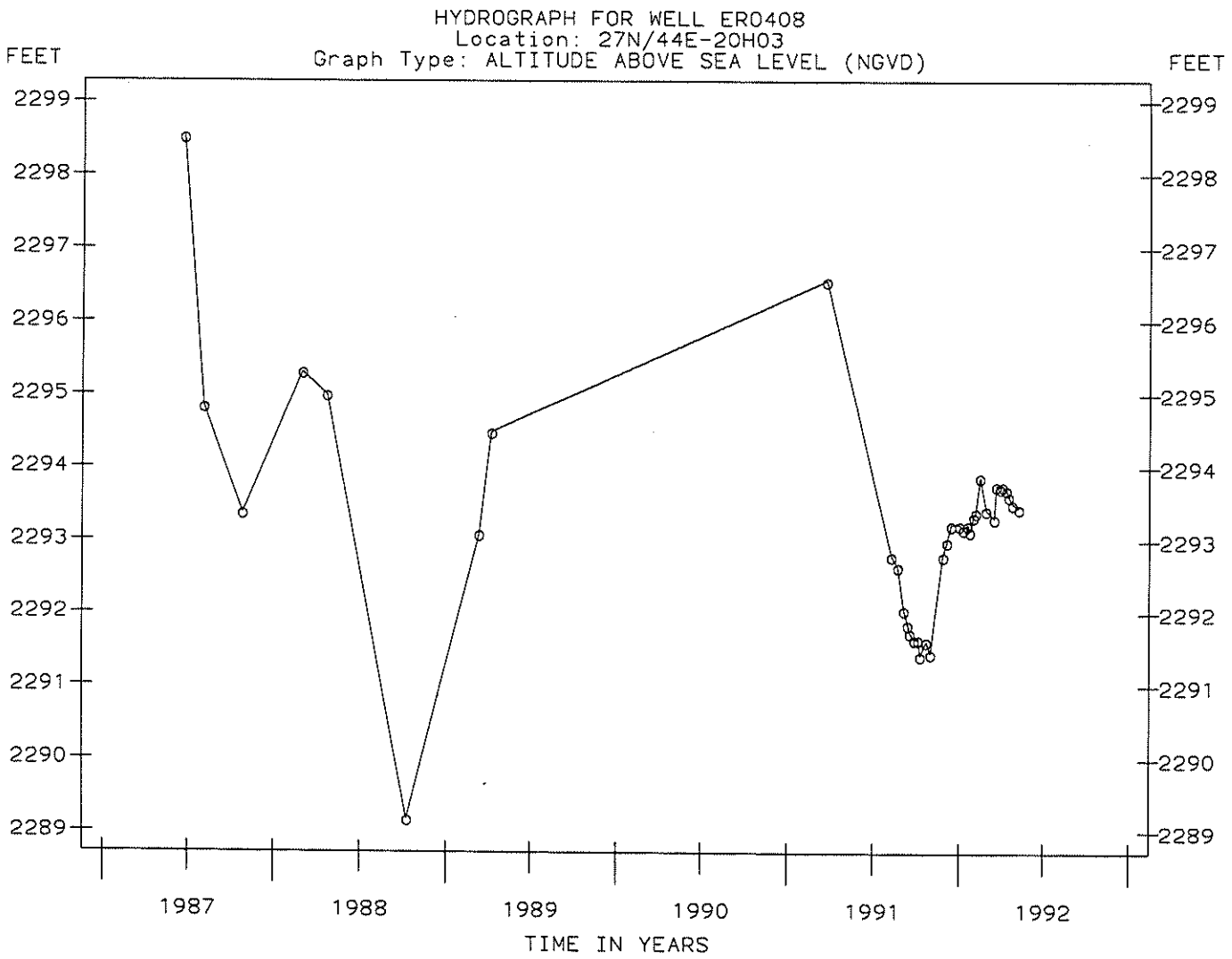

HYDROGRAPH FOR WELL ER0403
Location: 27N/44E-20B05
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2292
2290.8
2289.6
2288.4
2287.2
2286
2284.8
2283.6
2282.4
2281.2
2280
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
TIME IN YEARS

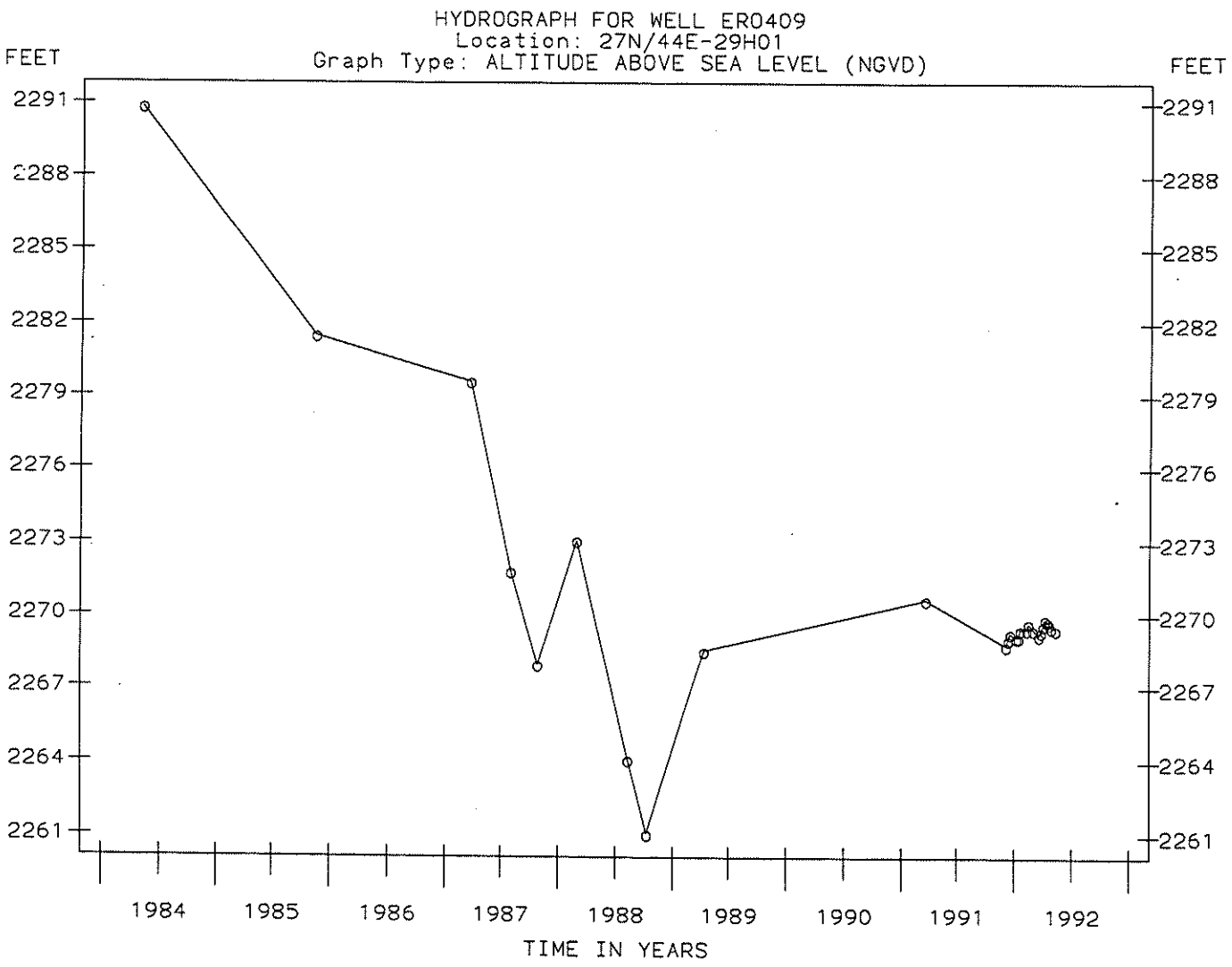

HYDROGRAPH FOR WELL ER0404
Location: 27N/44E-20B01
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2289
2286.2
2283.4
2280.6
2277.8
2275
2272.2
2269.4
2266.6
2263.8
2261
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
TIME IN YEARS

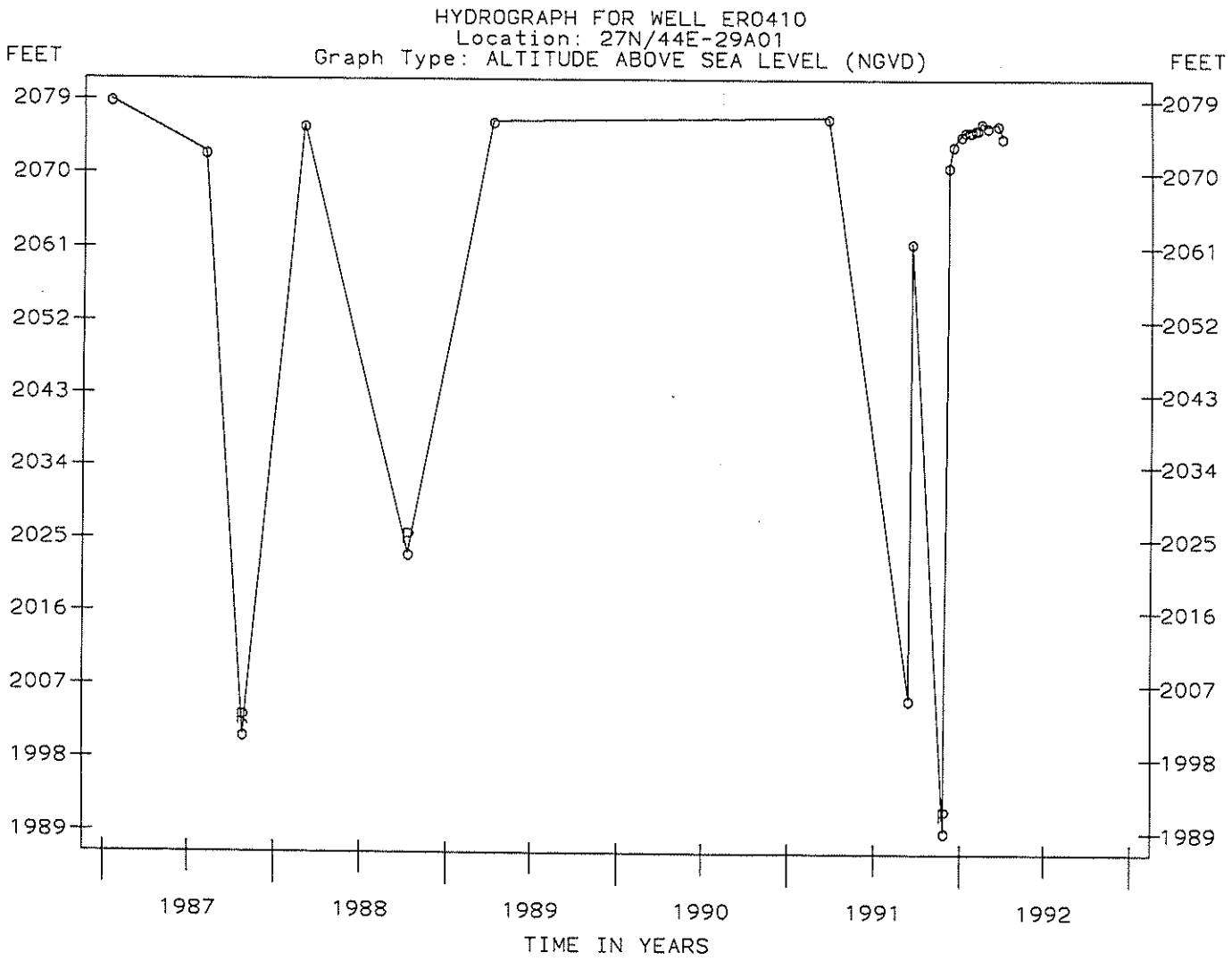

HYDROGRAPH FOR WELL ER0405
Location: 27N/44E-20B02
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2303
2299.4
2295.8
2292.2
2288.6
2285
2281.4
2277.8
2274.2
2270.6
2267
1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992
TIME IN YEARS


HYDROGRAPH FOR WELL ER0406
Location: 27N/44E-20B03
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2302
2299.4
2296.8
2294.2
2291.6
2289
2286.4
2283.8
2281.2
2278.6
2276
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
TIME IN YEARS


HYDROGRAPH FOR WELL ER0407
Location: 27N/44E-20H02
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2304
2300.2
2296.4
2292.6
2288.8
2285
2281.2
2277.4
2273.6
2269.8
2266
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
TIME IN YEARS


HYDROGRAPH FOR WELL ER0408
Location: 27N/44E-20H03
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2299
2298
2297
2296
2295
2294
2293
2292
2291
2290
2289
1987
1988
1989
1990
1991
1992
TIME IN YEARS


HYDROGRAPH FOR WELL ER0409
Location: 27N/44E-29H01
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2291
2288
2285
2282
2279
2276
2273
2270
2267
2264
2261
1984
1985
1986
1987
1988
1989
1990
1991
1992
TIME IN YEARS


HYDROGRAPH FOR WELL ER0410
Location: 27N/44E-29A01
Graph Type: ALTITUDE ABOVE SEA LEVEL (NGVD)
FEET
FEET
2079
2070
2061
2052
2043
2034
2025
2016
2007
1998
1989
1987
1988
1989
1990
1991
1992
TIME IN YEARS

APPENDIX D
Hydrograph for Stream Measurement
sites 290 and 290A

Flow in Unnamed Stream
Tributary to Deadman Creek