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THESIS APPROVAL

The abstract and thesis of Brett Todd Brodersen for the Master of Science in Geology, specializing in Geohydrology were presented on September 20, 1994 and accepted by the thesis committee and the department.

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[REDACTED] on 27 February 1995

ABSTRACT

An abstract of the thesis of Brett Todd Brodersen for the Master of Science in Geology specializing in Geohydrology presented September 20, 1994.

Title: The Geology of Parrett Mountain, Oregon, and its Influences on the Local Groundwater Systems.

A geologic study of the Parrett Mountain area, located twenty miles (32 kms) south-southwest of Portland, Oregon, was initiated by the Oregon Water Resources Department. The main goal was to create a stratigraphic and structural model of Parrett Mountain in order to better understand the local basalt aquifers present there.

Previous geologic studies of the area revealed the mountain to be composed of Columbia River basalt. Field mapping and hand lithologic and geochemical analyses allowed the basalt to be subdivided into eleven basalt flows. These flows are as follows: (from oldest to youngest) the Wapshilla Ridge (WpR), the Ortley-Grouse Creek (undifferentiated) (OGC), the Umtanum (U), the Winter Water (WW), and the Sentinel Bluffs (SB) basalt units of the Grande Ronde Basalt and the Ginkgo (Gk) flow of the Frenchman Springs Member of the Wanapum Basalt. All the basalt flows were found to be laterally extensive throughout

the entire area creating a stacked pancake-layered structure.

Thickness variations in the Wapshilla Ridge, Ortley-Grouse Creek and Ginkgo basalt flows reflect paleotopographic relief present during the emplacement of the basalt flows. Sedimentary interbeds appear to be highly localized, occurring sporadically throughout the entire area stratigraphic column.

Faults were identified based on geologic map compilation, cross section analysis, and topographic linear features. They trend N-S, E-W, NE and NW and are believed to dissect the entire basalt column. All faults have been designated with a normal sense of displacement, except those known to be thrust or reverse. Cross-cutting relationships suggest the NS-trending faults are the youngest and the NW-trending faults are the oldest. The faulting created twenty-four separate basalt blocks, each represented by a distinct strike and dip.

Flowtop morphology, stratigraphic layering, and the local geologic structures influence local groundwater systems. All flow boundaries yield water to at least one well on the mountain. The most commonly used aquifers are the U/OGC boundary, interflow zones within the OGC, the OGC/WpR boundary and permeable zones within the WpR. Faulting is believed to promote recharge of the groundwater systems by increasing the vertical infiltration of

percolating precipitation through the highly fractured fault zone.

THE GEOLOGY OF PARRETT MOUNTAIN, OREGON, AND ITS
INFLUENCES ON THE LOCAL GROUNDWATER SYSTEMS

by

BRETT TODD BRODERSEN

A thesis submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE
in
GEOLOGY
specializing in
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1995

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I would like to thank my family for the love and support they provided for me during this study.

Second, I would like to thank the Oregon Water Resources Department, especially Donn Miller, Sara Gates, and Mike Zwort. Without their help and data, this thesis would not have been possible.

Finally, I would like to thank all of the residents of Parrett Mountain, and the members of C.A.R.E. and Friends of Parrett Mountain (FOPM) for providing background history and knowledge of the area.

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INTRODUCTION

Concern over declining water levels on Parrett Mountain prompted a two year study by the Oregon Water Resources Department (OWRD) on the Parrett Mountain aquifer system(s). The groundwater study boundaries are: Cedar Creek, the Rock Creek-Seely Ditch lowland, the Willamette River, and the western portions of Corral Creek Road and Wilsonville Road (Figure 1). The objectives of the groundwater study, stated by Donn Miller of the OWRD (1992, written commun.) are the following:

- 1) to thoroughly characterize the stratigraphy and local structures present on Parrett Mountain;
- 2) to ascertain the geologic and hydrologic characteristics of the basalt aquifers;
- 3) to determine the magnitude and areal extent of present groundwater development;
- 4) to ascertain the rate of recharge;
- 5) to evaluate the effect of development (use) on the perennial supply of groundwater;
- 6) to evaluate the effect of well construction practices and climate on water levels in wells;
- 7) to identify areas where supplies are adequate for additional development; and
- 8) to describe the groundwater chemistry.

These objectives were answered in the Oregon Water Resources Groundwater Report #40 by Miller and others (1994).

The OWRD initially recommended the Parrett Mountain area be placed under a groundwater moratorium, eliminating all but exempt uses and precluding the construction of any new water wells. However, only Sections 5, 7, and 8 of T3S R1W, referred to as "Northern Parrett Mountain" by OWRD

Figure 1. Topographic view of the geologic study area. The bold line represents the study's boundaries.

staff, was deemed necessary for a withdraw order.

A secondary study, on the geology of Parrett Mountain, was initiated due to a lack of adequate geologic data needed to address objectives one and two of the OWRD study. The goal of this smaller study and the object of this thesis is to create a geologic map as well as develop a stratigraphic model of the mountain. Ultimately the structural and stratigraphic data will be used to help identify groundwater systems occurring on Parrett Mountain, and the geologic controls influencing them.

TOPOGRAPHY

Boundaries for the geologic study area have been designated as the Tualatin River, Oregon highway 99 West (99 W), the Willamette River, and Interstate 5 (Figure 1). The study area lies roughly twenty miles (32 km) south southwest of downtown Portland, Oregon, along the Interstate 5 corridor. The boundaries were designed to embody three distinct physiographic provinces: Parrett Mountain, the Tonquin area, and the Hess Creek-Spring Brook (HC-SP) area (Figure 2).

Four cities, Newberg, Wilsonville, Tualatin, and Sherwood, occur within or on the study boundaries. Population for the four cities has been documented in 1994 as 14,065 for Newberg, 10,000 residents in Wilsonville, 16,640 people in Tualatin, and 4,000 residents in Sherwood.

0 2,640 5,280 10,560

Figure 2. The three distinct physiographic provinces comprising the study area.

Within the Parrett Mountain groundwater study area Miller and others (1994) estimated at least 4,500 people with 3,500 as rural residents.

Groundwater is the sole source of water for the residents living in the study area. Four of the most heavily pumped wells are the Sherwood wells #3 and #5 and the two Dammasch wells. Miller and others (1994) estimated that roughly 558 million gallons per year is withdrawn from the basalt aquifers on Parrett Mountain.

Parrett Mountain

Parrett Mountain is centrally located in the study area, reaching a maximum elevation of 1,247 feet (380 m). The study area contains over 18,100 acres (7,325 hectares) of land of which 12,300 acres (4,978 hectares) were set aside for agricultural and forestry uses while the remaining 5,800 acres (2,347 hectares) have been zoned for rural residential development (Donn Miller, 1992, written commun.). Agricultural uses within the region include the development of orchards, timber, and nurseries plus the husbandry of sheep, cattle, horses and llamas.

Parrett Mountain is part of the Chehalem Mountain range separating the Tualatin and Willamette drainage basins. The mountain was described as "... a gently southeasterly dipping cuesta composed solely of Columbia River basalt and dissected by deeply incised, linear stream valleys."

(Schlicker and Deacon, 1967) For this study Grouse Butte

and La Butte, two basalt knobs located on the flanks of Parrett Mountain, will be included in the Parrett Mountain province due to similar geologic factors (Figure 2).

The Tonquin area

The Tonquin area includes the northeastern portion of the study area using the Rocky Creek-Seely Ditch lowland as a physiographic boundary (Figure 2). Thin soils and alluvium mantling the CRB are characteristic for the central portion of the Tonquin area. The remaining area is covered by a thick blanket of alluvium.

Primary uses within this region include the quarrying of rock aggregate and agricultural development. Agricultural uses include the development of orchards and nurseries. Quarrying occurs only in the central portion of the Tonquin area, near the town of Tonquin. Residential population is expected to increase in this area as the cities of Wilsonville, Sherwood, Tualatin, and Portland continue to expand.

The Hess Creek-Spring Brook Area

The Hess Creek-Spring Brook area (Figure 2), located between Parrett Mountain and the city of Newberg, is characterized by a nearly flat-lying alluvial plain dissected by Hess Creek and Spring Brook. The local geology of the area is comprised of the Willamette Silt, the Troutdale Formation, and the Oligocene-Miocene sedimentary

rocks at depth. Basalt is exposed at the surface only around Parrett Mountain and at shallow depths near Grouse Butte. This region supports both an agricultural industry and residential sections of Newberg.

CLIMATE

Monthly and yearly precipitation averages, since 1948, are presented in Table I. The climate data were collected from the REX 1S station, which lies within the study boundaries. Monthly numbers in italics represent partial values, reflecting one to nine daily values missing, while monthly values, in bold, represent values taken from McMinnville. The Parrett Mountain area averages roughly 42 inches (1,067 mm) of precipitation with 75% occurring between October to March.

TABLE I
PRECIPITATION DATA FROM REX 1S STATION,
PARRETT MOUNTAIN

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
1992	5.33	4.83	1.03	5.08	0.06	0.59	0.68	0.60	1.88	4.28	5.29	5.99	35.64
1991	3.41	5.04	4.53	5.43	3.38	2.59	0.24	1.83	0.16	2.83	7.67	5.26	42.37
1990	9.07	4.28	2.66	1.73	1.97	2.09	0.39	1.46	0.72	4.44	4.58	3.11	36.50
1989	4.24	3.29	7.58	0.87	2.13	1.26	0.30	0.98	1.06	1.80	4.21	3.85	31.57
1988	7.53	1.29	3.72	4.13	3.43	2.14	0.12	0.09	1.42	0.14	9.69	3.14	36.84
1987	8.40	4.55	6.11	1.83	1.39	0.20	1.50	0.27	0.37	0.34	2.75	10.77	38.48
1986	6.73	6.81	3.06	1.78	2.76	0.48	1.15	0.00	3.39	3.06	6.81	4.34	40.37
1985	0.25	2.60	4.38	1.14	0.82	2.42	0.54	0.44	1.72	3.54	4.66	2.52	25.03
1984	2.84	4.88	4.63	4.17	4.61	4.67	0.03	0.16	1.89	5.62	12.87	3.40	49.77
1983	7.26	10.49	7.66	2.60	1.94	2.05	2.82	2.29	0.23	2.06	10.47	6.10	55.97
1982	6.85	7.88	3.51	5.12	0.86	1.56	0.42	0.72	3.51	3.81	5.11	9.26	48.61
1981	1.97	4.00	3.65	2.18	2.35	3.74	0.16	0.02	2.61	4.48	5.61	11.01	41.78
1980	11.16	4.46	3.87	4.18	1.57	3.08	0.20	0.32	1.80	2.14	6.81	11.60	51.19
1979	2.99	6.87	2.65	2.55	2.25	0.57	0.14	1.03	2.70	5.99	3.92	8.09	39.75
1978	6.32	3.73	1.65	3.72	4.09	0.79	1.28	2.49	3.50	0.37	4.63	3.10	35.67
1977	1.03	2.86	3.41	0.62	4.03	1.24	0.94	3.03	3.22	2.95	6.75	12.30	42.38
1976	6.19	7.30	3.21	1.89	2.15	0.46	0.98	2.93	1.30	1.45	1.09	1.33	30.28
1975	7.09	4.88	4.69	2.19	1.81	1.52	0.52	2.66	0.00	6.09	5.41	6.17	43.03
1974	9.13	5.35	6.63	1.97	2.21	0.70	2.16	0.03	0.20	1.90	7.24	7.18	44.70
1973	5.03	1.55	3.75	1.56	1.44	1.27	0.04	0.80	2.70	3.85	14.27	10.85	47.11
1972	10.20	5.73	6.59	3.63	2.35	0.60	0.27	0.27	3.46	0.88	4.24	8.93	47.15
1971	8.92	3.81	6.13	3.44	1.36	2.62	0.21	0.90	2.99	3.90	7.05	8.74	50.07
1970	12.08	4.38	2.33	2.53	1.18	0.55	0.10	0.00	1.75	3.74	6.46	9.60	44.70
1969	6.73	3.01	1.24	2.84	1.66	3.35	0.06	0.04	3.64	4.51	2.97	8.98	39.03
1968	5.20	7.96	3.55	2.18	3.57	2.41	0.49	3.76	2.36	6.16	7.11	10.33	55.08
1967	7.85	1.83	3.99	2.29	1.42	0.80	0.00	0.20	0.83	5.21	2.70	4.83	31.95
1966	7.22	1.95	5.47	1.08	1.20	1.35	1.40	0.29	1.71	2.72	5.24	7.82	37.45
1965	8.60	1.54	0.94	3.08	1.30	0.99	0.33	0.98	0.00	2.14	6.74	6.98	33.62

TABLE I
PRECIPITATION DATA FROM REX 1S STATION,
PARRETT MOUNTAIN
CONTINUED

1964	12.32	0.72	3.47	1.37	0.77	1.49	0.88	0.70	1.45	0.87	8.87	12.58	45.49
1963	1.84	4.83	6.06	3.87	3.71	1.26	0.97	0.80	1.24	3.18	6.57	4.35	38.68
1962	1.75	3.40	4.91	3.59	2.03	0.76	0.01	1.65	2.06	4.18	12.02	2.96	39.32
1961	5.56	9.74	7.05	3.46	3.12	0.51	0.54	0.63	0.91	3.85	5.33	6.40	47.10
1960	4.00	4.52	5.83	4.37	4.38	0.46	0.00	0.71	0.72	3.70	10.23	3.43	42.35
1959	10.20	4.91	4.86	1.26	2.78	2.40	0.88	0.09	2.83	3.14	3.17	3.31	39.83
1958	7.93	7.18	2.34	4.24	0.68	3.30	0.00	0.04	0.97	2.21	8.00	5.64	42.53
1957	2.35	4.66	7.56	1.66	3.58	1.30	0.09	0.96	0.71	3.27	3.36	8.85	38.35
1956	12.87	3.87	5.99	0.63	1.35	1.37	0.02	1.82	1.26	6.76	1.60	4.29	41.83
1955	2.71	3.11	3.98	4.55	1.21	1.24	1.16	0.00	3.51	7.48	9.48	11.72	50.15
1954	10.19	5.79	2.71	3.57	1.21	3.00	0.53	1.29	1.71	4.32	5.56	5.88	45.76
1953	14.91	3.99	4.58	2.23	2.69	1.99	0.00	1.78	1.13	3.26	6.84	7.88	51.28
1952	6.09	4.34	2.91	1.73	0.49	3.51	0.00	0.20	0.33	1.05	0.97	7.15	28.77
1951	8.80	5.11	4.66	1.27	1.69	0.05	0.24	0.42	2.94	7.24	7.63	9.22	49.27
1950	9.30	6.10	5.52	1.61	0.63	2.47	0.53	0.58	1.80	9.24	9.77	6.20	53.75
1949	1.04	11.58	2.60	0.85	1.94	0.51	0.57	0.17	0.94	2.90	6.42	5.11	34.63
1948	6.81	5.95	4.35	3.50	4.87	0.64	0.59	0.74	2.96	2.96	7.14	9.33	48.96

REGIONAL GEOLOGY

GEOLOGIC SETTING

The geology of the study area has been described by Schlicker and Deacon (1967); Hart and Newcomb (1967), and by Frank and Collins (1978) (Figure 3). A generalized stratigraphic column (Figure 4) has the Oligocene-Miocene sedimentary rocks unconformably overlain by Columbia River basalt. The basalt is also unconformably overlain by the Helvetia Formation, when present, and by the Miocene - Pliocene Troutdale Formation in the valleys. The Troutdale Formation is unconformably overlain, when present, by the Willamette Silt deposit, which is in turn overlain by recent alluvium along the local drainages.

The lithology of the Oligocene-Miocene sedimentary units depicts a forearc depositional basin environment that deepened to the west (Yeats and others, 1991). The basin in which the Oligocene and Miocene sedimentary rocks were deposited was subsequently uplifted during the early Miocene period to form a gently south dipping subaerial plane (Frank and Collins, 1978).

During the middle Miocene the low lying elevations of northwestern Oregon were covered by the basalt flows of the Columbia River basalt. These basalt flows crossed the

Figure 3. Regional geologic map encompassing the Parrett Mountain area (Schlicker and Deacon, 1967).

Alluvium

* Willamette Silt and recent alluvium. Composed of unconsolidated silt, clay, sand, and gravel

— *unconformity*

Troutdale Formation

* Poorly indurated, gray brown silt and clay with fine silty sand and lenses or pebble conglomerate and clay horizons

Helvetia Formation

* Reddish-brown, poorly indurated sand, sandy silt, and silty clay deposits with local thin beds of quartzite and basalt pebbles

— *unconformity*

Columbia River Basalt (CRB)

* Miocene to Pliocene tholeiitic basalt flows. Previous mapping of Parrett Mountain has separated the CRB into (from oldest to youngest) the Low-Mg N2 Grande Ronde, the High-Mg N2 Grande Ronde, and the Ginkgo flow of the Frenchmen Springs Member of Wanapum Basalt.

— *unconformity*

Oligocene-Miocene Sedimentary Deposits

* Tuffaceous, quartzitic and granitic silt and clay deposits with lenses of fine sands, gravel, and carbonaceous siltstones and claystones

Figure 4. A generalized stratigraphic column representative of the Parrett Mountain study area (Modified from Schlicker and Deacon, 1967).

ancestral Cascades through the Columbia Trans Arc Lowland (Beeson and others, 1989) and into the Portland basin and paleo-Willamette Valley.

Tectonic deformation of northwestern Oregon resulted in the development of several fault-bounded, asymmetrical anticlines. Development of these anticlines along the Portland Hills-Clackamas River and Gales Creek-Mount Angel structural zones resulted in the obstruction of several basalt flows.

After the basalt emplacement, a period of quiescence, from late Miocene to early Quaternary, occurred. This period is marked by the deposition of lacustrine and fluvial sedimentary deposits from the ancestral Willamette and Columbia Rivers. This sedimentary material has been formally designated as the Troutdale Formation.

The lower ancestral Willamette Valley was affected by localized cinder cones and volcanic vents of the Boring Lava. This volcanic episode occurred from the upper Pliocene to lower Pleistocene along with the deposition of the Troutdale Formation. The Boring Lava has been found to be a massive, blocky, gray porphyritic olivine basalt (Schlicker and Deacon, 1967). Mount Sylvania, Mount Tabor and Mount Scott are all examples of Boring Lava cinder cones and volcanic vents. Since the Boring Lava does not occur within the study's boundaries it will not be discussed further.

During the Quaternary period, the entire Willamette Valley was affected by the glacial flood waters of Lake Missoula. It is believed that over 90 floods occurred, with most occurring between 15,300 and 12,700 BP (Waite, 1985).

REGIONAL STRATIGRAPHY

Oligocene-Miocene Sedimentary Rocks

The Oligocene-Miocene sedimentary rocks are composed of tuffaceous, quartzitic and granitic silt and clay deposits with lenses of fine sands, gravel, and carbonaceous siltstones and claystones (Frank and Collins, 1978; Hart and Newcomb, 1965). Schlicker and Deacon (1967) stated that "[a]lthough the Oligocene rocks are distinct in gross character, no persistent lithology has been recognized in the map area to permit recognition of separate formations." These deposits depict a marine depositional environment with some brackish near shore and fresh water characteristics (Hart and Newcomb, 1965). A maximum thickness of 5,000 feet (1524 m) was determined by Frank and Collins (1978) with several portions of the unit corresponding to Schlicker and Deacon's (1967) Yamhill and Spencer formations mapped to the south.

Exposures occur throughout the Newberg valley on the southwest flanks of the Chehalem Mountains and the northern and northwestern flanks of the Red Hills of Dundee. These deposits occur underneath the Columbia River basalt

comprising Parrett Mountain and the Chehalem Mountains, as seen in water well reports and corings (this report; Marvin Beeson, 1992, personal commun.). Near the central region of the Newberg valley, the marine sedimentary rocks are overlain by 10 to 15 feet (3 m to 4.6 m) of Willamette Silt with an additional 10 to 200 feet (3 m to 61 m) of Troutdale closer to the Willamette River (Hart and Newcomb, 1965; Frank and Collins, 1978).

Columbia River Basalt Group

The Columbia River Basalt Group is a series of Miocene to Pliocene tholeiitic basalt flows that erupted from fissures in eastern Washington and Oregon, and parts western Idaho. The total area covered by the basalt flows has been calculated to be 164,000 km² including central and southern Washington, parts of western Idaho, northcentral and eastern Oregon, the northern portion of the Willamette valley, and parts of the northern Oregon coast. The total volume of the basalt group has been estimated to be roughly 173 km³ (Tolan and others, 1989). The thickest known section of CRB occurs in the Pasco Basin, where subsidence occurred penecontemporaneously with basalt emplacement. Average thicknesses of individual basalt flows range from 650 to a few feet (<200 m). Interbeds developed during hiatuses between basalt outpourings and have been designated as part of the Ellensburg Formation. The frequency and thickness of these interbeds increases as you get higher in the CRB's

stratigraphic column and as you get to the edge of the CRB's maximum extent.

A stratigraphy has been created for the Columbia River basalt using geochemistry, magnetic-stratigraphy, and lithologic characteristics. Using the above methods, the CRB has been divided into five formations which have been further subdivided into distinct units, members, and flows (Beeson and others, 1989) (Figure 5). The five formations are the Imnaha, the Picture Gorge, the Grande Ronde, the Wanapum, and the Saddle Mountains Basalts.

Both the Imnaha and Picture Gorge formations occur in central and eastern Oregon and were erupted into basins that remained topographically separate from the Columbia Plateau. The Grande Ronde Basalt is a series of seventeen basalt units that were erupted between 17 to 15 Ma bp. This formation is the most voluminous formation of the Columbia River basalt group, containing several "great flows" with individual volumes ranging up to 2,000 or 3,000 km³ (Tolan and others, 1989). The Wanapum Basalt is separated from the Grande Ronde by a highly distinctive interbed/paleosol, the Vantage Interbed, which formed during a 100,000 to 300,000 year hiatus in basalt outpouring. This horizon is highly distinctive, occurring throughout most of the Columbia Plateau. The Wanapum Basalt is composed of a series of highly distinctive basalt flows in terms of geochemistry and lithology. The last formation, the Saddle Mountains Basalt,

SERIES	GROUP	FORMATION	MEMBER	ISOTOPIC AGE (m.y.)	MAGNETIC POLARITY		
MIOCENE	UPPER	SADDLE MOUNTAINS BASALT	LOWER MONUMENTAL MEMBER	6	N		
			<i>Erosional Unconformity</i>				
			ICE HARBOR MEMBER	8.5	N		
			Basalt of Goose Island		N		
			Basalt of Marindale		R		
			Basalt of Basin City		N		
			<i>Erosional Unconformity</i>				
			BUFORD MEMBER		R		
			ELEPHANT MOUNTAIN MEMBER	10.5	R.T		
			<i>Erosional Unconformity</i>				
			POMONA MEMBER	12	R		
			<i>Erosional Unconformity</i>				
			ESQUATZEL MEMBER		N		
			<i>Erosional Unconformity</i>				
			WEISSENFELS RIDGE MEMBER				
			Basalt of Slippery Creek		N		
			Basalt of Tenmile Creek		N		
			Basalt of Lewiston Orchards		N		
			Basalt of Cloverland		N		
			ASOTIN MEMBER	13	N		
			Basalt of Hutzinger		N		
			<i>Local Erosional Unconformity</i>				
	WILBUR CREEK MEMBER						
	Basalt of Lapwai			N			
	Basalt of Wahluke			N			
	<i>Local Erosional Unconformity</i>						
	UMATILLA MEMBER						
	Basalt of Sillusi			N			
	Basalt of Umatilla			N			
	<i>Local Erosional Unconformity</i>						
	MIDDLE		WANAPUM BASALT	PRIEST RAPIDS MEMBER	14.5		
				Basalt of Lolo		R	
				Basalt of Rosalia		R	
				<i>Local Erosional Unconformity</i>			
				ROZA MEMBER		T.R	
				FRENCHMAN SPRINGS MEMBER			
				Basalt of Lyons Ferry		N	
				Basalt of Sentinel Gap		N	
				Basalt of Sand Hollow	15.3	N	
				Basalt of Silver Falls		N.E	
				Basalt of Ginkgo		E	
				Basalt of Palouse Falls		E	
		ECKLER MOUNTAIN MEMBER					
		Basalt of Shumaker Creek			N		
		Basalt of Dodge			N		
		Basalt of Robinette Mountain			N		
		<i>Local Erosional Unconformity</i>					
		LOWER		PRIMEVILLE BASALT	SENTINEL BLUFFS UNIT	15.6	N ₂
					SLACK CANYON UNIT		
					FIELD SPRINGS UNIT		
	WINTERWATER UNIT						
	UMTANUM UNIT						
RONDE BASALT	ORTICEY UNIT				R ₂		
	ARMSTRONG CANYON UNIT						
	MEYER RIDGE UNIT						
	GROUSE CREEK UNIT						
	WAPSHILLA RIDGE UNIT						
LOWER	PICTURE GORGE BASALT	MT. HORRIBLE UNIT		N ₁			
		CHINA CREEK UNIT					
		DOWNEY GULCH UNIT					
		CENTER CREEK UNIT					
		ROGERSBURG UNIT					
		IMNAHA BASALT	TEEPEE BUTTE UNIT		R ₁		
			BUCKHORN SPRINGS UNIT	15.5			
See Hodder and others (1984) for Imnaha units							
				17.5			

Figure 5. Stratigraphic framework of the Columbia River Basalt Group (Modified from Beeson and others, 1989). Yellow shading indicates the basalt units composing Parrett Mountain.

comprises a series of basalt flows marking the waning of fissure eruptive activity.

Outcrops of Columbia River basalt occur throughout the study area, including the entire Parrett Mountain area, Grouse Butte, La Butte, and parts of the Tonquin area. Weathering depths vary from location to location on Parrett Mountain but typically range from 0 to 18 feet (0 to 6 m). Two distinct groups of soil series, mapped by Gerig (1985), are the Jory, Saum, and Laurelwood soils for the upland regions and the Helvetia and Willamette soils in the low lying areas. Both the Helvetia and Willamette soils occur on the Missoula flood deposits.

Helvetia Formation

Schlicker and Deacon (1967) describe the Helvetia Formation as a reddish-brown, poorly indurated sand, sandy silt, and silty clay deposit with local thin beds of quartzite and basalt pebbles unconformably overlying the Columbia River basalt. The type locality for this formation is a road cut exposure north of the town of Helvetia in T1N R2W, section 3 where a minimum thickness of 25 feet (7.5 m) is exposed around the town of Helvetia (Schlicker and Deacon, 1967). This formation was mapped as occurring throughout the entire Tualatin Valley ranging in elevation from 200 to roughly 900 feet (61 to 275 m) and was believed to be correlated to the earliest Troutdale Formation sediments. Currently, the Helvetia Formation is believed to

be a mixture of weathered basalt and sediment and should therefore lose its designated title of 'formation' (Marvin Beeson, 1994, personnel commun.). The Helvetia Formation is not considered to be an aquifer (Frank and Collins, 1978).

Troutdale Formation

The Miocene to Pliocene Troutdale Formation is a moderately- to well-indurated depositional unit (Yeats and others, 1991) composed of gravel, sands, silts, and clays of a lacustrine and riparian environment. Within the Tualatin and Newberg valleys, Schlicker and Deacon (1967) describe the formation as a poorly indurated, gray brown silt and clay with fine silty sand and lenses of pebble conglomerate and clay horizons. The Troutdale Formation unconformably overlies the Columbia River basalt with a varying thickness of 10 to 200 feet (3 to 61 m) in the Newberg area to over 400 feet (>122 m) near the city of Wilsonville and the Tualatin River (Frank and Collins, 1978). This unit extends throughout the Tualatin and Newberg valleys up to 700 feet (213 m) in elevation, save for a few locations where the unit is thin or nonexistent and the marine sediments underlie the Willamette Silt (Frank and Collins, 1978). Within the study boundaries, the Troutdale Formation is only exposed along the deep ravines along the Willamette River between the cities of Wilsonville and Newberg (Figure 2).

Willamette Silt

The Willamette Silt unit is a depositional layer composed of unconsolidated silt, clay, sand, and gravel originating from the deposition of Missoula flood's debris. This unit varies from a few feet to 50 feet (15 m) in thickness and underlies most of the basin lowlands up to the 250 foot (84 meters) elevation (Frank and Collins, 1978). However, the unit is only 5 to 10 feet (1.5 to 3 m) in thickness around the cities of Newberg and Wilsonville (Frank and Collins, 1978). Most of the material deposited in the lower elevations is basaltic in composition with some granitic and quartzitic sand and silt material. In addition, deposits of basaltic, granitic, and quartzitic gravel to boulder size rock fragments were ice rafted down the ancestral Columbia River on flood waters thereby marking water access and escape channels as well as the maximum elevation of ponded flood waters. Schlicker and Deacon (1967) have reported a maximum thickness of 50 feet (15 m) for these coarser-sized materials in the Rocky Creek-Seely Ditch area.

Alluvium

Since the last glacial flooding of the Willamette Valley, 12,700 years BP (Waite, 1985), alluvium and colluvium have been collecting in the local drainages (Figure 3). This material is essentially composed of peat and reworked flood material in the northeastern sections of the study area, with a reworking of the Willamette Silt,

marine sediments, basalt, and Troutdale deposits in the Newberg flat region (Schlicker and Deacon, 1967). Locations of active deposition mapped by Schlicker and Deacon (1967) are the Seely Ditch - Rock Creek area, Corral Creek and along its tributaries, along the Willamette River, and in Hess Creek and Spring Brook. Schlicker and Deacon (1967) further estimated that the alluvial material had a maximum thickness of 20 to 30 feet (6 to 9 m).

REGIONAL STRUCTURE

Northwest Oregon is composed of three physiographic provinces, the Coast Range, the Willamette Valley, and the Cascade Range. Development of these provinces began during the Tertiary period when the convergence rate between the Farallon Plate and the North American Plate decreased while the strike-slip component of the subduction increased (Figure 6) (Yeats and others, 1991).

Areal photographs and Landsat images of northwestern Oregon and southwestern Washington, indicate the presence of three northwest trending lineations (Balsillie and Benson, 1971, Beeson and others, 1989). Subsequently these lineations have been designated as the Frontal Fault Zone (Yelin and Patton, 1991), the Portland Hills - Clackamas River structural Zone and the Gales Creek - Mount Angel Structural Zone (Beeson and others, 1989) (Figure 7). Beeson and others (1989) have proposed and designated these

lineations to be structural zones with a dominant right lateral strike-slip sense of motion with a subordinate vertical sense of motion.

Gales Creek-Mount Angel Structural Zone

Beeson and others (1985, 1989) have depicted the Gales Creek-Mount Angel (GC-MA) structural zone as a series of en echelon faults rather than one continuous fault. Three fault segments, the Gales Creek Fault, the Newberg Fault, and the Mount Angel Fault were identified by Werner and others (1993) (Figure 7).

Gales Creek Fault. Seismic lines and gravity modeling showed that the Gales Creek Fault was composed of three fault segments extending from the town of Gaston to the base of the Chehalem Mountain range. A total southeast downdrop of 3 km was recorded along the Gales Creek Fault segment (Yeats and others, 1991) (Figure 7).

This downdropping has been postulated by Yeats and others (1991) to have occurred before the Columbia River basalt emplacement.

Newberg Fault. Identification of the Newberg Fault (Figure 7) was accomplished using water well data (Werner, 1990) and supported by aeromagnetic and gravity data (Yeats and others, 1991). Unlike the Gales Creek Fault, there is an apparent downdropping to the south (Yeats and others, 1991) based on the CRB and pre-basalt emplacement sediment boundary.

Figure 6. The convergence and subduction of the Juan de Fuca Plate against the North American Plate (Yeats and others, 1991).

Figure 7. Regional view of the tectonic features comprising the northern Willamette Valley. Boxed area represents the location of Parrett Mountain. (a) represents Gales Creek Fault; (b) represents the Newberg Fault, (c) represents the Mount Angel Fault, (d) represents the Sherwood Fault. (Modified from Tolan and Reidel, (1989)

The nature of the boundary between the Gales Creek and Newberg Faults remains unknown. At the boundary between the Gales Creek and Newberg Fault, seismic modeling failed to reveal any vertical displacement of the CRB's upper boundary (Yeats and others, 1991).

Mount Angel Fault. The Mount Angel Fault (Figure 7) was extended from the Waldo Hills to the city of Woodburn based on seismic lines and water well data (Werner and others, 1993). Displacement along the fault increases to the southeast with 100 feet (30.5 m) of vertical displacement observed near Woodburn to a vertical displacement of 250+ feet (76.2+ m) by the town of Mount Angel (Werner and others, 1993; Yeats and others, 1991). A possible 1 km dextral offset of a channelized Ginkgo basalt flow was also recorded near the town of Silverton (Marvin Beeson, 1994, personnel commun.).

Seismicity. Seismic activity along the Gales Creek-Mount Angel structural zone is recorded in Table II. As observed in Table II, the Woodburn segment is the most active segment along the Gales Creek - Mount Angel structural zones, with an average magnitude of a 2.3.

The Scotts Mills earthquake, depicted as earthquake #10 in Table II, had a 5.6 magnitude and showed a right lateral sense of motion. Although the earthquake occurred some distance away from the believed GC-MA structural zone some geologists believe that the sense of motion and the location

of the epicenter suggests some type of connection.

TABLE II

SEISMIC ACTIVITY ALONG THE GALES CREEK-MOUNT
ANGEL STRUCTURAL ZONE

Earthquake	Latitude	Longitude	Date	Magnitude
1	45.133	-122.886	07/03/80	1.7
2	45.142	-122.874	08/20/83	1.2
3	45.165	-122.871	09/17/90	1.6
4	45.153	-122.847	08/14/90	2.0
5	45.113	-122.877	08/14/90	2.5
6	45.118	-122.86	08/22/90	2.4
7	45.132	-122.867	08/22/90	2.2
8	45.12	-122.871	08/23/90	2.4
9	45.107	-122.866	08/23/90	1.4
10	45.02	-122.364	05/25/93	5.6

* Modified from Werner and others (1992)

Sherwood Fault

The Sherwood Fault (Figure 7) separates the Chehalem Mountain range from Parrett Mountain. This fault is one of the most pronounced features occurring in northwestern Oregon (Schlicker and Deacon, 1967). The style of faulting proposed for the Sherwood Fault has been postulated to be 1) a high-angle, north dipping, normal fault (Driscoll and Titus, 1991), or 2) a high-angle, south dipping, reverse fault, or 3) a low-angle, south dipping, thrust fault. Aeromagnetic and gravity studies have yielded little information into the nature of faulting, though a 330 to 495 foot (100 to 150 m) vertical separation of the CRB can be discerned (Beeson and others, 1989). Given the parallel trends of the Sherwood Fault and the postulated Columbia

Trans Arc Lowland it is possible that both features are related to each other (Beeson and others, 1989).

HYDROGEOLOGIC UNITS

Groundwater occurs in unconfined, confined and perched conditions within the study boundaries (Frank and Collins, 1978). These conditions are primarily governed by the bedrock material, and their lithologic characteristics.

Oligocene-Miocene Sedimentary Rocks

The Oligocene - Miocene sedimentary rock unit is considered to be a poor aquifer due to the low permeability and yields of the material. Yields typically average around 5 gal/min (.002 acre-feet/day) though some that tap into the shale and sandstone layers may obtain yields ranging from 10 to greater than 200 gal/min (.04 to .9 acre-feet/day) (Frank and Collins, 1978). The water typically shows an unconfined nature with the water table fluctuating with seasonal changes (Frank and Collins, 1978). Confined and perched aquifers can occur within this unit due to clay or silt lenses and layers (Frank and Collins, 1978).

Water quality tends to be the largest problem in developing the Oligocene and Miocene sedimentary aquifers. Typically, the water taken from this unit is high in sodium or calcium ions. Typically, the deeper the sedimentary units are penetrated the more likely the groundwater will be unusable (Frank and Collins, 1978).

Columbia River Basalt Group

One of the main characteristics of basalt aquifers, is that groundwater storage is largely limited to interflow zones within the basalt flow. These interflow zones occur only on the top and sides of an individual flow, near the flowtop. Because the flowtops are generally highly porous, it makes a natural groundwater source. Flowtops generally range from 3 to 24 feet (1 to 8 meters) thick, roughly 10 % of the total basalt flow (Heath, 1984).

A basalt aquifer can also be replenished through the vertical movement of water along cooling joints and stress fractures in the basalt flow. Baker (1978) showed that only a small amount of water migrates through the vertical fractures and joints due to the their small joint spacing. This observation means that the vertical infiltration rate is negligible compared to the lateral groundwater flow.

The groundwater present on Parrett Mountain was found to be in an unconfined and confined state (Frank and Collins, 1978). Average annual yields were found to be 15 gal/min (.06 acre-feet/day) in the uplands, and 1,000 gal/min (4.4 acre-feet/day) in the lowlands (Frank and Collins, 1978). Within the Rocky Creek-Seely Ditch area, yields of 100 to 1,000 gal/min (.4 to 4.4 acre-feet/day) were observed. A yearly decline of 1 foot (.3 m) in the groundwater table has been observed near the Dammasch water wells (Frank and Collins, 1978).

Troutdale Formation

The well yields taken from the Troutdale Formation range from 4 to 360 gal/min (.02 to 1.6 acre-feet/day) (Frank and Collins, 1978) with specific capacities ranging from 0.08 to 0.27 gal/min/ft. These ranges are due to variations in lithology, grain size, and lateral extent of the beds or lenses. Because of the lateral variation in deposition, unconfined, confined, and perched aquifers can and do occur (Frank and Collins, 1978). The most productive well, located in T3S R2W Sect. 33, yields 360 gal/min with a drawdown of 23 feet (7 m) and a specific capacity of 16 gal/min/ft (Frank and Collins, 1978).

Willamette Silt

The Willamette Silt is composed of clay, silt, sands, and a lenses of gravels. Aquifers range from unconfined to confined in nature due to the type of the material comprising the sedimentary unit, the depositional layering, the anisotropic characteristics within individual beds, along with the development of fragipans.

Typically the Willamette Silt has a low permeability and yields water slowly to wells. The low permeability, however, does not inhibit the infiltration of surface water into the underlying rock material (Frank and Collins, 1978). Areas where this unit is exposed at the surface are predominately wet, marked with high water tables (Frank and Collins, 1978).

METHODOLOGY

To accurately characterize the geology of Parrett Mountain, four avenues of investigation were conducted. The first task was to create a geologic map of the Parrett Mountain and Tonquin areas (Plate 2) in order to ascertain the location of the basalt units. Second, a stratigraphic model emphasizing the individual basalt flows was developed using well reports and lithologic analysis of basalt chips taken from newly drilled water wells (Plate 1; Figures 41 - 45, Tables XI and XII, Appendix A). Identification of the basalt units was based upon methods described by Holmgren (1969). The third avenue of investigation was a geochemical analysis, using x-ray fluorescence (XRF) and instrumental neutron activation analysis (INAA) on the basalt flows in order to obtain a geochemical signature for the various basalt units present as well as corroborate the hand lithologic analysis. Finally, the fourth investigation was the use of potentiometric surface map (Plate 3), collected by OWRD, to correlate head value changes to local geologic features.

FIELD MAPPING

The goal of the field mapping project, conducted during the summer and fall of 1992, was to create an accurate and

detailed surficial geologic map of the Columbia River Basalt Group (CRBG). Identification of the individual basalt units was accomplished using criteria specified by Reidel and others (1989). Obvious basalt characteristics used were jointing patterns expressed in outcrops (Figure 8), the presence and character of plagioclase phenocrysts, and to a smaller extent, the color on weathered surfaces. Care was taken to note whether the rock was exposed bedrock, colluvium, or flood deposits, as well as noting the presence of any exposed flowtops.

In May of 1992, an initial reconnaissance of the study area revealed a significant number of basalt exposures present on the local road systems. To take advantage of this fact, each road was designated as a traverse line across the study area. Each transect was then walked. The outcrops were studied, sampled, and marked on a $7\frac{1}{2}$ minute quadrangle. Samples were collected at every outcrop, except when the basalt was either too weathered or there was no question as to the identity of the basalt unit. Labeling of the samples was accomplished using one to two letters representing the road followed by a letter-number-letter combination that designated the location of the sampled outcrop.

Several streams/creeks were also investigated. Each drainage hiked was one that appeared to have stream beds of bedrock and was readily accessible. Little information was

Figure 8. Cross section of a basalt flow showing the distinct jointing patterns and lithologic features in regards to occurrence within a basalt flow.

obtained from the stream beds due to thick soil and organic litter covering the stream beds. Basalt float encountered in the stream beds was studied and sampled, however, some uncertainty exists for this material since the original location of the basalt boulders is unknown.

Springs

Naturally occurring springs, observed in the field or mentioned by local residents were also mapped. Since few springs were indicated on previous geologic maps, this small study was accomplished to help delineate flowtops, faults, and highly fractured zones.

BASALT STRATIGRAPHY

A three dimensional stratigraphic basalt model was essential to characterize the local groundwater aquifers. The stratigraphic model was based upon data from well reports along with hand lithologic and geochemical analysis of basalt chips.

Stratigraphy Based on Well Reports

The first step in determining the subsurface stratigraphy was completed using well reports that had a detailed lithologic column. A well report is a written document submitted to the OWRD by the well driller after a water well has been completed. Each report describes the location and owner of the well, specific information about

the construction of the well, the determined use of the well, and a generalized lithologic column of the penetrated material. Any changes to a well require a new well report to be submitted to the OWRD.

Depending upon the quality of the available lithologic log, individual flowtops can be inferred. Flowtops were used as stratigraphic markers due to their highly visible nature and their being natural basalt flow boundaries. Words used to describe a flowtop were 'red', 'porous', 'cinder', 'lava', and 'scoriaceous'. Interbeds and the underlying Oligocene and Miocene marine sediments were also depicted in the well reports with words such as 'interbed', 'shale', 'ash', 'conglomerate', and 'sandstone'. A conservative approach in analyzing the well reports was taken due to variations between drillers in terms of their interpretations and observations.

These data and their subsequent depths are presented in Table XII, Appendix A. Well locations are indicated on Plate 1.

Stratigraphy based on Drilling Chips

A lithologic description was made of chip samples collected at 5, 10 or 20 feet (1.5, 3, 6 m) intervals from 34 newly drilled water wells (Plate 1; Table XI, Appendix A). This set of data includes chip samples previously analyzed by Al-Eisa (1981) and Marvin Beeson (unpub. data).

Criteria used to define the identification of the

basalt units were delineated by Reidel and others (1989). Specifically, grain size, presence and character of plagioclase phenocrysts, presence and abundance of a microphyric texture, along with the presence and concentration of any glass, were used to define the identity of the basalt units. Furthermore, the proximity to a flowtop was inferred based on vesiculation and/or the amount of weathering and oxidation.

Cross Sections

A comparison between the flowtop elevations determined from the well report lithologic logs and from the detailed stratigraphic logs showed a good association. The degree of association was dependent upon the number of well reports used. Associations were best when a few highly detailed lithologic logs were used or when there were many moderately detailed well report logs available. Individual flowtop dips were drawn as close to the dip of the topography that the well log data would support.

This method related well with the surface geology mapped during the summer. Three-point problems were then conducted on the flowtops in order to ascertain the strike and dip of the various basalt units and faults were identified based on changes in dip and distinct elevation changes of the basalt units.

GEOCHEMICAL ANALYSIS

X-ray fluorescence (XRF) and instrumental neutron activation analysis (INAA) were the two geochemical analytical methods used to help delineate the basalt stratigraphy of Parrett Mountain. The ultimate goal using the geochemical analyses was to obtain a geochemical signature for all of the basalt units present on the mountain and to compare these values to those obtained from the Lake Oswego Quadrangle (Beeson and others, 1989b).

X-ray Fluorescence

The XRF analysis measures the concentration of the major oxides along with several trace elements. This process has been used extensively in determining the stratigraphy of the Columbia River basalt since the late 1970's.

Eleven basalt chip samples were sent to Washington State University for XRF analysis. This geochemical data can be observed under Table III. Eight of these samples were collected from the Thacker well near the intersection between Heater Road and Parrett Mountain Road. Each of the eight samples represents the occurrence of a distinct basalt flow, identified lithologically, in the well. This well was selected for sampling because it appeared to penetrate most of the basalt units comprising Parrett Mountain.

Two of the eleven samples were taken from the Manke #1

TABLE III

GEOCHEMICAL COMPOSITION OF THE LOW-MG GRANDE
RONDE BASALT DEFINED BY XRF ANALYSIS

	Winter Water		Umtanum		O-GC		Wapshilla Ridge	
# of Samp	2		4		7		5	
Elements	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
SiO ₂	56.68	0.39	57	0.36	56.13	0.78	55.37	0.84
Al ₂ O ₃	13.48	0.11	14.33	0.6	14	0.11	13.99	0.38
TiO ₂	2.11	0.018	2.21	0.13	1.92	0.16	2.33	0.11
FeO	11.58	0.61	11.31	1.66	11.27	0.97	12.21	0.59
MnO	0.2		0.18	0.02	0.19	0.001	0.18	0.003
CaO	7.02	0.035	0.68	1.09	7.38	0.44	7.13	0.14
MgO	3.4	0.02	3.04	0.68	3.85	0.46	3.514	0.1
K ₂ O	1.9	0.21	1.76	0.08	1.84	0.26	1.81	0.2
Na ₂ O	3.27	0.13	3.27	0.21	3.08	0.081	3.11	0.22
P ₂ O ₅	0.36		0.378	0.021	0.32	0.041	0.35	0.009
Ni					6	6.67	4	3.39
Cr	14.5	2.12	15	2.45	22.14	13.15	18.2	8.76
Sc	36		35	2.31	33.57	4.44	34.4	2.07
V	326.5	13.44	358	15.34	324.7	28.9	365.6	14.91
Ba	611	4.24	679.75	58.43	623.3	61.7	672.2	25.34
Rb	47.5	0.71	49.5	5.97	46	8.13	49.2	3.03
Sr	310.5	0.71	241.25	142.74	311.4	16.8	313.6	7.23
Zr	181	1.41	185.25	9.28	167	17.7	187	4.69
Yt	39		39.75	3.2	34.86	2.84	38	0.707
Nb	310.5	0.07	15.02	0.92	13.1	1.8	15.02	0.64
Cu			5.75	3.86	14.7	12.2	13.6	1.95
Zn	128.5	2.12	141.25	7.97	120.3	5	130.6	5.27
Pb	6		9.5	2.38	9.86	4.37	9	2.55
La	12	1.41	20.5	8.38	28.3	18.38	24	16.86
Ce	66	14.14	20.92	4.57	44.57	17.5	56	9.62
Th	5.5	0.71	5.75	0.96	56.43	2.3	5.8	2.17

and Adam's wells, in which a distinct basalt flow not occurring in the Thacker well was present. The last sample was collected from a small rock quarry on the southeastern side of La Butte. XRF data from the previously analyzed Cedar Creek well (Al-Eisa, 1981; Dr. Beeson, 1993, personal commun.), Sherwood well # 5, and the Woodburn well (Marvin Beeson, 1993, personal commun.) were reexamined in order to obtain more geochemical data on an individual basalt unit.

Instrumental Neutron Activation Analysis

The INAA process measures trace and several major element concentrations for rock samples, by measuring the gamma ray activity given off by a sample after it has been irradiated. When a sample is irradiated, the stable isotopes of some elements that composed the rock sample are converted to unstable isotopes and give off gamma rays as they decay. These gamma rays are then measured by a high purity germanium detector used by Portland State University.

Delineating the stratigraphy of the Columbia River basalt was attempted by INAA in the late 1970's to early 1980's (e.g. Nathan and Fruchter, 1974) but was then set aside due to the success of x-ray fluorescence. Therefore, the success of INAA as a definitive method of separating out Columbia River basalt units is very limited.

INAA was conducted on thirty-eight hand and well chip samples collected from the study area (Table IV). In an attempt to ascertain the usefulness of INAA in the

Figure 9. Location of wells where XRF and INAA samples were collected. The inset shows the location of the figure within the study area.

separation of the basalt units, thirteen of the thirty-eight basalt chip samples, were analyzed prior to the initiation of the Parrett Mountain study. These thirteen samples were taken from the Wipple, Hoffman, and Minard wells (Table XI, Appendix A) at various depths in order to correlate basalt units over a distance (Figure 9). The results of the smaller INAA project showed that several elements, Cr, Ba, and Ce, could be used to separate individual basalt units within a given water well, but that correlation of these units based on trace element concentrations over some distance was tenuous at best.

The remaining 25 samples were basalt chips collected from water wells along with basalt hand samples collected during field mapping. These samples underwent the INAA process solely to identify the Cr concentration in each sample. Cr concentrations have been known to delineate the high-magnesium ($\text{Cr} > 25$ ppm) and low-magnesium N_2 unit ($\text{Cr} < 25$) of the Grande Ronde Basalt. Therefore, by using INAA, a stratigraphic division can be accomplished.

POTENTIOMETRIC HEAD ANALYSIS

The potentiometric surface map (Plate 3) was devised for the entire Parrett Mountain area using the head data obtained from Miller and others (1994). The key problem in creating a potentiometric surface map, for the study area, was identifying which aquifer to map. This aquifer would

have to be regional in extent in order to obtain the most amount of information for the entire study area. Second, the aquifer had to have enough water well data, collected by OWRD, to make as accurate a map as possible. Using these two criteria, only the Ortley-Grouse Creek (undifferentiated) / Wapshilla Ridge basalt boundary was usable. However, several areas on Parrett Mountain had no data for this boundary. Therefore, it was necessary to designate the entire Columbia River basalt, comprising Parrett Mountain, as one aquifer.

Designation of the CRB as one aquifer allows for the possibility of composite heads. A composite head is an averaged water level, within a well, of several potentiometric heads. This typically can occur when a water well is uncased or unlined and penetrates several aquifers.

For the development of the potentiometric surface map, each head value was mapped with respect to the well's location. Each township and range section was divided into quarters (a,b,c,d) which were further subdivided into quarters (a,b,c,d). Every head value located in a quartered section was then averaged giving a head value representative for that part of the section (Figure 10; Table XVI, Appendix B). Individual head values obtained from Miller and others (1994) are found in Table XI in Appendix B while the compiled head data for the potentiometric surface map can be observed on Plate 3.

Figure 10. Diagram representing the quarter-quarter-averaging system used to define a potentiometric surface map.

Creation of the potentiometric surface map showed large head changes occurring within the quarter- quarter- sections. Through a comparison of the stratigraphic and hydrologic data (Tables XI and XII, Appendix A; Table XV, Appendix B) each large head change was related to 1) penetration into differing interflow zones or 2) groundwater barriers. If the head change was due to the penetration of differing flowtops then the difference was essentially ignored since the entire CRB has been considered to be one aquifer. However, if the head change was due to the presence of a groundwater barrier, then both head values were plotted with respect to approximate well locations in order to essentially approximate the location of the groundwater barrier.

BASALT STRATIGRAPHY

Field mapping and laboratory analysis revealed that the Columbia River basalt in the Parrett Mountain and Tonquin area is comprised of the Grande Ronde Basalt and the Wanapum Basalt formations. The Grande Ronde Basalt is composed of the following basalt units, from oldest to youngest: the Wapshilla Ridge, the Ortley-Grouse Creek, the Umtanum, the Winter Water, and the Sentinel Bluffs. The Wanapum basalt is represented by a single Ginkgo flow of the Frenchmen Springs Member. A maximum thickness of 900 feet (274 m) was measured for the CRB at Rex Hill. Figure 11 is a representative stratigraphic column of the basalt flows comprising Parrett Mountain.

Laboratory analysis included hand lithologic examination of basalt chips, XRF, and INAA techniques while the field analyses included field mapping and magnetic polarity measurements. These analyses have proven to be useful in identifying and correlating individual CRB basalt units at a local level (Holmgren, 1969).

GRANDE RONDE BASALT

Wapshilla Ridge Basalt Unit

The Wapshilla Ridge basalt unit, the oldest unit present in the area, unconformably overlies the Oligocene -

Figure 11. A representative stratigraphic column of the Columbia River basalt comprising Parrett Mountain.

Miocene sedimentary deposits. Exposures occur on the western side of Parrett Mountain, within the Fernwood Quarry (both the upper and lower quarries), as well as along Fernwood road (Figure 12). Of the wells studied, most on the western portions of Parrett Mountain penetrate the Wapshilla Ridge basalt while only a small percentage of the wells on the eastern half of the mountain actually reach the Wapshilla Ridge.

Only one Wapshilla Ridge basalt flow has been discovered in the study area with an approximate thickness of 250 to 300 feet (76.2 to 91.4 m). The maximum thickness is observed for the Rex Hill and the Old Parrett Mountain - Parrett Mountain Road junction area (Plate 2).

The Wapshilla Ridge basalt unit is easily distinguishable by its polarity and lithologic characteristics. Polarity was determined to be reverse using a portable field magnetometer. Typically a reverse reading is considered to be reverse while a normal reading should be questioned since a normal overprinting is possible due to the current normal polarity expressed by the Earth's magnetic field.

The most distinctive lithologic characteristics are the extremely fine-grained groundmass, a high glass content and a highly developed microphyric texture. The basalt unit is typically dense textured though several diktytaxitic zones have been observed within all of the Manke wells, the

Figure 12. Exposure of the Wapshilla Ridge basalt along the Fernwood Road.

Thacker well, and the Puderbaugh well (Plate 1; Figure 41, 42, Tables XI, Appendix B). The microphyric texture present in this unit is easily observed in a fresh to moderately weathered state. These microphyric plagioclase laths are typically one to two millimeters long and less than $\frac{1}{2}$ millimeter thick. Difficulty in observing this texture occurs in the highly weathered zones where oxidation and basalt alteration or diktytaxitic zones mask a plagioclase phenocryst's presence. Jointing, seen best in the Fernwood Quarry, is an entablature jointing pattern with the columnar section either suppressed or unexposed. The Wapshilla Ridge unit has a well developed oxidized and weathered flow top in many of the newly drilled wells analyzed.

Geochemically the Wapshilla Ridge unit has a lower SiO_2 content with high TiO_2 while the trace elements show higher concentrations of vanadium, barium, rubidium, zinc, and cesium and a lower concentration of lanthanum compared to the Ortley-Grouse Creek unit (Table III).

Ortley-Grouse Creek (undifferentiated) Basalt Unit

Ortley and Grouse Creek basalt units are separated based on distinct lithologic characteristics and chemical compositions. However, in the study area, the Ortley and Grouse Creek units could not be differentiated from one another based on the above criteria. Magnetic signatures proved ineffectual in separating out the Ortley and Grouse Creek units due to poor quality, highly weathered basalt

exposures. Due to the difficulty in separating the Ortley and Grouse Creek basalt units, they have for the purposes of this report been combined into the undifferentiated Ortley-Grouse Creek basalt unit.

Hand lithologic and geochemical analyses of the basalt chips identified three flows comprising the Ortley-Grouse Creek (undifferentiated) basalt unit. Exposures occur on the western side of Parrett Mountain, on the northwest side of Parrett Mountain, and along the north facing valley wall of the South Fork of Corral Creek. Typically the exposures of the Ortley-Grouse Creek (undifferentiated) basalt are covered by colluvium and alluvium.

The thickness of the unit varies from 80 to 160 feet (24.4 to 48.8 m) with an average of 100 feet (30.5 m). The maximum thickness occurs on the southwest side of Parrett Mountain near the junction of Corral Creek Road and Fernwood Road. The unit thickens to the northeast and west with a thinning occurring near the Parrett Mountain and Old Parrett Mountain Road junction. Thicknesses of the individual basalt flows generally range from 25 to 30 feet (7.6 to 9.1 m), the middle flow showing the most variability, from 20 to 35 feet (6.1 to 10.7 m).

Lithologic traits characteristic of the Ortley-Grouse Creek (undifferentiated) basalt are: a fine-grained groundmass, rare to moderate amount of glass, and a poorly developed microphyric texture. The microphyric texture is

composed of a small concentration of large plagioclase laths, two to three millimeters long, or a moderate abundance of very small plagioclase laths, equal or less than one millimeter in length, or both. Moderate amounts of weathering often mask the presence of the microphyric texture. Weathered surfaces range in color from green, white, to blue clay films. Only the upper basalt flow shows an oxidized flowtop, while all three are weathered. The lithologic columns, provided in the well reports, typically do not identify the flowtops of the two lower flows, suggesting that the flowtop characteristics are difficult to discern, very thin, or eroded away.

The jointing patterns, of this unit, are impossible to discern due to a lack of bedrock exposures. Work by Riedel and others (1989) discusses the jointing pattern of the Ortley and Grouse Creek units as being entablature in nature.

Based on XRF data, the Ortley-Grouse Creek (undifferentiated) basalt has a higher SiO_2 and MgO_2 with a lower TiO_2 content. The trace elements rubidium, barium, and zirconium tend to be lower in concentration while the chromium content is higher than either the Umtanum or Wapshilla Ridge units.

Umtanum Basalt Unit

Analysis of the well chips from the newly constructed water wells reveals the Umtanum unit to be composed of two

laterally extensive basalt flows. Thickness of the unit varies from 80 to 160 feet (24.4 to 48.8 m), with the maximum occurring at the Parrett Mountain-Old Parrett Mountain (PM/OPM) road junction area. A general thinning of the unit, to 80 feet (24.4 m), occurs in the northern Parrett Mountain region with a subsequent thickening away from that locale. A third flow, highly distinctive in its lithologic and geochemical characteristics, was identified along Cedar Creek, beneath the city of Sherwood, and exposed in a rock quarry at La Butte (Marvin Beeson, 1993, written commun.). The exact stratigraphic position appears to lie between the Umtanum and Winter Water units. For this report, this third flow has been grouped into the Umtanum basalt unit based on similar lithologic characteristics.

Generally water well reports do not recognize the boundary between the upper and lower Umtanum basalt flows in terms of a recognizable flow top. Hand lithologic analysis of the well chips show some flowtop development, though in several wells, e.g. Manke #1 and #3, the lower flow's flowtop is difficult to discern. Several possible explanations can be suggested for this phenomenon. First, the flowtop could possibly be very thin and poorly developed, second, the flowtop was not recovered due to the drilling techniques, or third it could have been eroded away before burial by later flows.

The Umtanum unit is difficult to discern from the

Winter Water unit due to similar lithologic characteristics and chemical compositions. Identification of the unit is based on aphyric fine-grained groundmass with minor amounts of glass. The main lithologic distinction between the Umtanum unit and the Winter Water unit is the lack of plagioclase phenocrysts in the Umtanum flows. Three wells, the Thacker, Brentano, and Pelling wells (Table X, Appendix A; and Plate 1) showed plagioclase phenocrysts within the designated Umtanum basalt flows. The basalt containing the plagioclase phenocrysts was designated as Umtanum basalt due to 1) possible contamination of drilling chips due to the sample collection process, 2) stratigraphic positioning, and 3) the lack of data supporting more than two flows of the Winter Water basalt unit within the study area.

Weathering of the Umtanum unit will cause a psuedomicrophyric texture to develop on the basalt fragments. This typically does not occur in the Winter Water basalt. A honey golden brown weathering color was observed solely with the Umtanum basalt unit. The Umtanum unit expresses an entablature jointing pattern with the colonnade portion suppressed or poorly exposed. Other weathering colors possible are blue, green, gray, and white.

The third flow, observed on the fringes of the study area has very distinctive lithologic characteristics. This flow has extremely fine grained aphanitic groundmass with a significant amount of glass. No plagioclase phenocrysts

were observed in the groundmass.

As stated above, the Umtanum and Winter Water units are similar geochemically (Table III). This similarity made a basalt unit division, based on geochemical composition, tenuous. However, some differentiation can be accomplished. The Umtanum unit typically shows a higher SiO_2 , Al_2O_3 , and FeO with a corresponding smaller concentration of MgO than the Winter Water and Ortley-Grouse Creek (undifferentiated) basalt units. Some specific differences in the trace element concentrations are also apparent. These differences are a lower barium concentration corresponding to higher concentrations of strontium and cesium.

Winter Water Basalt Unit

The Winter Water unit contains two basalt flows that are laterally extensive. Exposures of the Winter Water occur within the drainages. These flows are generally thinner than the other units, varying from 55 to 105 feet (16.8 to 32 m). The Winter Water unit thickens in the northeastern and northwestern direction while thinning to the southeast. Typically the upper flow has a constant thickness of 50 feet (15.2 m) while the lower flow varies from 45 to 55 feet (13.8 to 16.8 m). A thinning of the unit is seen at Roberts Hill where the upper flow is 25 feet (7.6 m) and the lower flow is 30 feet (9.1 m) thick.

This unit can be identified from the other units based on lithologic and geochemical characteristics. The Winter

Water unit has a fine-grained groundmass with a moderate to low abundance of plagioclase phenocrysts. These phenocrysts are typically one to two millimeter subhedral solitary crystals sometimes occurring in glomerocrysts. The edges of the plagioclase crystals typically appear rounded to slightly embayed, a characteristic uncommon in the Sentinel Bluffs unit (discussed below). Within the study area, the plagioclase phenocrysts are typically rare, encountered only once to a few times within any given chip sample and very rarely encountered in the field. The Winter Water unit is seen to have an entablature/colonnade jointing pattern with the colonnade being suppressed or poorly exposed.

The geochemical signature for the Winter Water unit given by XRF analysis shows that this unit differs from the Umtanum unit based on a lower SiO_2 , Al_2O_3 , TiO_2 concentrations and a corresponding increase in CaO and MgO content. Trace element concentrations show the Winter Water unit to have lower barium, rubidium, lanthanum, and zinc concentrations while elevated concentrations of strontium and cesium occur.

Sentinel Bluffs Basalt Unit

The Sentinel Bluffs unit is easily distinguishable from the other basalt units based on its lithologic characteristics and geochemical signature. Two Sentinel Bluffs flows have been mapped within the study area's boundaries with thickness ranging from 40 to 65 feet (12.2

to 20 m) for the upper flow and from 45 to 75 feet (13.8 to 23 m) for the lower flow. A generalized thickness trend for the unit shows a thickening towards the northeast and northwest corresponding to a thinning to the southeast and near Pleasant Hill. Field mapping reveals that most of eastern Parrett Mountain and the Tonquin area is covered by the two flows of Sentinel Bluffs. Identification of these flows, within the study area is fairly well constrained; however, well reports generally do not recognize the lower flow's flowtop thereby grouping the two flows together.

The most identifiable lithologic characteristic, of the Sentinel Bluffs unit, is a coarse-grained, dense to diktytaxitic texture expressed throughout most of the unit's thickness. The lower flow is phyric with euhedral plagioclase phenocrysts while the upper flow is aphyric. The basalt unit shows a columnar jointing pattern, expressed best in the Tonquin region where the columns are roughly 6 feet (2 m) in width (Figure 13). It is this jointing pattern that allows the Sentinel Bluffs basalt unit to weather into spheroidal shaped boulders. Weathering typically causes a greenish tint characteristic of the Sentinel Bluffs. Care must be taken in identifying this unit from the Winter Water unit, for weathering can cause a fine-grained diktytaxitic textured basalt to appear to be coarse grained. However, weathering of the Winter Water unit will also typically cause the development of a

Figure 13. Exposure of the Sentinel Bluffs basalt along highway 99 W.

hydration rind, that migrates from the surface to the core of the basalt fragment.

XRF and INAA analyzes can be used to distinguish this unit from the other Grande Ronde Basalt units. No XRF data of the Sentinel bluffs unit were collected for this study and therefore, not listed in Table III. Major oxide concentrations are provided by Beeson and others (1989b).

Some INAA data were collected on the Sentinel Bluffs unit. Examination of the data showed that the Sentinel Bluffs basalt unit is distinguishable, based on the chromium content, from the other basalt units. The data show that the unit generally has a chromium content equal to or greater than 40 ppm (Table IV).

WANAPUM

Frenchman Springs Member: Ginkgo flow

The Ginkgo flow is the sole representative of the Wanapum Basalt within the study boundaries. This flow is observed only along the tops of the ridges and along the southeasterly dipping slopes. The basalt thickness varies from 0 to 90 feet (0 to 27.4 m), with the maximum thickness occurring along the Old Parrett Mountain - Parrett Mountain Road junction. The large difference in the flow thickness could be a result of the large hiatus between the Sentinel Bluffs and Ginkgo flow. This large hiatus, the largest known for Parrett Mountain, could have allowed a greater

topographic development to occur as discussed on page 62.

The large thickness of the Ginkgo flow on Rex Hill and Parrett Mountain can be explained by either the inflation of the basalt flow or the stacking of two individual Ginkgo flows. Unfortunately there has been no observable data to support either hypothesis.

The Ginkgo flow of the Frenchmen Springs Member of the Wanapum Basalt is highly distinctive in terms of lithologic characteristics. This unit is coarse-grained, containing an abundance of euhedral to subhedral plagioclase phenocrysts one to three centimeters long. These phenocrysts vary in color from a reddish tint to a creamy white to clear translucent color.

As with the Sentinel Bluffs unit, the jointing pattern is typically columnar. This is inferred from the number of spheroidal Ginkgo basalt boulders excavated from the subsurface. There were no bedrock exposures of the Ginkgo flow on Parrett Mountain. Soils developed on this unit are typically a blood red color. This is very distinctive for the Ginkgo flow because the soils derived from the other basalt units tend to develop a reddish brown color.

Due to the highly weathered yet distinctive texture of the Ginkgo flow, no samples of this unit were analyzed for a geochemical concentrations. Published data for this flow are included with the Geologic Map of the Lake Oswego Quadrangle by Beeson and others (1989).

INTERBEDS

An interbed is a regional to local sedimentary or ash layer deposited during a hiatus between basalt flow eruptions. The type of material, occurrence and thickness of an interbed are dependent upon the source of the sediments, the type of depositional and erosional processes occurring, and the length of time between basalt eruptions.

The Vantage Horizon

The Vantage Member is a sedimentary layer seen throughout the Columbia River Plateau. This layer was deposited during a 100,000 to 300,000 year hiatus between the Grande Ronde Basalt and the Wanapum Basalt eruptions. The type of material composing the Vantage layer varies throughout the entire Columbia Plateau, from a sandstone to a shale, to an erosional surface.

Within the study area, the Vantage Member is unexposed. Two possible reasons are given. The first is that the Vantage Member is covered by soil and organic litter, masking its appearance. This is a plausible hypothesis due to the weathering depth and thick soil development where the Ginkgo flow is present. The second possibility, is that the Vantage Member is represented, in this area, as an erosional surface on the uppermost Sentinel Bluffs flow (Figure 14).

The Vantage interbed is not reported in the analyzed wells that penetrate the Ginkgo flow. One possible

Figure 14. Typical appearance of the Vantage Horizon on Parrett Mountain. Picture taken along Xanthus Court.

explanation for this apparent absence is the well drilling process itself, that is air rotary drilling. Air rotary may have caused the disaggregation of any material that may be contained in the Vantage horizon. Only within a few lithologic well reports, e.g. the Gordon well (T3S R2W section 14), was there a mention of an interbed that may represent the Vantage Horizon. However, most of the Vantage horizon appears to be a paleosol developed on the upper flow of the Sentinel Bluffs basalt unit.

Other Interflow Deposits

Interbeds have been mentioned in well reports throughout the entire study region. The lithology of these interbeds has varied from sandstone to shale to claystone to ash deposits. However, these interbeds mentioned by the well drillers must be taken with skepticism due to highly weathered basalt being identified as sedimentary material (Marvin Beeson, 1992, personal commun.).

PALEOTOPOGRAPHY

Three of the basalt units present on Parrett Mountain, the Wapshilla Ridge, the Ortley-Grouse Creek (undifferentiated), and the Ginkgo flow were influenced by paleotopography during emplacement. Identification of paleotopography has been primarily based on sizable thickness variations over relatively short distances where no faults have been identified.

One very significant interflow deposit was found within the Hansen well. The deposit appears as a white ash/clay layer at the Umtanum and Ortley-Grouse Creek (undifferentiated) boundary. Several well reports throughout the western portions of Parrett Mountain also mention a white ash or white clay layer (Table XII, Appendix A). Based on the lithologic data and the stratigraphic data obtained from field mapping the white ash or clay layer mentioned in the well reports is assumed to be the white ash/clay found in the Hansen well. This assumption allows for a stratigraphic datum line and boundary between the Umtanum and the Ortley-Grouse Creek basalt units.

Wapshilla Ridge Basalt Unit

Since the Wapshilla Ridge basalt unit was the first basalt flow to enter this region, it seems reasonable that it flowed upon a gently dipping, well-developed topography. Paleotopography was identified in Manke wells #1 and #6 (Plate 1) for the Wapshilla Ridge basalt due to a nearly 100 foot (30.5 m) difference in the basalt/sediment boundary. The elevation difference could not be correlated to fault offset or dip of the beds. Besides the Manke wells, only a few other wells penetrate the basalt/sediment boundary especially on the upper elevations and western portion of Parrett Mountain. Therefore, a quantification of the position of the basalt/sediment boundary is tenuous at best. The variation in the basalt/sediment boundary elevation over

a distance makes the use of this boundary as a datum for defining fault offset impossible though it does pose a potential problem for saline migration into the basalt aquifers.

Ortley-Grouse Creek (undifferentiated) Basalt Unit

The lowest flow of the Ortley-Grouse Creek (undifferentiated) basalt unit also appears to have been affected similarly by paleotopographic relief. This observation comes primarily from T3S R1W Sec. 7. Drilling chips collected from the deepening of the Puderbaugh well (Plate 1) revealed the OGC/Wapshilla Ridge basalt boundary to be roughly 70 feet (21.3 m) lower than expected from the structural contour maps. Analysis of well reports for water wells located near the Puderbaugh well and a discussion with Douglas Delano (personnel commun., 1993), a well driller who works on Parrett Mountain, identified a highly localized depression of the Ortley-Grouse Creek (undifferentiated) / Wapshilla Ridge unit boundary around the Puderbaugh well. Three possible explanations, fault offset, erosional paleotopography or constructional topography, have been postulated to explain the boundary offset.

Of the three explanations, erosional topography is believed to be the least probable. The erosional processes, in order to create the 70 foot (21.3 m) offset in less than a quarter mile, needed a substrate easily erodible. Since there appears to be very little topographic development

visible along this boundary elsewhere on Parrett Mountain, the hiatus between the Wapshilla Ridge and the Ortley-Grouse Creek (undifferentiated) basalt flows must have been short.

The hypothesis of fault offset is a distinct possibility due the structural complexity in the northern Parrett Mountain area. Lack of fault exposure could be used as an argument against this hypothesis, however, it is possible that the fault was active during the emplacement of the Wapshilla Ridge basalt and was then covered by the Ortley-Grouse Creek and younger basalt units.

Constructional topography, the last hypothesis, relates to the primary flow features developed on a basalt flow. Constructional features result when a lava flow's surface cools while the interior is still molten. Movement of the molten interior causes the development of inflationary features such as: inflation ridges, pressure plateaus, residual depressions, inflation clefts, and rotated crust (Chitwood, 1991). Since it has been theorized that the Wapshilla Ridge basalt tongued (lobated) into the region, it is conceivable that such features pock mark its surface. Therefore, the offset could be explained as a residual depression or a depression created by the merging of two basalt lobes.

Ginkgo Basalt Flow

The Ginkgo flow is believed to be influenced by paleotopography that developed during the 100,000 to 300,000

year hiatus. This hiatus, as discussed previously, allowed for the development of a sedimentary interbed, the Vantage Interbed, through much of the Columbia Plateau. However, in the study area, only an erosional surface has been identified for this hiatus.

Because of the hiatus and erosional surface it is probable that some topographic development occurred within the study boundaries. Field mapping revealed the presence of the Ginkgo flow on the southern flanks of the Earlwood-Roberts Hill portion of Parrett Mountain. The outcrop of Ginkgo flow near the Earlwood road suggests a small channel eroded into the upper flow of the Sentinel Bluffs basalt unit filled in with the Ginkgo flow. Other small topographic depressions are suggested, by field mapping, in the Parrett Mountain and Tonquin areas.

STRUCTURE

FAULTS

Parrett Mountain is considered by Schlicker and Deacon (1967) to be a gently southeast dipping cuesta composed of Columbia River basalt. Topographic maps, of the Parrett Mountain area, show the mountain to be highly dissected by linear stream valleys. Many of these stream valleys have been identified by Hart and Newcomb (1965) and Schlicker and Deacon (1967) as faults based solely on topographic expression.

Cross sections AA', BB', CC', C'C'' (Figures 15 - 18) depict the local tectonic features expressed during map compilation and cross sectional analysis. Locations of these cross sections are found on Plate 2.

Weathering and erosion of the basalt have preferentially attacked fault planes and fracture zones producing linear stream valleys and ridges. To assume that every linear stream is a weathered fault having measurable displacement would be erroneous, for an easily weathered zone may also result from a fractured zone. Weathering and deposition of thick alluvial/colluvial material made the mapping of the local faults tenuous in the field. Therefore, interpretation of a fault was based on the obvious vertical or lateral displacement of basalt

Map View along Cross Section C'-C''

stratigraphic units in map compilation and cross sectional analysis. Fault features, such as slickenslides and cataclastic material, were not observed in the few drill chips collected from designated fault zones, the one exception being the Tucker well. The basalt chips, taken throughout the entire well, are highly weathered and containing some silica banding.

Because slickenslides and cataclastic material are common within fault zones, the absence of these features is probably related more to the preservation by the drilling technique than to the actual presence of the fault features.

Using the above criteria in the designation of a 'fault', several north/south-, northeast-, northwest-, and east/west- trending faults were identified. All faults were classified as 'normal', as a conservative method, unless otherwise known. For simplicity, the designated faults were inferred to cut through the entire basalt column, though this was not based upon any observations. There is a possibility that a few faults, active during the early stages of basalt emplacement, were buried by later basalt flows.

Map compilation and cross sectional analysis have produced the approximate location of the faults identified in this study. Based on the location of the faults, individual basalt blocks were identified (Figure 19). A basalt block, as defined for this report, is a body of rock

Figure 19. Basalt block designation.

that is bounded on all sides by faults. Strike and dips were then established for each individual basalt block. Three general strike and dip trends are observed for the Parrett Mountain complex.

The faults mapped within this study were based on strict observations and conclusions. This does not negate the possible existence of other faults present within the Parrett Mountain study area.

North/South-Trending Faults

The north/south-trending faults (Plate 2) are the most prominent features observed within the study area. All four north/south-trending faults have been designated as high-angle normal faults and occur on the west side of Parrett Mountain. The fault traces are visible for 3,200 to 20,000 feet (975 to 6,096 m). Termination of the north/south-trending faults occurs to the north by the Cedar Creek Fault, while to the south the faults are buried by thick alluvial deposits. The eastern two north/south-trending faults (NS#3 and NS#4) show a minor stratigraphic displacement of 20 to 30 feet (6.1 to 9.1 m) along with minor dip variations while NS#1 shows 500 feet (152 m) and NS#2 shows 100 to 200 feet (30.5 to 61 m) of displacement.

The Western Kramien basalt block (Figure 19) forms a horst with the basalt blocks to the east and west being down dropped. The Rex Hill block is down dropped with respect to the Anna block but upthrown with respect to the Parrett

Mountain block (Figure 19). The region lying between NS#1 and NS#2 faults forms a graben that appears to be part of a flower structure along the NS#2 fault (Figure 17; Plate 2).

A fifth north/south-trending fault, the Oberst Fault, was observed during field mapping. Seven feet of displacement was recorded for the Oberst Fault due to an exposed flowtop on either side of a small gulley, the designated fault plane. The seven feet (2.1 m) is an approximate amount of displacement since the thickness of the flowtop is unknown and boundary between the overlying flow and the flowtop was not observed. Map compilation and cross section analysis infers the Oberst Fault to be highly inclined to vertical.

Although the north/south-trending features are most prominent in the western portion of the mountain, there is a definite north/south lineation overprinting the entire Parrett Mountain area (Plate 2).

East/West-Trending Faults

The east/west-trending faults (Plate 2) occur only in the western portion of Parrett Mountain. Only one distinct fault has been identified, though the relationship between this fault trend and the other fault trends remains unknown. This east/west-trending fault is transected by the NS#3 and NS#4 faults. Extension of the east/west fault is probable to the west based on the local basalt stratigraphy expressed by Grouse Butte and the Fernwood outcrop. Between the NS#3

and NS#4 faults, the east/west fault is believed to be a high angle reverse to thrust fault. To the west, the east/west fault appears to change its style of faulting from the high-angle reverse to a high angle normal fault. The normal style of faulting is supported by the stratigraphic placement of the Ginkgo flow to the Wapshilla Ridge basalt unit, a total displacement of approximately 600 feet (200 m) (Plate 2).

An east/west overprinting is observed over the entire Parrett Mountain area (Plate 2). This overprinting is not as pronounced or prominent as the north/south lineation and is typically masked by the northwest-trending structures. Cross cutting relationships suggest that the east/west trending fault are syn- or pre-tectonic to the north/south-trending faults, but post-tectonic to the northeast-trending faults.

Northeast-Trending Faults

Seven faults have been mapped in this fault category (Plate 2). These faults have been named informally for clarity. The designated faults are the Sherwood Fault (Cedar Creek Fault), the Pleasant Hill fault, the Dammasch fault, the Willamette fault, the Corral Creek-Earlwood fault, the Rim fault, and the Manke fault. Only the Sherwood and Corral Creek faults have been mapped by previous authors. All of the seven faults, save for Pleasant Hill and Corral Creek faults, have been mapped as

normal, though the true style and sense of faulting remains unknown.

Sherwood Fault. The Sherwood fault (Cedar Creek fault), was mapped based on the separation of Parrett Mountain from the Chehalem Mountains (Hart and Newcomb, 1965; Schlicker and Deacon, 1967). Studies on this fault (Werner, 1991) still have not found the exact fault position and style of faulting due to the thick alluvial and colluvial material covering most of the fault trace.

Detailed field mapping of the basalt units allowed for an approximate fault position to be identified, though the exact orientation, plane angle, and style of faulting remain unknown. Drilling chips collected from the Rolfs, the Cedar Creek, and the Hamness' wells, located slightly south of the fault trace, were examined in order to help identify the position of the fault plane. Examination of the drill chips revealed little cataclastic development and no recognizable, repeated basalt sections. A maximum of 1000 feet (305 m) total vertical displacement was measured at Rex Hill. The amount of displacement along the fault decreased away from Rex Hill in a general stair-step manner.

Corral Creek-Earlwood Fault. The Corral Creek-Earlwood fault lies along the South Fork of Corral Creek and divides the Roberts Hill-Earlwood basalt block from the Parrett Mountain and Eastern Kramien basalt blocks (Figure 19). A maximum vertical offset of 400 feet (122 m) was observed

across the fault (Figure 16; Plate 2).

The Corral Creek-Earlwood fault is unique for the area, expressing a thrusting component to the northeast and a normal style of faulting to the southwest. Three possible styles of faulting may explain this phenomena. The first, is that the Corral Creek-Earlwood fault represents a hinge fault where the basalt block is allowed to rotate in the vertical plane along a hinge lying close to the Parrett Mountain and Kramien road intersection. Second, the Corral Creek-Earlwood fault could represent a thrust fault that has been modified by several northwest trending faults, e.g. Roberts Hill fault. Each northwest fault would allow for a progressive downdrop to the southwest, resulting in the Earlwood segment being expressed as a 'normal fault'. The third possibility is that the Corral Creek and Earlwood basalt segment may actually represent two independent faults, separated by a undesignated fault.

Manke and Rim Faults. In the northern portion of Section 7 T3S R1W, two faults were mapped based on the obvious offset of stratigraphic units observed from basalt chip analysis and map compilation. The Rim fault is observed at the base of a basalt ridge that separates the northwestern slope from the southeastern slope of Parrett Mountain. The Manke fault was mapped based on water level data (Luzier, 1992) along with a linear topographic trace expressed by several stream pathways.

Both faults trend parallel to each other and subparallel to the Cedar Creek fault. Northwest downdropping of 30 feet (9.1 m) occurs for both faults. The faults are terminated on the southwest by the Ladd Hill Fault and by the Mill Creek fault to the northeast. Both faults may actually extend farther to the southwest and northeast.

Pleasant Hill Fault. The Pleasant Hill fault was identified in cross sectional analysis (Figure 15; Plate 2) due to a drastic decrease in basalt flow dips. The fault is believed to be bounded by the Mill Creek Fault to the southwest and the Seely Ditch Fault to the northeast. Approximately 200 feet (61 m) of vertical offset has been inferred from cross section AA' (Figure 15). Analysis of drilling chips and numerous well reports allow the Pleasant Hill Fault to be identified as a low angle thrust fault.

Dammasch Fault. The Dammasch fault was mapped based on a linear stream valley and the vertical displacement of the Ginkgo flow. On the northwest side of the Dammasch Fault the Ginkgo flow is exposed at the 250 foot (76.2 m) elevation, while it is buried by sediment 110 feet (33.5 m) below the surface on the southeast side of the fault. The fault is believed to terminate against the Seely Ditch Fault to the north and to be the possible extension of the implied Willamette Fault.

Willamette Fault. The exact position of this fault is

difficult to discern due to the thick alluvial material covering the entire area between Parrett Mountain and La Butte. The fault was mapped based solely on the distinct elevation change of the Umtanum and Winter Water basalt boundary from Parrett Mountain to La Butte. The exact style of faulting, fault plane angle, and number of the faults buried beneath the alluvium is unknown.

The Northwest-Trending Faults

The northwest trending faults (Plate 2) have been informally named for clarity in this report. The NW trending faults mapped are the Mill Creek fault, the Ladd Hill fault, the Heater fault, the Roberts Hill fault, the Seely Ditch fault, and the Kramien fault.

Mill Creek, Ladd Hill, and Heater Faults. The Mill Creek and Ladd Hill Faults are the most topographically distinct of all the northwest-trending faults. Both show nearly 100 feet (30.5 m) of vertical displacement. The Heater Fault is an extension of the Ladd Hill fault. A change in the strike and dip direction for the basalt flows was the main criterion used to designate the occurrence of the Heater Fault. The strike and dip variation suggests a lateral component to the sense of motion along the northwest-trending faults.

Middle Fork of Corral Creek Lineation. The Middle Fork of Corral Creek may represent a northwest-trending fault similar to the Ladd Hill, Mill Creek and Heater Faults based

on the topographic similarity between Middle Fork and North Fork. However, map compilation and cross sectional analysis do not indicate any lateral or vertical displacement. Therefore, the Middle Fork has not been designated as a fault.

Roberts Hills Fault. The nature of the Roberts Hill fault was discussed under the Corral Creek-Earlwood fault in the northeast trending fault section (discussed above). The fault is observed as a semi-linear feature that separates Roberts Hill block from the Earlwood block (Figure 19). An approximate 50 feet (15.2 m) of offset was observed in cross sectional analysis and map compilation. Similar northwest linear stream gullies dissect the Earlwood-Roberts Hill basalt block. Although, the Roberts Hill Fault dissects the Earlwood-Roberts Hill basalt block, there are no observable strike and dip changes between the two independent blocks, implying that there was no rotational component to the style of faulting along the Roberts Hill fault.

Seely Ditch Fault. The Seely Ditch Fault is based on 1) significant offset of the basalt stratigraphy, 2) a change in the dip of the basalt unit across this line, and 3) a highly linear topographic ridge. Offset of 100 feet (30.5 m) is inferred in the cross sectional analysis. This fault is inferred to terminate the Pleasant Hill and Dammasch faults while being terminated by the Sherwood Fault. The surface trace of the fault coincides with a

linear trough cut out by the Missoula flood waters.

STRIKE AND DIP

Cross sectional analysis of the Parrett Mountain area assumes a pancake layered stratigraphy composed of basalt flows (Figures 15 - 18). Due to the nature of basalt emplacement, primary dips are typically horizontal to a few degrees. Therefore, changes in the primary dips will reflect the amount of structural activity that occurred after the emplacement of the basalt flows. Thus, the overall southeasterly and southwesterly topographic dips of Parrett Mountain (Table V) are a reflection of the fault activity along the Sherwood and Corral Creek faults.

TABLE V

STRIKE AND DIP OF THE BASALT BLOCKS COMPRISING PARRETT MOUNTAIN

Basalt Block	Strike	Dip
Anna Road	N24°W	2°SW
Eastern Kramien	N86°E	2°SE
Manke® (maximum)	N81°E	10°NW
(minimum)	N81°E	6°NW
Northern Ladd Hill	N08°E	5°SE
Parrett Mountain	N53°E	4°SE
Pleasant Hill	N13°E	2°SE
Poison Oak	N15°W	4°NE
Rex Hill	N33°W	2°SW
Roberts Hill - Earlwood	N42°E	5°SE
Southern Ladd Hill	N65°E	3°SE
Western Kramien	N50°W	2°SW

@ :: maximum and minimum dip values are given due to a missing section of drill chips taken from Manke well #4.

In the northeastern portion of Parrett Mountain, the strike is approximately north/south, a northeast strike was observed for the central portion of the mountain complex; and, a northwest strike was observed for the western portion of Parrett Mountain forming an apparent anticline.

STRUCTURAL CONTOUR MAPS

Structural contour maps (Figures 20a - 20e) were created to illustrate the approximate elevation of a basalt unit's top and bottom. These maps were drawn using strike and dip measurements taken from the compiled geologic map. Cross sections AA' through C'C'' (Figures 15 - 18), exposed flowtops, outcrops, and collected basalt drill chips were used as qualifiers to check and modify the structural contour maps.

In order to construct and use these structural contour maps, several assumptions are necessary. The structural contour maps produced represent an ideal situation. The first assumption is that each basalt block is represented by only one strike and dip, i.e. each basalt unit, within a designated basalt block, yields the same strike and dip as the unit above and below it in the stratigraphic column. This ignores the possibility of secondary strike and dips occurring from lobe structures or other flow emplacement features. This assumption creates a basalt sheet (layer), or pancake layered structure, with little deviation in

Figure 20a. Contour elevations of the Ginkgo flow/Sentinel Bluffs basalt unit boundary. Contour interval is 50 feet.

Figure 20b. Contour elevation of the Sentinel Bluffs/Winter Water basalt units boundary. Contour interval is 50 feet.

Figure 20c. Contour elevation of the Winter Water/Umtanum basalt boundary. Contour interval is 50 feet.

Figure 20d. Contour elevation of the Umtanum/Ortley-Grouse Creek basalt boundary. Contour interval is 50 feet.

Figure 20e. Contour elevation of the Ortley-Grouse Creek/Wapshilla Ridge basalt boundary. Contour interval is 50 feet.

thicknesses from the bending or folding of the individual basalt units by tectonic forces. A pancake layer structure is transposed from the cross sectional analysis (Figures 15 - 18). Such folding and bending of the units would be difficult to discern in the cross sections with the available data.

The second assumption takes into account thickness variations. General thickening and thinning of the basalt flows, identified from cross sectional analysis, were incorporated into the structural contour maps. These thickness changes reflect changes occurring along the cross sections and are assumed to be standard for the entire basalt block. Therefore, some thickness variations due to paleotopographic influences have been ignored. Paleotopography was found only to influence the Wapshilla Ridge basalt unit, the lower flow of the Ortley-Grouse Creek (undifferentiated) basalt unit, and the Ginkgo flow and therefore essentially disavows this assumption.

The third assumption, used in the creation of these maps, was that the designated basalt blocks were not dissected by unidentified faults. This assumption also assumes that there was no sporadic faulting occurring during the emplacement of the basalt units. If there is an unrecognized fault within a designated basalt block, then the designated strike and dip of the basalt block would most likely be inaccurate.

Using the above assumptions, the structural contour maps were constructed. Qualifiers; flowtops, outcrops, and analyzed drill chips, were used to check and improve the constructed maps. In areas where little surface or subsurface data existed, topographic analysis was used to infer the unit boundaries. Gently inclined slopes were typically assumed to be flowtops of the basalt units while the steeply-to-moderately inclined slopes were inferred to represent a basalt flow's interior. Such topographic evidence helped in the interpretation of the western side of Parrett Mountain, where subsurface and surface data were scarce to nonexistent.

The structural contour maps concurred with all the qualifiers, taking into account the uncertainty existing in locating the analyzed wells and the sampling procedure. Two wells, however, did not agree with the constructed structural contour maps. The first well, the Puderbaugh well (Plate 1; Table XI, Appendix A), is located in the Southern Ladd Hill basalt block (T3S R1W Section 7). This anomaly has already been discussed under "Paleotopography" and therefore will not be discussed further.

The second well that does not agree with the structural contour maps is the Metcalf well (Plate 1; Table XI, Appendix A), located in the Pleasant Hill block, (T3S R1W Section 8). The basalt unit boundaries occurring in this well have an elevation lower than expected compared to the

Severine well (T3S R1W Section 8), located near the Metcalf well. The elevation changes from the two wells are the most pronounced at the Wapshilla Ridge/Ortley-Grouse Creek (undifferentiated) boundary and decrease in sequential order to the Sentinel Bluffs/Winter Water boundary. This elevation difference would suggest that at least one of the three assumptions listed is incorrect. Several other wells, Hoffman, Lofton, Carraher, and Severine, located within the Pleasant Hill block, agree with little uncertainty with the derived structural contour map. Therefore, it is likely that the cause of the anomaly occurs locally around the Metcalf well.

GROUNDWATER

Groundwater systems located on Parrett Mountain were delineated and studied through static water level measurements, groundwater conductivity and groundwater temperature measurements. These measurements were taken by the OWRD from domestic and irrigation wells located throughout the study area. This groundwater data set was then plotted on the geologic map in order to discern the effects stratigraphy and structure have on the groundwater systems.

GROUNDWATER OCCURRENCE

Alluvial/Colluvial Aquifers

Alluvial/colluvial aquifers occur in the Tonquin and Hess Creek-Spring Brook area as well as within the Cedar Creek and Corral Creek drainages (Plate 3). The geologic formations associated with the alluvial/colluvial aquifers are the Oligocene and Miocene sedimentary deposits, the Troutdale Formation, the Willamette Silt and coarse flood deposits, and recent alluvium. Because the groundwater problem affecting Parrett Mountain occurs solely in the basalt aquifers the alluvial aquifers will not be discussed in this report.

One very important alluvial aquifer needs to be

addressed. This aquifer, identified solely through well reports, exists as a perched aquifer at the alluvium/basalt boundary. The aquifer develops due to a decrease in the infiltration rate of the vertically migrating groundwater across the alluvial/basalt boundary.

Future studies into groundwater recharge of basalt aquifers should include the role alluvial aquifers play as potential (basalt) groundwater recharge reservoirs.

Basalt Aquifers

Basalt aquifers occur within flowtops, flow-bottoms, and flow-margins of individual lava flows. These zones are typically highly porous, marked by a scoriaceous crust, numerous vesicles, and primary (cooling) joints. Primarily, an aquifer will develop within the flowtop since the thickness of the flowbottom and flow-margins is relatively small compared to the flowtop.

Interflow sedimentary deposits, if present, usually have lower permeability than the flowtop and may result in a hydraulic separation of a flowbottom from the underlying flowtop. Since there appears to be no extensive interflow sedimentary deposits, a hydraulic connection between the overlying flowbottom and the underlying flowtop will be assumed under the term 'interflow zone' unless otherwise stated.

Groundwater migrates through a basalt flow both vertically and laterally (Figure 21). The lateral

Figure 21. Idealized groundwater flow through several vertically stacked basalt flows (Modified from Lite (1988). 1976; Baker, 1979).

groundwater transmission occurs primarily through the flowtop due to the porosity and permeability of this zone. If the flowtop is inclined it will allow for an easier pathway for the water to travel allowing for pressure differences to occur creating a hydraulic gradient. The vertically migrating groundwater travels through the primary and secondary joints, if present. However, the opening of the primary joints is typically very small and hinders a large vertical migration of groundwater. Because of the impermeable nature of the basalt flow's interior, the ratio between the lateral and vertical groundwater transmissions is very high (McNish and Baker, 1976.) Table VI compares two hydrogeologic characteristics, porosity and hydraulic conductivity, as a function of the aquifer's lithology. Table VII compares the same aquifer characteristics as a function of a basalt flow's morphology.

TABLE VI

AQUIFER CHARACTERISTICS OF VARIOUS ROCK TYPES

Rock Type	Hydraulic Conductivity	Porosity (%)
	K (m/s)	
Permeable Basalt	10^{-2} to 10^{-7}	5 to 50
Karst Limestone	10^{-2} to 10^{-6}	5 to 50
Sandstone	10^{-6} to 10^{-10}	5 to 30
Unfract. crystalline rock	10^{-10} to 10^{-14}	0 to 5
Unweath. marine clay	10^{-9} to 10^{-12}	0 to 10

* Data taken from Freeze and Cherry (1979)

For the Parrett Mountain area, the porosity and

hydraulic conductivity, is probably on the low side of the data range given in Tables VI and VII. This is most likely due to a lack of pillow basalt complexes (Marvin Beeson, 1993, personnel commun.), lack of adequate recharge zones, and thin basalt flows.

TABLE VII
AQUIFER CHARACTERISTICS FOR BASALT AQUIFERS

Type of Basalt	Hydraulic Conductivity m/s	Porosity %
Dense Basalt	10^{-11} to 10^{-8}	0.1 to 1
Vesicu. Basalt	10^{-9} to 10^{-8}	5
Fract, weath/ brecciated basalt	10^{-9} to 10^{-5}	10
Interbeds/flowtops	10^{-8} to 10^{-5}	20

* Data taken from Freeze and Cherry (1979)

GEOLOGIC INFLUENCES ON GROUNDWATER MIGRATION

Stratigraphy

Lateral. Since the lateral groundwater transmission is greater than the vertical, the direction of groundwater movement will be dependent upon the primary and secondary dips of the basalt flows. Examination of the potentiometric surface map shows a southeasterly flow direction. This suggests that lateral groundwater gradient is governed by the secondary (structural) dips since the primary dips, inferred from thickness variations, are to dip to the northeast and northwest.

Intraflow and primary dips have resulted in small variations in the dip directions for the individual basalt

flows. The effects these small dip variations play in the migration of groundwater systems remains unknown.

Vertical. Since a basalt flow's interior is relatively impermeable, the aquifer developed in the flowtop will generally be isolated. Stacking basalt flows vertically, will result in development of several isolated to semi-isolated aquifers (interflow zones). Each aquifer can be identified by a specific potentiometric head value (head) if there is little communication between the aquifers. Typically these head values will decrease with increasing depth, reflecting a vertical groundwater gradient (Figure 22). Figure 23 depicts one small area on Parrett Mountain where the head decreases with depth.

An example of a stratigraphic control over the groundwater system can be observed in T3S R1W Section 4. Three wells, Axelson, Nielson, and Phil, lie within four hundred feet of one other and at nearly the same surface elevation. Current head values are 197 feet (60 m) for Axelson, 212 feet (64.6 m) for Phil and 242 feet (73.8 m) for Nielson. The only notable difference, among the three wells, is that the Nielsen well is twenty feet shallower than the other two wells. Well reports record that half of the well's yield, for both Phil and Axelson, occurs in the bottom 10 feet (3 m). It can be concluded, from this comparison, that by penetrating the lower aquifer both Axelson and Phil have obtained 1) a larger groundwater

Figure 22. Schematic drawing of an idealized vertical gradient occurring in a stacked basalt flow system. Black triangles represent potentiometric surface of the individual interflow zones.

Figure 23. A map view of the Pleasant Hill basalt block showing the heads of individual wells throughout the area. Essentially, the lower the hydraulic head the deeper the aquifer. The inset shows the location of the figure within the study area.

and 2) a smaller hydraulic head.

Morphology

Flowtop. The thickness of the scoriaceous crust, the concentration of vesicles and primary joints, and the degree of weathering of the flowtop will all directly influence the ability of an aquifer to yield groundwater to individual wells. This geologic influence was extremely difficult to quantify using the available data, since neither the transmissivity and storativity coefficients govern the hydraulic head.

The effect of the flowtop's morphology on the local aquifers is known solely through discussions with local residents and inferred from the analyzed basalt chips. Variations in the flowtop's morphology appears to affect the groundwater systems over a small distance, perhaps a few to tens of feet.

Basalt Flow Interior. Analysis of the collected drilling chips shows that in some locations the Winter Water and Umtanum basalt flows are highly vesicular throughout the thickness of the flows. In such cases, weathering was observed throughout the basalt flow.

The drilling chips and water well data also suggest that the Wapshilla Ridge is highly porous for most of its thickness over the entire Parrett Mountain area. The exact cause of this high porosity, whether due to permeable lenses/layers or from primary jointing, remains unknown.

Faulting

Newcomb (1961) postulated that a fault may cause a groundwater barrier to form. One possible way for the barrier to form results from the offset of a fault. When the interflow zone is relatively thin, little offset is needed to abut the interflow zone to an impermeable flow interior (Figure 24a). When an interflow zone is relatively thick, or if the entire flow yields groundwater, e.g. the Wapshilla Ridge, the offset has to be great enough to offset the entire flowtop or flow (Figure 24b). Because of the changing interflow zone thicknesses, a groundwater barrier may exist from one interflow zone but not for another. Second, the development of fault gouge due to tectonic activity, alteration of basalt fragments, and the build up of silica and other precipitates may clog the fractures and pores providing a groundwater barrier. The examination of well chips has not revealed the presence of fault gouge or significant amount of weathering at mapped fault planes. One exception occurs in the Conway well, where banded silica was noted along the North/South #2 fault.

The Rim and Manke Faults. In a hydrogeologic study of the Manke property, Jim Luzier studied the hydrogeologic effects of the area (1993, written commun.). Using pump test data, Dr. Luzier created a structural model of the Manke property. He designated two faults that dissected the property. For this report these faults have been informally

Figure 24. A generalized diagram showing the effects on a potentiometric surface depending upon the thickness of the interflow zone and amount of fault offset. 24a represents a thin interflow zone or large offset while 24b represents a thick interflow zone or small fault offset.

named as the Rim and Manke Faults (this report). Based on his data, both faults acted as groundwater barriers, separating the aquifers occurring to the south and to the north.

Sherwood Fault. The potential of the Sherwood Fault to act as a groundwater barrier has been studied by the City of Sherwood (David Driscoll, P.E., and Willard Titus, P.G., 1991, written commun.). Since the amount of offset, the exact fault position, and the dip of the fault plane remain unknown, it is tenuous at best to assume this fault to be an effective hydrologic barrier.

GROUNDWATER BARRIERS

Examination of the potentiometric surface map (Plate 3) shows the presence of several groundwater barriers. A few of the barriers coincide with mapped faults. This shows that a few of the faults on Parrett Mountain are acting as groundwater barriers.

Some of the barriers do not have a mapped fault counterpart. This may be explained by the conservative approach used in mapping a fault. This is apparent in the Anna and Earlwood-Roberts basalt blocks. Several groundwater barriers (Plate 3) are seen throughout these two basalt blocks where no mapped faults have been designated.

One of the most important observations made from the potentiometric surface map exists near the Pleasant Hill

Fault (Plate 3). Within this area, the groundwater's potentiometric surface dropped 200 feet (61 m) across the Pleasant Hill Fault. A similar drop, 100 feet (30 m) occurs in the Southern Ladd Hill basalt block in roughly the same trend and area as the Pleasant Hill Fault. This suggests that the Pleasant Hill Fault crosses the northwest trending Mill Creek Fault.

One other important observation occurs around the Sherwood Fault, along the Cedar Creek drainage. The local head for wells penetrating the basalt show no deviation across the inferred fault trace. Therefore, the Sherwood Fault does not act as a groundwater barrier.

PARRETT MOUNTAIN GROUNDWATER MODEL

Aquifers

The term 'aquifer' has a variety of definitions. For the purpose of this study, an aquifer will be any layer of strata that yields an economic source of water for a individual well. This definition allows for the following basalt units in Table VIII to be considered aquifers.

Interflow Zones. Comparison between the stratigraphic model of Parrett Mountain and the groundwater data taken from water well reports reveals that every basalt flow boundary contributes some water to at least one water well investigated (Table VIII). Further groundwater data are presented in Table XV in Appendix B.

The Wapshilla Ridge Aquifer. The data in Table VIII and Table XV (Appendix B) show that the Wapshilla Ridge aquifer (WpR) is the most extensively used aquifer on Parrett Mountain. The existence and nature of this aquifer most likely corresponds to the emplacement features present within the Wapshilla Ridge basalt. In analyzing the drilling chips, the vesicular flowtop was found to range from roughly 10 to over 40 feet (3.1 to >12.2 m) in thickness. Repeated zones of diktytaxitic textures may represent vesicular zones and/or lenses which may have led to the development of perched or layered aquifers.

TABLE VIII

PRINCIPAL AQUIFER(S) OF STUDY WELLS

Principal Aquifer	Number of Wells	
	Single Aquifer	Two Aquifers [@]
Winter Water	4	0
Winter Water/Umtanum	32	4
Umtanum	14	0
Umtanum/Ortley-Grouse Creek	41	6
Ortley-Grouse Creek (OGC)	24	5
OGC/Wapshilla Ridge	52	11
Wapshilla Ridge	110	

@ number aligned between named units
indicates the number of wells that apparently
draw water from both units.

* Table taken from Miller and others, 1994.

Recharge

Groundwater recharge of the basalt aquifers occurs through exposed flowtops, fault zones, along the alluvium/basalt or colluvium/basalt boundaries, and by vertical migration through a basalt flow. Figure 25 is a generalized graph showing the relationship between the length of lag time and the distance from the measuring point to a recharge zone. This is a simplified model of the aquifer system, essentially ignoring the anisotropic characteristics of the basalt aquifers, yet relates importance of distance as a function of recharge. Well #A in figure 25 is closer to the recharge pattern, ignoring anisotropic characteristics than well #B since the lag time between precipitation/infiltration and recharge at well #1 is shorter than the lag time for well #2. Hydrographs (Figure 26) were examined to reveal the local and regional recharge patterns.

Exposed Flowtops. Because of the highly permeable nature of the basalt flowtops, the infiltration rate will be greater along an exposed flowtop as opposed to the basalt flow's interior. Flowtops are exposed throughout the entire Parrett Mountain area. Because of the southeasterly dip, the flowtops exposed along the northwestern slopes of Parrett Mountain, Roberts Hill, and along the local drainages will act as groundwater recharge zones.

Faults. Newcomb (1961) discussed the possible effects

Figure 25. The graph shows the difference in lag time between precipitation and recharge based on distance away from a recharge zone. The time duration for recharge of well A (t_1) is shorter than the time duration for well B (t_2).

Figure 26. Comparison of hydrographs, Bach vs. Cogger and Rilee School House vs. Mills, to determine basalt recharge zones. Arrow designates the beginning of Seasonal Recharge.

faults may have on the aquifer systems. He postulated that faults could aid in the recharge of the groundwater systems because of the higher permeability associated with the numerous secondary joints surrounding the fault plane. This allows for an easy vertical transmission of groundwater from the surface and shallow aquifers into the deeper aquifers.

Examination of the potentiometric surface map shows the head values are highest near and decrease away from the mapped faults (Figure 27). This implies that the faults aid in groundwater recharge. Further evidence to support this observation is seen in several hydrographs (Figure 26, Bach vs Cogger) obtained from the OWRD. These hydrographs show that there is a natural lag time between the period of precipitation and the maximum head value. The lag time appears to be smallest near and longest away from mapped faults.

Landslides. The steep slopes on the northwestern face of Parrett Mountain hampers the amount of recharge to the flowtop aquifers by decreasing the time precipitation has to vertically infiltrate into the soil and flowtops. The landslides on the northwestern face of Parrett Mountain have decrease the northwestern slopes and thereby increase the time precipitation has to infiltrate. Second, the physical movement of the landslide material has created a more permeable substrate for groundwater infiltration. The infiltrating groundwater will migrate vertically through the

Figure 27. View of the potentiometric surface of the Columbia River basalt aquifer decreasing away from mapped fault zones.

landslide colluvial material. Eventually, this infiltrating groundwater will reach the colluvial/basalt boundary, at the base of the landslide, where it will pond forming a perched aquifer. This perched aquifer will slowly yield groundwater into the basalt bedrock over a longer period of time than would occur without the presence of the landslide.

Vertical Infiltration. The infiltration of precipitation through the soil is classified, for this study, under the term 'vertical infiltration'. Groundwater infiltration occurs through a basalt flow's impermeable interior. Both of these infiltration processes recharge the underlying basalt interflow zones. The amount of infiltration was not discerned in either case.

Discharge

Groundwater discharge from the aquifer systems occurs through groundwater pumpage, vertical seepage, and spring discharge.

Groundwater Pumpage. Withdraw of the basalt aquifers is related to permitted and non-permitted (domestic) uses. The largest groundwater withdraws from the study area are from the City of Sherwood and Dammasch State Hospital. "Current annual water use as reported by these users is about 227.7 million gallons per year (mgy)." (Miller and others 1994) Table IX depicts the estimated basalt groundwater withdraw for the Parrett Mountain area from 1960 to 1993. Further data on the amount of groundwater pumpage

and uses can be obtained from Miller and others, 1994.

Vertical Seepage. Within the study area, vertical migration of groundwater, represented as changes in the vertical heads, can occur through a basalt flow's interior and/or along fault planes. Figures 22, 23 and Plate 3 reveal a generally positive vertical head gradient for Parrett Mountain. Whether this vertical head gradient is caused by groundwater migration through a basalt flow's interior, along a fault plane, or some combination of the two pathways is unknown.

TABLE IX

ESTIMATED BASALT GROUNDWATER WITHDRAWALS ON PARRETT MOUNTAIN. (in million gallons per year (mg/y) from 1960 to 1993)

	1960	1970	1980	1990	1993
Domestic	48 mg/y	66 mg/y	141 mg/y	187 mg/y	193 mg/y
Permitted	111 mg/y	197 mg/y	237 mg/y	367 mg/y	365 mg/y
Total	159 mg/y	263 mg/y	378 mg/y	554 mg/y	558 mg/y

* Taken from Miller and others (1994).

Many wells in the Parrett Mountain study area artificially increase the yield of a well in order to obtain more water from the well. This artificial increase, commingling, is created by the penetration of two or more aquifers, allowing their groundwater to co-mingle.

Commingling was noted during field measurements when the sound of flowing to dripping water in the well or the

generation of an intermittent sound from the electrical measuring tape was heard. The list of wells where commingling was noted as occurring can be found in Miller and others (1994). At least half of the basalt wells existing on Parrett Mountain have some amount of commingling occurring (Miller and others, 1994) .

To understand the effects of commingling it is first necessary to understand how an aquifer develops. Within an aquifer, water enters as infiltrating groundwater and leaves as groundwater flow, well discharge, and vertical seepage to underlying rock strata. If the vertical seepage is increased, through commingling, and the other variables remain constant, the effect is to drain the aquifer. Commingling will also overshadow any effects the vertical transmission of groundwater will have (Davies-Smith, 1988). Figure 28a is a schematic drawing of the effects commingling has on several penetrated aquifers.

Typically, it is believed that if commingling occurs it will develop the lower aquifers due to groundwater migration driven by gravity. However, groundwater migration is not driven by gravity, rather it is driven by head potentials. If the head potential is lower in a overlying aquifer then commingling will cause a upward decreasing vertical gradient through the well to occur. This will develop the upper aquifer at the expense of the lower aquifer (Figure 28b).

Several other effects caused by commingling should be

Figure 28. Cascading water from an uncased or unlined well creating a composite head (Heath, 1984). The schematic drawing showing the two forms of cascading water. (a) represents the migration of groundwater down the well-hole, depleting the upper aquifer(s); while (b) represents groundwater migration up the well-hole depleting the lower aquifer(s).

noted. First, several of the heads measured by OWRD (Table XIII, Appendix B) are actually composite heads. A composite head is a representative head value of the aquifers penetrated by a well (Figure 29). Second, groundwater chemistry becomes questionable as a means of identifying different aquifers due to groundwater mixing. Finally, contaminants, if present in one aquifer, have a greater chance of migrating to other aquifers in the study area.

Springs. Figure 30 depicts the locations of springs encountered during the study. Field mapping has revealed that the springs encountered on the southeastern slope resulted from the daylighting of the interflow zones. Examples are the Ginkgo/Sentinel Bluffs and Sentinel Bluffs/Sentinel Bluffs' interflow zones which were observed to yield water to several springs.

On the northwestern slope, springs were observed to be associated with the landslides. Due to the enhanced permeability and the low slope angle of the landslides infiltrating groundwater will migrate vertically and laterally through the colluvium. Anisotropic characteristics and varying hydraulic conductivities within the landslide colluvium will create the ponding and lateral stratification of the infiltrating groundwater if the landslide is of a thickness to allow hydrologic stratification. The most prominent boundary, the colluvium/basalt boundary, at the base of the landslide,

Figure 29. A generalized diagram of a composite head. The water table in the well represents an equilibrated system between the interflows penetrated by the well.

Figure 30. Location of springs observed on Parrett Mountain.

will cause a ponding of the infiltrating groundwater. If the colluvium/basalt boundary is exposed at the surface then springs will occur, outlining the boundary of the landslide. Such an example can be observed in Figure 31. Several other springs were mapped within the landslide areas. These springs occur due to the anisotropic nature of the landslide colluvium.

Along with the springs associated with the landslide areas a few others were mapped within fault zones, e.g. the NS#4 and the Oberst Fault.

GROUNDWATER CHEMISTRY

Groundwater geochemical data were obtained from Driscoll and Titus (1991) and supplemented with the Sherwood and Dammasch well reports. Further geochemical data, generally temperature and salinity, were supplied in a few well reports.

Table X compares the groundwater chemistry of the City of Sherwood wells #3 and #5 to three Parrett Mountain wells: Bach, Langston, and Owens. Figure 32 shows the locations of the five wells sampled in Table X.

Tritium. Tritium (H^3), a radioactive isotope of hydrogen, is naturally and artificially created in the atmosphere. Artificial creation of tritium occurred in the early 1950's due to atmospheric testing of thermonuclear bombs (Freeze and Cherry, 1979). Because of this artificial

Figure 31. A generalized representation of spring development on the northwestern slopes of Parrett Mountain with respect to the presence of landslide material.

increase in tritium, this isotope a good time indicator for dating groundwater systems. If the tritium concentration (TU) is roughly 5 to 10 TU then the groundwater must have originated before 1953 (Freeze and Cherry, 1979). The above statement does not take into account groundwater mixing. If very old groundwater (TU < 2) mixes with groundwater fed from recent to near recent precipitation (TU >25) then the resulting TU would be a representation of how much old groundwater mixed with the recent precipitation.

Table X shows the amount of tritium detected in the analysis of three Parrett Mountain wells and two Sherwood wells as pci/L. Under the conditions of the analysis, one

TABLE X

GROUNDWATER CHEMISTRY

Analyte	City of Sherwood Wells		Private		
	No. 3	No. 5	Bach	Langston	Owens
Hardness, mg/L	88.0	81.0	49.0	60.0	45.0
Chloride, mg/L	1.5	2.0	2.0	<0.10	<0.50
Nitrate, mg/L	0.1	<0.01	0.8	0.7	1.3
Conductivity (umho/cm)	192.0	210.0	120.0	150.0	110.0
Total Dissolved Solids, mg/L	134.0	147.0	84.0	105.0	116.0
Tritium, pci/L	ND	18.0	5.9	32.0	19.0

ND = Not analyzed

* Taken from Driscoll and Titus (1991)

pci/L equals one TU.

Due to the uncertainty in the amount of groundwater mixing resulting from commingling the tritium concentration

Figure 32. Location of the five wells where the groundwater geochemistry was analyzed (Driscoll and Titus, 1991). The inset shows the location of the figure within the study area.

should be held questionable.

Groundwater Geochemistry. Based solely on a visual analysis of the geochemical data (Table X), comparing Sherwood well #5 and the three Parrett Mountain wells, it appears that Sherwood well #5 obtains its groundwater from a separate aquifer system. This observation is based solely on apparent differences in hardness, nitrate, total dissolved solids, and conductivity. This separation should be suspected due to the occurrence of groundwater mixing from commingling wells. Since the amount and extent of groundwater mixing remains unknown variations in the groundwater chemistry from site to site should be expected.

Additional groundwater chemical data were extracted from the OWRD and the well reports. Groundwater temperature and conductivity values for wells measured are reported in Miller and others (1994) and are not included in this study. Typically the groundwater temperature was between 50 to 54°C while the conductivity range from 35 to 900 micromhos/cm with most occurring between 100 to 200 microhmos/cm. Based on collected geochemical data, separation of aquifer systems was impossible due to similar values throughout the study area (Miller and others, 1994).

Although very similar in characteristics, the groundwater geochemistry does not prove or disprove the separation of aquifer systems. Given the small variation in the geochemical parameters over the entire study area, a

larger sample base is deemed necessary to differentiate between aquifers.

Saline Water

Saline water was recorded in only three wells within the study area. No well reports were found for these three saline wells so a measure of how deep the saline water is encounter is unknown. Their approximate locations were given by Schlicker and Deacon (1967) and discussions with local landowners. Figure 33 shows the approximate locations of the three wells.

Occurrence of Saline Water. Hart and Newcomb (1965) discussed three plausible explanations for the occurrence of the saline water within the basalt aquifers. The first process (Figure 34a) involves the bending and flexing of the basalt layers during folding. The bending and flexing cause tension cracks to develop which allow the saline water to travel upward into the basalt aquifers. The second process (Figure 34b) results from the positioning of a basalt interflow zone adjacent to the marine sediments by faulting. Groundwater from the marine sediments will flow into the interflow zone due to diffusion. The third method (Figure 34c) involves the onlapping of the basalt flow onto a paleohigh composed of marine sediments. This onlapping creates a permeable boundary between the CRB and the marine sediments allowing groundwater easier passage from the marine sediments into the basalt aquifers.

Figure 33. Location of saline wells within the Parrett Mountain area.

Figure 34. Three possible processes in which saline water can occur in basalt aquifers. a) Tensional cracks developed due to bending of the basalt, b) fault acting as a flow path into a now exposed flowtop, and c) exposed flowtops along a paleohigh composed of marine sediment. paleohigh composed of marine sediments.

The exact process governing the presence of the saline water remains unknown but it does appear that hypothesis two (Figure 34b) and three (Figure 34c) occur. The saline well near the Willamette River and the one at the junction of the North and South Forks of Corral Creek both occur near or in fault zones. Possibly the presence of saline water is due to fluid flow along the faults. The saline water in the third well, located in Section 18 T3S R1W by Heater Road, is probably caused by a saline water flow from a paleohigh into an exposed basalt interflow zone. This is not unexpected given the variable paleotopography observed in the Wapshilla Ridge.

QUATERNARY GEOLOGY

GLACIAL FLOOD EFFECTS

The flood waters from glacial Lake Missoula inundated both the Tualatin and Willamette valleys forming Lake Allison (Allen and others, 1985). These flood waters eroded the soil and bedrock and then redeposited it as sediment. This deposited material is a combination of clay, silt, sand, cobbles, and boulders of mostly basaltic, granitic, and quartzitic composition. Basaltic boulders deposited within the study area's boundaries are typically from the Ginkgo, Sentinel Bluffs, and Winter Water basalt flows, though some boulders of Umtanum and Ortley-Grouse Creek (undifferentiated) units are also present (Figure 35).

Erratics, cobbles and boulders of granitic or quartzitic composition, were used to define the maximum elevation affected by the flood waters. Previous workers (e.g. Allen, 1986) have identified the maximum elevation in the Willamette Valley as 400 feet (122 m). This elevation was based on erratic boulder locations and erosional features. Within the confines of this study, all the erratics were found near the 300 to 310 foot (91.4 to 94.5 m) elevation on Parrett Mountain and around 320 to 330 feet (97.5 to 100.6 m) elevation in the Tonquin area (Figures 36

Figure 35. Flood scour channel cut into the upper flow of the Sentinel Bluffs. Boulders are basalt typically of Ginkgo, Sentinel Bluffs, and Winter Water basalt lithology.

and 37). The locations of the erratics were used to delineate the maximum extent of flood water deposits on the flanks of Parrett Mountain and in the Tonquin area.

Tonquin Scablands

The Tonquin area was severely affected by the glacial flood waters. Erosional features similar to those seen in eastern Washington have allowed this area to be named the Tonquin Scablands (Allen, 1986). The Tonquin scablands area was one of the three main water escape zones where flood waters that filled the Tualatin valley emptied back into the Willamette Valley.

The basalt exposed belongs to the youngest flow of the Sentinel Bluffs basalt, though the Ginkgo flow crops out in a few locations (Plate 2). The basalt has an apparent dip of 1 to 2 degrees to the north northeast. Erosion, by the Missoula floods, appears to have concentrated on the flow boundaries. The few outcrops of the Ginkgo flow as opposed to the upper Sentinel Bluffs basalt flow suggest that the Vantage Horizon was the most easily eroded zone in this area.

Alluvial deposits range from less than one to over three hundred feet (92 m) in thickness. A general thickness of the alluvial material mantling the basalt, including recent alluvium, flood deposits, and Troutdale Formation, can be obtained from Schlicker and Deacon (1967). Within the Tonquin region, the flood deposits were mapped to

Figure 36. Position of erratics found within the study boundaries.

Figure 37. Twenty erratics found within one hundred square feet (Black dot #1 in Figure 36).

the maximum elevation of 340 feet (104 m), due to erratic and basalt flood material positions. Subsequent erosion after the Missoula Floods has revealed portions of the basalt bedrock. The approximated alluvium/basalt boundary is based on the soil surveys for Washington and Clackamas Counties unless otherwise known.

Parrett Mountain

The Helvetia Formation. Two lobes of the Helvetia Formation have been mapped on the northeastern fringe of Parrett Mountain near the city of Sherwood (Figure 3). Several questions have arisen on the status and origin of the Helvetia Formation occurring within the study boundaries. Twenty or more erratics (Figure 36 and 37) were discovered adjacent to the designated Helvetia Formation. The erratics were found at roughly 310 to 320 feet (94.5 to 97.5 m) in elevation. This places the lower lobe of the Helvetia Formation below the maximum elevation affected by the Missoula Floods. Therefore, the material designated as belonging to the Helvetia Formation should actually be classified as Missoula flood deposits over a lateritic soil on the basalt. In the upper Helvetia Formation lobe highly weathered basalt was recently excavated from newly constructed foundations. Examination of the new excavations and of the surface revealed a lateritic soil with highly-to-slightly weathered, in-place basalt cobbles only half a foot (.15 m) below the surface. The Helvetia Formation, as

mapped by Schlicker and Deacon (1967), for this area, is actually flood deposits, given its color by the residual soils on the Columbia River basalt.

Loess. Wind blown silt deposits, loess, does not exist or is very thinly deposited on the flanks of Parrett Mountain. If thinly deposited, the loess is more than likely masked by the lateritic coloring developed on the Columbia River basalt. This observation corresponds with Lentz's (1977) regional mapping of these deposits.

LANDSLIDES

Several areas showing landslide features have been mapped on Parrett Mountain (Figure 38). Schlicker and Deacon (1967) mapped one landslide on the northeastern portion of Section 4, T3S R1W, (Figure 39). The landslide occurs in the flood deposits.

Two landslides were mapped on the steeply dipping northwestern face of Parrett Mountain. These landslides were also mentioned by Schlicker and Deacon (1967) but not noted on their geologic hazards map. Topographic analysis was used to determine landslide features. These questionable sites were then field checked for landslide features, such as pressure ridges, seeps, sag ponds, and landslide scarps. Designation of a landslide does not evaluate the stability of the designated area under present conditions.

Figure 38. Location of designated landslide areas.

Figure 39. Location of a landslide (T3S R1W Sect. 4) mapped by Schlicker and Deacon (1967). The inset shows the location of the figure within the study area.

One of two landslides is located in the central portion of Section 14 T3S R2W (Figure 40; Plate 2) and covers an estimated 320 acres. Field evidence used to evaluate this landslide is the numerous small earthflows and slump features present along Haugen Road. Second, a hummocky topography was noted and verified in the field. Downhole caliper logs taken from the Rolfs #1 well shows the upper 200 feet (61 m) to be highly fractured (Marvin Beeson, 1992, personal commun.) suggesting that the landslide might be deep seated.

The second landslide complex (Figure 41; Plate 2) was found in the northern portion of Section 7 T3S R1W and continues into the northeastern portion of Section 12 T3S R2W. This landslide covers an estimated 640 acres and appears to be a combination of several slump and translational slides (Scott Burns, 1993, personal commun.) with an average depth of roughly 30 feet (9.1 m) . The timing relationship of the landslides is unknown, though it is the belief of Scott Burns (1993, personal commun.) that the landslides occurred at various intervals of time and not as one large failure. Although the entire area has been designated as a landslide, the region is actually characterized by a series of landslides separated by stable land ridges. The larger landslides have smaller failures superimposed on them. Designation of this area as a landslide complex by no means refers to the stability of the

Figure 40. Location of one landslide (T3S R2W Sect. 14) on the northwestern slope of Parrett Mountain. The inset shows the location of the figure within the study area.

Figure 41. Location of the other landslide (T3S R1W Sect. 7 and 12) on the northwestern slope of Parrett Mountain. The inset shows the location of the figure within the study area.

area under present conditions.

Field mapping along the south facing wall of the South Fork of Corral Creek showed the existence of several small earth slumps. Several factors contributing to these small failures are 1) steep slopes, 2) daylighting of a failure plane, the basalt/soil boundary, and 3) groundwater seepage. All three of the above factors were observed in the field. Areas with similar geologic conditions are present and should be looked at carefully in order to discern stability.

FUTURE WORK

GEOLOGY

Stratigraphy

First, the overall basalt stratigraphy is known for most of the study area, however several large sections in the south and central portions of Parrett Mountain and the Tonquin area remained essentially unknown. Therefore basalt chips should be collected for any new water wells constructed in these areas. Second, several more XRF analyses should be conducted in hopes to separate the Ortley and Grouse Creek basalt units from the Ortley-Grouse Creek basalt unit. Also further XRF analyses would help further differentiate the geochemical compositions of the Umtanum and Winter Water basalt flows.

Structure

The location of any of the fault planes, at depth, would help in the understanding of the tectonic development of the area as well as help in the understanding of the local hydrogeology. Only three methods can truly help in identifying the fault planes. Being on site during the drilling of a water well is the best method for obtaining fault plane locations. This method allows an individual to note changes in the drilling rate and in the amount of

basalt chips collected to the depth of the drill, thereby identifying potential fault planes. Second, interviews with the drillers can yield some information but this method is subjective to their interpretations. The last method that can help is hand analyzing the drilling chips. The reliability of this method for recognizing fault zones is still in question but should not be ruled out.

Landslides

No work was done on the landslides located within this study area. Any data on these landslides will prove useful. Several questions that should be answered are the activity of the landslides, when did the landslide complexes occur, what is the failure plane, and depth of the colluvium/alluvium comprising the landslide complexes.

HYDROGEOLOGY

Basalt Aquifers

The main question that needs to be addressed is whether the Columbia River basalt comprising Parrett Mountain is acting as one or more aquifers in non-faulted areas. Several methods should be employed to study this question. First several pump tests could be conducted within the centers of known non-faulted basalt blocks. Second, piezometers could be placed within each of the interflow zones to identify the heads of the individual aquifers. Third, and the most important, a geochemical analysis of the

groundwater systems should be conducted. Sampling should be conducted using wells that are known to draw water from only one interflow zone. The groundwater chemistry from one interflow zone should be compared analytically to other interflow zones. Samples should also be collected from wells known to penetrate several interflow zones.

Another important area of study is the alluvial aquifers. The role of these aquifers to the basalt aquifers is still unknown. Do these aquifers act as recharge sources to the basalt aquifers should be answered. Special emphasis should be taken with the landslides on the northwestern slope of Parrett Mountain. Their role in the hydrogeology of the mountain needs to be understood.

CONCLUSION AND SUMMARY

GEOLOGY

Stratigraphy

Eleven basalt flows of the Columbia River Basalt Group comprise Parrett Mountain. These basalt flows were identified as, from oldest to youngest: the Wapshilla Ridge, the undifferentiated Ortley-Grouse Creek, the Umtanum, the Winter Water, and the Sentinel Bluffs basalt units of the Grande Ronde Basalt along with one Ginkgo flow of the Frenchman Springs Member of the Wanapum Basalt. The maximum basalt thickness of 900 feet (274 m) was measured at Rex Hill.

The Wapshilla Ridge basalt unit is the thickest basalt unit present on Parrett Mountain. This unit is exposed on the western, northwestern, and a few southern slopes of Parrett Mountain. The unit is laterally extensive throughout Parrett Mountain, but terminates near the Fernwood Road exposure. This basalt unit appears to have lobated into the paleo-Willamette Valley during emplacement. As a result the flow's thickness varies to a maximum thickness of 350 feet (113 m) due to a highly variable lower and upper boundary.

The Ortley-Grouse Creek basalt unit is a combination of

the Ortley and Grouse Creek basalt units mapped to the north. This combination was necessary due to an inability in separating the two units based on geochemical or lithologic signatures. The unit is comprised of three laterally extensive basalt flows with their individual thicknesses highly variable.

The Umtanum basalt unit occurs as two thick basalt flows extending over the Parrett Mountain area. A third Umtanum flow was observed on the fringes of Parrett Mountain, beneath the city of Sherwood and exposed in a rock quarry at La Butte. The thickness of the entire unit appears to be rather constant; however, this unit thins towards the southeast.

Both the Winter Water and Sentinel Bluffs basalt units are represented by two laterally extensive basalt flows. The Winter Water basalt unit is the thinnest of all the basalt units comprising Parrett Mountain and decreases in thickness towards the southeast.

The Sentinel Bluffs basalt units changes across the entire area. The upper basalt flow appears to have undergone some erosion before the emplacement of the Ginkgo basalt flow. Field observations show most of the basalt exposed in the Tonquin area to belong to the Sentinel Bluffs basalt unit.

The Ginkgo flow is observed in only a few locations on Parrett Mountain and the Tonquin area. Only one flow has

been observed within the study area and its thickness varies from 0 to 90 feet (0 to 30 m). This basalt flow appears to have been slightly channelled in the initial stages of emplacement.

Structure

Tectonic deformation, based on basalt flow thickness variations and cross cutting relationships, occurred during and after the emplacement of the basalt flows. Based on the termination of the Wapshilla Ridge basalt flow in the Newberg Valley and the missing Umtanum basalt flow on Parrett Mountain the extent of the deformation appears to have occurred through most if not the entire study area.

Cross-cutting relationships allow for the relative age dating of the fault trends. The north/south (and possibly the east/west) trending faults are the youngest in terms of relative age. This is based on the cross-cutting of the northeast and northwest trending faults, and the lack of surficial weathering along the fault traces. Next are the northeast-trending faults. Again this is inferred from the cross-cutting relationships with the northwest-trending faults. This leaves the northwest-trending faults as the oldest. Absolute age dating of these faults has proved unsuccessful.

The faults on Parrett Mountain are more than likely an expression of activity on the Gales Creek-Mount Angel structural zone. The northeast and northwest trending

faults probably were active during and after the emplacement of the basalt in a roughly north/south and east/west trend. Subsequent rotation of northwestern Oregon has rotated these active faults into the observed northeast and northwest trending faults. Further activity along the Gales Creek-Mount Angel Structural Zone has resulted in the development of the newer north/south and east/west trending faults.

Quaternary Processes

Several key points have been addressed within this section. First, based on erratic locations, the minimum height of the Missoula Flood water within the Tonquin area should be raised to an elevation of 330 to 335 feet (100 to 102 m). Second, the material listed as the Helvetia Formation should be redesignated as Willamette Silt.

GROUNDWATER

The groundwater systems that have developed within the Parrett Mountain area appear to be controlled by the local geology. Each fault block appears to have a separate groundwater system. Faults appear to act as recharge paths for infiltrating groundwater as well as barriers to lateral groundwater migration.

Every basalt flow boundary was found to yield groundwater to water wells and springs throughout the study area. Thickness variations in the interflow zones as well as the presence of interflow sediments affect the local

transmissivity and storativity factors for the individual basalt flows. Variations in these coefficients can be noted from the large variations in groundwater yield from the same basalt flows.

The primary aquifers used by the residents of Parrett Mountain are the following interflow zones: Umtanum/Ortley-Grouse Creek and the Ortley-Grouse Creek/Wapshilla Ridge, along with the Wapshilla Ridge basalt aquifer. Each aquifer is separated from one another resulting in distinct head values, though some vertical communication occurs along fault planes, due to commingling, and possibly through a basalt flows's interior.

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APPENDIX A

LITHOLOGIC AND STRATIGRAPHIC DATA

Thacker Well

Figure 41. Stratigraphic column of the Thacker well.

Severine Well

Figure 42.. Stratigraphic column of the Severine well.

Figure 43. Stratigraphic column of the Manke #1 well.

Figure 44. Stratigraphic column of the Adams well.

Figure 45. Stratigraphic column of the Kurisa well.

TABLE XI

STRATIGRAPHIC DIVISIONS BASED ON BASALT DRILLING CHIPS

2S 1W			elev	Gk	SB	WW	Umt	OGC	WpR
32cd	Sherwood #5	W	1717	190		?	100-480		?
32dc	Crawford	W	1371	320		82-95	95-178		
3S 1W				Gk	SB	WW	Umt	OGC	WpR
4cd	Wheeler	C	1774	2260			55-75	75-165	
4cd	Wright	C	1775	2260				90-185	
6bd	Hamness			190	130-150	150-200			
6db	Hansen	W	1360	427	0-90	90-170	170-295	295-340	
7ba	Manke #2	W	1363	572					
7bb	Manke #3	W	1366	506		0-130	130-230	230-400	400-536
7bb	Manke #4	W	1364	659				250-310	410-630
7ba	Manke #6	W	1362	659					420-560
7cb	Whipple	W	1359	1020		150-210	210-320	320-460	460-630
7da	Puderbaugh	W	1256	790				530-570	570-665
8bb	Robinson	C	1776	6650	0-80	80-180	180-280	280-370	
8bd	Loften	C	1775	3480	0-30	30-130	130-210	210-290	
			(repeat::				290-360		
8ac	Hoffman	C	1775	0570	0-70	70-160	160-250	210-290	
			(repeat::			250-290	290-380	380-490	
8cb	Kiefel	C	1775	6650	0-60	60-120	120-290	290-330	
9bc	Metcalf	C	1775	5480	0-35	35-160	160-280	280-385	385-465
10bb	Carraher				0-70	70-180			
15bb	Dix	C	790	230	123-16	190-200			

TABLE XI

STRATIGRAPHIC DIVISIONS BASED ON BASALT DRILLING CHIPS
CONTINUED

29bb	Brentano		350		50-70	50-70	70-140		
17ba	Minard	C 17743	575					460-470	
29bb	Blondeau		320			0-130	130-250	250-400	
3S 2W				Gk	SB	WW	Umt	OGC	WpR
	Cedar Creek Well					70-140	140-230	230-430	430-500
12db	Manke #5	W 1365	680			0-120	120-250	250-350	350-640
14	Haraden	Y1665					0-120		
14cc	Rolfs	Y 885	835			0-110	110-200	200-310	310-430
15ac	Pelling	Y 1678	520			0-110	110-230	230-380	
22ad	Kurisa	Y 1675	520						0-180
		(repeat:.					180-215		
22ad	Conway		530						0-190
22ac	Tucker		310				0-10	10-170	

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Flowtops		Lith. Ident.	Strat.			bslt units penetrated					F	M
					Top	Bottom		Al	G	SB	WW	UMT	O-GC	WpR			
2/1 32bda	190	W1823	Sherwood #3	339										-1/2	X		
2/1 32cbc	190	W717	Sherwood #5	800	83	189				?	X	X	X	X	?		
					317	324											
					355	378	Red										
					478	481	Red/gry										
					481	493	Red/gry										
					531	544	Blk/brwn										
					544	551	Red										
					567	583	Red										
T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Flowtops		Lith. Ident.	Strat.			bslt units penetrated					F	M
					Top	Bottom		Al	G	SB	WW	UMT	O-GC	WpR			
3/1 4bdb	270	C7723	Axelson	200	41	44						X	+1/2			X	
					63	67	Red										
					116	123											
					156	164											
					187	194											
3/1 4add	145	C7766	Dorsett	125	106	118				X	X	+1/2?					
3/1 4aca	170	C7704	Erwert	155	142	146				X	X	+1/2?				X	
3/1 4bcd	270	C7760	Ferry *	175								X	X			X	
													X*				
3/1 4bcd	270	C17735	Ferry	180	64	69						X	X	?		X	
3/1 4bcc	295	C7725	Hess	145								X	X			X	
3/1 4bca	285	C18840	Kaplan	150									X	+1/2		X	
3/1 4ddd	240	C7731	Neemish	145								-1/2	X				
3/1 4bdb	275	C7859	Nielsen	180	23	25						X	+1/2			X	
					25	27	Red										
					21	35											
					102	114											
					131	134											
					134	146	Red										

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

						163	172											
						172	178											
3/1	4bca	275	C7722	Phil	205								X	+1/2			X	
3/1	4dab	180	C17819	Sheehan	145					-1/2	X		+1/2				X	
3/1	4dba	250	C7743	Stevens	185								-1/2	+1/2				
T/R	Elev.	Well	Well	Well	Flowtops	Lith.				Strat.	bslt	units	penetrated					
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.			Al	G	SB	WW	UMT	O-GC	WpR	F	M
3/1	5ccb	610	C7822	Bancroft	155	63	118											
					360	142	146					-1/2	X	X	X	B		
						306	342											
3/1	5ada	310	C07842	Basel	122							-1/2	X		+1/2			
3/1	5bac	405	C7799	Cairns	410	95	102	Red										
						382	398											
3/1	5cad	440	C7781	Coe	245								-1/2	X		+1/2		
3/1	5aab	345	C7807	Edy	170	64	72					X	X		+1/2			
						152	164											
3/1	5bdb	405	C18432	Eppich	320	292	314							-1/2	X		+1/2	
3/1	5bdc	370	C7782	Fifield	144									-1/2	+1/2			
3/1	5bca	395	C7824	Garstka	245	106	142							-1/2	X		+1/2	
						226	238											
3/1	5bcd	410	C7829	Garstka	230	104	142							-1/2	X		+1/2	
3/1	5bcd	415	C7828	Garstka	260									-1/2	X		+1/2	
3/1	5cad	440	C7808	Holst	140							-1/2	X	X		+1/2		
3/1	5bcd	445	C7809	Moore	260									-1/2	X		+1/2	
3/1	5bcd	425	C7830	Owens	200	178	192					-1/2	X	X		+1/2		
					324							-1/2	X	X	X			
3/1	5bdb	413	C7840	Pitney	114									-1/2	X		B-	
					230									-1/2	X		X	
3/1	5ccc	610	C7828	Radke	245	194	214					-1/2	X	X	B			
					585							-1/2	X	X	X	X		
3/1	5ccb	595	C7817	Richards	600							X	X	X	X	X		
3/1	5aba	390		Schmeer														
3/1	5caa	410	C7864	Skeeters	315							B-	X	X	X	+1/2		
				#2														

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/1 5caa	425	C12324	Skeeters #2	323					B-	X	X	+1/2					
3/1 5daa	310	C7841	Smith	165							-1/2 X		?				
3/1 5cba	440	C7797	Vanlac	320							-1/2 X		+1/2				
3/1 5	310	C7802	Voss	315	292	307					-1/2 X	X	B				
3/1 5aba	390	C7889	Wirfs-Bro.	167	153	167	Red		-B	X	X	B					
3/1 5ccd	610	C7887	Woodcock	570	182	243			-1/2 X	X	X	X	+1/2				
					317	322											
					348	391											
					484	515											
					556	562											
3/1 5	450		Wozniak	90	25	38	S.S.		-B	X		B					
					56	91											
					446	458											
3/1 5	450		Wozniak	462	82	90	Red		-B	X	X	X					
					118	135	S.S.										
T/R	Elev.	Well	Well	Well	Flowtops	Lith.			Strat.	bslt	units	penetrated					
(Sect.)	I.D.	Owner	Depth	Top	Bottom	Ident.		Al	G	SB	WW	UMT	O-GC	WpR	F	M	
3/1 6dbd	427	W1360	Hansen	345													
3/1 6dbc	340	W1894	Mueller	230							X	X	B				
3/1 6bbd	205	W1855	Sadler	165													
3/1 6abb	210	W864	Scott	200													
3/1 6dbd	340	W1904	Troudt	230	206	224				-B	X	X	B				
				290						-B	X	X	1/2				
3/1 6bbd	190	W1881	Ulrich	110													
T/R	Elev.	Well	Well	Well	Flowtops	Lith.			Strat.	bslt	units	penetrated					
(Sect.)	I.D.	Owner	Depth	Top	Bottom	Ident.		Al	G	SB	WW	UMT	O-GC	WpR	F	M	
3/1 7dbc	820	W1929	Auel	485						X	X	X	X	B			
3/1 7dbb	880	W1942	Bach	200						X	X	X	B				
3/1 7dab	780	W1930	Barron #1	110						B-	X	X	B				
3/1 7dab	750	W1939	Barron #2	492						B-	X	X	X	B			
3/1 7adb	805	W1920	Bennett	410						X	X	X	1/2				
3/1 7aad	775	W3458	Bitzenbur	712	500	510				-B	X	X	X	X			
					600	620											

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/1 7aad	730	W868	Briggs	715				X	X	X	X	
3/1 7cdd	825	W1806	Bulloch	430				-1/2	X	X	X	+1/2
3/1 7aaa	720	W3150	Burton	260				X	X	X	+1/2	X
3/1 7adc	825	W1923	Butler	605				X	X	X	X	B
3/1 7dac	735	W1947	Engels	530			B-	X	X	X	X	+1/2
3/1 7aaa	710	W1945	Hix	685				X	X	X	X	X
3/1 7dac	755	W1943	Hoftiezer	570				X	X	X	X	+1/2
3/1 7cab	962	W1807	Husband	710				-1/2	X	X	X	X
3/1 7daa	700	W1158	Imbrie	505			B-	X	X	X	X	+1/2
3/1 7aad	760	W1949	Johnson	805				X	X	X	X	X
3/1 7cab	985	W1937	Kimble	640	460	475	-B	X	X	X	X	+1/2 X
					600	640						
3/1 7dda	685		Landis				X	X	X	X	X	+1/2
3/1 7bac	708	W1361	Manke #1	760				X	X	X	X	X
3/1 7bad	572	W1363	Manke #2	622					X	X	X	X
3/1 7bba	506	W1366	Manke #3	573	135	185			X	X	X	X
					421	424						
					454	485						
3/1 7bbc	659	W1364	Manke #4	650	498	591			X	X	X	X
					597	625						
3/1 7bac	659	W1362	Manke #6	562				X	X	X	X	X
3/1 7cdc	880	W1915	Miller	436			-1/2	X	X	X	X	B
3/1 7cbd	1010	W865	Montague	705			-1/2	X	X	X	X	X
3/1 7cbd	1020	W1948	Mozenico	735								
3/1 7aac	780	W1946	Nixon	515			B-	X	X	X	X	B
3/1 7cdb	905	W1926	Paulson	615			-1/2	X	X	X	X	XX
3/1 7daa	790	W1938	Puderbaug	531			-1/2	X	X	X	X	1/2
				665			-1/2	X	X	X	X	1/2
3/1 7aaa	710	W1913	Rieger	520				1/2	X	X	X	X
3/1 7ddb	740	W1941	Roberg	480	455	480	X	X	X	X	X	B
3/1 7ccd	910	W1912	Smith	475			X	X	X	X	1/2	
3/1 7adc	805	W1927	Southwell	615	55	60	-1/2	X	X	X	X	+1/2
					60	67						
					494	496						

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

				496	506										
3/1 7dca	775	W1906	Theus	560					X	X	X	X	X	B	
3/1 7dab	800	W1921	Wahl	565					-1	X	X	X	X	B	
3/1 7dad	710	W1933	Walker	460	334	342			-1/2	X	X	X	X	B	
					461	452									
3/1 7aad	795	W1924	Weidenweb	445	80	90	Red		-1/2	X	X	X	X	B	
3/1 7dad	725	W1916	Wentz	700					-1/2	X	X	X	X		
3/1 7cbc	1020	W1359	Whipple	630											
T/R	Elev.	Well	Well	Well	Flowtops	Lith.			Strat.	bslt	units	penetrated			
(Sect.)	I.D.	Owner	Depth	Top	Bottom	Ident.			Al	G	SB	WW	UMT	O-GC	WpR
3/1 8bbc	665	C7904	Allen	282							-1/2	X	X	+1/2	
3/1 8dba	560	C7875	Baker	305							X	X	X	+1/2	
3/1 8bad	575	C18431	Barnett	200					B-	X	X	X	B		
3/1 8dda	460	C7892	Beach	333	95	98	Red		-B	X	X	X	X	+1/2	
3/1 8abd	495	C7901	Crechaft	470	146	152	Red		-B	X	X	X	X	+1/2	X
					278	288									
3/1 8dba	560	C7879	Cowgill	405							X	X	X	+1/2	X
3/1 8bca	640	C7893	Day	315							-1/2	X	X	X	+1/2
3/1 8aba	470	C6004	Feves	415								X	X	X	+1/2
3/1 8cdb	590	C8243	Gifford	330	99	106	Red		-B	X	X	X	B		
					238	257	Red/Brwn								
					302	307									
3/1 8daa	505	C7888	Gilmore	405							X	X	X	X	B
				445							X	X	X	X	1/2
3/1 8dba	510	C7928	Gross	405					-B	X	X	X	X	+1/2	X
				436					-B	X	X	X	X	1/2	X
3/1 8abb	465	C7900	Hart	365							-1/2	X	X	+1/2	X
3/1 8bda	555	C7932	Hoffman	155							-1/2	+1/2			
3/1 8bda	560	C18118	Kelly	200					X	X	B				X
3/1 8cbb	660	C7931	Kidd	470	68	85			-1/2	X	X	X	X	B	
					334	342									
					451	457	Red								
					457	470									
3/1 8cbd	636	C17756?	Kiefel	330											

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/1 8bbc	685	C11961	Langston	568						X	X	X	X	+1/2					
3/1 8bac	595	C7885	Langston	540						-B	X	X	X	X					
3/1 8bac	595	C7921	Langston	155						-B	X	B							
3/1 8cbc	695	C9092	Mooers	192						X	X	B							
				470						X	X	X	X	B					
3/1 8cdc	620	C7871	Philpot	305						X	X	X	X	B					
3/1 8abc	565	C7918	Rogers	455	150	168				-1/2	X	X	X	+1/2				X	
					406	448													
3/1 8dad	493	C7903	Rose	375						-B	X	X	X	X	B				
3/1 8abd	525	C7927	Smeed	210						X	X	X	B						
				358						X	X	X	X/F					X	
3/1 8abc	525	C7911	Smith	470						-B	X	X	X	X	+1/2				
3/1 8ccb	675	C7874	Sumner	595						X	X	X	X	X	+1/2				
3/1 8	495		Swearingt.	423	392	419				-B	X	X	X	X	+1/2				
3/1 8daa	505	C7883	Theim	465						X	X	X	X	X	+1/2				
3/1 8dbb	565		Thomsen	200						X	X	X	+1/2						
3/1 8aca	540	C7895	Tidball	508	180	186	Red			X	X	X	X	X	+1/2				
3/1 8ccd	620	C7873	Ugoretz	225	97	105	Red			X	X	X	+1/2						
3/1 8bbd	650	C7907	Williams	340	97	106	Red			X	X	X	+1/2						
				450	272	290				X	X	X	X	B					
3/1 8bba	620	C7908	Williams	260	172	180				-1/2	X	X	X	+1/2					
					208	214													
3/1 8bbd	655	C7902	Williams	436						-1/2	X	X	X	1/2					
3/1 8bba	620	C14427	Williams	590						X	X	X	X	X					
T/R	Elev.	Well	Well	Well	Flowtops	Lith.				Strat. bslt units penetrated									
(Sect.)	I.D.	Owner	Depth	Top	Bottom	Ident.				Al	G	SB	WW	UMT	O-GC	WpR	F	M	
3/1 9dbc	415	C7965	Bacon	335								X	X	X	B				
3/1 9aab	290	C9128	Birkeland	140								X	X	X	+1/2				
3/1 9abd	360	C7944	Brown	132								-1/2	+1/2						
3/1 9dac	330	C7960	Burda	230	24	54	S.S.					-1/2	X	B					
				315	122	130	Red					-1/2	X	X	+1/2				
					198	212													
					302	309													
3/1 9bad	400	C7968	Goldbeck	200								-1/2	X	X	+1/2				

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/1 9dcc	380	C7943	Hansen	445	118	134		-1/2	X	X	X	+1/2				
					302	324										
3/1 9dac	330	C7941	Lundy	340	177	192		-1/2	X	X		+1/2				
					314	332										
3/1 9abc	405	C7952	Martinson	405				X	X	X	X	+1/2				
3/1 9cad	465	C7949	Meyer	480				X	X	X	X	+1/2				
3/1 9cac	465	C7958	Meyer	425				X	X	X	X	B				
3/1 9cda	425	C7948	Meyer	425				X	X	X	X	B				
3/1 9baa	375	C7946	Miller	235				B-	X	X	B					
3/1 9dbc	395	C7951	Reitz	245				X	X		+1/2					
3/1 9adc	385	C7966	Risberg	335	314	325		X	X	X	B					
3/1 9cbc	470	C7959	Smith	335	305	324		-B	X	X	X	+1/2				
3/1 9dba	376	C1435	Stevenson	405				-1/2	X	X	X	B				
3/1 9acc	455	C7903	Taylor	435	330	352		X	X	X	X	B				
		C7963		540	412	418		X	X	X	X	+1/2				
					506	524										
3/1 9bcd	485	C7957	Ward	395	204	255		X	X	X	X	B				
					330	372										
					372	388										
T/R	Elev.	Well	Well	Well	Flowtops		Lith.	Strat. bslt units penetrated								
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M
3/1 10cbc	285	C8016	Amato	170	142	150				-1/2	X	B				
					156	162										
3/1 10dcc	185	C8014	Bischof	230	93	102				----	UA	----				
					148	157										
					157	166	Red									
					166	214										
3/1 10caa	185	C18836	ChickaDee	182						----	UA	----				
				226												
3/1 10cdc	235	C8012	Hough	212	60	77	S.S.			----	UA	----				
					157	159	Red									
					169	171	Red									
					200	211										
3/1 10cab	195	C7989	Jacobson	200						-1/2	X				?	

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/1 10cda	210	C8002	Karvia	266						X	+1/2								
3/1 10cad	180	C7999	McKay	120						----	UA	----							
3/1 10bdd	170	C8007	Miller	110						----	UA	----							
3/1 10			Pamovskis	244	138	142				x	+1/2								
					153	161													
					161	164													
					192	199													
					199	201													
3/1 10cac	250	C7987	Potts	205	56	69	S.S.			X	B								
					136	140													
					144	148													
3/1 10adb	150		Rockwell							----	UA	----							
3/1 10ccb	255	C8017	Salazer	155							X	B							
3/1 10ccd	250	C8009	Sorokovsk	115							-1/2	B							
		C7979		244							-1/2	X	1/2						
3/1 10cdc	235	C8022	Thompson	205						----	UA	----							
3/1 10cbd	255	C7997	Wright	220						X	B								
T/R	Elev.	Well	Well	Well	Flowtops	Lith.				Strat.	bslt	units	penetrated						
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M			
3/1 15cac	215	C8184	Dammasch	920		240	S/Bslt B.	?X	X	X	X	X	X	X?					
			#1		481	500													
					573	598	Soft intbd												
					640	660	Soft bslt												
					674	677	Porous												
					816	828	Red												
					871	875	Soft intbd												
3/1 15ccb	193	C8189	Gibson	210	190	200	Decp. Bslt			----	UA	----							
3/1 15bab	240	C8162	Rumpf	180						----	UA	----							
3/1 15bab	230	C8179	Tabor	245						----	UA	----							
T/R	Elev.	Well	Well	Well	Flowtops	Lith.				Strat.	bslt	units	penetrated						
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M			
3/1 16aca	320	C8240	Alexander	290	226	244	Red	X	X	X	X	X	+1/2						
					262	274													
3/1 16aca	295	C8222	Bolstad	205						X	X	+1/2							

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/1 16dcc	180		Calkins							----	UA	----								
3/1 16aaa	250	C8172	Cleek	150							X		B							
3/1 16ddd	185	C8231	Dammach #2	1000							----	UA	----							
3/1 16bad	315	C8229 C189	Dugan	173 295	86 123 280	90 128 295	Soft Soft			-1/2 X		+1/2								
										-1/2 X		X	X		B					
3/1 16cda	150	C8230	Garrett	105									-1/2 B							X
3/1 16caa	235		Jones #1	113							X		1/2							
3/1 16caa	235	C18057	Jones #2	198	147	171	Soft brwn			X	X	B								
3/1 16dbb	220	C8209	Mason	300			250	S/BSlt B.		X	X	X			+1/2					
					260	270	Red													
3/1 16dba	210	C8214	Mcgee	245	154 230	176 238				X	X	X		B						
T/R	Elev.	Well	Well	Well	Flowtops	Lith.				Strat.	bslt	units	penetrated							
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.			Al G	SB	WW	UMT	O-GC	WpR	F	M			
3/1 17aac	350	C8283	Adams #1	285								X	X	B						
3/1 17aac	280	C17780	Adams #2	184								X	X	B						
3/1 17bad	530	C8253	Arkless	505						X	X	X	X	X	X					
3/1 17bbd	560	C8297	Barrows	440							X	X	X	X	1/2					
3/1 17bba	610	C8298	Benson	545						X	X	X	X	X	1/2					
3/1 17bbd	565	C8269	Bethune	525						X	X	X	X	X	+1/2					
3/1 17bcd	510	C8303	Biles	380	102	105	Red			-B	X	X	X	X	B					
3/1 17ddc	200	C17781	Bisenius	123						-1/2 X		1/2								
3/1 17aca	455	C18317	Cogger	140 240 380	282 352	306 374				X	X	X	X	+1/2						
3/1 17cab	400	C8270	Fullmer	305							-1/2 X	X	1/2							
3/1 17cdc	170	C8402	Handy	95											X					
3/1 17aaa	335	C8282	Hill	268	75 209	121 250	Porous				-1/2 X	X	X	B						X
3/1 17add	265		Langer								----	UA	----							
3/1 17baa	570	C8280	Leith	405						X	X	X	X	+1/2						
3/1 17cac	280	C1073	Lewis	216	0	30	S.S.					X	X	B						

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/1 17aad	250	C1486	Marshall	163	30	S/Bslt B.												
					195	205	Fract. Bslt											
					101	105	Gry/red								X	X	B	
					105	118												
					118	123	Blk/red											
3/1 17dcc	235	C8301	Miller	175							-1/2	X	B					
3/1 17bad	575	C17743	Minard	495					X	X	X	X	X		+1/2			
3/1 17adc	385	C8310	Numrich	152	63	75	Red/brwn		-B	X	X		+1/2					
3/1 17adc	365	C17722	Numrich	168	56	60	Red		-B	X	X		+1/2					
					92	107	Fract.											
3/1 17dcb	310	C8255	Pascoe	240	76	90					-B	X	B					
					122	136												
					204	226												
3/1 17aaa	295	C8256	Pierson	285	122	125	Red				-B	X	X		+1/2			
3/1 17acd	375	C8252	Rankin	240	35	38	Red Cinder	X	X	X	X		+1/2					
3/1 17abb	565	C9345	Rogowicz	395				X	X	X	X		X		+1/2			
3/1 17ddb	195	C8260	Runnels	110	84	98			-B	X	X		+1/2					
					98	103	Red											
3/1 17ddb	210	C8262	Stolley	145					B-	X	X		+1/2					
3/1 17bdb	485	C8289	Zurstadt	470	264	278			X	X	X	X	X		+1/2			
					428	442												
3/1 17	485	C8287	Zurstadt*	275	136	142			X	X	X	X	B					
					243	268												
T/R	Elev.	Well	Well	Well	Flowtops		Lith.	Strat. bslt								units penetrated		
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M		
3/1 18aba	600		Beckham	30						-1/2	X	X	X		+1/2			
3/1 18cbd	760	C8333	Cary	365						-1/2	X	X	X	B				
3/1 18aab	655	C8342	Clark	435						X	X	X	X		1/2			
3/1 18cdb	660	C18316	Cox	200						B-	X	X	X		+1/2			
3/1 18cca	750	C8321	Heald	405						B-	X	X	X	X?				
				405														
3/1 18aba	660	C8330	Martingal	260						B-	X	X	X		+1/2			
3/1 18aac	630	C8341	Pompe	453	209	226	S.S.			-B	X	X	X	X		+1/2		
					435	438	Red											

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Flowtops Top Bottom	Lith. Ident.	Strat.	bslt	units penetrated							
3/1 19bdb	610	C8360	Abe	505	425 435	Red	Al G	SB	WW	UMT	O-GC	WpR	F	M		
								-1/2	X	X	X	+1/2				
3/1 19add	320	C8379	Bischof	200	180 195							X	X			
3/1 19bac	670	C8375	Buckner	325				-B	X	X	B					
3/1 19aad	280	C8378	Dixon/Cas	185								X	X			
3/1 19bac		C11944	Heater	385	100 115	Red/brwn		-1/2	X	X	X	+1/2				
					140 145	Red/brwn										
					225 235	Red/brwn/blk										
3/1 19bac	655	C8387	Parkin	545				B-	X	X	X	X				
3/1 19bcb	660	C59	Steen	315	280 306			-B	X	X	B					
T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Flowtops Top Bottom	Lith. Ident.	Strat.	bslt	units penetrated							
3/1 20acc	405	C8409	Bole III	330	14 17	Red	Al G	SB	WW	UMT	O-GC	WpR	F	M		
					198 201				1/2	X	1/2					
					201 205											
					205 213	Red										
					272 282											
					282 289											
3/1 20ccd	430	C8679	Grant	425				1/2	X	X	1/2					
3/1 20	375	C8409	Marriott	330	103 109	Lava			-1/2	X	+1/2					
3/1 20bbb	197	C5340	Wisthoff	151			X			B	1/2					
T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Flowtops Top Bottom	Lith. Ident.	Strat.	bslt	units penetrated							
3/1 21dcb	175	C8411	Farley	384				----	UA	----						
3/1 21aba	150		Hazel	60			X X								X	
3/1 21dbd	180	C8418	Jensen	135			X X	B								
3/1 21bba	290	C8235	Smith	245			X X	X	B							
3/1 21cac	170	C8413	Tippet	204			X X	1/2								
T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Flowtops Top Bottom	Lith. Ident.	Strat.	bslt	units penetrated							
3/1 29bda	210	C8674	Beck	277				-1/2	X	X	B					
3/1 29bbd	395	C8678	Eichman	230	226 234			-1/2	X	X	X	+1/2				

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

				340	299	305	Red										
					315	340											
3/1 29bba	383	C17738	Numrich	283					-1/2 X	X	B						
T/R	Elev.	Well	Well	Well	Flowtops	Lith.			Strat.	bslt	units	penetrated					
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al G	SB	WW	UMT	O-GC	WpR	F	M		
3/1 30aab	505	C8689	Bartell	303					-1/2 X	X	+1/2			X			
3/1 30bcd	620	C8702	Bartell	290					-1/2 X	X	1/2						
3/1 30ada	430	C124	Betts/Bla	425	23	35	Red/brwn		-1/2 X	X	+1/2			X			
3/1 30cac	480	C8705	Bordner	460	44	48	Red		-1/2 X	X	X		+1/2				
					118	126											
					442	454											
3/1 30bda	605	C8695	Bryant	545					X	X	X	X		1/2			
3/1 30	610	C8687	Clock	250	36	37	Red/brwn		-1/2 X	X	B						
					78	82	Red										
3/1 30dbc	480	C8697	Conrad	460	50	65	Red		-1/2 X	X	X		1/2				
					85	90	Red										
					400	410											
					435	460											
3/1 30caa	570	C8704	Crew	585					-1/2 X	X	X		+1/2				
3/1 30acb	580	C8713	Heinz	515	86	92	Red		-B X	X	X		+1/2				
					122	138											
					494	508											
3/1 30bdd	575	C8706	Johnsen	176					-B X	X	B						
				558					-B X	X	X	X		1/2			
3/1 30ddb	300	C8691	Reger	285					-1/2 X	X	+1/2						
3/1 30bbd	405	C18406	Salzman	385		46	S/Bslt B.					X	X	X			
					140	152	Red tint				X*	X*	X*				
					180	183	Red Cinder										
					197	205	Red/blk										
					210	214	Red, vesic.										
					214	230	Red, vesic.										
3/1 30aaa	515	C8690	Schoening	365	21	35	Red		-1/2 X	X	B						
T/R	Elev.	Well	Well	Well	Flowtops	Lith.			Strat.	bslt	units	penetrated					
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al G	SB	WW	UMT	O-GC	WpR	F	M		

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/1 31aba	275	C11991	Conner	500					B-	X	X	X	X					
3/1 31acd	170	C8740	Dawson	167					-1/2	X	+1/2							
3/1 31aad	185	C8748	Ellison	185				X	-1/2	X	+1/2							
3/1 31adb	185	C8744	Ellison	152					-1/2	X	+1/2							
3/1 31ddc	110		Frye	150				X										
3/1 31bbb	485	C8720	Hann	438	29	41	Sandy clay		X	X	X	X	B					
					221	228												
					228	240	Claystone											
					298	305												
3/1 31abb	315	C8751	Johnson	315					-1/2	X	X	+1/2						
3/1 31cbc	105		Mckay	400+				X	-B	X	X	1/2						
3/1 31bad	285	C8746	Neal	300					-1/2	X	X	+1/2						
3/1 31dda	110		Quelette	293				X										
3/1 31bdb	270	C8741	Smith	365	24	26	Red		-B	X	X	X	B					
T/R	Elev.	Well	Well	Well	Flowtops	Lith.			Strat.	bslt	units	penetrated						
(Sect.)	I.D.	Owner	Depth	Top	Bottom	Ident.		Al	G	SB	WW	UMT	O-GC	WpR	F	M		
3/2 1adb	250	W1960	Baron	200	194	192												
3/2 1dba	260	W1979	Roybal	260					X	or	X							
T/R	Elev.	Well	Well	Well	Flowtops	Lith.			Strat.	bslt	units	penetrated						
(Sect.)	I.D.	Owner	Depth	Top	Bottom	Ident.		Al	G	SB	WW	UMT	O-GC	WpR	F	M		
3/2 11ddc	368	W2003	Will. Pac	502											X	X		
T/R	Elev.	Well	Well	Well	Flowtops	Lith.			Strat.	bslt	units	penetrated						
(Sect.)	I.D.	Owner	Depth	Top	Bottom	Ident.		Al	G	SB	WW	UMT	O-GC	WpR	F	M		
3/2 12dcd	1100	W2042	Bach	260					X	X	1/2							
				620					X	X	X	X	X					
3/2 12dcd	1100	W2044	Knudsen	388	230	240	Conglom.		-1/2	X	X	+1/2						
				765	288	417			-1/2	X	X	X	X					
					730	760												
3/2 12dbc	680	W1365	Manke #5	647														
3/2 12acb	445	W2037	Pannier	365	350	358									X	X		
3/2 12dda	1050	W1910	Pentz	380	52	73			-B	X	X	B						
3/2 12ddc	1090	W2033	Willis	540	55	70	Red/brwn		-B	X	X	X	+1/2					
				670	505	510	Red/brwn											
					550	557	Red/brwn											

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/2	12dda	1030	W1931	Vollium	422				-1/2	X	X	X	B	X		
			YAMHILL													
T/R	Elev.	Well	Well	Well	Flowtops	Lith.	Strat.	bslt	units	penetrated						
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M
3/2	13bdd	1145	Y2309	Au	885			X	X	X	X	X	X	X		
3/2	13cba	1245	Y2313	Austin	920	315	340	X	X	X	X	X	X	+1/2		
						379	403									
						510	525									
						550	555									
						600	618									
3/2	13cab	1180	Y2314	Bane	780			X	X	X	X	X	X	+1/2		
3/2	13abb	1100	Y2322	Clay	885	600	625			X	X	X	X	XM		
							880									
							Marine									
3/2	13adb			Duncan	880			X	X	X	X	X	X	X		
3/2	13cab	1180	Y2324	Gordon	924	77	83	X	X	X	X	X	X	X	X	
						157	187									
						187	199									
						249	260									
						343	365									
						473	489									
						508	519									
						519	524									
						539	549									
						563	581									
							901									
							Bslt/Marine									
3/2	13bda	1110	Y2308	Gregg	570			X	X	X	X	X	X	1/2		
3/2	13acc	1075		Hawkin Av	880	92	94			-1/2	X	X	X	X		
						852	866									
3/2	13abd	1085	Y107	Juza	815	590	600			-1/2	X	X	X	+1/2		
3/2	13	980	Y1680	Kimball	700	50	72			B-	X	X	X	X		
		980				250	258									
						258	260									
						465	480									
						600	625									
							White ash									

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

					630	640	Claystone										
3/2	13adc	970	Y114	Lemelson	495					-1/2	X	X	X	B			
3/2	13ccd	1110	Y842	Morris	740	694	723			X	X	X	X	X	1/2		
3/2	13abd	1095	Y1672	Paul	260	124	131			-1/2	X	B					
						131	158										
3/2	13ccd	1090	Y2549	Rilee	500					X	X	X	X	B			
3/2	13aad	1120		Zanetos	745	60	85	Blk/brwn		-1/2	X	X	X	X			
						615	625	Red									
T/R	Elev.	Well	Well	Well	Flowtops	Lith.	Strat.	bslt	units	penetrated							
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M	
3/2	14cdb	1010	Y2350	Alexander	680						-1/2	X	X	X			
3/2	14cdc	965	Y2327	Alexander	625							-1/2	X		+1/2		
3/2	14bcb	515	Y2345	Cramer	445	412	414	Red		-1/2	X	X?					
3/2	14ccb	695		Garvey	293								-1/2		+1/2		
3/2	14cbb	690	Y2336	Lakovics	575												
3/2	14bbb	430	Y2346	Lewis	200						-1/2	X	B				
3/2	14bdd	805	Y761	Poehler	780	160		S/Bslt B.				X	X	X			
						227	228	Clay									
						390	391	Clay									
						485	690										
						740	780										
3/2	14ccb	680	Y0002	Polizzi	422	57		S/Bslt B.				-1/2	X		X		
						106	135										
						154	205	Red									
3/2	14caa	835	Y885	Rolfs	436	193	265	Soft brwn				X	X		X		
						371	373	Slight decom.									
						415	434	Heavily decom									
3/2	14caa	815	Y886	Rolfs	800	440	456	gry shale				X	X		X		
						456	466										
						488	491	White ash									
							531	Bslt/Marine S									
3/2	14ccc	730	Y2331	Stang	310								X		+1/2		
3/2	14dda	1180	Y152	Stukey	884		45	S/Bslt B.	X	X	X	X	X		X		
							874	Bslt/Marine S									

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

3/2 14caa	830	Y2340	Town	482	99	103	Clay					-1/2	X				
3/2 14aad	835	Y680	Walsh	495		488	Marine Sed							XM			
3/2 14bdb	680	Y292	Wissusik	560								-1/2	+1/2				
T/R	Elev.	Well	Well	Well	Flowtops	Lith.	Strat.	bslt	units	penetrated							
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M	
3/2 15dbb	210	Y2381	Hermanson	140									X	1/2			
3/2 15dad	615	Y2412	Mueller	348									-1/2	X			
3/2 15aac	495	Y2379	Schaad	530	506	520				X	X	X	X	1/2			
3/2 15ada	510	Y2378	Schaad	485	448	476							B-	X			
3/2 15dbb	230	Y2371	Scholz	103									-1/2	1/2			
3/2 15dda	600	Y2380	Zauner	255									X	1/2			
T/R	Elev.	Well	Well	Well	Flowtops	Lith.	Strat.	bslt	units	penetrated							
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M	
3/2 22acb	305		Craft	38									-1/2	B			
3/2 22aaa	555	Y2522	Darby	165									-1/2	1/2			
3/2 22aca	330	Y2518	Friedman	97									-1/2	1/2			
			Seitz														
3/2 22aab	505	Y2512	Hendren	245									-B	X			
3/2 22ddc	280	Y2509	Renne	165									X			X	
3/2 22cad	222	Y2501	Siefken	145									-1/2	B			
T/R	Elev.	Well	Well	Well	Flowtops	Lith.	Strat.	bslt	units	penetrated							
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M	
3/2 23dca	665	Y2532	Bauer	403							B-	X	X	X			
3/2 23dcc	830	Y2536	Bauer	586								X	X	X			
3/2 23cac	705	Y2535	Ferris (#	581		436	Bslt/Marine S						X	X			
3/2 23	720		Ferris (#	600		27	S/Bslt B.						X	XM			
					44	53											
					73	81	S.S.										
					93	123											
					181	198											
						465	Bslt/Marine S										
3/2 23bba	760	Y168	Par. Mt.	600								B-	X	X			
			Est. #1														
3/2 23bbb	691	Y167	Par. Mt.	285								-B	X	1/2			

TABLE XII

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED

(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M
3/2 35bbd	265	Y2683	Bryson	586												
T/R	Elev.	Well	Well	Well	Flowtops		Lith.									
(Sect.)		I.D.	Owner	Depth	Top	Bottom	Ident.	Al	G	SB	WW	UMT	O-GC	WpR	F	M
3/2 36acd	445		Acott	147							-1/2 X	+1/2				
3/2 36acd	445	Y2686	Acott	545							-1/2 X	X	X	X		
3/2 36aca	520	Y2697	Brown	350	237	258	Red				-1/2 X	X	X	B		
				450							-1/2 X	X	X	+1/2		
3/2 36acc	515	Y2716	Cole	493							-1/2 X	X	X	+1/2		
3/2 36aba	560	Y2703	Cox	280	175	190	Red/blk				X	X	X	+1/2		
3/2 36aad	490	Y2709	Dickensen	207							-1/2 X	+1/2				
				450							-1/2 X	X	X	+1/2		
3/2 36abb	610	Y2714	Kroger	285							-1/2 X	X	X	B		
3/2 36aca	500	Y2685	McCaffrey	545							-1/2 X	X	X	X		
3/2 36aad	520	Y2708	Sterrett	147							-1/2 X	X	B			
				260							-1/2 X	X	X	B		
3/2 36dab	390	Y2687	Whitaker	505							-1/2 X	X	X	X		
3/2 36abb	625	Y2565	Wise	550							-1/2 X	X	X	X		
3/2 36abb	650	Y2555	Wise	743							-1/2 X	X	X	X		
3/2 36aca	500	Y2706	Wood	155	56	62	Red				-1/2 X	B				
					122	136										
3/2 36acc	520	Y2700	Wood	545	45	50	Red				-1/2 X	X	X	X		
					450	455										

STRATIGRAPHIC DIVISIONS OF WELLS MEASURED BY THE OWRD
CONTINUED181

Guidelines for Table XII

TABLE XIII

DESIGNATION OF BASALT UNIT PENETRATION BY A WATER WELL

- X - full penetration of the unit
- 1/2 - lower portion of the unit is penetrated
- +1/2 - upper portion of the unit is penetrated
- B - upper basalt flow boundary is penetrated
- B - lower basalt flow boundary is penetrated

TABLE XIV

LIST OF INITIALS FOR BASALT UNIT BOUNDARIES

Basalt Flow Boundaries	Basalt Boundary Designation
Ginkgo/Sentinel Bluffs	G/SB
Sentinel Bluffs/Sentinel Bluffs	SB/SB
Sentinel Bluffs/Winter Water	SB/WW
Winter Water/Winter Water	WW/WW
Winter Water/Umtanum	WW/U
Umtanum/Umtanum	U/U
Umtanum/Ortley-Grouse Creek	U/OGC
Ortley-Grouse Creek #1/Ortley-Grouse Creek #2	OGC2
Ortley-Grouse Creek #2/Ortley-Grouse Creek #3	OGC3
Ortley-Grouse Creek/Wapshilla Ridge	OGC/WpR
Within the Wapshilla Ridge	WpR

APPENDIX B

HYDROLOGIC DATA

* hydrologic data provided by Miller and others (1994)

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured by	Water top	Bear. bot.	Corresp Units	Est. gpm	Design. Head	Design. Aquifer	Main
2/1 32bda	190	W1823	Sherwood #3	339		26	01/01/46	driller	137		WpR		133		
						32	03/05/63	OWRD							
						19.5	05/15/63	OWRD							
						20	07/01/63	OWRD							
						22	07/27/63	OWRD							
						27	08/14/63	OWRD							
						38	08/23/63	OWRD							
						40	09/07/63	OWRD							
						26	10/07/63	OWRD							
						25	11/04/63	OWRD							
						38	12/16/63	OWRD							
						31	01/07/64	OWRD							
						22	02/03/64	OWRD							
						26	03/03/64	OWRD							
						24	06/02/64	OWRD							
						24	07/05/64	OWRD							
						26	08/02/64	OWRD							
						28	11/01/64	OWRD							
						23	12/01/64	OWRD							
						23	01/01/65	OWRD							
						24	02/02/65	OWRD							
						22	03/02/65	OWRD							
						19	04/28/65	OWRD							
						24	05/08/65	OWRD							
						26	06/06/65	OWRD							
						26	07/08/65	OWRD							
						40	08/04/65	OWRD							
						38	11/01/65	OWRD							
						25	01/26/66	OWRD							
						25	03/02/66	OWRD							
						25	04/05/66	OWRD							
						22	04/26/66	OWRD							
						25	05/03/66	OWRD							

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA CONTINUED

25	06/01/66	OWRD
25	07/05/66	OWRD
36	07/27/66	OWRD
25	08/03/66	OWRD
25	09/04/66	OWRD
66	10/04/66	OWRD
40	10/25/66	OWRD
25	11/01/66	OWRD
25	12/06/66	OWRD
34	02/01/67	OWRD
24	04/25/67	OWRD
41	07/18/67	OWRD
44	10/18/67	OWRD
42	11/01/67	OWRD
38	12/05/67	OWRD
38	01/03/68	OWRD
28	01/16/68	OWRD
27	02/06/68	OWRD
26.5	04/16/68	OWRD
37	07/17/68	OWRD
33	08/28/68	OWRD
40.5	10/15/68	OWRD
27	11/29/68	OWRD
35	01/21/69	OWRD
35	02/03/69	OWRD
25	03/04/69	OWRD
26	04/04/69	OWRD
41.5	07/15/69	OWRD
48	10/15/69	OWRD
59.5	01/15/70	OWRD
44	01/19/70	OWRD
43	02/02/70	OWRD
39	03/12/70	OWRD
39.5	04/14/70	OWRD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA CONTINUED

46	06/23/70	OWRD
54	07/21/70	OWRD
54	08/04/70	OWRD
52.5	10/20/70	OWRD
47	12/29/70	OWRD
46	01/25/71	OWRD
45	02/18/71	OWRD
44	04/20/71	OWRD
45	07/19/71	OWRD
54	09/02/71	OWRD
52	10/14/71	OWRD
43	12/20/71	OWRD
44	02/21/72	OWRD
42	03/06/72	OWRD
39	04/11/72	OWRD
53	05/19/72	OWRD
57	07/05/72	OWRD
67	08/07/72	OWRD
63	02/14/73	OWRD
59	04/12/73	OWRD
46	07/12/73	OWRD
52	07/31/73	OWRD
47	10/04/73	OWRD
45	12/07/73	OWRD
43	01/03/74	OWRD
40	03/04/74	OWRD
37	04/19/74	OWRD
46	09/30/74	OWRD
42	01/13/75	OWRD
38	03/31/75	OWRD
40	06/30/75	OWRD
63	10/06/75	OWRD
42	01/05/76	OWRD
39	04/05/76	OWRD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

40	07/09/76	OWRD
63	07/08/77	OWRD
46	09/26/77	OWRD
61	01/09/78	OWRD
39	04/03/78	OWRD
23	04/23/79	OWRD
61.5	04/15/80	OWRD
50	10/01/80	OWRD
51.49	10/02/80	OWRD
46.81	04/16/81	OWRD
51.5	10/23/81	OWRD
65.35	10/01/82	OWRD
67.7	10/13/82	OWRD
42.8	03/08/83	OWRD
47	10/20/83	OWRD
43.98	05/21/84	OWRD
68.82	10/17/84	OWRD
51.49	04/05/85	OWRD
51.49	04/25/85	OWRD
58.42	10/24/85	OWRD
71.7	04/28/86	OWRD
51.7	04/12/88	OWRD
57.7	07/22/88	OWRD
56	11/01/89	SHERWOOD
60	12/01/89	SHERWOOD
52	01/01/90	SHERWOOD
52	02/01/90	SHERWOOD
55	03/01/90	SHERWOOD
68	04/01/90	SHERWOOD
50	05/01/90	SHERWOOD
55	06/01/90	SHERWOOD
52	07/01/90	SHERWOOD
56	08/01/90	SHERWOOD
52	09/01/90	SHERWOOD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

50	10/01/90	SHERWOOD
65	11/01/90	SHERWOOD
65	12/01/90	SHERWOOD
65	01/01/91	SHERWOOD
65	02/01/91	SHERWOOD
65	03/01/91	SHERWOOD
64	03/04/91	SHERWOOD
63	03/15/91	SHERWOOD
62	03/22/91	SHERWOOD
62	4/1/91	SHERWOOD
62	04/02/91	SHERWOOD
63	05/01/91	SHERWOOD
63	05/20/91	SHERWOOD
63	06/01/91	SHERWOOD
62	06/04/91	SHERWOOD
63	06/24/91	SHERWOOD
66	07/01/91	SHERWOOD
66	07/03/91	SHERWOOD
66	07/10/91	SHERWOOD
67	07/23/91	SHERWOOD
68	08/01/91	SHERWOOD
68	08/06/91	SHERWOOD
68	08/15/91	SHERWOOD
70	09/01/91	SHERWOOD
70	09/05/91	SHERWOOD
70	09/16/91	SHERWOOD
70	10/01/91	SHERWOOD
70	10/08/91	SHERWOOD
72.6	10/17/91	SHERWOOD
72	10/23/91	SHERWOOD
70	10/30/91	SHERWOOD
68	11/04/91	SHERWOOD
66	06/09/92	SHERWOOD
71	06/25/92	SHERWOOD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

					67	07/17/92	SHERWOOD			
					68	08/14/92	SHERWOOD			
					62	11/01/92	SHERWOOD			
					62	12/01/92	SHERWOOD			
					63	01/18/93	SHERWOOD			
					60	02/12/93	SHERWOOD			
					60	03/12/93	SHERWOOD			
					57.5	03/30/93	SHERWOOD			
					57	04/15/93	SHERWOOD			
					57	05/15/93	SHERWOOD			
					57	06/15/93	SHERWOOD			
					57	07/15/93	SHERWOOD			
					57	08/19/93	SHERWOOD			
					63.2	10/21/93	OWRD			
2/1	32cbc	190	W717	Sherwood	800	48	10/25/84	driller	252	266
				#5		53	11/01/89	SHERWOOD	283	288
						57	12/01/89	SHERWOOD		
						55	01/01/90	SHERWOOD		
						55	02/01/90	SHERWOOD		
						52	03/01/90	SHERWOOD		
						52	04/01/90	SHERWOOD		
						52	05/01/90	SHERWOOD		
						52	06/01/90	SHERWOOD		
						52	07/01/90	SHERWOOD		
						67	08/01/90	SHERWOOD		
						63	09/01/90	SHERWOOD		
						65	10/01/90	SHERWOOD		
						58.6	11/01/90	SHERWOOD		
						58.6	12/01/90	SHERWOOD		
						58.6	01/01/91	SHERWOOD		
						58	02/01/91	SHERWOOD		
						58	03/01/91	SHERWOOD		
						55	04/01/91	SHERWOOD		
						54	05/01/91	SHERWOOD		

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

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TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 4add	145	C7766	Dorsett	125	30	3	12/03/71	driller	106	118	6	3	NA		
3/1 4aca	170	C7764	Erwert	155	80	-9.24	05/19/70	driller	142	146	WW/U	0		155	OGC/WpR
						15.21	11/06/92	OWRD			WW/U				
3/1 4bcd	270	C7760	Ferry *	175		20	12/20/63	driller						240	OGC
						29.67	10/21/93	OWRD							
3/1 4bcc	295	C7725	Hess	145	23	45	09/24/87	driller	120	125		23		259	OGC
						36.1	10/22/92	OWRD							
3/1 4bca	285	C18840	Kaplan	150	30	90	11/17/88	driller	89					264	WW/U
						20.79	12/11/92	OWRD	115						
									134						
3/1 4ddd	240	C7731	Neemish	145	33	65	09/09/86	driller						163	U/U
						77.12	10/09/92	OWRD							
3/1 4bdb	275	C7859	Nielsen	180	15	45	03/21/89	driller	102	114		2		242	OGC/WpR
						45.63	07/08/92	OWRD	163	172		4			
						41.46	10/27/92	OWRD	172	178		9			
						40.7	11/23/92	OWRD							
						33.76	12/21/92	OWRD							
						33.43	01/27/93	OWRD							
						36.73	02/25/93	OWRD							
						34.13	03/29/93	OWRD							
						33.27	04/28/93	OWRD							
						36.2	05/27/93	OWRD							
						37.61	06/28/93	OWRD							
						38.48	07/27/93	OWRD							
						41.22	08/25/93	OWRD							
						41.23	09/30/93	OWRD							
						40.68	10/26/93	OWRD							
3/1 4bca	275	C7722	Phil	205	25	80	10/11/88	driller	70					212	OGC/WpR
						63.07	11/12/92	OWRD	175						
									195						
3/1 4dab	180	C17819	Sheehan	145	30	21	03/09/92	driller	120					158	OGC
						22.32	11/12/92	OWRD							

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 4dba	250	C7743	Stevens	185		83	01/04/80	driller	94				163	U/OGC
						86.55	11/06/92	OWRD						
T/R	Elev.	Well	Well	Well	Yield	St. Water	Date of	Measured	Water	Bear.	Corresp	Design.	Design.	Main
(Sect.)		I.D.	Owner	Depth		Level	Measur.	by	top	bot.	Units	Est.	Head	Aquifer
3/1 5ccb	610	C7822	Bancroft	155	10	101	07/15/72	driller	142	146	WW/U		333	
				360	20	210	08/13/79	driller	306	342	OGC?/OGC			
						254	08/18/79	Phillips Pump						
						280	02/10/92	pump inst.						
						281.77	06/18/92	OWRD						
						277.19	09/10/92	OWRD						
3/1 5ada	310	C7842	Basel	122	20	42	06/25/64	driller					258	
						52.38	07/14/92	OWRD						
3/1 5bac	405	C7799	Cairns	410	50	254	03/11/78	driller	382		WpR		130	
						283	09/02/92	pump inst.						
						275.46	10/19/93	OWRD						
3/1 5cad	440	C7781	Coe	245	25	140	06/04/86	driller	110		U/U		331	
						115.9	05/20/92	OWRD	185		OGC?/OGC			
						117.41	10/27/92	OWRD						
						117.44	11/23/92	OWRD						
						115.94	12/21/92	OWRD						
						113.35	01/27/93	OWRD						
						112.94	02/27/93	OWRD						
						111.32	03/29/93	OWRD						
						109.93	04/28/93	OWRD						
						108.94	05/27/93	OWRD						
						109.5	06/28/93	OWRD						
						109.95	07/27/93	OWRD						
						111.48	08/25/93	OWRD						
						112.38	09/30/93	OWRD						
						113.28	10/26/93	OWRD						
3/1 5aab	345	C7807	Edy	170	60	57	10/17/75	driller	152	164	U/OGC		266	
						79.14	10/01/92	OWRD						

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 5bdb	405	C18432	Eppich	320	11	75	12/12/62 driller	155		OGC?/OGC	147
					15	210	04/20/73 OWRD	292	314	WpR	
						265.14	05/19/92 OWRD				
						272.41	08/14/92 OWRD				
						270.18	10/27/92 OWRD				
						268.79	11/23/92 OWRD				
						267.31	12/23/92 OWRD				
						264.73	01/27/93 OWRD				
						262.64	02/25/93 OWRD				
						261.19	03/29/93 OWRD				
						259.96	04/29/93 OWRD				
						259.41	05/27/93 OWRD				
						257.95	06/28/93 OWRD				
						258.35	07/27/93 OWRD				
						264.87	08/25/93 OWRD				
						271.48	09/29/93 OWRD				
						268.41	10/26/93 OWRD				
3/1 5bdc	370	C7782	Fifield	144	30	86	11/27/82 driller	52		U/OGC	287
						82.81	07/10/92 OWRD	106		OGC1/OGC	
3/1 5bca	395	C7824	Garstka	245	30	120	04/04/72 driller	106	145	OGC2/OGC	242
						139	07/23/79 owner	226	238	OGC/WpR	
						140	04/07/80 owner				
						141	06/27/80 owner				
						160	09/09/88 owner				
						169	08/12/90 owner				
						158.6	08/18/90 owner				
						156	02/26/92 owner				
						155.06	05/26/92 OWRD				
						161.45	10/27/92 OWRD				
						162.12	11/24/92 OWRD				
						161.56	12/21/92 OWRD				
						159.87	01/27/93 OWRD				
						159.03	02/25/93 OWRD				
						162.6	03/29/93 OWRD				

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						155.39	04/28/93	OWRD					
						153.21	05/27/93	OWRD					
						153.11	06/28/93	OWRD					
						153.76	07/27/93	OWRD					
						155.28	08/25/93	OWRD					
						157.58	09/29/93	OWRD					
						158.52	10/26/93	OWRD					
3/1	5bcd	415	C7828	Garstka	260	35	112	05/15/71	driller	224		OGC/WpR	245
							215.55	05/27/92	OWRD				
							170.22	08/13/92	OWRD				
3/1	5cad	440	C7808	Holst	140	40	84	04/02/75	driller	126		U/OGC	325
							114.85	05/26/92	OWRD				
3/1	5bcd	445	C7809	Moore	260	10	178	02/21/75	driller	248		OGC/WpR	235
							209.57	06/30/92	OWRD				
3/1	5bcd	425	C7830	Owens	200	40	145	05/03/71	driller	176		OGC?/OGC?	240
					324	42	185	08/16/90	driller	218	261	OGC/WpR	33
							185.06	07/14/92	OWRD	300	321	WpR	42
3/1	5bdb	413	C7840	Pitney	114	10	80	08/31/66	driller	101		U/OGC	249
					230	30	132	07/29/72	driller	218		WpR	
							150.8	08/15/75	USGS				
							164.06	06/24/92	OWRD				
							165.82	09/15/92	OWRD				
3/1	5ccc	610	C7826	Radke	245	20	140	04/06/72	driller	194	214	U/U	158
					585	20	440	04/09/89	driller	470	510	WpR	4
							445	11/14/89	Phillips	545	580	WpR	16
							442.23	09/10/92	OWRD				
3/1	5ccb	595	C7817	Richards	600	16	170	04/05/73	driller	70		WW/WW	NA
						25	233	12/17/79	driller	200		U/OGC	
						30	380	11/12/81	driller	292		OCG?/OGC?	
3/1	5aba	390		Schmeer			120.04	11/06/92	OWRD				270
3/1	5caa	410	C7864	Skeeters	315	60	90	04/01/61	driller	74		WW/U	294
				#2		50	105	03/16/67	driller	126		U/OGC	
							113.02	10/11/76	OWRD				
							114.34	01/18/77	OWRD				

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						113.02	04/18/77	OWRD												
						115.8	07/19/77	OWRD												
						115.26	10/10/77	OWRD												
						107.81	01/27/78	OWRD												
						109.58	04/11/78	OWRD												
						116.07	10/09/78	OWRD												
						110.46	04/19/79	OWRD												
						108.15	04/02/80	OWRD												
						114.45	09/16/80	OWRD												
						114.2	10/07/81	OWRD												
						106.4	04/15/82	OWRD												
						112.6	09/29/82	OWRD												
						105.5	04/29/83	OWRD												
						111.68	09/22/83	OWRD												
						107.08	05/17/84	OWRD												
						108.89	06/05/85	OWRD												
						113.67	10/03/85	OWRD												
						111.9	06/04/86	OWRD												
						115.3	06/16/87	OWRD												
						111.37	06/13/88	OWRD												
						111.26	05/15/91	OWRD												
						115.66	08/13/92	OWRD												
3/1	5caa	425	C12324	Skeeters	323	37	119	09/05/91	driller	210		OGC?/OGC?	302		OGC,OGC/WpR					
				#2			123.07	08/13/92	OWRD	278		OGC/WpR								
3/1	5daa	310	C7841	Smith	165	30	40	05/17/65	driller	125		U/U	249		OGC/WpR					
							51.4	08/15/75	USGS	155		U/OGC								
							60.96	08/13/92	OWRD											
3/1	5cba	440	C7797	Vanlac	320	20	184	10/07/78	driller	246		OGC/WpR	252		WpR					
							196	05/07/83	Phillips	Pump										
							196.33	01/24/86	Phillips	Pump										
							188	05/19/92	OWRD											
3/1	5	310	C7802	Voss	315	60				292	307	OGC/WpR			OGC/WpR					

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 5aba	390	C7790	Wirfs-Broc.	167	30	118	01/09/79	driller					282	U/OGC
						108.1	10/01/92	OWRD						
3/1 5ccd	610	C7887	Woodcock	570	20	370	05/22/79	driller	556	562	WpR		156	WpR
						370	07/25/79	Phillips Pump						
						449.5	10/01/92	OWRD						
						453.69	10/19/93	OWRD						
T/R	Elev.	Well	Well	Well	St. Water	Date of	Measured	Water	Bear.	Corresp			Design.	Main
(Sect.)		I.D.	Owner	Depth	YIELD	Level	Measur. by	top	bot.	Units	Est. gpm		Aquifer	
3/1 6dbd	427	W1360	Hansen	345	50	233	03/07/92	driller	300			199	U/OGC	
						235.24	07/10/92	OWRD						
						238.81	10/27/92	OWRD						
						238.62	11/24/92	OWRD						
						237.38	12/21/92	OWRD						
						235.05	01/27/93	OWRD						
						233.94	02/25/93	OWRD						
						232.14	03/29/93	OWRD						
						229.77	04/29/93	OWRD						
						227.67	05/27/93	OWRD						
						227.61	06/29/93	OWRD						
						227.92	07/27/93	OWRD						
						232.91	08/25/93	OWRD						
						231.96	09/29/93	OWRD						
						233.78	10/26/93	OWRD						
3/1 6dbc	340	W1894	Mueller	230	75	119	10/10/72	driller	218		U/OGC		208	U/OGC
		*				131.94	10/19/93	driller						
3/1 6bbd	205	W1855	Sadler	165	40	35	08/17/88	driller	95				182	
		*				22.79	04/08/93	OWRD	130					
3/1 6abb	210	W864	Scott	200	25	32	06/05/76	driller	186				753	
3/1 6dbd	340	W1904	Troudt	230	20	166	08/06/70	driller	206	224	U/OGC		161	U/OGC
				290	30	180	11/07/90	driller	230		OGC?/OGC?			
						179.38	07/10/92	OWRD						
3/1 6bbd	190	W1881	Ulrich	110	13	6	07/11/67	driller	16				171	
						19.3	03/11/93	OWRD	47					
									57					

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Level	Water Date of Measured Water	75 top	Bear. bot.	Corresp Units	Est.	Design. Head	Design. Aquifer	Main
3/1 7dbc	820	W1929	Auel	485	30	335	11/11/86 driller	115		WW/WW		489	OGC/WpR	
						330	08/03/87 Phillips	415		OGC?/OGC?				
						330.67	09/10/92 OWRD							
3/1 7dbb	880	W1942	Bach	200	10	158	04/28/78 driller	178		WW/U		748	WW/U	
						125	05/11/78 Phillips Pump							
						144	08/25/92 OWRD							
						146.93	10/27/92 OWRD							
						148.48	11/24/92 OWRD							
						148.47	12/21/92 OWRD							
						142.86	01/28/93 OWRD							
						139.66	02/25/93 OWRD							
						141.49	03/30/93 OWRD							
						134.11	04/25/93 OWRD							
						131.95	05/28/93 OWRD							
						133.47	06/29/93 OWRD							
						134.65	07/28/93 OWRD							
						137.85	08/26/93 OWRD							
						142.6	09/30/93 OWRD							
						144.66	10/26/93 OWRD							
3/1 7dab	780	W1930	Barron #1	110	4	50	05/01/86 driller	67		SB/WW		NA	WW/U	
3/1 7dab	750	W1939	Barron #2	492	15	400	07/07/86 driller	458		OGC/WpR		NA	OGC/WpR	
3/1 7adb	805	W1920	Bennett	410	20	335	02/13/75 driller	399		OGC?/OGC?		457	OGC	
						348.28	10/09/92 OWRD							
3/1 7aad	775	W3458	Bitzenb.	712	9	509	11/19/70 driller	500	510	OGC/WpR		185	WpR	
						590	05/13/93 Phillips	694		WpR				
3/1 7aad	730	W868	Briggs	715	7.5	430	06/17/83 driller	240		U/OGC		NA	OGC/WpR	
						430	10/18/83 Phillips Pump							
3/1 7cdd	825	W1806	Bulloch	430	25	338	06/25/74 driller	92		WW/WW		NA	OGC/WpR	
						208	03/31/88 OWRD	230		OGC?/OGC?				
								360		OGC/WpR				
								395		WpR				

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 7aaa	720	W3150	Burton	260	12	195	08/03/71	driller	210	OGC?/OGC?	522	U/OGC
						211.8	08/17/78	OWRD				
						197	07/21/86	Phillips Pump				
						198.28	05/19/92	OWRD				
3/1 7adc	825	W1923	Butler	605	15	370	05/22/89	driller	115	WW/WW	411	OGC
						294.21	07/08/92	OWRD	155	WW/U		
						413.71	10/19/93	OWRD	585	OGC/WpR		
3/1 7dac	735	W1947	Engels	530	15	391	12/13/75	driller	494	WpR	352	OGC/WpR
						383.25	10/23/92	OWRD				
						383.32	01/12/93	OWRD				
3/1 7ddd	685		Hall	200		54.34	04/08/93	OWRD			631	
3/1 7aaa	710	W1945	Hix	685	12	550	08/10/87	driller	220	OGC?/OGC?	NA	WpR
									555	WpR		
									665	WpR		
									670	WpR		
3/1 7dac	755	W1943	Hoftiezer	570	30	420	03/08/78	driller	525	WpR	347	WpR
						407.8	11/19/92	OWRD				
3/1 7cab	962	W1807	Husband	710	10	478	08/08/75	driller	676	WpR	480	WpR
						480.35	08/12/75	USGS				
						483.09	08/14/92	OWRD				
						481.72	11/19/92	OWRD				
3/1 7daa	700	W1158	Imbrie	505	10	380	05/03/91	driller	460	WpR	347	WpR
						352.6	07/16/92	OWRD				
3/1 7aad	760	W1949	Johnson	805	55	580	04/14/87	driller	705	WpR	170	WpR
						586.3	06/16/92	OWRD				
						593.42	10/27/92	OWRD				
						591.68	12/21/92	OWRD				
						588.62	03/02/93	OWRD				
						590.49	03/30/93	OWRD				
						591.56	04/29/93	OWRD				
3/1 7cab	985	W1937	Kimble	640	10	475	05/27/64	driller	60	SB/WW	453	WpR
						535.37	06/19/92	OWRD				
						531.8	09/15/92	OWRD				
						536.2	10/27/92	OWRD				

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						537.24	12/21/92	OWRD											
						536.8	01/28/93	OWRD											
						537.06	02/25/93	OWRD											
						536.43	03/30/93	OWRD											
						535.66	04/29/93	OWRD											
						534.44	05/28/93	OWRD											
						532.53	06/29/93	OWRD											
						531.92	07/28/93	OWRD											
						533.85	08/26/93	OWRD											
						534.12	09/30/93	OWRD											
						534.87	10/26/93	OWRD											
3/1	7dda	685		Landis		486.7	10/15/92	OWRD								193	WpR		
						492.3	10/19/93	OWRD											
3/1	7bac	708	W1361	Manke #1	760	4	418	03/12/92	driller	450						350	OGC/WpR, WpR		
							384.02	06/07/92	Luzier										
							454.2	04/22/93	OWRD										
							384.22	06/26/93	Luzier										
							384.18	07/06/93	Luzier										
							358.21	10/21/93	OWRD										
3/1	7bad	572	W1363	Manke #2	622	8	370	03/12/92	driller	461						189	WpR		
							385.59	06/07/92	Luzier	480									
							386.56	07/07/92	Luzier										
							386.61	07/08/92	Luzier										
							386.52	07/09/92	Luzier										
							386.5	07/11/92	Luzier										
							386.54	07/12/92	Luzier										
							392.7	09/15/92	OWRD										
							382.86	04/22/93	OWRD										
							385.57	10/21/93	OWRD										
3/1	7bba	506	W1366	Manke #3	573	50	322	03/09/92	driller	405	421			3.5		187	WpR		
							321.55	06/07/92	Luzier	454	485			7.5					
							323.74	07/07/92	Luzier	490									
							323.99	07/10/92	Luzier										
							323.67	07/11/92	Luzier										

PARRETT MOUNTAIN HYDROLOGIC DATA
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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED201

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PARRETT MOUNTAIN HYDROLOGIC DATA
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3/1 7aad	795	W1924	Weidenwebe	445	15	300	05/18/84	driller	220		U/OGC	434	OGC/WpR	
						350	07/01/84	Phillips	320		OGC?/OGC?			
						366.45	05/21/92	OWRD						
						372.08	09/10/92	OWRD						
						361.31	03/11/93	OWRD						
3/1 7dad	725	W1916	Wentz	700	40	400	07/19/78	driller	440		OGC/WpR	352	WpR	
						372.99	11/12/92	OWRD	540	550	WpR			
3/1 7cbc	1020	W1359	Whipple	630	30	442	03/07/92	driller	610			563	WpR	
						460.93	06/30/92	OWRD						
						452.58	07/10/92	OWRD						
						457.15	07/14/92	OWRD						
						457.04	09/10/92	OWRD						
						460.59	01/11/93	OWRD						
T/R	Elev.	Well	Well	Well	Yield	St. Water	Date of	Measured	Water	Bear.	Corresp	Design.	Design.	Main
(Sect.)		I.D.	Owner	Depth		Level	Measur.	by	top	bot.	Units	Est.	Head	Aquifer
3/1 8bbc	665	C7904	Allen	282	20	165	08/07/69	driller	256		WW/U		440	U/U
						224.51	10/08/92	OWRD						
3/1 8dba	560	C7875	Baker	305	15	180	02/23/88	driller	115		WW/WW		368	U/OGC
						180	03/03/88	Phillips	240		WW/U			
						191.88	08/25/92	OWRD	265		fault			
3/1 8bad	575	C18431	Barnett	200	25	155	05/08/59	driller	193		WW/U		413	WW/U
						165	06/30/87	Phillips Pump						
						161.85	07/16/92	OWRD						
3/1 8dda	460	C7892	Beach	333	20	275	06/15/73	driller	95		SB/WW		165	OGC
						225	07/01/89	pump inst.						
						295.39	10/15/92	OWRD						
3/1 8abd	495	C7901	Creecraft	470	35	315	08/18/73	driller	456	462	WpR		160	OGC/WpR
						330	08/05/88	Phillips Pump						
						334.91	05/20/92	OWRD						
						336.73	09/15/92	OWRD						
						339.97	03/11/93	OWRD						
						339.78	04/15/93	OWRD						

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 8dba	560	C7879	Cowgill	405	16	110	07/09/87 driller	115	135	WW/WW	3	365	OGC/WpR
						117	09/21/87 Phillips	150	180	WW/U	1		
						195.4	10/01/92 OWRD	305	315	U/OGC	4		
								355	365	fault	9		
								390	400	U/OGC	3		
3/1 8bca	640	C7893	Day	315	40	240	06/27/73 driller	305		U/OGC		NA	U/OGC
3/1 8aba	470	C6004	Feves	415	20	315	04/24/91 driller	340		OGC?/OGC?		165	OGC/WpR
						304.61	07/16/92 OWRD	365		OGC?/OGC?			
3/1 8cdb	590	C8243	Gifford	330	22	210	07/10/89 driller	257	265	U/U	6	363	OGC
						226.76	10/01/92 OWRD	302	307	OGC?/OGC	12		
								315	322	OGC?/OGC	4		
3/1 8daa	505	C7888	Gilmore	405	15	110	03/17/78 driller	120		SB/WW		163	OGC/WpR
				445	15	340	09/04/90 driller	440		WpR			
						342.44	09/10/92 OWRD						
3/1 8dba	510	C7928	Gross	405	10	200	06/14/76 driller	187		U/U		160	WpR
				436	10	350.08	08/14/92 OWRD						
						318	09/17/92 driller						
3/1 8abb	465	C7900	Hart	365	12	292	02/06/78 driller	344		OGC?/OGC?		165	OGC
						290	04/10/78 Phillips Pump						
						303	10/31/86 Phillips Pump						
						299.85	01/11/93 OWRD						
3/1 8bda	555	C7932	Hoffman	155	36	74	10/24/67 driller	136		SB/WW		450	WW/WW
						100	07/28/85 Phillips Pump						
						77	07/01/87 owner recoll.						
						100	09/01/91 owner recoll.						
						100	02/18/92 Pump inst.						
						104.71	10/01/92 OWRD						
3/1 8bda	560	C18118	Kelly	200	14	55	06/24/80 driller	54		fault		505	WW/U
						54.85	10/09/92 OWRD	112		WW/U			
3/1 8cbb	660	C7931	Kidd	470	15	312	03/07/69 driller	334	342	OGC?/OGC?		353	OGC/WpR
						305.65	08/14/75 USGS	457		WpR			
						307.15	08/13/92 OWRD						

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 8cbd	636	C17756?	Kiefel	330	22	272	03/10/92	driller	306			369	U/OGC
						266.96	07/10/92	OWRD					
3/1 8bbc	685	C11961	Langston	568	60	292	07/25/91	driller	100	SB/SB		378	OGC/WpR, WpR
						307.21	07/10/92	OWRD	365	U/OGC			
									498	OGC?/OGC?			
									541	WpR			
3/1 8bac	595	C7885	Langston	540	200	142	11/21/79	driller	510	WpR		363	WpR
						250	06/25/80	Phillips Pump					
						231.75	03/18/93	OWRD					
3/1 8bac	595	C7921	Langston	155	20	14	03/17/66	driller				451	WW/WW
						144.11	03/18/93	OWRD					
3/1 8cbc	695	C9092	Mooers	192	6	81	09/08/67	driller	62	SB/WW		357	OGC/WpR
				470	12	361	11/16/67	driller	146	U/U			
						245	10/19/89	Phillips	448	OGC/WpR			
						337.78	10/01/92	OWRD					
3/1 8cdc	620	C7871	Philpot	305	33	85	05/23/88	driller	90	SB/WW		386	WW/U
						241.17	08/14/92	OWRD	110	U/U			
						239.21	10/27/92	OWRD	260	U/U			
						240.38	11/23/92	OWRD					
						239.9	12/22/92	OWRD					
						238.96	01/28/93	OWRD					
						238.12	03/02/93	OWRD					
						237.11	03/30/93	OWRD					
						235.64	04/29/93	OWRD					
						234.26	05/28/93	OWRD					
						235.54	06/29/93	OWRD					
						237.2	07/28/93	OWRD					
						240.76	08/26/93	OWRD					
						241.98	09/29/93	OWRD					
						242.22	10/27/93	OWRD					
3/1 8abc	565	C7918	Rogers	455	36	212	08/14/75	driller	406	448	OGC?/OGC?	342	OGC
						212	12/19/79	PGE					
						244	08/15/86	Phillips Pump					
						293.8	05/27/92	OWRD					

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						285.55	08/13/92	OWRD							
						273.99	10/27/92	OWRD							
						262.56	11/23/92	OWRD							
						250.98	12/21/92	OWRD							
						238.88	01/27/93	OWRD							
						233.51	02/25/93	OWRD							
						226.55	03/29/93	OWRD							
						223.37	04/28/93	OWRD							
						226.69	05/27/93	OWRD							
						229.97	06/28/93	OWRD							
						237.82	07/27/93	OWRD							
						253.94	08/26/93	OWRD							
						269.93	09/29/93	OWRD							
						277.82	10/26/93	OWRD							
3/1	8dad	493	C7903	Rose	375	24	295	04/28/70	driller	358		OGC?/OGC?	168	OGC/WpR	
							314.2	08/14/75	USGS						
							325.4	09/10/92	OWRD						
3/1	8abd	525	C7927	Smeed	210		280	10/07/57	driller				247	U/OGC	
					358		277.57	06/16/92	OWRD						
3/1	8abc	525	C7911	Smith	470	12	212	09/27/77	driller				NA	OGC/WpR	
							359	09/02/88	Phillips	Pump					
3/1	8ccb	675	C7874	Sumner	595	8	480	03/02/88	Phillips	80		SB/WW	NA	OGC, OGC/WpR	
							480	10/27/88	driller	150		WW/U			
										330		U/OGC			
3/1	8	495		Swearington	423	44				392	419	WpR	44		
3/1	8daa	505	C7883	Theim	465	18	280	05/02/86	driller				163	OGC/WpR	
							341.79	10/23/92	OWRD						
3/1	8dbb	565		Thomsen	200		101	02/23/87	Phillips	Pump			445		
							120	11/05/92	OWRD						
3/1	8aca	540	C7895	Tidball	508	12	400	06/23/76	driller	272		U/OGC	NA	OGC/WpR	
3/1	8ccd	620	C7873	Ugoretz	225	20	100	04/18/88	driller	180	190	U/U	15	485	WW/U
							134.98	08/13/92	OWRD	200	205	U/U	420		

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 8bbd	650	C7907	Williams	340	15	93	07/30/71	driller	290	308	U/U	379	OGC/WpR
				450	200	179	08/17/78	OWRD	424		OGC/WpR		
						195	08/17/79	OWRD					
						241	05/06/83	driller					
						244.5	09/22/83	OWRD					
						271.31	04/08/93	OWRD					
3/1 8bba	620	C7908	Williams	260	50	146	07/31/71	driller	243	254	U/U	385	U/OGC
						181.85	08/17/79	OWRD					
						190.6	04/02/80	OWRD					
						203.51	09/16/80	OWRD					
						192.93	04/23/81	OWRD					
						202.33	10/07/81	OWRD					
						200.53	05/15/82	OWRD					
						205.1	09/29/82	OWRD					
						196.85	04/29/83	OWRD					
						202.6	09/22/83	OWRD					
						197.34	05/17/84	OWRD					
						201.79	06/05/85	OWRD					
						202.65	10/03/85	OWRD					
						197.41	06/04/86	OWRD					
						201.55	06/16/87	OWRD					
						211.6	06/17/88	OWRD					
						208.55	10/27/88	OWRD					
						205.68	05/30/90	OWRD					
						197.79	05/15/91	OWRD					
						235.48	10/27/92	OWRD					
						237.2	11/30/92	OWRD					
						237.44	12/21/92	OWRD					
						238.31	01/27/93	OWRD					
						238.96	03/02/93	OWRD					
						239.43	03/29/93	OWRD					
						239.24	04/28/93	OWRD					
						238.98	05/27/93	OWRD					
						239.96	06/28/93	OWRD					

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED207

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 9dcc	380	C7943	Hansen	445	30	240	02/12/80	driller	270		U/U	172	U/OGC
						208.19	11/05/92	OWRD	302	324	U/OGC		
3/1 9dac	330	C7941	Lundy	340	35	150	07/07/81	driller	314	332	U/OGC	150	U/OGC
						180.03	10/09/92	OWRD					
3/1 9abc	405	C7952	Martinson	405	40	206	05/11/77	driller	384		OGC/WpR	164	OGC/WpR
						241.29	10/22/92	OWRD					
3/1 9cad	465	C7949	Meyer	480	12	281	07/10/69	driller	432		OGC/WpR	161	OGC/WpR
						304.36	10/22/92	OWRD					
3/1 9cac	465	C7958	Meyer	425	75	280	08/10/78	driller	320		U/OGC	NA	U/OGC, OGC
3/1 9cda	425	C7948	Meyer	425	37	240	11/22/69	driller				164	OGC/WpR
						260.99	10/22/92	OWRD					
3/1 9baa	375	C7946	Miller	235	10	136	05/20/71	driller	70		WW/WW	234	U/OGC
						140	06/30/87	Phillips Pump					
						140.8	10/15/92	OWRD					
3/1 9dbc	395	C7951	Reitz	245	13	134	04/28/63	driller				262	WW/U
						133.09	11/19/91	OWRD					
3/1 9adc	385	C7966	Risberg	335	24	224	06/22/73	driller	314	328	U/U	160	U/OGC
						233.67	06/29/76	OWRD					
						220.07	10/11/76	OWRD					
						218.87	01/18/77	OWRD					
						226.71	04/18/77	OWRD					
						235.28	07/19/77	OWRD					
						221.61	10/10/77	OWRD					
						220.52	01/24/78	OWRD					
						218.67	04/03/78	OWRD					
						220.48	10/08/78	OWRD					
						218.51	04/19/79	OWRD					
						219	04/02/80	OWRD					
						222.38	09/17/80	OWRD					
						219.4	04/16/81	OWRD					
						223.3	10/07/81	OWRD					
						219.4	04/15/82	OWRD					
						223.85	09/30/82	OWRD					
						220	04/29/83	Phillips Pump					

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						217.95	05/04/83	OWRD											
						221.35	09/23/83	OWRD											
						219.08	05/17/84	OWRD											
						220.5	06/05/84	OWRD											
						226.5	10/03/85	OWRD											
						221.55	06/04/86	OWRD											
						225.02	6/16/87	OWRD											
						224.82	06/17/88	OWRD											
						231.66	10/13/88	OWRD											
						228.14	05/30/90	OWRD											
						238.5	10/28/92	OWRD											
						238.57	11/23/92	OWRD											
						237.47	12/21/92	OWRD											
						237.19	01/27/93	OWRD											
						235.82	02/25/93	OWRD											
						235.24	03/29/93	OWRD											
						230.43	04/28/93	OWRD (quest.)											
						234.87	05/27/93	OWRD											
						235.35	06/28/93	OWRD											
						237.15	07/27/93	OWRD											
						239.64	08/25/93	OWRD											
						241.59	09/29/93	OWRD											
						242.36	10/26/93	OWRD											
3/1	9cbc	470	C7959	Smith	335	20	178	03/21/79	driller	305	325	GOC?/OGC?	270	U/OGC, OGC					
							178	08/28/79	Phillips Pump										
							199.57	10/05/92	OWRD										
3/1	9dba	376	C1435	Stevenson	405	30	220	10/17/90	driller	290		U/U	154	OGC/WpR					
							221.84	01/12/93	OWRD	395		OGC/WpR							
3/1	9acc	455	C7903	Taylor	435	15	262	03/02/68	driller	330	352	U/U	180	OGC/WpR, WpR					
			C7963		540	40	290.5	06/29/76	OWRD	412	418	OGC?/OGC?							
							276	07/19/76	OWRD	506	524	WpR							
							270	10/10/76	OWRD										
							270	10/11/76	OWRD										
							271	01/18/77	OWRD										

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measured Measur. by	Water top	Bear. bot.	Corresp Units	Est.	Design. Head	Design. Aquifer	Main
3/1 9bcd	485	C7957	Ward	395	25		269 04/18/77 OWRD 270 01/27/78 OWRD 269 04/11/78 OWRD 270 10/09/78 OWRD 267 04/19/79 OWRD 440 06/27/83 driller 268 06/28/83 Phillips Pump 275 04/04/92 owner 274.75 07/08/92 OWRD 275 01/04/93 Phillips Pump 307 04/23/75 driller 372 388 OGC?/OGC? 320 09/24/85 owner 316 09/24/85 Phillips Pump 316 07/13/89 owner 318.47 05/26/92 OWRD							167 OGC
3/1 10cbc	285	C8016	Amato	170	12	120	10/24/72 driller	156	162	WW/WW		NA	WW/WW	
3/1 10dcc	185	C8014	Bischof	230	60	39	06/02/70 driller	166	214			NA	WW/U	
						41.73	01/18/77 OWRD							
						41.61	04/18/77 OWRD							
						39.1	01/27/78 OWRD							
						40.09	04/11/78 OWRD							
						41.81	10/09/78 OWRD							
						45.92	11/12/91 OWRD							
3/1 10caa	185	C18836	ChickaDee Nursery	182 226	200 300	30	01/14/69 driller	118				143	U/U	
						19.5	12/01/75 DEEP	136						
						19.1	06/29/76 OWRD	170						
						18.85	10/11/76 OWRD	182						
						16.61	01/18/77 OWRD	219						
						14.89	04/18/77 OWRD							
						23.66	07/19/77 OWRD							
						21.09	10/10/77 OWRD							
						14.6	01/27/78 OWRD							

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						16.26	04/11/78	OWRD					
						19.93	10/09/78	OWRD					
						14.93	04/19/79	OWRD					
						34	10/13/88	OWRD					
						30.01	05/30/90	OWRD					
						28.17	05/31/91	OWRD					
						42.24	10/01/92	OWRD					
3/1	10cdc	235	C8012	Hough	212	20	65	01/24/72	driller	200	211	144	WW/U
							91.5	10/05/92	OWRD				
3/1	10cab	195	C7989	Jacobson	200	100	35	10/09/79	driller	90	SB/WW	140	
							55.24	11/19/92	OWRD				
3/1	10cda	210	C8002	Karvia	266	50	64	01/08/83	driller	94		136	U/U
							83.99	10/22/92	OWRD	129			
										249			
										262			
3/1	10cad	180	C7999	McKay	120	40	41	09/05/84	driller	102		138	WW/U
							42.11	10/15/92	OWRD				
3/1	10bdd	170	C8007	Miller	110	15	31.55	06/29/76	OWRD			NA	WW/U
							33.16	07/26/76	OWRD				
							28.77	01/18/77	OWRD				
							29.46	04/18/77	OWRD				
3/1	10			Pamovskis	244					244		20	
3/1	10cac	250	C7987	Potts	205	35	123	01/20/81	driller	140		132	WW/U
							118.45	10/08/92	OWRD	196			
3/1	10adb	150		Rockwell			4.95	11/05/92	OWRD			NA	WW/U
							9	09/11/93	Phillips Pump				
3/1	10ccb	255	C8017	Salazer	155	40	74	06/21/72	driller	138		135	WW/U
							119.96	10/08/92	OWRD				
3/1	10ccd	250	C8009	Sorokovsky	115	35	70.02	07/11/51	USGS			148	WW/U
			C7979		244		70.52	07/17/51	USGS				
							70.95	08/15/51	USGS				
							71.91	09/27/51	USGS				
							72.97	10/24/51	USGS				
							72.68	11/26/51	USGS				

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA CONTINUED

71.11	06/25/57	USGS
73.69	09/25/57	USGS
73.94	10/11/57	USGS
74.18	12/16/57	USGS
74.3	01/09/58	USGS
71.29	04/02/58	USGS
71.89	04/21/58	USGS
71.41	05/01/58	USGS
71.6	05/29/58	USGS
71.97	05/30/58	USGS
72.14	07/08/58	USGS
73.27	08/07/58	USGS
76.26	09/03/58	USGS
74.58	09/29/58	USGS
74.95	09/30/58	USGS
75.26	10/28/58	USGS
75.82	11/26/58	USGS
75.25	12/22/58	USGS
75.22	01/13/59	USGS
75.04	01/14/59	USGS
74.55	01/30/59	USGS
73.06	03/10/59	USGS
72.4	04/07/59	USGS
71.94	04/20/59	USGS
71.94	04/22/59	USGS
71.98	05/07/59	USGS
71.82	06/02/59	USGS
71.8	06/23/59	USGS
74.55	06/30/59	USGS
72.3	07/23/59	USGS
73.68	08/25/59	USGS
73.38	09/04/59	USGS
74.41	10/06/59	USGS
75.56	11/24/59	USGS

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA CONTINUED

72.24	12/19/51	USGS
71.98	01/15/52	USGS
70.84	02/20/51	USGS
70.08	03/19/52	USGS
70.04	04/28/52	USGS
71.07	07/01/52	USGS
71.7	08/01/52	USGS
72.03	08/22/52	USGS
72.94	09/27/52	USGS
73.61	10/30/52	USGS
74.06	11/28/52	USGS
74.9	12/23/52	USGS
74.08	02/04/53	USGS
72.97	03/02/53	USGS
71.73	05/05/53	USGS
72.08	06/02/53	USGS
72.04	07/01/53	USGS
73.41	09/01/53	USGS
73.74	10/05/53	USGS
74.56	12/07/53	USGS
72.56	02/04/54	USGS
70.55	04/20/54	USGS
71.05	07/15/54	USGS
72.67	09/29/54	USGS
71.94	03/22/55	USGS
70.91	05/29/55	USGS
72.11	08/03/55	USGS
72.8	09/06/55	USGS
73.41	11/25/55	USGS
72.27	12/20/55	USGS
69.46	02/18/56	USGS
68.42	05/12/56	USGS
70.65	08/20/56	USGS
72.87	12/23/56	USGS

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PARRETT MOUNTAIN HYDROLOGIC DATA CONTINUED

75.62	12/27/59	USGS
75.79	01/05/60	USGS
75.12	01/26/60	USGS
73.56	03/23/60	USGS
73.15	04/06/60	USGS
72.72	07/12/60	USGS
76	10/12/60	USGS
75.35	10/18/60	USGS
74.67	01/17/61	USGS
73.82	02/20/61	USGS
70.52	05/06/61	USGS
70.77	05/23/61	USGS
73.2	07/27/61	USGS
71.59	09/19/61	USGS
75.75	10/13/61	USGS
75.95	01/15/62	USGS
75.5	02/26/62	USGS
74.74	03/30/62	USGS
76.25	08/01/62	USGS
77.19	11/19/62	USGS
74.59	02/16/63	USGS
73.38	04/23/63	USGS
74.88	08/01/63	USGS
76.4	11/12/63	USGS
74.09	02/10/64	USGS
72.35	04/30/64	USGS
75.2	07/29/64	USGS
77.46	10/27/64	USGS
76.28	01/22/65	USGS
74.06	04/28/65	USGS
76.75	07/23/65	USGS
78.67	11/01/65	USGS
77.44	01/26/66	USGS
75.44	04/26/66	USGS

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

79.28	07/27/66	USGS
80.35	10/25/66	USGS
78.68	01/31/67	USGS
76.32	04/25/67	USGS
79.45	07/18/67	USGS
81.15	10/18/67	USGS
80.42	01/16/68	USGS
77.75	04/16/68	USGS
79.21	07/17/68	USGS
80.46	10/15/68	USGS
76.26	01/21/69	USGS
74.62	04/15/69	USGS
76.55	07/15/69	USGS
80.36	10/15/69	USGS
79.1	01/27/70	USGS
75.65	04/14/70	USGS
80.45	07/21/70	USGS
82.46	10/20/70	USGS
81.25	01/25/71	USGS
77.42	04/20/71	USGS
78.83	07/21/71	USGS
82.3	10/14/71	USGS
80.55	01/18/72	USGS
80.98	09/08/72	USGS
83.33	01/18/73	USGS
83.14	06/04/73	USGS
81.36	07/16/74	USGS
91.26	10/17/74	USGS
85.07	01/21/75	USGS
81.36	04/14/75	USGS
84.29	07/14/75	USGS
88.48	10/21/75	USGS
85.59	01/19/76	USGS
82.21	04/20/76	USGS

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

85.85	07/26/76	USGS
88.07	10/11/76	USGS
87.52	01/18/77	USGS
87.18	03/17/77	USGS
85.95	04/18/77	OWRD
89.13	07/19/77	OWRD
90.25	10/10/77	OWRD
87.23	01/27/78	OWRD
84.05	04/13/78	OWRD
88.82	10/09/78	OWRD
85.17	04/19/79	OWRD
90.26	07/12/79	OWRD
85.35	03/28/80	OWRD
92.64	10/05/80	OWRD
92.64	10/05/80	OWRD
85.1	04/16/81	OWRD
92.42	10/19/81	OWRD
84.93	04/15/82	OWRD
93.6	10/01/82	OWRD
92.95	10/13/82	OWRD
87.37	03/08/83	OWRD
85.05	04/29/83	OWRD
90.2	09/23/83	OWRD
89.84	10/20/83	OWRD
84.51	05/17/84	OWRD
84.11	05/21/84	OWRD
91.21	10/17/84	OWRD
87.1	04/25/85	OWRD
94.45	10/24/85	OWRD
88.9	04/25/86	OWRD
90.47	04/23/87	OWRD
101.06	10/01/87	OWRD
96.76	04/13/88	OWRD
99.28	07/25/88	OWRD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						100.23	07/30/88	OWRD					
						101.42	08/10/88	OWRD					
						102.6	07/18/88	OWRD					
						106	09/07/88	driller					
						104.53	10/10/88	OWRD					
						96.79	04/20/89	OWRD					
						102.06	04/11/90	OWRD					
						104.66	02/15/91	OWRD					
						110.17	09/20/91	OWRD					
						104.13	02/19/92	OWRD					
						103.4	04/01/92	OWRD					
						110.03	07/22/92	OWRD					
						111.53	10/21/92	OWRD					
						111.08	10/28/92	OWRD					
						111.1	11/23/92	OWRD					
						109.58	12/21/92	OWRD					
						109.91	01/22/93	OWRD					
						108.22	01/29/93	OWRD					
						107.32	02/25/93	OWRD					
						105.78	03/29/93	OWRD					
						105.13	04/05/93	OWRD					
						103.61	04/28/93	OWRD					
						101.96	05/27/93	OWRD					
						101.52	06/28/93	OWRD					
						103.3	07/26/93	OWRD					
						111.95	10/14/93	OWRD					
						111.54	10/26/93	OWRD					
3/1	10cdc	235	C8022	Thompson	205	33	73	09/20/78	driller	74	143	WW/U	
							92.37	10/08/92	OWRD	196			
3/1	10cbd	255	C7997	Wright	220	60	60	02/25/79	driller	200	WW/U	170	WW/U
							85.46	10/23/92	OWRD				

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured by	Water top	Bear. bot.	Corresp. Units	Design. Est.	Design. Head	Main Aquifer
3/1 15cac	215	C8184	Dammasch #1	920	300	70	07/02/58	driller					112	WpR
						65.83	04/22/59	OWRD						
						65.54	05/07/59	OWRD						
						65.67	06/02/59	OWRD						
						66.4	07/23/59	OWRD						
						67.46	10/06/59	OWRD						
						69.18	10/18/60	OWRD						
						66.6	02/20/61	OWRD						
						67.52	05/23/61	OWRD						
						68.98	01/17/62	OWRD						
						67.92	04/09/62	OWRD						
						72.75	08/01/62	OWRD						
						70.37	11/19/62	OWRD						
						69.08	02/19/63	OWRD						
						70.79	04/23/63	OWRD						
						71.73	08/01/63	OWRD						
						70.37	11/13/63	OWRD						
						68.62	04/30/64	OWRD						
						71.18	10/27/64	OWRD						
						69.75	01/22/65	OWRD						
						69.74	04/28/65	OWRD						
						73.04	11/01/65	OWRD						
						71.45	01/26/66	OWRD						
						70.6	04/26/66	OWRD						
						74.91	10/25/66	OWRD						
						71.9	02/01/67	OWRD						
						71.94	04/25/67	OWRD						
						77.8	07/19/67	OWRD						
						68.1	10/19/67	OWRD						
						74.45	01/16/68	OWRD						
						72.75	04/16/68	OWRD						
						71.95	01/21/69	OWRD						

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA CONTINUED

71.28	04/15/69	OWRD
74.29	10/22/69	OWRD
72.6	01/27/70	OWRD
71.46	04/14/70	OWRD
76.68	10/20/70	OWRD
73.13	01/25/71	OWRD
72.56	04/20/71	OWRD
74.93	01/18/72	OWRD
73.79	01/18/73	OWRD
77.38	01/21/75	OWRD
74.84	04/14/75	OWRD
79.79	10/21/75	OWRD
75.7	04/20/76	OWRD
79.99	10/11/79	OWRD
77.45	01/18/77	OWRD
76.33	04/18/77	OWRD
82.25	07/19/77	OWRD
81.97	10/10/77	OWRD
78.36	01/24/78	OWRD
81.39	10/09/78	OWRD
77.6	04/19/79	OWRD
87.47	07/12/79	OWRD
79.19	03/28/80	OWRD
90.21	10/02/80	OWRD
79.82	04/16/81	OWRD
80.58	04/15/82	OWRD
89.9	10/01/82	OWRD
81.87	03/07/83	OWRD
80.45	04/29/83	OWRD
84.97	09/27/83	OWRD
82.38	11/15/83	OWRD
88.39	10/17/84	OWRD
81.42	04/25/85	OWRD
91.38	10/24/85	OWRD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA CONTINUED

99.5	10/16/86	OWRD
94.28	05/07/87	OWRD
97.95	04/13/88	OWRD
292.27	07/22/88	OWRD, ppg
107.02	10/10/88	OWRD
98.88	04/20/89	OWRD
108.46	01/18/90	OWRD
104.15	04/11/90	OWRD
120	10/10/90	OWRD
103.84	02/15/91	OWRD
105.17	06/06/91	OWRD, ppg
123.72	09/20/91	OWRD
103.57	02/19/92	OWRD
102.51	04/01/92	OWRD
116.7	07/29/92	OWRD
117.81	10/21/92	OWRD
116.53	10/28/92	OWRD
115.65	11/12/92	OWRD
113.4	12/21/92	OWRD
111.7	01/22/93	OWRD
111.61	01/29/93	OWRD
111.05	02/25/93	OWRD
106.3	03/29/93	OWRD
105.72	04/05/93	OWRD
104.64	04/28/93	OWRD
103.28	05/27/93	OWRD
103.33	06/28/93	OWRD
108.57	07/27/93	OWRD
108.25	07/28/93	OWRD
112.51	08/25/93	OWRD
114.21	09/29/93	OWRD
237.6	10/14/93	OWRD, ppg
113.88	10/26/93	OWRD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 15ccb	193	C8189	Gibson	210	14	40	08/25/67	driller					150	U/U
						43.92	10/09/92	OWRD						
3/1 15bab	240	C8162	Rumpf	180	30	110	04/12/76	driller	140				139	WW/U
						101.04	10/22/92	OWRD						
3/1 15bab	230	C8179	Tabor	245	60	73	08/05/71	driller	218				134	WW/U,U/U
						100.65	11/06/92	OWRD						
T/R	Elev.	Well	Well	Well	Yield	St. Wate	Date of	Measured	Water	Bear.	Corresp	Design.	Design.	Main
(Sect.)		I.D.	Owner	Depth		Level	Measur.	by	top	bot.	Units	Est.	Head	Aquifer
3/1 16aca	320	C8240	Alexander	290	40	162	08/25/71	driller	262	274	U/OGC		NA	U/OGC
3/1 16aca	295	C8222	Bolstad	205	15	140	08/14/79	driller	150		WW/U		138	WW/U
						156.89	11/05/92	OWRD						
3/1 16dcc	180		Calkins			90.9	10/22/92	OWRD					NA	
3/1 16aaa	250	C8172	Cleek	150	15	90	02/14/78	driller	135		WW/U		132	WW/U
						118.3	10/08/92	OWRD						
3/1 16ddd	185	C8231	Dammasch	####		36	04/12/60	driller	971				111	WpR
			#2			50	09/19/61	OWRD						
						50	10/05/61	OWRD						
						50	10/17/61	OWRD						
						50	10/19/61	OWRD						
						50	10/31/61	OWRD						
						55	11/15/61	OWRD						
						50	11/30/61	OWRD						
						45	01/17/62	OWRD						
						43.5	03/30/62	OWRD						
						48	08/01/62	OWRD						
						46	11/19/62	OWRD						
						44.5	02/19/63	OWRD						
						44.5	04/23/63	OWRD						
						47.5	08/01/63	OWRD						
						46.5	11/13/63	OWRD						
						45	02/10/64	OWRD						
						45	04/30/64	OWRD						
						48.5	07/29/64	OWRD						
						47.5	10/27/64	OWRD						

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

45.5	01/22/65	OWRD
45.5	04/28/65	OWRD
50.5	07/23/65	OWRD
49	11/01/65	OWRD
47.5	01/26/66	OWRD
46.5	04/26/66	OWRD
54	07/27/66	OWRD
50.5	10/25/66	OWRD
47.5	02/01/67	OWRD
47.5	03/16/67	OWRD
47	04/25/67	OWRD
47.5	05/11/67	OWRD
50.5	06/27/67	OWRD
53.5	07/18/67	OWRD
55	08/15/67	OWRD
55	09/06/67	OWRD
53	10/18/67	OWRD
51.5	11/16/67	OWRD
50.5	12/13/67	OWRD
49.5	01/16/68	OWRD
48	04/16/68	OWRD
47.5	06/11/68	OWRD
51.5	07/17/68	OWRD
52.5	08/05/68	OWRD
50.5	09/18/68	OWRD
49.5	10/15/68	OWRD
49.5	11/25/68	OWRD
47	01/21/68	OWRD
46.5	04/15/69	OWRD
46.5	05/05/69	OWRD
46.5	06/02/69	OWRD
49.5	07/17/69	OWRD
51.5	08/04/69	OWRD
53.5	09/11/69	OWRD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA CONTINUED

50.5	10/15/69	OWRD
50.5	11/25/69	OWRD
47.5	01/27/70	OWRD
47.5	09/09/70	OWRD
47.5	04/14/70	OWRD
46	05/07/70	OWRD
49.5	06/11/70	OWRD
58.5	07/21/70	OWRD
55.5	08/20/70	OWRD
54.5	09/10/70	OWRD
52.5	10/20/70	OWRD
52.5	11/10/70	OWRD
52.5	12/20/70	OWRD
48.5	01/25/71	OWRD
48.5	04/20/71	OWRD
56.5	07/21/71	OWRD
52	10/14/71	OWRD
48.5	01/18/72	OWRD
56.5	09/08/72	OWRD
49.5	01/18/73	OWRD
51.5	06/04/73	OWRD
52.5	07/16/74	OWRD
60.5	10/17/74	OWRD
52.5	01/21/75	OWRD
50.5	04/14/75	OWRD
54	07/14/75	OWRD
60.5	10/21/75	OWRD
57	01/09/76	OWRD
54	02/18/76	OWRD
53	03/16/76	OWRD
53	04/15/76	OWRD
58.5	04/20/76	OWRD
54	05/17/76	OWRD
56.5	07/26/76	OWRD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

56.5	10/11/76	OWRD
54	01/18/77	OWRD
53.5	04/18/77	OWRD
60	07/19/77	OWRD
68.5	10/10/77	OWRD
55	01/24/78	OWRD
53.5	04/13/78	OWRD
58.5	10/09/78	OWRD
55	04/19/79	OWRD
53.5	03/28/80	OWRD
64	10/05/80	OWRD
52.4	04/16/81	OWRD
62.25	10/01/81	OWRD
54.75	04/15/82	OWRD
64.25	10/01/82	OWRD
56.17	03/07/83	OWRD
56.17	04/29/83	OWRD
61.94	09/23/83	OWRD
62.25	10/20/83	OWRD
54.17	05/21/84	OWRD
64.56	10/17/84	OWRD
56.48	04/25/85	OWRD
66.41	10/24/85	OWRD
59.94	04/24/86	OWRD
86.5	10/01/87	OWRD
68.9	04/13/88	OWRD
80.73	10/10/88	OWRD
70.9	04/20/89	OWRD
85.3	01/18/90	OWRD
85.3	04/11/90	OWRD
99	08/01/90	OWRD
73.8	02/15/91	OWRD
96.9	09/20/91	OWRD
73.8	02/19/92	OWRD

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						73.8	04/01/92	OWRD									
						87.66	07/29/92	OWRD									
						96.9	10/21/92	OWRD									
						96.9	01/22/93	OWRD									
						78.42	04/04/93	OWRD									
						77.25	04/16/93	OWRD									
						79.54	07/28/93	OWRD									
						85.35	10/14/93	OWRD									
3/1	16bad	315	C8229	Dugan	173	18	138	12/14/65	driller	215	223	U/U	6	162	U/OGC		
			C189		295		143.72	08/13/75	USGS	258		U/OGC	13				
							158	08/22/90	driller	280		OGC?/OGC?					
						152.54	09/15/92	OWRD									
3/1	16cda	150	C8230	Garrett	105	20	30	09/01/65	driller	90		U/OGC		NA	Al		
							41.63	08/13/75	USGS								
							34.45	11/05/92	OWRD								
3/1	16caa	235		Jones #1	113		94.85	06/19/92	OWRD						140		
3/1	16caa	235	C18057	Jones #2	198	32	72	07/25/92	driller	179	198	U/OGC	32	141	U/OGC		
						100.48	10/28/92	OWRD									
						99.6	11/23/92	OWRD									
						97.87	12/21/92	OWRD									
						96.31	01/27/93	OWRD									
						96.05	02/25/93	OWRD									
						95.36	03/29/93	OWRD									
						90.58	04/28/93	OWRD									
						93.73	05/27/93	OWRD									
						93.58	06/28/93	OWRD									
						94.15	07/27/93	OWRD									
						95.58	08/25/93	OWRD									
						98	09/29/93	OWRD									
						98.59	10/26/93	OWRD									
3/1	16dbb	220	C8209	Mason	300	50	70	08/27/77	driller	150		Al/Bas.		151	OGC/WpR, WpR		
							68.75	10/15/92	OWRD								
3/1	16dba	210	C8214	Mcgee	245	40	70	06/16/77	driller	230	238	OGC?/OGC?		138	U/OGC		
						72.28	10/05/92	OWRD									

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured by	Water top	Bear. bot.	Corresp Units	Design. Est.	Design. Head	Main Aquifer
3/1 17aac	350	C8283	Adams #1	285	27	175	10/02/86	driller	190		U/U		188	U/OGC
						179	07/05/90	Phillips	265		OGC?/OGC?			
						162.32	11/06/90	OWRD						
3/1 17aac	280	C17780	Adams #2	184	11	95	03/06/92	driller	145	154	U/OGC	11	186	U/OGC
						95.65	11/12/92	OWRD						
						96.5	11/23/92	OWRD						
						96.5	11/25/92	OWRD						
						96	12/02/92	OWRD						
						96.3	12/09/92	OWRD						
						95.8	12/16/92	OWRD						
						96.3	12/23/92	OWRD						
						95.8	12/30/92	OWRD						
						95.5	01/06/93	OWRD						
						95	01/13/93	OWRD						
						95	01/20/93	OWRD						
						95.2	01/27/93	OWRD						
						95.2	02/03/93	OWRD						
						95	02/10/93	OWRD						
						95	02/17/93	OWRD						
						94.2	02/19/93	OWRD						
						95	02/24/93	OWRD						
						95.2	03/03/93	OWRD						
						95.8	03/09/93	OWRD						
						96	03/16/93	OWRD						
						96.3	03/23/93	OWRD						
						97.8	03/30/93	OWRD						
						98.8	04/06/93	OWRD						
						99.9	04/13/93	OWRD						
						100.6	04/20/93	OWRD						
						101.2	04/27/93	OWRD						
						100.9	05/02/93	OWRD						
						99.1	05/09/93	OWRD						

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						99.4	05/16/93	OWRD											
						99.9	05/23/93	OWRD											
						100.1	05/30/93	OWRD											
						100.4	06/06/93	OWRD											
						100.9	06/13/93	OWRD											
						100.9	06/20/93	OWRD											
						100.9	06/27/93	OWRD											
						101.4	07/04/93	OWRD											
						102.2	07/11/93	OWRD											
						101.9	07/18/93	OWRD											
						101.9	07/25/93	OWRD											
						101.9	08/01/93	OWRD											
						101.9	08/08/93	OWRD											
						102.2	08/15/93	OWRD											
						102.2	08/22/93	OWRD											
						102.7	08/29/93	OWRD											
						102.7	09/05/93	OWRD											
						102.4	09/12/93	OWRD											
						102.2	09/19/93	OWRD											
						102.2	09/26/93	OWRD											
						101.9	10/03/93	OWRD											
						101.7	10/10/93	OWRD											
						101.4	10/17/93	OWRD											
						101.2	10/24/93	OWRD											
						100.6	11/07/93	OWRD											
						100.9	11/14/93	OWRD											
						100.1	11/21/93	OWRD											
						100.4	11/28/93	OWRD											
						101.13	11/30/93	OWRD											
3/1	17bad	530	C8253	Arkless	505	22	325	06/17/82	driller	115	SB/WW		204	OGC, OGC/WpR					
							322.87	05/18/84	OWRD	375	U/OGC								
							325.82	10/19/93	OWRD										
3/1	17bbd	560	C8297	Barrows	440	9	310	02/11/71	driller	420	OGC/WpR		NA	OGC/WpR					
							345	09/27/79	Phillips										

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 17bba	610	C8298	Benson	545	15	416	09/10/73 driller	495	WpR	198	WpR
						412.25	10/19/93 OWRD				
3/1 17bbd	565	C8269	Bethune	525	18	340	03/29/78 driller	397	OGC/WpR	218	WpR
						346	06/26/89 Phillips	518	WpR		
						347.47	03/11/93 OWRD				
3/1 17bcd	510	C8303	Biles	380	15	260	09/30/76 driller	150	U/U	212	OGC/WpR
						298.13	11/19/92 OWRD				
3/1 17ddc	200	C17781	Bisenius	123	15	67	03/06/92 driller	98	WW/U	131	U/U
						68.83	01/11/93 OWRD				
3/1 17aca	455	C18317	Cogger	140	12	100	07/29/60 driller	115	WW/U	203	U/OGC, OGC
				240	40	125	04/25/77 driller	352	374	OGC?/OGC?	
				380		310	10/24/77 driller				
						280	06/10/80 Phillips Pump				
						242.18	06/30/90 OWRD				
						243.22	10/28/92 OWRD				
						243.89	11/23/92 OWRD				
						243.24	12/22/92 OWRD				
						242.53	01/28/93 OWRD				
						242.02	03/02/93 OWRD				
						242.49	03/30/93 OWRD				
						244.41	04/29/93 OWRD				
						244.24	05/28/93 OWRD				
						244.83	06/30/93 OWRD				
						245.16	07/28/93 OWRD				
						246.54	08/25/93 OWRD				
						247.07	09/29/93 OWRD				
						248.34	10/27/93 OWRD				
3/1 17cab	400	C8270	Fullmer	305	25	199	04/03/78 driller	262	U/OGC	195	OGC
						204.8	12/30/92 OWRD				
3/1 17cdc	170	C8402	Handy	95	35	12	06/12/75 driller	50	WpR	155	WpR
						15.43	12/11/92 OWRD				
3/1 17aaa	335	C8282	Hill	268	42	151	03/31/87 driller	121	202	OGC?/OGC	5
						165.11	11/12/92 OWRD	238	268	OGC/WpR	47
3/1 17add	265		Langer			91.77	11/12/92 OWRD			173	

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1	17baa	570	C8280	Leith	405	18	280	11/15/88 driller	155			240	WW/U, U/U	
							329.68	01/11/93 OWRD	300					
									375					
3/1	17cac	280	C73	Lewis	216	25	72	06/12/90 driller	195	205	OGC/WpR	25	203	OGC
							77.34	11/05/92 OWRD						
3/1	17aad	250	C1486	Marshall	163	25	62	01/14/91 driller	101	147	OGC?/OGC	25	186	OGC
							64.25	11/06/92 OWRD						
3/1	17dcc	235	C8301	Miller	175	15	70	07/03/77 driller	76		U/U		155	U/U
							80.38	11/05/92 OWRD						
3/1	17bad	575	C17743	Minard	495	27	345	03/03/92 driller	370		OGC1/OGC2		221	OGC, OGC/WpR
							354.14	01/11/93 OWRD	445		OGC2/OGC3			
									495		OGC/WpR			
3/1	17adc	385	C8310	Numrich	152	20	66	10/18/72 driller	70		WW/U		275	WW/U, U/U
							71.73	08/08/75 USGS	103		unknown			
							109.51	10/23/92 OWRD	129	152	U/U			
							106.33	10/12/93 Schneider pump						
3/1	17adc	365	C17722	Numrich	168	17	85	02/25/92 driller	92	107	WW/U	17	229	WW/U
							135.84	10/23/92 OWRD	236		U/OGC			
							136	10/12/93 Schneider pump						
							172	11/22/93 driller						
3/1	17dcb	310	C8255	Pascoe	240	35	116	05/07/81 driller	204	226	U/OGC		205	U/OGC
						50	120	09/05/86 Phillips Pump						
							104.6	10/08/92 OWRD						
3/1	17aaa	295	C8256	Pierson	285	35	130	05/12/81 driller	125		U/OGC		167	OGC/WpR
							127.98	10/05/92 OWRD						
3/1	17acd	375	C8252	Rankin	240	30	165	10/01/82 driller	75		WW/U		223	U/U
							163	03/13/87 Phillips Pump						
							152.09	10/05/92 OWRD						
3/1	17abb	565	C9345	Rogowicz	395	15	295	08/30/78 driller	22		Gk/SB		259	U/OGC
							306.34	10/09/92 OWRD	130		SB/WW			
									372		U/OGC			
									382		OGC?/OGC?			

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 17ddb	195	C8260	Runnels	110	60	6	11/08/78	driller	84		U/U		195	U/U	
						0	11/01/91	owner	98	103	U/U				
						0.38	10/15/92	OWRD							
3/1 17ddb	210	C8262	Stolley	145	75	15	05/01/76	driller	50		unknown		202	U/U	
						7.64	01/11/93	OWRD	118		U/U				
									135		U/U				
3/1 17bdb	485	C8289	Zurstadt	470	10	301	03/03/77	03/03/77	428	442	OGC/WpR		199	OGC/WpR	
						285.75	10/09/92	10/09/92							
3/1 17	485	C8287	Zurstadt	275					243	268					
T/R	Elev.	Well	Well	Well	Yield	St. Wate	Date of	Measured	Water	Bear.	Corresp		Design.	Design.	Main
(Sect.)		I.D.	Owner	Depth		Level	Measur.	by	top	bot.	Units	Est.	Head	Aquifer	
3/1 18aba	600		Beckham	30		10	02/04/93	owner					NA		
3/1 18cbd	760	C8333	Cary	365	18	245	10/13/78	driller	315		U/U		512	OGC/WpR	
						248.22	01/12/93	OWRD							
3/1 18aab	655	C8342	Clark	435	30	230	10/03/75	driller	160		U/U		335	OGC/WpR	
						320.43	02/04/93	OWRD							
3/1 18cdb	660	C18316	Cox	200	12	85	08/21/74	driller	45		WW/U		572	U/U	
						78.73	08/07/75	USGS							
						88.31	06/24/92	OWRD							
3/1 18cca	750	C8321	Heald	405	3	320	04/17/81	driller	325		U/OGC		NA	OGC/WpR	
				405	6	250	11/18/81	Phillips Pump							
						240	08/15/89	Phillips Pump							
						240	11/28/89	driller							
3/1 18aba	660	C8330	Martingale	260	16	89	04/23/81	driller	244		U/OGC		569	U/OGC	
						90	05/01/92	pump							
						90.98	0.0043	OWRD							
3/1 18aac	630	C8341	Pompe	453	20	320	05/07/76	driller	390		OGC/WpR		337	OGC/WpR	
						293.69	05/19/92	OWRD							
						297.1	10/28/92	OWRD							
						297.46	11/23/92	OWRD							
						297.17	12/22/93	OWRD							
						298	01/28/93	OWRD							
						296.4	03/02/93	OWRD							
						296.27	03/30/93	OWRD							

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PARRETT MOUNTAIN HYDROLOGIC DATA
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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured by	Water top	Bear. bot.	Corresp Units	Design. Est.	Design. Head	Design. Aquifer	Main
3/1 19bdb	610	C8360	Abe	505	17	345	10/08/86	driller	265		U/U		258	WpR	
					11	340	03/30/87	pump test							
						352.21	01/19/93	OWRD							
3/1 19add	320	C8379	Bischof	200	30	143	06/03/72	driller	180	195	WpR		147	OGC/WpR	
						148.96	05/01/75	OWRD							
						148.86	08/01/75	OWRD							
						143.8	04/02/80	OWRD							
						145.12	09/16/80	OWRD							
						142.88	04/23/81	OWRD							
						145.15	10/06/81	OWRD							
						142.89	04/15/82	OWRD							
						145.1	09/29/82	OWRD							
						141.8	05/04/83	OWRD							
						144.97	09/27/83	OWRD							
						143.57	06/05/85	OWRD							
						145.18	06/16/87	OWRD							
						144.34	06/17/88	OWRD							
						147.89	10/28/92	OWRD							
						148.36	11/25/92	OWRD							
						147.62	12/22/92	OWRD							
						147.15	01/28/93	OWRD							
						147.06	03/02/93	OWRD							
						146.66	03/30/93	OWRD							
						146.38	04/29/93	OWRD							
						146.26	05/26/93	OWRD							

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PARRETT MOUNTAIN HYDROLOGIC DATA
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3/1 20ccd	430	C8679	Grant	425	22	244	09/20/75	driller	300	U/OGC	176	U/OGC, OGC
						253	05/22/91	Phillips Pump				
						254.33	01/12/93	OWRD				
3/1 20bbb	197	C5340	Wisthoff	151	24	70	04/13/91	driller	135	OGC?/OGC?	130	WpR
						67.25	01/12/93	OWRD				
T/R	Elev.	Well	Well	Well	Yield	St. Water	Date of	Measured	Water	Bear.	Corresp	Design.
(Sect.)		I.D.	Owner	Depth		Level	Measur.	by	top	bot.	Units	Head
3/1 21dcb	175	C8411	Farley	384	30	80	09/02/88	driller				103
					25	72.17	05/13/92	pump inst.				
3/1 21aba	150		Hazel	60								NA
3/1 21dbd	180	C8418	Jensen	135	14	65	09/04/62	driller, Td				NA
						79.93	11/03/92	OWRD, Td				
						78.12	11/23/92	OWRD, Td				
						78.24	12/21/92	OWRD, Td				
						75.18	01/27/93	OWRD, Td				
						75.94	02/25/93	OWRD, Td				
						75	03/29/93	OWRD, Td				
						75.85	04/28/93	OWRD, Td				
						75.93	05/27/93	OWRD, Td				
3/1 21bba	290	C8235	Smith	245	25	166	05/25/70	driller	221	WW/U	119	U/U
						171.04	01/12/93	OWRD				
3/1 21cac	170	C8413	Tippet	204	75	67	06/22/72	driller	138	GK/SB	107	WW/U
						63.39	01/12/93	OWRD				
T/R	Elev.	Well	Well	Well	Yield	St. Water	Date of	Measured	Water	Bear.	Corresp	Design.
(Sect.)		I.D.	Owner	Depth		Level	Measur.	by	top	bot.	Units	Head
3/1 29bda	210	C8674	Beck	277	15	100	07/06/74	driller	135	WW/U	122	OGC
						88.33	01/19/93	OWRD				
3/1 29bbd	395	C8678	Eichman	230	10	224	03/15/56	driller				167
				340		217.05	07/31/75	USGS				U/OGC
						216.15	07/31/75	USGS				
						225	10/01/88	driller				
						228	01/12/93	owner's hydrog				
						228.5	01/19/93	OWRD				

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/1 29bba	383	C17738	Numrich	283	20	190	03/05/92	driller	262	U/U		189	U/OGC	
						196	09/16/92	Phillips Pump						
						194.32	01/21/93	OWRD						
T/R	Elev.	Well	Well	Well	Yield	St. Water	Date of	Measured	Water	Bear.	Corresp	Design.	Design.	Main
(Sect.)		I.D.	Owner	Depth		Level	Measur.	by	top	bot.	Units	Est.	Head	Aquifer
3/1 30aab	505	C8689	Bartell	303	10	227	09/12/83	driller	235		U/OGC		276	U/OGC
						228.69	02/04/93	OWRD						
3/1 30bcd	620	C8702	Bartell	290	16	226	12/08/65	driller					396	U/OGC
						224.65	05/22/90	OWRD						
						224.46	03/18/93	OWRD						
3/1 30ada	430	C124	Betts/ Black.	425	15	205	06/27/90	driller	265		U/U	3	229	OGC
						201.07	01/21/93	OWRD	390	415	OGC/WpR	12		
3/1 30cac	480	C8705	Bordner	460	30	312	04/12/75	driller	442	454	WpR		130	OGC/WpR
						350.33	01/29/93	OWRD						
3/1 30bda	605	C8695	Bryant	545	7	305	06/07/69	driller	492		OGC/WpR		124	WpR
						480.68	04/15/93	OWRD						
3/1 30dbc	480	C8697	Conrad	460	19	328	06/16/72	driller	400		OGC/WpR		122	OGC/WpR
						337.05	07/30/75	USGS	435		WpR			
						341.95	04/02/80	OWRD						
						343.74	09/16/80	OWRD						
						343.99	04/15/82	OWRD						
						346.75	09/30/82	OWRD						
						344.2	05/04/83	OWRD						
						346.75	09/22/83	OWRD						
						347.7	05/17/84	OWRD						
						350.9	06/04/86	OWRD						
						354.45	06/16/87	OWRD						
						358.31	06/17/88	OWRD						
						361.91	10/27/88	OWRD						
						362.82	05/23/90	OWRD						
						363.6	05/15/91	OWRD						
						368.4	10/28/92	OWRD						
						369.27	12/22/92	OWRD						
						370.15	01/29/93	OWRD						

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PARRETT MOUNTAIN HYDROLOGIC DATA
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						370	03/02/93	OWRD					
						369.59	03/30/93	OWRD					
						369.16	04/30/93	OWRD					
						368.98	05/26/93	OWRD					
						369.26	06/30/93	OWRD					
						369.29	07/28/93	OWRD					
						370.17	08/26/93	OWRD					
						371.28	09/30/93	OWRD					
						371.32	10/27/93	OWRD					
3/1	30caa	570	C8704	Crew	585	10	412	07/27/78	driller	164		WW/U	122 WpR
							447.67	03/25/93	OWRD	545			
3/1	30acb	580	C8713	Heinz	515	12	372	09/03/73	driller	494	508	WpR	119 WpR
							460.75	03/25/93	OWRD				
3/1	30bdd	575	C8706	Johnsen	176	9	108	08/16/65	driller	485		WpR	126 WpR
					558	9	465	08/14/73	driller				
							470	02/11/93	OWRD				
							448.71	04/15/93	OWRD				
3/1	30ddb	300	C8691	Reger	285	15	140	10/19/81	driller	65		SB/WW	127 U/OGC
							172.64	07/09/92	OWRD				
3/1	30bbd	405	C18406	Salzman	385	30	190	10/16/92	driller	37		OGC?/OGC?	216 WpR
							191.05	12/11/92	OWRD	190		fault	
							190.78	12/22/92	OWRD				
							190.89	01/28/93	OWRD				
							189.97	03/02*93	OWRD				
							190.66	03/30/93	OWRD				
							190.27	04/29/93	OWRD				
							189.33	05/26/93	OWRD				
							189.46	06/30/93	OWRD				
3/1	30aaa	515	C8690	Schoening	365	14	235	07/20/83	driller	65		SB/SB	273 U/OGC
							235	07/25/83	Phillips	120		SB/WW	
							241.89	02/04/93	OWRD	238		U/U	

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured by	Water top	Bear. bot.	Corresp Units	Design. Est. Head	Design. Aquifer	Main
3/1 31aba	275	C11991	Conner	500		154	08/02/67	driller				123	WpR	
						152.13	03/11/93	OWRD						
3/1 31acd	170	C8740	Dawson	167	20	70	06/05/63	driller	151		U/U	105	WW/U	
						64.88	01/21/93	OWRD						
3/1 31aad	185	C8748	Ellison	185	18	88	06/24/77	driller	94		WW/U	96	WW/U, U/U	
					18	88.82	02/11/93	OWRD	131		U/U			
3/1 31adb	185	C8744	Ellison	152		66	06/10/62	driller				111	WW/U	
						73.68	02/11/93	OWRD						
3/1 31ddc	110		Frye	150		50.04	02/11/93	OWRD				NA		
3/1 31bbb	485	C8720	Hann	438	12	320	04/30/85	driller	305		U/OGC	186	OGC/WpR	
						299.32	02/04/93	OWRD	426	438	OGC/WpR			
3/1 31abb	315	C8751	Johnson	315		129	05/27/60	driller				117	OGC	
						171	02/02/84	Phillips Pump						
						197.98	03/11/93	OWRD						
3/1 31cbc	105		Mckay	400+		4						93		
						22	01/12/93	OWRD						
3/1 31bad	285	C8746	Neal	300	60	140	09/29/78	driller				144	U/OGC, OGC	
						141.44	03/11/93	OWRD						
3/1 31dda	110		Quelette	293		40	07/01/46	owner				NA		
						45.32	01/12/93	OWRD						
3/1 31bdb	270	C8741	Smith	365	18	195	09/23/77	driller	305		OGC/WpR	86	OGC/WpR	
						213.57	08/14/92	OWRD	345		WpR			
						191.83	10/29/92	OWRD						
						193.49	11/25/92	OWRD						
						189.56	12/56/92	OWRD						
						189.84	01/29/93	OWRD						
						188.85	03/02/93	OWRD						
						190.12	03/30/93	OWRD						
						184.14	04/30/93	OWRD						
						184.75	05/26/93	OWRD						
						189.69	06/30/93	OWRD						
						201.78	08/25/93	OWRD						

PARRETT MOUNTAIN HYDROLOGIC DATA
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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured Water by top	Bear. bot.	Corresp Units	Design. Est. Head	Design. Aquifer	Main
3/2 11ddc	368	W2003	Will. Pac. #3	502	450	69	09/29/78	driller	180	fault	303	WpR	
						67.47	06/16/87	OWRD					
						66.7	06/13/88	OWRD					
						64.62	05/23/90	OWRD					
						65.02	12/13/83	P. Hughes					
						65.88	04/16/86	OWRD					
						65.84	06/18/87	OWRD					
						67.03	06/17/88	OWRD					
						69.04	10/27/88	OWRD					
						68.97	05/23/90	OWRD					
						69.92	05/15/91	OWRD					
						71.82	10/28/92	OWRD					
						72.31	11/24/92	OWRD					
						72.19	12/21/92	OWRD					
						72.04	01/29/93	OWRD					
						71.45	02/25/93	OWRD					
						80.05	03/29/93	OWRD					
						81.28	04/02/93	OWRD					
						68.48	04/29/93	OWRD					
						78.8	05/27/93	OWRD					
						65.84	06/29/93	OWRD					
						65.43	07/27/93	OWRD					
						78.94	08/25/93	OWRD					
						78.74	09/29/93	OWRD					
						76.58	10/26/93	OWRD					
						79.27	10/26/93	OWRD					
3/2 12dcd	1100	W2042	Bach	260	10	220	08/01/66	driller	240	605	U/U	NA	WpR
				620	10	448	05/06/77	driller					

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/2 12dcd	1100	W2044	Knudsen	388	18	350	01/16/68	driller	363		U/OGC	572	WpR
				765	10	600	05/29/73	driller	383		OGC?/OGC?		
						520	08/09/86	Phillips	730		WpR		
						527.85	05/21/92	OWRD					
3/2 12dbc	680	W1365	Manke #5	647	60	389	03/12/92	driller	347			318	WpR
						380.05	03/15/92	Luzier	552				
						374.07	06/07/92	Luzier					
						375.48	06/29/92	OWRD					
						375.39	07/08/92	Luzier					
						372.4	07/09/92	OWRD					
						375.47	07/09/92	Luzier					
						375.35	07/11/92	Luzier					
						374.12	10/01/92	OWRD					
						361.86	04/22/93	OWRD					
						374.34	10/21/93	OWRD					
3/2 12acb	445	W2037	Pannier	365	12	190	09/27/73	driller	320		unknown	247	WpR
						181.85	07/17/75	USGS					
						198.12	11/12/92	OWRD					
3/2 12dda	1050	W1910	Pentz	380		350	04/04/66	driller	341	360	U/OGC	692	WpR
						354.73	05/20/92	OWRD					
						360.12	11/03/92	OWRD					
						360.05	11/25/92	OWRD					
						360.15	12/22/92	OWRD					
						359.9	01/27/93	OWRD					
						359.92	03/02/93	OWRD					
						359.56	03/29/93	OWRD					
						359.22	04/29/93	OWRD					
						358.38	05/27/93	OWRD					
						358.16	06/30/93	OWRD					
						358	07/28/93	OWRD					
						358.3	08/25/93	OWRD					
						358.54	09/29/93	OWRD					
						358.7	10/26/93	OWRD					

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured by	Water top	Bear. bot.	Corresp Units	Est.	Design. Head	Design. Aquifer	Main
3/2 12ddc	1090	W2033	Willis	540 670	12	dry	06/16/76	driller	557	567	WpR	4	573	WpR	
							07/22/76	driller	590	615	WpR	3			
							09/14/76	USDOE	630	650	WpR	2			
						516.85	02/27/92	OWRD	650	660	WpR	3			
						516.79	05/21/92	OWRD							
3/2 12dda	1030	W1931	Vollium	422	12		11/06/64	driller	350		U/OGC		702	U/OGC	
						328.37	07/08/92	OWRD							
3/2 13bdd	1145	Y2309	Au	885	12	577	01/24/74	driller	730		WpR		NA	WpR	
3/2 13cba	1245	Y2313	Austin	920	12	385	05/19/70	driller					NA	WpR	
						660	08/15/92	owner							
3/2 13cab	1180	Y2314	Bane	780	15	520	10/02/74	driller	520		OGC?/OGC		559	WpR	
						621.19	01/21/93	OWRD							
3/2 13abb	1100	Y2322	Clay	885	14	520	05/10/85	driller	165		WW/U		NA	WpR	
						510	06/07/85	Phillips Pump							
3/2 13adb			Duncan	880					705	800		15		WpR	
									800	880		15			
3/2 13cab	1180	Y2324	Gordon	924	250	519	06/24/88	driller	520		OGC/WpR		NA	WpR	
									720		WpR	5-6			
									924		Marine S.	20			
3/2 13bda	1110	Y2308	Gregg	570	10	287	09/08/70	driller	162		WW/U		NA	WpR	
						315.35	09/26/75	USGS	379		U/OGC				
						339.87	07/08/77	OWRD							
						343.68	10/10/77	OWRD							
						291.18	01/28/78	OWRD							
						336.56	04/11/78	OWRD							
						483.48	10/09/78	OWRD							

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/2 13abd	1085	Y107	Juza	815	6.5	520	08/22/90	driller	540		WpR	576	WpR	
						509.16	01/21/93	OWRD	790		WpR			
									810	815	WpR			
3/2 13adc	970	Y114	Lemelson	495	15	435	08/30/90	driller	485		OGC/WpR	549	WpR	
						421.39	10/21/93	OWRD	515		WpR			
3/2 13ccd	1090	Y2549	Rilee	500	4	425	11/05/62	driller				654	U/OGC	
						437.89	05/21/92	OWRD						
						439.15	10/29/92	OWRD						
						438.74	11/25/92	OWRD						
						439.93	12/21/92	OWRD						
						438.93	01/28/93	OWRD						
						438.49	02/25/93	OWRD						
						431.06	04/02/93	OWRD						
						430.73	04/29/93	OWRD						
						430.57	05/27/93	OWRD						
						431.96	06/29/93	OWRD						
						433.02	07/27/93	OWRD						
						435.14	08/25/93	OWRD						
						436.62	09/30/93	OWRD						
						437.36	10/26/93	OWRD						
T/R	Elev.	Well	Well	Well	Yield	St. Water	Date of	Measured	Water	Bear.	Corresp	Design.	Design.	Main
(Sect.)		I.D.	Owner	Depth		Level	Measur.	by	top	bot.	Units	Est.	Head	Aquifer
3/2 14cdb	1010	Y2350	Alexander	680	12	602	10/23/73	driller	664		WpR		445	WpR
						540	07/01/77	owner						
						564.86	04/02/93	OWRD						
3/2 14cdc	965	Y2327	Alexander	625	7.5	516	03/15/88	driller	516		WpR		440	WpR
						525.14	04/02/93	OWRD						
3/2 14bcb	515	Y2345	Cramer	445	12	240	08/18/69	driller					214	WpR
						301.2	04/02/80	OWRD						
						298.95	09/15/80	OWRD						
						298.09	04/23/81	OWRD						
						299.5	10/07/81	OWRD						
						298.74	04/15/82	OWRD						
						296.05	09/29/82	OWRD						

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TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						293.4	05/04/83	OWRD				
						291.65	09/27/83	OWRD				
						292.33	05/17/84	OWRD				
						293.15	06/05/85	OWRD				
						296.45	10/03/85	OWRD				
						298	04/15/87	OWRD				
						300.18	06/16/87	OWRD				
						302.17	06/17/88	OWRD				
						304.69	05/23/90	OWRD				
						304.67	05/15/91	OWRD				
						306.6	06/30/92	OWRD				
						307.53	10/29/92	OWRD				
						308.37	11/24/92	OWRD				
						308.04	12/21/92	OWRD				
						308.01	01/27/93	OWRD				
						307.61	02/25/93	OWRD				
						306.25	03/29/93	OWRD				
						304.21	04/30/93	OWRD				
						302.44	05/27/93	OWRD				
						301.79	06/29/93	OWRD				
						301.21	07/27/93	OWRD				
						302.03	08/25/93	OWRD				
						302.58	09/29/93	OWRD				
						303.58	10/26/93	OWRD				
3/2	14ccb	695		Garvey	293	215	01/17/79	?			NA	
						225	?	?				
3/2	14cbb	690	Y2336	Lakovics	575	12	350	09/10/73	driller	85	OGC?/OGC	228 WpR
							350	10/24/75	driller			
							449	07/29/82	Phillips Pump			
							462.28	03/11/93	OWRD			
3/2	14bbb	430	Y2346	Lewis	200	15	88	01/31/78	driller	138	U/U	277
							152.73	01/19/93	OWRD			

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/2 14bdd	805	Y761	Poehler	780	25	580	05/31/91 driller	68		Al/Bas.		215	WpR	
						589.89	03/18/93 OWRD	525		WpR				
								690		WpR				
3/2 14caa	835	Y885	Rolfs	436	12	378	10/29/91 driller	415	434	WpR	12	456	WpR	
						378.71	01/19/93 OWRD							
3/2 14caa	815	Y886	Rolfs	800	1.5	456	10/15/91 driller	456	466	OGC/WpR	15	NA	WpR	
3/2 14ccc	730	Y2331	Stang	310	15	230	05/11/76 driller	190		OGC/WpR		549	WpR	
						181.3	03/11/93 OWRD							
3/2 14caa	830	Y2340	Town	482	18	366	01/02/90 driller	103	104	Al/Bas.	4	437	WpR	
					19	372.56	02/04/93 OWRD	196	299	Al/Bas.	7			
								455	476	OGC/WpR	18			
3/2 14aad	835	Y680	Walsh	495	20	357	02/26/91 driller	410	411	WpR	6	485		
						350.05	01/12/93 OWRD	485	488	WpR	14			
3/2 14bdb	680	Y292	Wissusik	560	12	140	11/18/74 driller	78		OGC/WpR		281	WpR	
					10	405	09/24/89 pump tes	375		WpR				
						398.93	12/30/92 OWRD							
T/R	Elev.	Well	Well	Well	Yield	St. Wate	Date of	Measured	Water	Bear.	Corresp	Design.	Design.	Main
(Sect.)		I.D.	Owner	Depth		Level	Measur.	by	top	bot.	Units	Est.	Head	Aquifer
3/2 15dbb	210	Y2381	Hermanson	140	20	60	08/01/42 driller						155	WpR
3/2 15dad	615	Y2412	Mueller	348	14	194	09/10/84 driller	265		WpR		412	WpR	
						200	07/01/88 owner							
						203.35	04/22/93 OWRD							
3/2 15aac	495	Y2379	Schaad	530	40	330	05/27/77 driller	506		OGC/WpR		219	WpR	
						281.18	06/16/92 OWRD							
						282.48	10/29/92 OWRD							
						283.28	11/24/92 OWRD							
						283.09	12/21/92 OWRD							
						282.7	01/27/93 OWRD							
						284	02/01/93 Phillips Pump							
						282.53	02/25/93 OWRD							
						281.07	03/29/93 OWRD							
						279.22	04/30/93 OWRD							
						277.54	05/27/93 OWRD							
						276.95	06/29/93 OWRD							

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PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

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TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

							27.62	05/17/84	OWRD										
							29.04	06/05/85	OWRD										
							31.88	06/16/87	OWRD										
							29.06	06/17/88	OWRD										
							28.95	05/15/91	OWRD										
							30.86	10/29/92	OWRD										
							30.93	11/24/92	OWRD										
							30.28	12/22/92	OWRD										
							29.5	01/28/93	OWRD										
							29.4	03/02/93	OWRD										
							29.02	03/30/93	OWRD										
							28.33	04/30/93	OWRD										
							28.14	05/26/93	OWRD										
							28.81	06/30/93	OWRD										
							29.62	08/03/93	OWRD										
							31.25	08/25/93	OWRD										
							30.82	09/30/93	OWRD										
							30.39	10/27/93	OWRD										
T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured by	Water top	Bear. bot.	Corresp Units	Design. Est.	Design. Head	Main Aquifer					
3/2 23dca	665	Y2532	Bauer	403	12	238	06/21/75	driller	154		WpR		444	WpR					
							228.25	07/23/75	USGS										
							226.25	04/02/80	OWRD										
							232.85	09/23/80	OWRD										
							221.65	04/23/81	OWRD										
							227.3	10/07/81	OWRD										
							227.1	04/15/82	OWRD										
							231.7	09/30/82	OWRD										
							218.7	04/05/83	OWRD										
							228.72	09/23/83	OWRD										
							219.05	05/18/84	OWRD										
							229.6	06/16/87	OWRD										
							237.67	06/17/88	OWRD										
							247	09/12/88	OWRD										

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measured Measur. by	Water top	Bear. bot.	Corresp Units	Design. Est. Head	Design. Aquifer	Main
3/2 23bac	765	Y2539	Streed #1	500	5	201.75	05/19/93 owner						
						199.75	05/30/93 owner						
						198.08	06/07/93 owner						
						199.5	08/04/93 owner						
						230.83	12/01/93 owner						
						236.92	12/12/93 owner						
3/2 23bac	660	Y2339	Streed #2	360	15	350	05/07/80 driller	390		WpR	NA	WpR	
						360	07/01/92 pump man est.						
3/2 23bac	660	Y2339	Streed #2	360	15	190	09/11/81 driller	322		WpR	445	WpR	
						214.55	07/16/92 OWRD						
T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measured Measur. by	Water top	Bear. bot.	Corresp Units	Design. Est. Head	Design. Aquifer	Main
3/2 24bdb	960	Y2548	Dugan	625	12	447	03/08/68 driller				513	WpR	
						446.52	04/22/93 OWRD						
3/2 24bdc	920	Y2550	Fulmer	620	25	260	09/15/69 driller	586		OGC/WpR	442	WpR	
						480.03	03/18/93 OWRD						
						478.08	04/15/93 OWRD						
3/2 24bad	1000	Y2544	Mills	380	4	265	06/16/74 driller	265		SB/WW	518	OGC/WpR	
				625	10	475	10/08/74 driller						
						484.53	05/21/92 OWRD						
						486.04	11/03/92 OWRD						
						485.61	11/25/92 OWRD						
						485.96	12/21/92 OWRD						
						486.05	01/28/93 OWRD						
						486.06	02/25/93 OWRD						
						485.48	03/29/93 OWRD						
						484.64	04/29/93 OWRD						
						483.47	05/27/93 OWRD						
						482.68	06/29/93 OWRD						
						482.68	07/27/93 OWRD						
						482.42	08/25/93 OWRD						
						483.38	09/29/93 OWRD						
						484.76	10/26/93 OWRD						
3/2 24dbd	750		Rilee	400		303.68	05/21/92 OWRD				446	U/OGC	

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured Water by top	Bear. bot.	Corresp Units	Design. Est. Head	Design. Aquifer	Main
3/2 25aca	470	Y2566	Horrocks	135	45	61	08/25/70	driller	75	WpR	406	WpR	
						64.27	04/02/93	OWRD					
3/2 25cbc	850	Y2574	Moffit	680	7.5	575	03/21/70	driller			261	WpR	
						580.05	06/30/92	OWRD					
						590.33	10/29/92	OWRD					
						590.67	11/25/92	OWRD					
						592.73	12/22/92	OWRD					
						591.45	03/03/93	OWRD					
						589	03/30/93	OWRD					
3/2 25aaa	615		Rilee	267		211.12	06/02/92	OWRD			404	WW/U	
3/2 25bad	495	Y2559	Wooton	125	10	25	10/09/78	driller	35	WW/U	472	WpR	
						26	10/27/89	Phillips Pump					
						22.87	03/25/93	OWRD					
T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur.	Measured Water by top	Bear. bot.	Corresp Units	Design. Est. Head	Design. Aquifer	Main
3/2 26aab	625	Y2528	Boyles	245	20	202	12/15/67	driller			439	WpR	
						186.05	04/02/93	OWRD					
3/2 26bda	640	Y2599	Clement	465	25	352	05/29/74	driller	448	WpR	303	WpR	
						352	05/20/75	USGS					
						342.54	10/29/92	OWRD					
						343.05	11/24/92	OWRD					
						342.84	12/22/92	OWRD					
						343.11	01/28/93	OWRD					
						343.29	03/02/93	OWRD					
						342.51	03/30/93	OWRD					
						340.44	04/29/93	OWRD					
						338.56	05/26/93	OWRD					
						337.72	06/30/93	OWRD					
						337.44	08/03/93	OWRD					
						337.37	08/26/93	OWRD					
						337.12	09/30/93	OWRD					
						337.5	10/27/93	OWRD					

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

3/2 26bab	700	Y2563	Dombek	560	20	150	07/19/72 driller	497	WpR	285	WPR
				460	14	410	07/01/74 pump shop				
						414.68	02/11/93 OWRD				
3/2 26bba	655	Y2592	Klingele	480	22	350	07/20/74 driller	460	WpR	293	WpR
					20	361.99	03/18/93 OWRD				
3/2 26bdb	610	Y2609	Kloster	466	30	310	04/15/87 driller	410	WpR	282	WpR
						327.57	03/25/93 OWRD	440	WpR		
3/2 26daa	855	Y2596	Porter	720	9.5	535	12/31/76 driller	670	WpR	267	WpR
						595.07	04/02/93 OWRD				
						591.69	05/26/93 OWRD				
						590.25	06/30/93 OWRD				
						592.69	08/03/93 OWRD				
						588.25	08/26/93 OWRD				
						587.98	09/30/93 OWRD				
						588.61	10/27/93 OWRD				
3/2 26abb	830	Y316	Snow	775	12	550	09/13/85 driller	550	WpR	306	WpR
						523.51	03/25/93 OWRD	605	WpR		
T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	Yield	St. Water Level	Date of Measur. by	Measured Water top bot.	Bear. Corresp Units	Design. Est. Head	Design. Main Aquifer
3/2 35bbd	265	Y2683	Bryson	586	60	132	04/18/80 driller	238	WpR	130	WpR
						135.21	10/22/93 OWRD				
T/R (Sect.)	Elev.	Well I.D.	Well Owner	Well Depth	YIELD	St. Water Level	Date of Measur. by	Measured Water top bot.	Bear. Corresp Units	Design. Est. gpm	Design. Main Aquifer
3/2 36acd	445		Acott	147		138.9	04/02/93 owner			NA	
3/2 36acd	445	Y2686	Acott	545	30	412	02/26/90 driller	505	WpR	104	WpR
						340.74	04/02/93 OWRD				
3/2 36aca	520	Y2697	Brown	350	8	90	10/20/81 driller	130	WW/U	195	OGC/WpR, WpR
				450	15	308	06/15/82 driller	403	WpR		
						325.06	08/25/92 OWRD				
3/2 36acc	515	Y2716	Cole	493	14	400	09/24/71 driller	480	WpR	97	WpR
						418	02/11/93 OWRD				
3/2 36aba	560	Y2703	Cox	280	14	212	08/30/76 driller	245	WpR	354	WpR
						211.72	06/19/92 OWRD	250	WpR		
						211.85	10/29/92 OWRD				

TABLE XV

PARRETT MOUNTAIN HYDROLOGIC DATA
CONTINUED

						212.15	11/25/92	OWRD					
						212.11	12/22/92	OWRD					
						212.14	01/29/93	OWRD					
						211.53	03/02/93	OWRD					
						211.49	03/30/93	OWRD					
						211.16	04/30/93	OWRD					
						208.62	05/26/93	OWRD					
						207.35	06/30/93	OWRD					
						206.29	08/03/93	OWRD					
						206.03	08/26/93	OWRD					
						205.59	09/30/93	OWRD					
						205.71	10/27/93	OWRD					
3/2	36aad	490	Y2709	Dickensen	207	13	125	01/19/77	driller	180	WW/U	244	WpR
					450	11	295	05/06/88	driller	343	OGC?/OGC?		
							246.02	05/27/92	OWRD	426	WpR		
3/2	36abb	610	Y2714	Kroger	285	7	230	08/10/62	driller	280	OGC/WpR	357	WpR
							253.47	03/25/93	OWRD				
3/2	36aca	500	Y2685	McCaffrey	545	5	320	06/29/83	driller	126	WW/U	136	WpR
							363.88	06/16/92	OWRD				
3/2	36aad	520	Y2708	Sterrett	147	12	150	01/18/77	driller	250	U/OGC	373	U/U
					260		146.92	12/22/93	OWRD				
3/2	36dab	390	Y2687	Whitaker	505	5	190	09/18/89	driller	430	WpR	121	WpR
							269.15	01/21/93	OWRD				
3/2	36abb	625	Y2565	Wise	550	5	50	08/09/72	driller	53	WW/WW	157	WpR
							468.39	04/08/93	OWRD				
3/2	36abb	650	Y2555	Wise	743	5	470	04/01/83	driller	335	WpR	147	WpR
							503.29	04/08/93	OWRD				
3/2	36aca	500	Y2706	Wood	155	15	32	05/08/71	driller	122	WW/U	420	WW/U
							38.28	07/24/74	Phillips Pump				
							80.14	02/11/93	OWRD				
3/2	36acc	520	Y2700	Wood	545	9	400	07/24/84	driller	140	WW/U	114	WpR
							398	03/11/85	Phillips	460	WpR		
							406.05	02/11/93	OWRD				

TABLE XVI

QUARTER- QUARTER- POTENTIOMETRIC HEAD VALUES
FOR PARRETT MOUNTAIN

T2S R1W			
Section 31			
aa)	ba)	ca)	da)
ab) 139'	bb)	cb)	db)
ac)	bc)	cc)	dc)
ad) 162'	bd)	cd)	dd)
Section 32			
aa)	ba)	ca)	da)
ab)	bb)	cb) 139'	db)
ac)	bc)	cc)	dc)
ad)	bd) 133'	cd)	dd)
Section 33			
aa)	ba) 139'	ca)	da)
ab)	bb)	cb)	db)
ac)	bc)	cc)	dc)
ad)	bd)	cd)	dd)
T3S R1W			
Section 4			
aa)	ba)	ca)	da) 158'
ab)	bb)	cb) 259'	db) 163'
ac)	bc) 239'	cc)	dc)
ad) 155'	bd) 219'	cd)	dd) 163'
Section 5			
aa)	ba) 130'	ca) 313'	da) 249'
ab) 273'	bb)	cb) 252'	db)
ac)	bc) 242'	cc) 245'	dc)
ad) 261'	bd) 147' / 289'	cd)	dd)
Section 6			
aa)	ba)	ca)	da) 199'
ab) 153'	bb) 176'	cb)	db) 184'
ac)	bc)	cc)	dc)
ad)	bd)	cd)	dd)
Section 7			
aa) 332'	ba) 189' / 358'	ca) 169'	da) 419' / 350'
ab)	bb) 188'	cb) 564'	db) 748'
ac)	bc)	cc)	dc) 489'
ad) 397'	bd)	cd) 504'	dd) 393'

Section 8

aa)	ba) 409'	ca)	da) 164'
ab) 205' / 360'	bb) 386'	cb) 357'	db) 393'
ac)	bc)	cc) 485'	dc)
ad)	bd) 450'	cd) 378'	dd) 165'

Section 9

aa) 181'	ba) 258'	ca) 161'	da) 150'
ab) 228'	bb)	cb) 270'	db) 218'
ac) 180'	bc) 167'	cc)	dc) 172'
ad) 160'	bd)	cd) 164'	dd)

Section 10

aa)	ba)	ca) 138'	da)
ab)	bb)	cb) 170'	db)
ac)	bc)	cc) 142'	dc)
ad)	bd)	cd) 144'	dd)

Section 15

aa)	ba) 136'	ca)	da)
ab)	bb)	cb)	db)
ac)	bc)	cc) 150'	dc)
ad)	bd)	cd) 112'	dd)

Section 16

aa) 132'	ba) 162'	ca) 144'	da)
ab)	bb)	cb)	db)
ac) 138'	bc)	cc)	dc) 138'
ad)	bd)	cd)	dd) 111'

Section 17

aa) 178'	ba) 229'	ca) 195'	da)
ab) 259'	bb) 208'	cb)	db)
ac)	bc) 212'	cc)	dc) 180'
ad)	bd) 201'	cd) 179'	dd) 176'

Section 18

aa) 569'	ba)	ca) 512'	da)
ab)	bb) 576'	cb)	db)
ac)	bc) 549'	cc)	dc) 572'
ad)	bd)	cd)	dd)

Section 19

aa)	ba) 370'	ca)	da)
ab)	bb)	cb)	db)
ac)	bc) 446'	cc)	dc)
ad) 174'	bd) 258'	cd)	dd)

Section 20

aa)	ba)	ca)	da)
ab)	bb)	cb)	db)
ac) 193'	bc)	cc) 176'	dc)
ad)	bd)	cd)	dd)

Section 21

aa)	ba)	ca)	da)
ab)	bb) 119'	cb)	db)
ac)	bc)	cc)	dc)
ad)	bd)	cd)	dd)

Section 29

aa)	ba)	ca)	da)
ab)	bb) 173'	cb)	db)
ac)	bc)	cc)	dc)
ad)	bd) 122'	cd)	dd)

Section 30

aa) 274'	ba)	ca) 128'	da)
ab)	bb) 216'	cb)	db) 122'
ac) 119'	bc) 396'	cc)	dc)
ad) 229'	bd) 123'	cd)	dd) 127'

Section 31

aa) 96'	ba) 144'	ca)	da)
ab) 120'	bb) 186'	cb)	db)
ac) 108'	bc)	cc)	dc)
ad)	bd) 86'	cd)	dd)

T3S R2W

Section 1

aa)	ba)	ca)	da) 219'
ab)	bb)	cb)	db)
ac)	bc)	cc)	dc)
ad)	bd)	cd)	dd)

Section 11

aa)	ba)	ca)	da)
ab)	bb)	cb)	db)
ac)	bc)	cc)	dc)
ad)	bd)	cd)	dd) 303'

Section 12

aa)	ba)	ca)	da)
ab)	bb)	cb)	db) 318'
ac) 247'	bc)	cc)	dc) 572'
ad)	bd)	cd)	dd) 635'

Section 13

aa) 576'	ba)	ca) 559'	da)
ab)	bb)	cb)	db)
ac)	bc)	cc) 559'	dc)
ad) 549'	bd)	cd)	dd)

Section 14

aa) 485'	ba)	ca) 215' / 456'	da)
ab)	bb)	cb) 228'	db)
ac)	bc) 214'	cc) 549'	dc)
ad)	bd) 281'	cd) 442'	dd)

Section 15

aa)	ba)	ca)	da) 412'
ab)	bb)	cb)	db) 155' / 205'
ac)	bc)	cc)	dc)
ad) 214'	bd)	cd)	dd) 423'

Section 22

aa) 396' / 468'	ba)	ca) 194'	da)
ab)	bb)	cb)	db)
ac) 292'	bc)	cc)	dc) 215'
ad)	bd)	cd)	dd)

Section 23

aa) 445'	ba)	ca)	da)
ab) 451' / 493'	bb)	cb)	db)
ac)	bc)	cc)	dc) 318'
ad)	bd)	cd)	dd) 444'

Section 24

aa)	ba)	ca)	da) 446'
ab)	bb) 518'	cb)	db)
ac)	bc)	cc)	dc)
ad)	bd) 442' / 513'	cd)	dd)

Section 25

aa) 404'	ba) 472'	ca)	da)
ab)	bb)	cb)	db)
ac) 406'	bc)	cc) 261'	dc) 357'
ad)	bd)	cd)	dd)

Section 26

aa) 439'	ba) 285'	ca)	da) 267'
ab) 306'	bb) 293'	cb)	db)
ac)	bc) 282'	cc)	dc)
ad)	bd) 303'	cd)	dd)

Section 35

aa)	ba)	ca)	da)
ab)	bb) 130'	cb)	db)
ac)	bc)	cc)	dc)
ad)	bd)	cd)	dd)

Section 36

aa) 308' / 354'	ba)	ca)	da) 121'
ab) 152'	bb)	cb)	db)
ac) 106' / 202'	bc)	cc)	dc)
ad)	bd)	cd)	dd)

APPENDIX C

HYDROGRAPHS

* hydrographs provided by the OWRD

CITY OF SHERWOOD WELL #3 (WASH 1823)
T2S/R1W-32bdd
WELL DEPTH = 339 FEET

CITY OF SHERWOOD WELL #5 (WASH 717)
T2S/R1W-32cbc
WELL DEPTH = 800 FEET

TRI-COUNTY GUN CLUB WELL (WASH 1847)
T2S/R1W-33dda
ORIGINAL WELL DEPTH = 109 FEET
DEEPEMED TO 230 (2/9/73)

NIELSEN WELL (CLAC 7859)
T3S/R1W-4bdb
WELL DEPTH = 180 FEET

GARSTKA WELL (CLAC 7824)
T3S/R1W-5bca
WELL DEPTH = 245 FEET

GARSTKA WELL (CLAC 7824)
T3S/R1W-5bca
WELL DEPTH = 245 FEET

MANKE LUMBER CO. #4 WELL (WASH 1364)
T3S/R1W-7bbc
WELL DEPTH = 650 FEET

MANKE LUMBER CO. #6 WELL (WASH 1362)
T3S/R1W-7bac
WELL DEPTH = 562 FEET

KIMBALL WELL (WASH 1937)
T3S/R1W-7cab
ORIGINAL WELL 575 FEET
DEEPEMED TO 640 FEET (5/27/64)

MANKE LUMBER CO. #3 WELL (WASH 1366)
T3S/R1W-7bba
WELL DEPTH = 573 FEET

PHILPOT WELL (CLAC 7871)
T3S/R1W-8cdc
WELL DEPTH = 305 FEET

ROGERS WELL (CLAC 7918)
T3S/R1W-8abc
WELL DEPTH = 455 FEET

DAMMASCH STATE HOSPITAL WELL #1 (CLAC 8184)
T3S/R1W-15cac
WELL DEPTH = 920 FEET

DAMMASCH STATE HOSPITAL WELL #1 (CLAC 8184)
T3S/R1W-15cac
WELL DEPTH = 920 FEET

BISCHOFF WELL (CLAC 8379)
T3S/R1W-19add
WELL DEPTH = 200 FEET

BISCHOFF WELL (CLAC 8379)
T3S/R1W-19add
WELL DEPTH = 200 FEET

CONRAD WELL (CLAC 8697)
T3S/R1W-30dbc
WELL DEPTH = 460 FEET

CONRAD WELL (CLAC 8697)
T3S/R1W-30dbc
WELL DEPTH = 460 FEET

SALZMAN WELL (CLAC 18406)
T3S/R1W-30bbd
WELL DEPTH = 385 FEET

SMITH WELL (CLAC 8741)
T3S/R1W-31b db
WELL DEPTH = 365 FEET

CRAMER WELL (YAMH 2345)
T3S/R2W-14bcb
WELL DEPTH = 445 FEET

CRAMER WELL (YAMH 2345)
T3S/R2W-14bcb
WELL DEPTH = 445 FEET

SIEFKEN WELL (YAMH 2501)
T3S/R2W-22cad
WELL DEPTH = 150 FEET

SIEFKEN WELL (YAMH 2501)
T3S/R2W-22cad
WELL DEPTH = 150 FEET

CLEMENT WELL (YAMH 2599)
T3S/R2W-26bda
WELL DEPTH = 465 FEET

PORTER WELL (YAMH 2596)
T3S/R2W-26daa
WELL DEPTH = 720 FEET