# Assessment of Declining-Water Levels in Lake Devereaux, Mason County, Wa.

By

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

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# INTRODUCTION

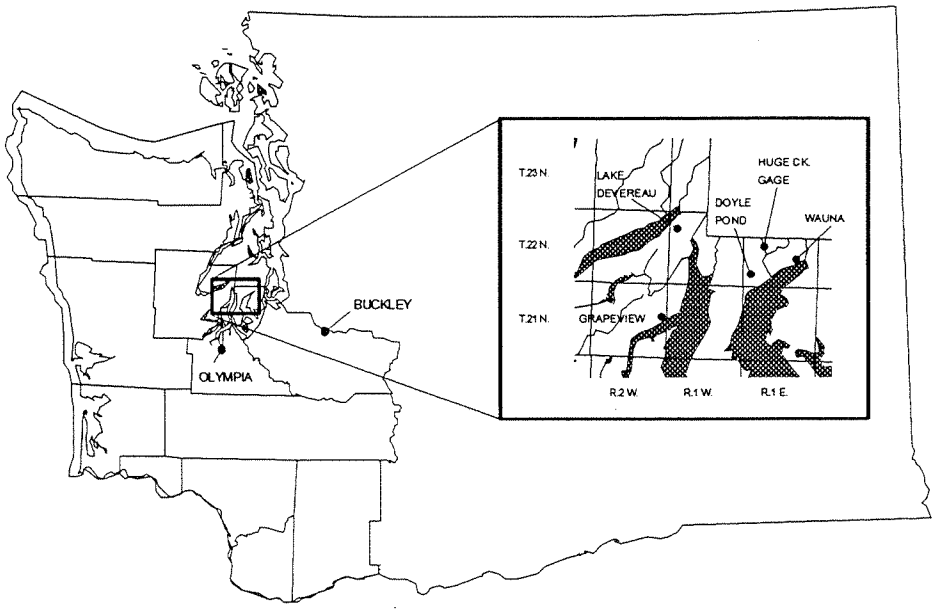
Lake Devereaux is a small lake situated in the uplands between the Hood Canal and North Bay in northeastern Mason County, Washington State (Figure 1). In recent years, landowners living adjacent to Lake Devereaux have noticed a general decline in lake level that has left many of them with grounded docks and impaired access to the lake. During the summer of 1993, the Water Resources program of the Department of Ecology (Ecology), received several letters from landowners expressing concern about the lack of water in the lake (Engel, 1993, Roder, 1993, Sergent, 1993).

In November 1993, Ecology initiated an investigation to determine the probable cause(s) of the water-level declines affecting Lake Devereaux. This report presents the findings of that investigation, which included the following elements:

- Evaluating existing ground water and surface-water use within the Lake Devereaux area.
- Compiling and evaluating information on the area's lake and ground-water levels.
- Evaluating precipitation records for National Weather Service stations in the vicinity of Lake Devereaux.
- Compiling and evaluating studies and reports about the hydrogeology of the Lake Devereaux area.
- Evaluating well reports and visiting outcrops and gravel pits.
- Locating and tagging wells and measuring water levels.

FIGURE 1

Location of Lake Devereaux



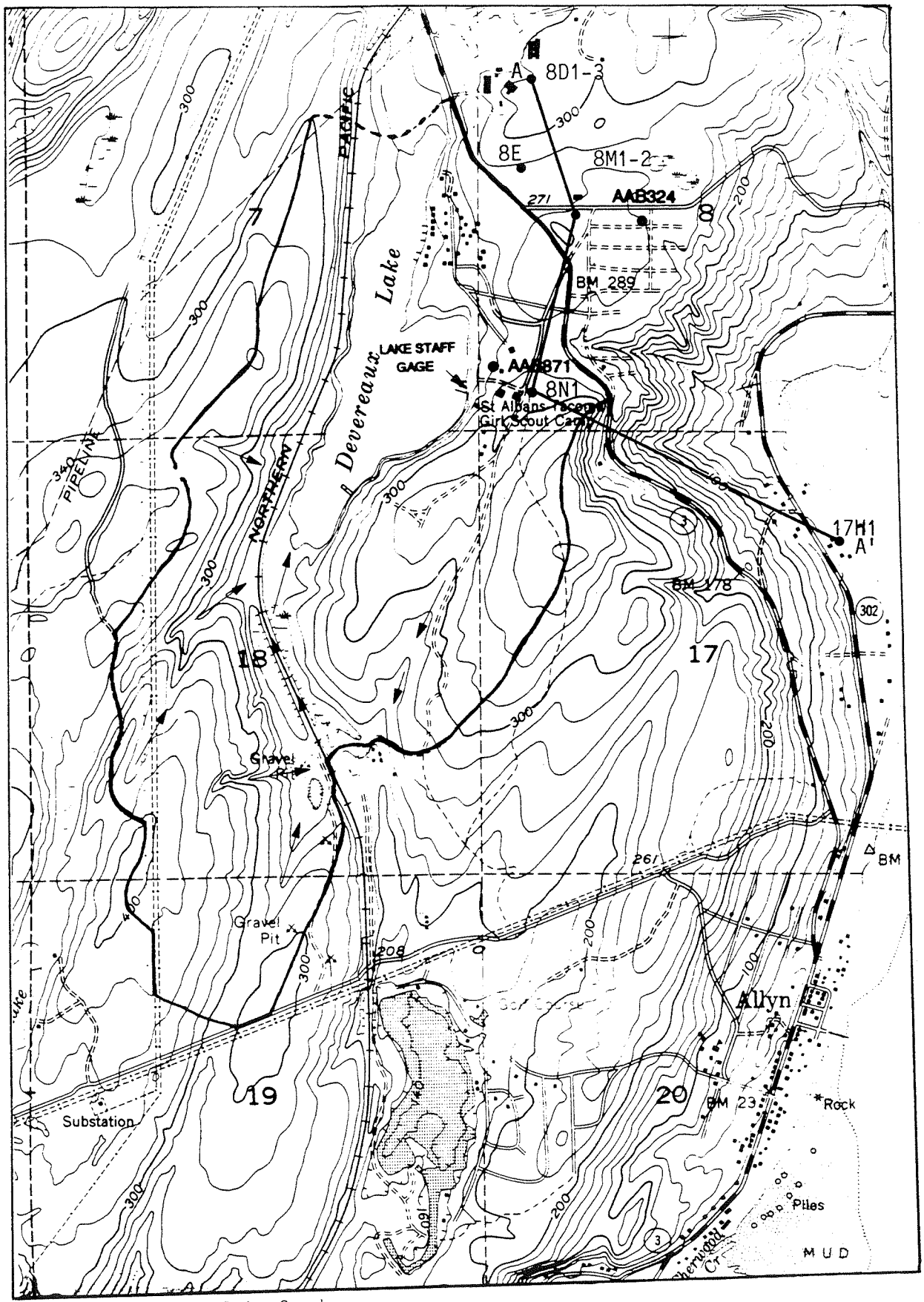

Physiographic Setting and Lake Morphology

The area surrounding Lake Devereaux consists of gently undulating terrain of low relief with northeasterly-trending valleys (Figure 2). Land-surface elevations within the Lake Devereaux watershed range from approximately 400 feet above mean sea level (msl) in the surrounding uplands to 215 feet at the lake proper. Lake Devereaux has a drainage area of approximately 1.5 square miles, is approximately one mile long, and has a general north-south orientation. It has a maximum reported depth of 55 feet, a mean depth of 19 feet, and covers approximately 100 acres. The lake contains approximately 1790 acre feet of water (Wolcott, 1973).

The surface area of the lake has varied considerably in recent years, owing to large (six feet or more) annual water-level fluctuations. The variability in surface area is accentuated by the lake's gently sloping bottom. Thus, small changes in lake level (stage), cause large changes in the lake's surface area. When the lake is full, it purportedly drains toward the north, to Lynch Cove. There was no surface expression of outflow from the lake during this or previous Ecology investigations.

PROJECT VICINITY AND WELL LOCATION MAP

FIGURE 2




Base Map: USGS Belfair Quad.
(7.5 Min. Series)

## Land Use

In contrast with most lowland-Puget Sound lakes, the shore of Lake Devereaux is largely undeveloped. Exceptions occur along the east and northeast shores of the lake where the St. Albans Girl Scout Camp and a small concentration of single-family residences are located. Land use for property outside of Girl Scout ownership has varied considerably over the years as property was cleared for farming, residential development, or industrial purposes.

The relative timing of land-use changes affecting the Lake Devereaux watershed can be inferred from aerial photographs which are available for the period 1942 to 1991. Aside from early logging activities, the first major change in land use occurred in 1945 with construction of the Bremerton and Bangor rail spur which lies along the north shore of the lake. During construction of the rail line, gravel was mined at several sites along the south side of the track between Lake Devereaux and the Anderson Farm. Many of these excavations have since filled with water to create shallow ponds. Between 1951 and 1965, initial construction of the school complex located at the northeast end of the watershed began. In addition, the property occupied by Lakeland Village was logged and readied for subsequent residential development. By 1968, Lake Anderson, a reservoir immediately south of Lake Devereaux, had been created and construction at Lakeland Village was underway.

## Climate

The climate at Lake Devereaux is typical of the Puget Sound lowlands, with mild, wet winters and dry summers. Annual precipitation at the towns of Grapeview and Wauna, the closest National Weather Service stations to Lake Devereaux, have averaged 52.79 and 51.16 inches respectively, during water years[1] 1948 to 1993 (Figure 3 and Tables 1 and 2). About 80 percent of this precipitation falls between October and March of each year.

## Summary of Previous Investigations

Lake Devereaux and vicinity have been the topic of several prior studies. Geology and ground-water occurrence were described and mapped by Molenarr and Noble (1970) during their evaluation of the geology and ground-water development potential of Mason County. Subsequent investigations by Mason Co. (1992) and Sebren (1993) were undertaken to define the water supply of localized areas near Lake Devereaux.

Bergstrom (1980) and Davidson and Schlorff (1989) conducted reconnaissance investigations to identify the cause(s) of stage declines in Lake Devereaux. Through a series of field investigations and office research, they concluded that the diminished lake levels resulted from several years of lower-than-average precipitation.

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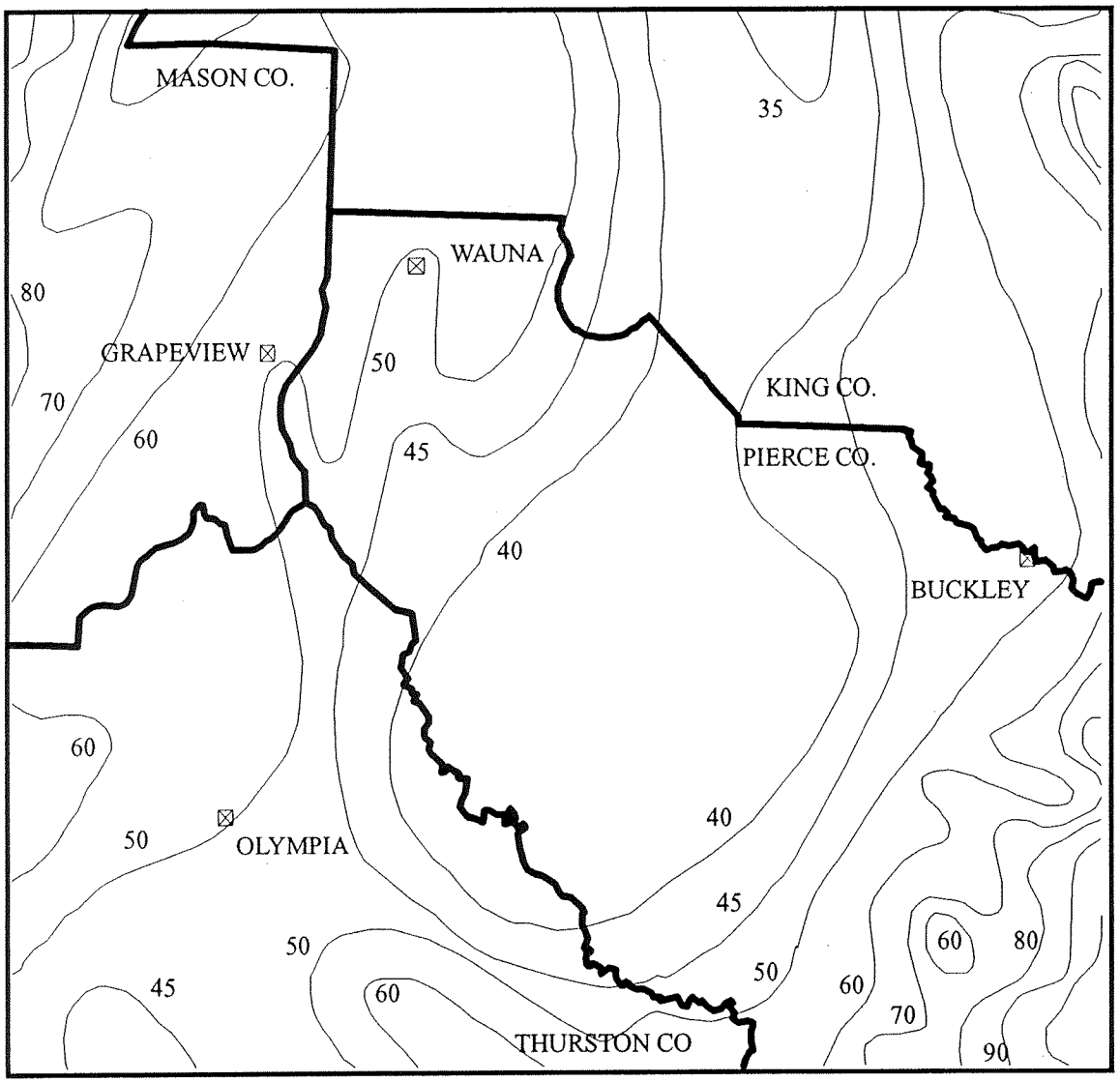
[1]A water year includes the 12 month period from October 1 to September 30 and is designated by the calendar year in which it ends. Thus, the water year starting on October 1, 1991 and ending September 30, 1992, is called the "1992 water year".

Davidson and Schlorff (1989) measured static water levels in the St. Albans Girl Scout Camp wells located near the lake. Sekor (1993) installed a staff gage to monitor lake levels at the Saint Albans Girl Scout Camp.

National Weather Service Climate Stations and Distribution
of Mean Annual Precipitation (Isohyets)




STATION NAME (Period of Record)

Buckley (1932 to present)
Grapeview (1948 to present)
Olympia (1948 to present)
Wauna (1948 to present)

50 Isohyet showing mean annual precipitation in inches

FIGURE 3

# TABLE 1

## Monthly and Annual Precipitation at Grapeview, for Water Years 1949 to 1992 (inches)
## Latitude: N47:18:00 Longitude: W122:52:00 Station Elevation: 30 Ft
## (Earthinfo, 1993)

| Water Year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Annual Total | Departure From Annual Mean (inches) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1949 | 3.38 | 9.84 | 9.92 | 0.93 | 11.18 | 4.51 | 1.23 | 1.37 | 0.65 | 0.73 | 0.64 | 1.98 | 46.36 | -6.43 |
| 1950 | 4.86 | 12.00 | 8.87 | 8.41 | 9.20 | 11.14 | 3.36 | 1.41 | 0.74 | 0.65 | 2.26 | 1.87 | 64.77 | 11.98 |
| 1951 | 9.56 | 8.81 | 10.69 | 10.32 | 11.87 | 4.23 | 1.09 | 1.02 | 0.14 | 0.42 | 0.41 | 3.09 | 61.65 | 8.86 |
| 1952 | 7.53 | 6.32 | 5.87 | 6.66 | 3.87 | 2.74 | 2.10 | 1.10 | 0.90 | 0.52 | 1.25 | 0.44 | 39.30 | -13.49 |
| 1953 | 1.31 | 1.72 | 9.61 | 22.39 | 4.93 | 4.23 | 2.93 | 2.24 | 1.39 | 0.39 | 0.90 | 3.45 | 55.49 | 2.70 |
| 1954 | 6.55 | 7.35 | 8.55 | 11.25 | 8.90 | 2.80 | 4.27 | 1.31 | 2.55 | 1.61 | 1.57 | 1.87 | 58.58 | 5.79 |
| 1955 | 2.83 | 11.46 | 6.33 | 3.68 | 4.55 | 6.57 | 4.33 | 0.96 | 0.97 | 2.51 | 0.07 | 1.73 | 45.99 | -6.80 |
| 1956 | 9.23 | 12.52 | 11.16 | 12.22 | 3.09 | 9.19 | 0.26 | 0.85 | 3.29 | 0.26 | 0.94 | 2.57 | 65.58 | 12.79 |
| 1957 | 9.20 | 2.38 | 9.31 | 2.71 | 6.67 | 7.21 | 2.80 | 1.71 | 1.51 | 1.55 | 1.37 | 0.56 | 46.98 | -5.81 |
| 1958 | 4.69 | 3.96 | 9.72 | 10.25 | 7.29 | 2.48 | 4.90 | 1.56 | 0.79 | 0.00 | 0.33 | 1.70 | 47.67 | -5.12 |
| 1959 | 4.39 | 10.90 | 8.94 | 8.55 | 2.94 | 4.40 | 8.06 | 1.93 | 2.13 | 0.34 | 0.46 | 3.79 | 56.83 | 4.04 |
| 1960 | 4.13 | 9.65 | 8.74 | 9.02 | 7.36 | 6.87 | 5.22 | 3.88 | 0.95 | 0.00 | 1.61 | 1.25 | 58.68 | 5.89 |
| 1961 | 4.59 | 9.77 | 4.52 | 12.99 | 14.93 | 8.96 | 2.04 | 3.26 | 0.72 | 0.71 | 1.16 | 0.74 | 64.39 | 11.60 |
| 1962 | 5.70 | 6.51 | 9.07 | 2.87 | 3.81 | 5.37 | 3.33 | 2.44 | 1.00 | 0.20 | 3.11 | 2.28 | 45.69 | -7.10 |
| 1963 | 5.52 | 12.97 | 7.70 | 2.96 | 7.00 | 4.35 | 4.10 | 1.65 | 1.29 | 2.05 | 0.57 | ---- | ---- | |
| 1964 | ---- | ---- | ---- | 15.88 | 1.63 | 4.37 | 1.15 | 1.42 | 3.07 | 1.89 | 1.08 | 2.15 | ---- | |
| 1965 | 1.54 | 17.08 | 7.66 | 7.66 | 5.77 | 0.51 | 4.73 | 2.15 | 0.36 | 0.73 | 2.37 | 0.41 | 50.97 | -1.82 |
| 1966 | 4.01 | 8.20 | 7.86 | 10.56 | 2.70 | 4.75 | ---- | 1.14 | 1.14 | 1.06 | 0.30 | 1.81 | ---- | |
| 1967 | 4.75 | 8.12 | 12.61 | 10.11 | 4.73 | 5.52 | 2.13 | 0.30 | 1.35 | 0.26 | 0.00 | 1.81 | 51.69 | -1.10 |
| 1968 | 10.28 | 3.72 | 8.74 | 11.13 | 10.51 | 6.69 | 2.47 | 0.96 | 3.25 | 0.56 | 4.28 | 1.22 | 63.81 | 11.02 |
| 1969 | 6.45 | 6.62 | 6.36 | 5.07 | 3.54 | 2.12 | 4.50 | 2.19 | 1.06 | 0.48 | 0.29 | 7.74 | 46.42 | -6.37 |
| 1970 | 2.49 | 4.10 | ---- | 10.98 | 4.66 | 4.79 | 4.02 | 1.77 | 0.42 | 0.41 | 0.53 | 2.97 | ---- | |
| 1971 | 4.22 | 7.64 | 12.83 | 10.28 | ---- | ---- | 3.34 | 1.24 | 2.64 | 0.83 | 0.86 | 3.11 | ---- | |
| 1972 | 4.12 | 8.31 | 8.25 | 8.30 | 11.00 | 10.98 | 5.75 | 0.65 | 0.99 | 2.93 | 0.68 | 4.83 | 66.79 | 14.00 |
| 1973 | 0.38 | 4.62 | 11.84 | 7.11 | 2.27 | 2.72 | 1.35 | 2.68 | 3.26 | 0.20 | 0.37 | 2.72 | 39.52 | -13.27 |
| 1974 | 3.35 | 10.69 | 11.53 | 8.14 | 6.19 | 5.67 | 5.77 | 3.57 | 1.77 | 2.36 | 0.07 | 0.39 | 59.50 | 6.71 |
| 1975 | 1.18 | 8.20 | 11.14 | 9.40 | 6.86 | 5.81 | 2.60 | 1.44 | 0.67 | 0.28 | 1.25 | 0.11 | 51.94 | -0.85 |
| 1976 | 11.09 | 9.88 | 11.75 | 8.78 | 8.11 | 4.89 | 2.24 | 2.96 | 0.46 | 1.49 | 2.15 | 0.91 | 64.71 | 11.92 |
| 1977 | 2.49 | 1.99 | 2.34 | 2.60 | 3.89 | 5.88 | 1.29 | 3.74 | 0.71 | 0.54 | 4.51 | 4.17 | 34.15 | -18.64 |
| 1978 | 3.73 | 8.71 | 10.00 | 7.28 | 5.41 | 3.60 | 3.70 | 3.23 | 1.08 | 1.07 | 1.92 | 7.98 | 57.71 | 4.92 |
| 1979 | 0.44 | 5.99 | 1.62 | 2.96 | 9.98 | 3.33 | 2.23 | 1.63 | 0.26 | 1.45 | 1.44 | 2.23 | 33.56 | -19.23 |
| 1980 | 6.57 | 3.36 | 13.59 | 4.09 | 8.03 | 2.93 | 4.42 | 1.28 | 2.69 | 0.40 | 0.33 | 1.49 | 49.18 | -3.61 |
| 1981 | 1.86 | 7.92 | 9.78 | 2.84 | 8.04 | 3.95 | 2.90 | 1.45 | 2.36 | 0.25 | 0.75 | 3.39 | 45.49 | -7.30 |
| 1982 | 7.45 | 7.35 | 10.57 | 6.91 | 10.97 | 4.86 | 4.40 | 0.25 | 1.54 | 0.32 | 0.37 | 2.11 | 57.10 | 4.31 |
| 1983 | 6.36 | 7.48 | 10.28 | 11.70 | 10.89 | 10.01 | 1.64 | 1.07 | 3.40 | 2.79 | 1.48 | 2.34 | 69.44 | 16.65 |
| 1984 | 1.79 | 15.28 | 7.62 | 5.46 | 5.55 | 6.69 | 5.33 | 5.50 | 3.52 | 0.00 | 0.06 | 2.28 | 59.08 | 6.29 |
| 1985 | 5.57 | 13.63 | 5.74 | 0.33 | 4.70 | 5.30 | 2.11 | 1.66 | 2.29 | 0.05 | 0.66 | 2.20 | 44.24 | -8.55 |
| 1986 | 9.99 | 4.89 | 2.76 | 13.42 | 7.66 | 3.97 | 2.28 | 3.38 | 0.85 | 1.24 | 0.11 | 1.96 | 52.51 | -0.28 |
| 1987 | 3.64 | 11.13 | 7.05 | 8.46 | 5.35 | 8.73 | 3.23 | 3.45 | 0.20 | 1.35 | 0.32 | 0.43 | 53.34 | 0.55 |
| 1988 | 0.37 | 3.65 | 11.10 | 7.37 | 0.96 | 6.45 | 5.37 | 3.02 | 1.73 | 0.75 | 0.32 | 2.37 | 43.46 | -9.33 |
| 1989 | 2.97 | 12.85 | 5.10 | 4.58 | 4.39 | 9.83 | 3.54 | 1.86 | 1.42 | 1.65 | 0.43 | 0.09 | 48.71 | -4.08 |
| 1990 | 3.49 | 7.86 | 5.66 | 13.74 | 6.30 | 4.27 | 2.28 | 2.27 | 3.44 | 0.31 | 1.84 | 0.00 | 51.46 | -1.33 |
| 1991 | 5.85 | 12.32 | 5.76 | 6.51 | 7.48 | 6.51 | 8.62 | 2.92 | 1.49 | 0.45 | 3.04 | 0.00 | 60.95 | 8.16 |
| 1992 | 2.41 | 8.06 | 4.86 | 11.86 | 6.10 | 1.03 | 5.77 | 0.09 | 1.59 | 1.02 | 0.67 | 1.49 | 44.95 | -7.84 |
| MAX | 11.09 | 17.08 | 13.59 | 22.39 | 14.93 | 11.14 | 8.62 | 5.50 | 3.52 | 2.93 | 4.51 | 7.98 | 69.44 | |
| MIN | 0.37 | 1.72 | 1.62 | 0.33 | 0.96 | 0.51 | 0.26 | 0.09 | 0.14 | 0.00 | 0.00 | 0.00 | 33.56 | |
| MEAN | 4.70 | 8.27 | 8.41 | 8.15 | 6.54 | 5.38 | 3.47 | 1.95 | 1.55 | 0.89 | 1.18 | 2.14 | 52.79 | |

# TABLE 2

## Monthly and Annual Precipitation at Wauna, for Water Years 1949 to 1994 (inches)
## Latitude: N47:22:00 Longitude: W122:42:00 Station Elevation 20 Ft.
## (Earthinfo, 1994)

| Water Year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Annual Total | Departure From Annual Mean (inches) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1949 | 1.93 | 8.23 | 9.57 | 1.18 | 7.33 | 4.88 | 1.61 | 0.38 | 0.77 | 0.94 | 1.60 | 1.70 | 40.12 | -11.04 |
| 1950 | 4.00 | 9.66 | 8.20 | 9.37 | 9.29 | 11.03 | 3.10 | 1.78 | 0.48 | 0.81 | 2.42 | 1.99 | 62.13 | 10.97 |
| 1951 | 9.54 | 8.65 | 11.12 | 9.76 | 11.75 | 4.09 | 0.95 | 1.38 | 0.11 | 0.22 | 0.63 | 2.85 | 61.05 | 9.89 |
| 1952 | 7.16 | 6.20 | 6.31 | 6.45 | 3.62 | 2.53 | 2.28 | 0.97 | 0.55 | 0.30 | 0.97 | 0.39 | 37.73 | -13.43 |
| 1953 | 1.17 | 1.55 | 9.11 | 20.33 | 5.66 | 4.32 | 2.77 | 3.27 | 1.03 | 0.64 | 1.27 | 2.73 | 53.85 | 2.69 |
| 1954 | 6.18 | 8.05 | 7.83 | 12.07 | 7.99 | 3.00 | 4.23 | 1.57 | 1.85 | 2.01 | 1.55 | 2.32 | 58.65 | 7.49 |
| 1955 | 2.75 | 10.38 | 6.63 | 3.67 | 5.14 | 4.03 | 5.07 | 1.80 | 0.89 | 2.00 | 0.29 | 1.52 | 44.17 | -6.99 |
| 1956 | 8.45 | 12.08 | 11.10 | 11.96 | 3.08 | 10.31 | 0.42 | 1.42 | 3.62 | 0.36 | 0.99 | 2.92 | 66.71 | 15.55 |
| 1957 | 8.64 | 1.69 | 9.02 | 3.44 | 6.79 | 7.66 | 2.07 | 1.54 | 0.98 | 1.02 | 1.55 | 0.81 | 45.21 | -5.95 |
| 1958 | 4.77 | 4.08 | 6.08 | 11.24 | 6.76 | 2.57 | 4.78 | 1.04 | 0.69 | 0.00 | 0.26 | 1.48 | 43.75 | -7.41 |
| 1959 | 4.38 | 10.09 | 9.21 | 11.01 | 4.30 | 4.46 | 7.03 | 1.63 | 1.86 | 0.46 | 0.45 | 4.02 | 58.90 | 7.74 |
| 1960 | 3.38 | 9.45 | 8.07 | 8.16 | 6.83 | 6.35 | 5.32 | 3.94 | 0.65 | 0.00 | 1.25 | 1.01 | 54.41 | 3.25 |
| 1961 | 4.82 | 10.46 | 4.74 | 11.70 | 14.18 | 8.47 | 2.30 | 3.06 | 0.66 | 0.58 | 1.28 | 0.70 | 62.95 | 11.79 |
| 1962 | 5.07 | 5.95 | 8.44 | 3.03 | 3.00 | 4.90 | 2.94 | 1.83 | 1.06 | 0.18 | 2.43 | 2.22 | 41.05 | -10.11 |
| 1963 | 6.33 | 12.26 | 6.57 | 2.47 | 6.59 | 4.14 | 3.82 | 1.43 | 1.32 | 1.65 | 0.35 | ---- | ---- | |
| 1964 | ---- | ---- | ---- | 14.25 | 1.44 | 4.45 | 0.95 | 1.42 | 3.87 | 1.63 | 1.11 | 1.47 | ---- | |
| 1965 | 1.27 | 10.60 | 8.05 | 7.54 | 5.32 | 0.59 | 4.56 | 1.95 | 0.68 | 1.90 | 2.32 | 0.50 | 45.28 | -5.88 |
| 1966 | 3.37 | 7.57 | 8.18 | 10.61 | 2.97 | 8.38 | 0.89 | 1.03 | 1.13 | 0.88 | 0.35 | 1.49 | 46.85 | -4.31 |
| 1967 | 3.65 | 7.35 | 11.65 | 12.47 | 3.66 | 5.75 | 2.50 | 0.41 | 1.63 | 0.37 | 0.02 | 1.06 | 50.52 | -0.64 |
| 1968 | 9.88 | 3.55 | 7.69 | 10.50 | 9.31 | 7.22 | 2.29 | 1.41 | 3.24 | 0.38 | 4.75 | 2.86 | 63.08 | 11.92 |
| 1969 | 5.72 | 6.56 | 9.63 | 7.64 | 4.04 | 2.87 | 4.35 | 2.63 | 1.19 | 0.37 | 0.57 | 6.15 | 51.72 | 0.56 |
| 1970 | 2.36 | 3.82 | 8.08 | 10.48 | 3.88 | 4.81 | 4.12 | 1.45 | 0.48 | 0.41 | 0.27 | 2.44 | 42.60 | -8.56 |
| 1971 | 3.57 | 7.09 | 12.96 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| 1972 | ---- | ---- | ---- | 8.92 | 11.28 | 11.33 | 4.74 | 0.44 | 0.77 | 2.33 | 1.38 | 4.60 | ---- | |
| 1973 | 0.37 | 4.39 | 12.55 | 7.10 | 2.33 | --- | 1.49 | 3.23 | 3.43 | 0.00 | 0.22 | 1.76 | ---- | |
| 1974 | 4.08 | 11.15 | 12.68 | 11.38 | 9.91 | 6.97 | 5.17 | 2.76 | 1.60 | 3.05 | 0.09 | 0.35 | 69.19 | 18.04 |
| 1975 | 1.43 | 7.45 | 9.34 | 8.45 | 6.57 | 5.53 | 2.66 | 1.81 | 0.66 | 0.41 | 4.08 | 0.00 | 48.39 | -2.77 |
| 1976 | 9.96 | 9.43 | 11.23 | 8.58 | 7.93 | 6.01 | 2.02 | 2.47 | 0.72 | 1.48 | 2.34 | 1.17 | 63.34 | 12.18 |
| 1977 | ---- | 1.94 | 2.46 | 2.46 | 3.63 | 6.47 | 1.23 | 2.43 | 1.57 | 0.55 | 4.44 | 4.55 | ---- | |
| 1978 | 4.27 | 11.45 | 10.47 | 6.40 | 4.91 | 3.52 | 5.04 | 2.72 | 0.86 | 1.39 | 2.10 | 7.08 | 60.21 | 9.05 |
| 1979 | 0.19 | 5.21 | 2.32 | 3.46 | 10.94 | 3.15 | 2.23 | 1.28 | 0.36 | 1.67 | 1.16 | 1.98 | 33.95 | -17.21 |
| 1980 | 6.79 | 3.35 | 16.18 | 5.76 | 7.33 | 3.47 | 4.94 | 1.34 | 2.80 | 0.62 | 0.43 | 1.94 | 54.95 | 3.79 |
| 1981 | 1.17 | 11.35 | 10.91 | 3.09 | 7.29 | 4.99 | 4.16 | 1.84 | 2.60 | 0.58 | 0.36 | 3.94 | 52.28 | 1.12 |
| 1982 | ---- | 6.48 | 9.81 | 6.96 | 10.75 | 4.24 | 3.63 | 0.20 | 1.02 | 0.29 | 0.41 | 2.04 | ---- | |
| 1983 | 5.29 | 6.05 | 11.83 | 11.42 | 9.37 | 8.78 | 1.43 | 1.38 | 2.37 | 2.34 | 1.84 | 2.00 | 64.10 | 12.94 |
| 1984 | 1.99 | 14.62 | 6.60 | 4.37 | 5.10 | 6.37 | 4.65 | 5.83 | 3.80 | 0.00 | 0.13 | 2.18 | 55.64 | 4.48 |
| 1985 | 4.86 | 12.41 | 5.54 | 0.58 | 3.72 | 4.33 | 1.96 | 0.66 | 2.48 | 0.06 | 0.36 | 2.03 | 38.99 | -12.17 |
| 1986 | 8.43 | 3.38 | 2.34 | 13.96 | 6.47 | 3.29 | 2.32 | 3.32 | 1.36 | 1.04 | 0.09 | 2.41 | 48.41 | -2.75 |
| 1987 | 3.83 | 9.88 | 6.00 | 7.70 | 4.70 | 8.67 | 2.25 | 3.69 | 0.13 | 0.72 | 0.28 | 0.17 | 48.02 | -3.14 |
| 1988 | 0.29 | 2.84 | 9.52 | 5.98 | 1.63 | 5.24 | 4.46 | 3.44 | 1.76 | 0.58 | 0.39 | 2.88 | 39.01 | -12.15 |
| 1989 | 4.26 | 12.00 | 4.84 | 4.48 | 3.97 | 8.43 | 3.17 | 2.02 | ---- | 1.52 | 0.48 | 0.15 | ---- | |
| 1990 | 4.12 | 7.65 | 5.77 | 13.72 | 6.66 | 4.05 | 2.15 | 2.62 | 4.31 | 0.38 | 1.70 | 0.00 | 53.13 | 1.97 |
| 1991 | 6.65 | 14.45 | 5.97 | 6.17 | 6.74 | 6.11 | 9.10 | 2.35 | 1.53 | 0.93 | 2.95 | 0.23 | 63.18 | 12.02 |
| 1992 | 2.16 | 7.58 | 4.98 | 11.24 | 5.09 | 0.91 | 4.74 | 0.34 | 1.39 | 0.72 | 0.71 | 1.66 | 41.52 | -9.64 |
| 1993 | 2.27 | 7.70 | 4.47 | 6.05 | 0.55 | 5.37 | 7.22 | 3.39 | 1.93 | 1.78 | 0.27 | 0.00 | 41.00 | -10.16 |
| 1994 | 1.72 | 1.63 | 8.07 | 5.21 | 6.89 | 4.61 | 2.34 | 1.53 | 3.10 | 0.33 | 0.36 | 2.44 | 38.23 | -12.93 |
| MAX | 9.96 | 14.62 | 16.18 | 20.33 | 14.18 | 11.33 | 9.10 | 5.83 | 4.31 | 3.05 | 4.75 | 7.08 | 69.19 | |
| MIN | 0.19 | 1.55 | 2.32 | 0.58 | 1.44 | 0.59 | 0.42 | 0.20 | 0.13 | 0.00 | 0.02 | 0.00 | 33.95 | |
| MEAN | 4.34 | 7.67 | 8.23 | 8.06 | 6.15 | 5.42 | 3.36 | 1.96 | 1.57 | 0.89 | 1.18 | 1.96 | 51.16 | |

# TABLE 3

## Monthly and Annual Precipitation at Buckley, for Water Years 1932 to 1992 (inches)
## Latitude: N47:10:00 Longitude: W122:00:00 Station Elevation 690 Ft.
## (Earthinfo, 1993)

| Water Year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Annual Total | Departure From Annual Mean (inches) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1932 | 4.82 | 4.15 | 5.54 | 5.07 | 7.26 | 8.74 | 4.02 | 2.22 | 0.72 | 3.08 | 2.11 | 0.98 | 48.71 | 0.27 |
| 1933 | 5.32 | 11.49 | 5.47 | 7.10 | 3.32 | 6.99 | 2.23 | 5.13 | 2.71 | 0.93 | 2.35 | 5.34 | 58.38 | 9.94 |
| 1934 | 6.45 | 4.48 | 21.02 | 9.28 | 1.72 | 6.28 | 3.46 | 3.30 | 0.71 | 0.81 | 1.00 | 3.34 | 61.85 | 13.41 |
| 1935 | 9.58 | 9.58 | 6.75 | 7.20 | 2.20 | 4.53 | 1.63 | 0.85 | 3.74 | 2.01 | 1.01 | 2.25 | 51.33 | 2.89 |
| 1936 | 4.89 | 3.43 | 4.26 | 7.82 | 6.12 | 4.89 | 2.27 | 5.15 | 4.74 | 2.16 | 1.21 | 2.20 | 49.14 | 0.70 |
| 1937 | 1.34 | 1.57 | 8.44 | 2.83 | 5.19 | 4.30 | 6.47 | 1.55 | 7.12 | 0.54 | 2.59 | 1.42 | 43.36 | -5.08 |
| 1938 | 3.13 | 12.34 | 8.58 | 4.94 | 2.31 | 5.26 | 5.18 | 2.19 | 0.80 | 0.64 | 0.28 | 1.17 | 46.82 | -1.62 |
| 1939 | 5.50 | 4.20 | 4.45 | 5.48 | 5.61 | 3.70 | 1.12 | 2.84 | 4.18 | 2.10 | 0.84 | 1.74 | 41.76 | -6.68 |
| 1940 | 3.20 | 3.59 | 6.85 | 1.54 | 8.72 | 4.72 | 4.85 | 1.77 | 0.51 | 2.29 | 0.78 | 4.35 | 43.17 | -5.27 |
| 1941 | 6.43 | 5.45 | 3.87 | 3.18 | 1.93 | 2.35 | 3.05 | 5.41 | 2.84 | 0.17 | 3.44 | 4.75 | 42.87 | -5.57 |
| 1942 | 4.39 | 4.32 | 8.27 | 3.11 | 2.96 | 3.46 | 3.58 | 3.52 | 5.70 | 2.50 | 0.45 | 0.61 | 42.87 | -5.57 |
| 1943 | 3.79 | 7.93 | 6.04 | 2.78 | 2.60 | 6.30 | 4.28 | 3.09 | 4.79 | 1.01 | 1.10 | 1.51 | 45.22 | -3.22 |
| 1944 | 6.35 | 2.11 | 3.87 | 4.05 | 4.13 | 2.35 | 3.52 | 4.68 | 1.75 | 0.21 | 0.71 | 3.06 | 36.79 | -11.65 |
| 1945 | 2.30 | 4.46 | 2.65 | 6.34 | 5.43 | 4.87 | 6.57 | 4.85 | 0.80 | 0.22 | 0.70 | 5.17 | 44.36 | -4.08 |
| 1946 | 5.02 | 6.79 | 5.99 | 7.05 | 6.93 | 6.47 | 3.10 | 0.97 | 7.23 | 1.90 | 0.33 | 3.33 | 55.11 | 6.67 |
| 1947 | 5.01 | 7.07 | 8.87 | 6.66 | 3.00 | 4.03 | 5.45 | 1.46 | 4.68 | 1.21 | 0.79 | 1.76 | 49.99 | 1.55 |
| 1948 | 9.17 | 6.27 | 6.02 | --- | --- | --- | --- | --- | 4.33 | 3.52 | 2.86 | 4.47 | ---- | |
| 1949 | 3.00 | 6.33 | 7.61 | 1.01 | 7.39 | 3.04 | 3.20 | 1.70 | 2.54 | 1.39 | 1.22 | 1.78 | 40.21 | -8.23 |
| 1950 | 5.73 | 7.96 | 7.69 | 7.36 | 7.43 | 8.34 | 4.43 | 2.41 | 1.99 | 1.06 | 2.28 | 2.18 | 58.86 | 10.42 |
| 1951 | 8.37 | 8.81 | 8.63 | 6.78 | 9.12 | 4.51 | 0.93 | 3.87 | 0.58 | 0.10 | 1.19 | 2.87 | 55.76 | 7.32 |
| 1952 | 5.59 | 4.57 | 4.77 | 3.11 | 4.41 | 3.86 | 3.30 | 2.78 | 2.63 | 0.76 | 0.67 | 0.50 | 36.95 | -11.49 |
| 1953 | 1.59 | 0.78 | 3.58 | 14.89 | 3.79 | 3.92 | 4.63 | 4.59 | 4.43 | 1.64 | 1.82 | 2.73 | 48.39 | -0.05 |
| 1954 | 5.25 | 7.20 | 10.08 | 8.16 | 3.88 | 2.73 | 4.38 | 3.49 | 4.30 | 1.75 | 3.14 | 3.18 | 57.54 | 9.10 |
| 1955 | 3.16 | 5.05 | 5.70 | 2.55 | 4.45 | 5.11 | 6.40 | 2.75 | 3.11 | 2.77 | 0.20 | 2.02 | 43.27 | -5.17 |
| 1956 | 8.90 | 8.75 | 9.96 | 7.51 | 2.99 | 6.80 | 1.13 | 2.13 | 4.14 | 0.90 | 1.10 | 2.41 | 56.72 | 8.28 |
| 1957 | 6.94 | 3.03 | 8.00 | 2.99 | 4.49 | 7.08 | 3.29 | 2.72 | 3.30 | 1.13 | 2.25 | 1.42 | 46.64 | -1.80 |
| 1958 | 3.81 | 3.43 | 6.51 | 7.20 | 5.90 | 2.19 | 5.50 | 1.54 | 2.85 | 0.05 | 0.64 | 2.60 | 42.22 | -6.22 |
| 1959 | 4.55 | 10.70 | 8.25 | 7.33 | 3.16 | 4.89 | 4.20 | 3.21 | 4.66 | 0.61 | 1.51 | 8.02 | 61.09 | 12.65 |
| 1960 | 4.64 | 9.17 | 6.07 | 4.11 | 4.11 | 4.67 | 4.98 | 7.20 | 1.83 | 0.00 | 3.16 | 1.53 | 51.47 | 3.03 |
| 1961 | 5.94 | 12.02 | 3.40 | 6.41 | 11.32 | 4.47 | 4.32 | 4.18 | 1.67 | 0.64 | 1.06 | 1.71 | 57.14 | 8.70 |
| 1962 | 4.37 | 4.10 | 6.31 | 2.86 | 2.59 | 4.09 | 3.01 | 3.98 | 1.62 | 0.51 | 3.57 | 3.03 | 40.04 | -8.40 |
| 1963 | 3.30 | 9.63 | 5.47 | --- | --- | --- | --- | --- | --- | --- | 1.16 | --- | ---- | |
| 1964 | --- | --- | --- | 10.77 | 2.08 | 4.66 | 3.23 | 3.27 | 5.52 | 1.54 | 1.96 | 2.62 | ---- | |
| 1965 | 2.61 | 8.69 | 8.51 | 8.81 | 4.99 | 0.87 | 5.39 | 2.53 | 0.52 | 1.29 | 3.45 | 0.82 | 48.48 | 0.04 |
| 1966 | 3.87 | 4.97 | 6.33 | 5.51 | 2.95 | 3.99 | 3.42 | 2.63 | 3.83 | 2.42 | 0.49 | 2.89 | 43.30 | -5.14 |
| 1967 | 5.23 | 6.72 | 6.12 | 10.44 | 4.34 | 4.33 | 4.19 | 1.40 | 2.01 | 0.23 | 0.01 | 1.33 | 46.35 | -2.09 |
| 1968 | 8.35 | 2.66 | 4.43 | 5.81 | 6.94 | 5.36 | 2.52 | 2.81 | 5.22 | 0.68 | 6.25 | 3.85 | 54.88 | 6.44 |
| 1969 | 4.38 | 7.12 | 7.78 | 6.74 | 2.36 | 3.60 | 5.33 | 4.50 | 3.12 | 0.51 | 0.54 | 6.23 | 52.21 | 3.77 |
| 1970 | 2.77 | 3.44 | 6.57 | 9.51 | 2.80 | 2.76 | 5.61 | 2.28 | 1.42 | 1.13 | 0.61 | 3.26 | 42.16 | -6.28 |
| 1971 | 3.36 | 5.19 | 6.98 | 8.76 | 4.20 | 6.41 | 2.99 | 2.96 | 4.57 | 1.29 | 0.83 | 4.30 | 51.84 | 3.40 |
| 1972 | 3.23 | 5.71 | 6.98 | 8.28 | 9.35 | 6.71 | 5.75 | 1.55 | 4.05 | 2.27 | 1.29 | 5.77 | 60.94 | 12.50 |
| 1973 | 1.37 | 3.94 | 8.90 | 3.81 | 2.77 | 2.98 | 2.64 | 3.89 | 4.44 | 0.13 | 0.31 | 2.71 | 37.89 | -10.55 |
| 1974 | 4.72 | 8.33 | 8.46 | 8.45 | 4.82 | 5.15 | 5.17 | 4.03 | 2.63 | 3.19 | 0.31 | 0.48 | 55.74 | 7.30 |
| 1975 | 2.11 | 7.43 | 7.51 | 10.19 | 7.11 | 4.03 | 2.26 | 2.65 | 2.25 | 1.07 | 5.66 | 0.22 | 52.49 | 4.05 |
| 1976 | 7.93 | 7.39 | 10.19 | 6.72 | 4.83 | 3.48 | 3.37 | 3.02 | 2.76 | 1.71 | 5.54 | 2.44 | 59.38 | 10.94 |
| 1977 | 2.26 | 1.96 | 3.19 | 1.17 | 1.77 | 5.84 | 1.92 | 4.91 | 1.23 | 0.38 | 5.85 | 4.30 | 34.78 | -13.66 |
| 1978 | 3.23 | 6.26 | 7.65 | 4.58 | 3.27 | 2.56 | 4.59 | 2.99 | 2.80 | 1.20 | 3.05 | 6.77 | 48.95 | 0.51 |
| 1979 | 1.08 | 7.10 | 3.47 | 4.05 | 7.65 | 2.77 | 3.87 | 1.83 | 1.48 | 2.06 | 1.38 | 3.46 | 40.20 | -8.24 |
| 1980 | 4.73 | 2.23 | 9.81 | 6.19 | 5.76 | 5.54 | 5.11 | 2.52 | 2.05 | 1.11 | 2.04 | 3.07 | 50.16 | 1.72 |
| 1981 | 1.62 | 9.01 | 9.37 | 2.76 | 6.54 | 2.78 | 4.63 | 5.10 | 5.11 | 1.95 | 0.73 | 3.22 | 52.82 | 4.38 |
| 1982 | 6.18 | 4.77 | 8.17 | 6.52 | 8.93 | 5.02 | 2.87 | 0.94 | 2.12 | 2.18 | 1.09 | 2.89 | 51.68 | 3.24 |
| 1983 | 4.55 | 4.18 | 5.60 | 8.05 | 4.35 | 5.27 | 1.70 | 2.39 | 4.29 | 5.24 | 1.38 | 3.57 | 50.57 | 2.13 |
| 1984 | 2.66 | 9.59 | 5.43 | 8.07 | 4.58 | 5.28 | 4.55 | 6.46 | 4.74 | 0.00 | 0.47 | 2.04 | 53.87 | 5.43 |
| 1985 | 3.51 | 8.16 | 5.22 | 0.85 | 3.15 | 3.85 | 2.95 | 2.36 | 2.73 | 0.08 | 2.40 | 2.59 | 37.85 | -10.59 |
| 1986 | 7.44 | 5.86 | 1.19 | 6.37 | 6.09 | 4.83 | 3.45 | 4.62 | 1.33 | 2.50 | --- | 3.80 | ---- | |
| 1987 | 2.69 | 11.34 | 3.16 | 4.81 | 3.29 | 4.91 | 5.12 | 3.61 | 0.50 | 1.12 | 0.70 | 1.12 | 42.37 | -6.07 |
| 1988 | 1.03 | 3.96 | 5.59 | 4.59 | 1.72 | 7.46 | 6.57 | 5.41 | 1.59 | 1.85 | 0.85 | 2.67 | 43.29 | -5.15 |
| 1989 | 4.95 | 9.73 | 3.64 | 6.85 | 2.44 | 6.94 | 3.70 | 2.66 | 1.72 | 0.78 | 0.74 | 0.32 | 44.47 | -3.97 |
| 1990 | 2.28 | 9.36 | 4.98 | 10.34 | 5.31 | 3.54 | 5.38 | 3.75 | 4.83 | 1.75 | 3.40 | 0.16 | 55.08 | 6.64 |
| 1991 | 7.39 | 11.85 | 3.84 | 4.14 | 7.73 | 3.26 | 7.30 | 3.20 | 1.47 | 0.06 | 2.14 | 0.11 | 52.49 | 4.05 |
| 1992 | 1.95 | 7.96 | 3.51 | 5.88 | 3.58 | 2.26 | 4.93 | 1.09 | 1.68 | 1.84 | 1.30 | 2.96 | 38.94 | -9.50 |
| MAX | 9.58 | 12.34 | 21.02 | 14.89 | 11.32 | 8.74 | 7.30 | 7.20 | 7.23 | 5.24 | 6.25 | 8.02 | 61.58 | |
| MIN | 1.03 | 0.78 | 1.19 | 0.85 | 1.72 | 0.87 | 0.93 | 0.85 | 0.50 | 0.00 | 0.01 | 0.11 | 34.78 | |
| MEAN | 4.49 | 6.43 | 6.52 | 6.03 | 4.75 | 4.60 | 3.98 | 3.17 | 2.98 | 1.34 | 1.70 | 2.72 | 48.44 | |

# TABLE 4

## Monthly and Annual Precipitation at Olympia, for Water Years 1949 to 1994 (inches)
## Latitude: N46:58:00 Longitude: W122:54:00 Station Elevation: 190 Ft
## (Earthinfo, 1994)

| Water Year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Annual Total | Departure From Annual Mean (inches) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1949 | 4.35 | 10.19 | 12.11 | 0.69 | 9.96 | 3.75 | 1.52 | 1.54 | 0.72 | 0.51 | 0.82 | 1.39 | 47.55 | -2.54 |
| 1950 | 5.24 | 12.33 | 10.73 | 9.31 | 9.66 | 10.13 | 3.10 | 0.79 | 0.86 | 1.35 | 1.47 | 2.19 | 67.16 | 17.07 |
| 1951 | 9.20 | 9.49 | 9.16 | 10.59 | 11.28 | 5.89 | 0.54 | 1.91 | 0.05 | 0.28 | 0.54 | 2.83 | 61.76 | 11.67 |
| 1952 | 6.95 | 7.32 | 5.80 | 5.65 | 3.96 | 3.13 | 2.25 | 0.85 | 1.22 | 0.10 | 0.74 | 0.43 | 38.40 | -11.69 |
| 1953 | 1.55 | 1.39 | 8.65 | 19.84 | 5.12 | 3.55 | 2.58 | 2.72 | 1.50 | 0.27 | 1.63 | 2.68 | 51.48 | 1.39 |
| 1954 | 6.85 | 7.79 | 9.42 | 11.96 | 8.40 | 3.13 | 4.07 | 1.63 | 3.36 | 0.82 | 1.74 | 1.89 | 61.06 | 10.97 |
| 1955 | 3.38 | 7.87 | 6.99 | 3.01 | 5.23 | 4.76 | 4.19 | 1.35 | 0.71 | 2.68 | 0.02 | 1.84 | 42.03 | -8.06 |
| 1956 | 9.31 | 12.18 | 12.59 | 10.75 | 3.93 | 8.27 | 0.37 | 0.30 | 2.57 | 0.38 | 0.88 | 2.30 | 63.83 | 13.74 |
| 1957 | 9.52 | 2.81 | 9.36 | 3.02 | 5.88 | 7.43 | 1.72 | 1.42 | 1.78 | 0.97 | 0.87 | 0.66 | 45.44 | -4.65 |
| 1958 | 4.74 | 4.05 | 8.91 | 7.87 | 6.40 | 2.29 | 4.39 | 1.47 | 1.65 | 0.00 | 0.62 | 1.52 | 43.91 | -6.18 |
| 1959 | 5.41 | 12.35 | 8.43 | 8.91 | 4.53 | 4.63 | 4.51 | 1.45 | 1.85 | 0.30 | 0.70 | 4.26 | 57.33 | 7.24 |
| 1960 | 3.92 | 10.36 | 7.50 | 6.35 | 5.93 | 6.12 | 4.53 | 3.50 | 0.59 | 0.00 | 1.16 | 1.21 | 51.17 | 1.08 |
| 1961 | 5.84 | 11.33 | 3.89 | 8.69 | 13.18 | 6.26 | 3.29 | 2.93 | 1.05 | 0.80 | 1.01 | 0.33 | 58.60 | 8.51 |
| 1962 | 4.97 | 6.78 | 8.25 | 3.22 | 3.72 | 3.82 | 4.50 | 1.81 | 0.89 | 0.14 | 3.17 | 2.45 | 43.72 | -6.37 |
| 1963 | 6.00 | 15.51 | 5.81 | 3.47 | 6.42 | 5.10 | 4.13 | 1.76 | 0.63 | 1.48 | 0.79 | ---- | ---- | |
| 1964 | ---- | ---- | ---- | 15.13 | 2.54 | 4.47 | 1.58 | 0.98 | 2.35 | 1.07 | 1.47 | 2.26 | ---- | |
| 1965 | 1.79 | 9.18 | 9.11 | 9.37 | 4.93 | 0.48 | 3.61 | 1.89 | 0.33 | 0.48 | 2.05 | 0.60 | 43.82 | -6.27 |
| 1966 | 3.30 | 5.84 | 7.81 | 7.89 | 3.38 | 7.28 | 1.71 | 1.30 | 1.28 | 1.34 | 0.68 | 1.95 | 43.76 | -6.33 |
| 1967 | 4.83 | 8.16 | 11.53 | 12.21 | 3.58 | 4.31 | 2.88 | 0.25 | 1.49 | 0.02 | 0.00 | 1.36 | 50.62 | 0.53 |
| 1968 | 10.00 | 3.90 | 5.94 | 9.04 | 7.83 | 6.53 | 3.02 | 2.57 | 2.43 | 0.89 | 5.45 | 2.51 | 60.19 | 10.10 |
| 1969 | 6.07 | 7.96 | 9.95 | 9.45 | 3.41 | 2.90 | 3.44 | 2.07 | 1.68 | 0.50 | 0.18 | 5.23 | 52.84 | 2.75 |
| 1970 | 2.69 | 3.60 | 7.24 | 12.48 | 4.30 | 3.07 | 4.76 | 1.21 | 0.14 | 0.16 | 0.15 | 3.20 | 43.00 | -7.09 |
| 1971 | 2.71 | 7.40 | 14.32 | 11.15 | 4.41 | 9.11 | 2.78 | 1.50 | 3.00 | 0.78 | 0.71 | 3.06 | 60.93 | 10.84 |
| 1972 | 4.43 | 7.59 | 9.18 | 12.43 | 11.06 | 10.01 | 5.87 | 0.83 | 1.07 | 1.72 | 0.70 | 5.04 | 69.93 | 19.84 |
| 1973 | 0.85 | 4.17 | 10.66 | 5.66 | 1.71 | 3.02 | 2.23 | 2.66 | 2.60 | 0.05 | 0.59 | 2.18 | 36.38 | -13.71 |
| 1974 | 4.60 | 12.95 | 11.61 | 10.57 | 5.68 | 6.65 | 4.77 | 2.65 | 1.57 | 2.29 | 0.07 | 0.50 | 63.91 | 13.82 |
| 1975 | 1.38 | 7.44 | 8.86 | 9.70 | 5.61 | 4.32 | 1.88 | 1.51 | 0.72 | 0.25 | 3.97 | 0.00 | 45.64 | -4.45 |
| 1976 | 8.38 | 9.54 | 11.42 | 9.40 | 7.25 | 4.24 | 2.79 | 2.66 | 1.07 | 1.26 | 2.71 | 1.22 | 61.94 | 11.85 |
| 1977 | 2.64 | 1.37 | 3.00 | 1.55 | 3.70 | 4.44 | 1.27 | 5.21 | 0.64 | 0.32 | 4.17 | 4.58 | 32.89 | -17.20 |
| 1978 | 3.40 | 9.30 | 12.36 | 6.61 | 4.39 | 3.45 | 3.97 | 2.90 | 1.54 | 1.49 | 1.47 | 7.59 | 58.47 | 8.38 |
| 1979 | 0.78 | 6.81 | 2.95 | 2.67 | 9.25 | 2.73 | 2.21 | 1.40 | 1.11 | 1.58 | 1.56 | 2.72 | 35.77 | -14.32 |
| 1980 | 6.20 | 2.38 | 13.01 | 6.27 | 6.18 | 3.98 | 4.14 | 0.93 | 2.46 | 0.41 | 0.36 | 2.21 | 48.53 | -1.56 |
| 1981 | 1.84 | 9.77 | 10.92 | 2.54 | 9.19 | 3.86 | 4.77 | 1.81 | 2.96 | 0.36 | 0.85 | 2.44 | 51.31 | 1.22 |
| 1982 | 8.17 | 7.22 | 8.60 | 7.79 | 9.91 | 4.67 | 3.89 | 0.51 | 1.15 | 0.54 | 0.55 | 1.89 | 54.89 | 4.80 |
| 1983 | 6.12 | 5.74 | 10.64 | 9.99 | 7.09 | 6.63 | 2.26 | 1.51 | 2.80 | 3.00 | 2.18 | 1.89 | 59.85 | 9.76 |
| 1984 | 1.66 | 12.84 | 7.28 | 6.97 | 5.49 | 6.42 | 3.67 | 5.48 | 3.74 | 0.00 | 0.21 | 1.76 | 55.52 | 5.43 |
| 1985 | 5.13 | 12.19 | 4.97 | 0.29 | 3.54 | 4.10 | 2.65 | 0.94 | 2.48 | 0.37 | 0.70 | 2.65 | 40.01 | -10.08 |
| 1986 | 9.86 | 4.99 | 2.50 | 12.14 | 6.84 | 2.29 | 2.87 | 3.20 | 0.92 | 1.11 | 0.01 | 3.38 | 50.11 | 0.02 |
| 1987 | 4.12 | 11.09 | 5.20 | 8.38 | 3.55 | 7.14 | 3.11 | 2.71 | 0.32 | 0.84 | 0.24 | 0.29 | 46.99 | -3.10 |
| 1988 | 0.39 | 3.65 | 9.14 | 5.18 | 2.35 | 5.66 | 4.94 | 3.36 | 2.06 | 0.42 | 0.43 | 1.93 | 39.51 | -10.58 |
| 1989 | 2.26 | 10.14 | 5.16 | 5.41 | 4.19 | 7.88 | 2.49 | 1.99 | 1.47 | 0.70 | 0.55 | 0.49 | 42.73 | -7.36 |
| 1990 | 2.42 | 8.50 | 5.66 | 14.53 | 8.52 | 3.54 | 3.29 | 2.06 | 2.86 | 0.32 | 1.79 | 0.03 | 53.52 | 3.43 |
| 1991 | 6.34 | 15.06 | 5.05 | 5.35 | 5.85 | 4.32 | 7.80 | 1.69 | 1.30 | 0.33 | 2.31 | 0.00 | 55.40 | 5.31 |
| 1992 | 2.20 | 7.00 | 4.28 | 9.45 | 4.19 | 1.50 | 5.15 | 0.19 | 1.15 | 0.36 | 0.82 | 2.44 | 38.73 | -11.36 |
| 1993 | 2.80 | 6.82 | 5.28 | 5.36 | 0.22 | 4.95 | 6.67 | 4.57 | 1.77 | 1.35 | 0.15 | 0.00 | 39.94 | -10.15 |
| 1994 | 1.63 | 2.86 | 6.02 | 3.80 | 6.38 | 4.83 | 1.82 | 1.44 | 1.90 | 0.29 | 0.80 | 1.52 | 33.29 | -16.80 |
| Max | 10.00 | 15.51 | 14.32 | 19.84 | 13.18 | 10.13 | 7.8 | 5.48 | 3.74 | 3.00 | 5.45 | 7.59 | 69.93 | |
| Min | 0.39 | 1.37 | 2.50 | 0.29 | 0.22 | 0.48 | 0.37 | 0.19 | 0.05 | 0.00 | 0.00 | 0.00 | 32.89 | |
| Mean | 4.58 | 7.94 | 8.16 | 7.87 | 5.87 | 4.83 | 3.31 | 1.91 | 1.52 | 0.75 | 1.16 | 2.03 | 50.09 | |

## STUDY METHODS

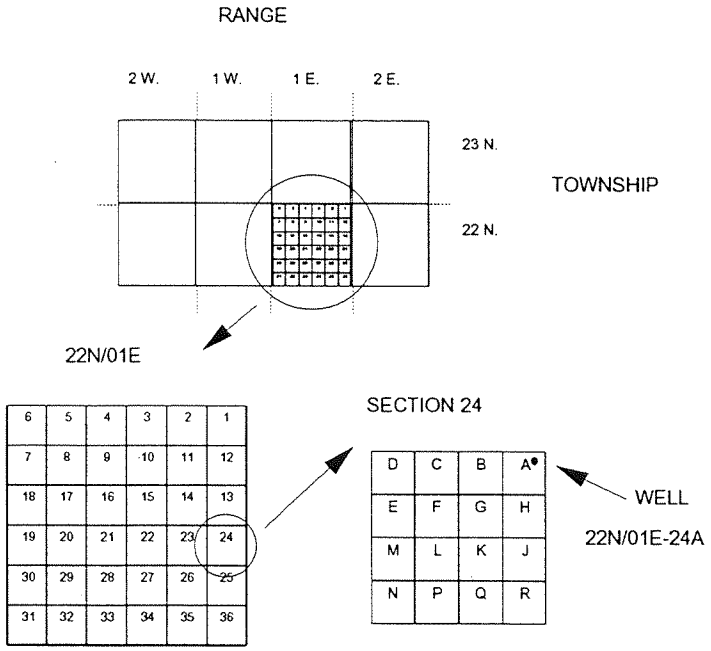
This section contains brief descriptions of the methods and procedures we used for locating and numbering wells, determining well-head elevations, and measuring ground-water levels and lake stage.

### Well Numbering and Location System

Following Ecology's standard procedure, we assigned unique identification numbers to the wells we monitored. The identification number, which consists of three letters followed by three numbers (i.e. AAB324), is stamped on a metal tag that is secured to the well casing or another permanent fixture of the water system. We defined well locations in terms of township, range, section, and quarter-quarter of the section (Public Land Survey system). Township designations include an "N" and range designations include an "E" to indicate the well lies north and east of the Willamette baseline and meridian, respectively. The quarter-quarter section is represented by a single capital letter. For example, a well in the northeast quarter of the northeast quarter of Section 24, Township 22 North, Range 01 East, is recorded as 22N/01E-24A (Figure 4). If more than one well is referenced per quarter-quarter section, a sequential number is included after the last letter to assure uniqueness of identification.

FIGURE 4

Well Numbering and Location System



## Determination of Well-Head Elevations

We determined well-head elevations from 7.5 minute topographic maps and verified them using a surveying altimeter. The well elevations referenced in this report should only be considered accurate to ± 5 feet.

## Measurement of Ground-Water Levels

For this study, we measured ground-water levels in two wells: the Lakewood Plat's Well 1 and the St. Albans Girl Scout Camp's well 3 (Figure 2 and Table 5). We measured ground-water levels with an electric well probe to the nearest 0.01 foot. We rounded the measured values to the nearest 0.10 foot for reporting purposes.

## Measurement of Lake Stage

The stage of Lake Devereaux has been measured periodically since January 1990 by Syke Sekor, St. Alban's Scout Camp Ranger (Sekor, 1994; Table 6). Stage measurements are taken at a gage installed near the camp dock in late 1989 (Figure 2). The gage consists of a one-inch diameter pipe imbedded in concrete. The pipe is graduated in one-foot increments with the upper surface of the concrete pad representing an arbitrary datum of zero. All gage readings cited in this report are referenced to this arbitrary datum.

# TABLE 5

## Ground-Water Level Records

| Unique Well Number | Well Location | Latitude | Longitude | Land Surface Elevation (Ft msl) | Drilled Depth (Ft) | Cased/ Lined Depth (Ft) | Open/Screened Interval (Feet Below Land Surface) | Water Level Measurement Date | Static Water Level (Feet Below Land Surface) | Static Water Level Elevation (Feet, MSL) | Measurement Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AAB324 | 22N/01W-08L | 472438 | 1225005 | 274 | 199 | 178.8 | 178.8-199.7 | 06/18/1993 | 123.0 | 150.0 | R |
| | | | | | | | | 06/23/1993 | 123.6 | 150.5 | V |
| | | | | | | | | 11/05/1993 | 123.7 | 150.3 | T |
| | | | | | | | | 12/17/1993 | 124.3 | 149.7 | T |
| | | | | | | | | 01/19/1994 | 123.9 | 150.1 | T |
| | | | | | | | | 02/16/1994 | 123.8 | 150.2 | T |
| | | | | | | | | 03/18/1994 | 123.7 | 150.3 | T |
| | | | | | | | | 04/21/1994 | 124.3 | 149.7 | T |
| | | | | | | | | 06/16/1994 | 124.7 | 149.3 | T |
| | | | | | | | | 08/26/1994 | 124.8 | 149.2 | T |
| AAB871 | 22N/01W-08N | 472421 | 1225030 | 260 | 81* | 81 | Unknown | 01/04/1990 | 50.6 | 209.7 | T |
| | | | | | | | | 02/27/1990 | 44.6 | 215.4 | T |
| | | | | | | | | 03/15/1990 | 43.7 | 216.4 | T |
| | | | | | | | | 11/05/1993 | 49.3 | 210.8 | T |
| | | | | | | | | 12/17/1993 | 50.0 | 210.0 | T |
| | | | | | | | | 01/19/1994 | 49.7 | 210.3 | T |
| | | | | | | | | 02/16/1994 | 49.7 | 210.3 | T |
| | | | | | | | | 03/18/1994 | 47.6 | 212.5 | T |
| | | | | | | | | 04/21/1994 | 46.6 | 213.4 | T |
| | | | | | | | | 06/16/1994 | 47.0 | 213.0 | T |
| | | | | | | | | 08/26/1994 | 48.8 | 211.2 | T |

(*) Well depth sounded-no well report available.

Measurement Method Status Codes:

R - water level was measured and reported by driller at time of well completion.
V - water level was measured with a calibrated electric tape.
T - water level was measured with an electric tape.

TABLE 6

Lake Devereaux Stage, as Measured at the Saint Albans Girl Scout Camp Gage (Sekor, 1994)

| Measurement Date | Lake Stage (Ft) | Measurement Date | Lake Stage (Ft) |
|---|---|---|---|
| 01/06/90 | 10.8 | 02/16/93 | 13.3 |
| 01/10/90 | 12.1 | 03/10/93 | 13.1 |
| 01/29/90 | 13.0 | 03/23/93 | 13.3 |
| 02/02/90 | 14.0 | 04/13/93 | 13.3 |
| 02/07/90 | 15.0 | 04/28/93 | 13.6 |
| 02/27/90 | 16.2 | 05/12/93 | 13.6 |
| 03/09/90 | 16.6 | 05/30/93 | 13.3 |
| 03/15/90 | 16.9 | 06/09/93 | 13.1 |
| 04/02/90 | 17.0 | 06/21/93 | 13.0 |
| 04/18/90 | 16.8 | 07/07/93 | 12.6 |
| 05/03/90 | 16.6 | 07/21/93 | 12.3 |
| 05/23/90 | 16.3 | 08/04/93 | 12.0 |
| 06/03/90 | 16.2 | 08/15/93 | 11.7 |
| 08/20/90 | 14.1 | 08/19/93 | 11.5 |
| 10/02/90 | 13.0 | 09/01/93 | 11.3 |
| 10/31/90 | 12.9 | 09/10/93 | 10.8 |
| 11/13/90 | 13.1 | 09/20/93 | 10.7 |
| 11/28/90 | 15.0 | 09/27/93 | 10.5 |
| 12/05/90 | 15.8 | 10/06/93 | 10.4 |
| 12/30/90 | 16.6 | 10/13/93 | 9.9 |
| 01/10/91 | 16.8 | 10/27/93 | 10.0 |
| 01/21/91 | 17.8 | 11/02/93 | 9.8 |
| 02/02/91 | 18.0 | 11/18/93 | 9.6 |
| 02/08/91 | 18.8 | 11/30/93 | 9.3 |
| 03/06/91 | 19.2 | 12/07/93 | 9.7 |
| 03/27/91 | 18.4 | 12/15/93 | 10.2 |
| 04/05/91 | 19.0 | 01/06/94 | 10.6 |
| 04/09/91 | 19.4 | 01/18/94 | 10.7 |
| 04/19/91 | 18.8 | 01/26/94 | 10.7 |
| 06/01/91 | 18.0 | 02/02/94 | 10.6 |
| 06/21/91 | 17.8 | 02/16/94 | 10.8 |
| 10/10/91 | 15.0 | 02/23/94 | 11.3 |
| 11/12/91 | 14.5 | 02/28/94 | 11.6 |
| 11/27/91 | 15.0 | 03/04/94 | 12.3 |
| 01/04/92 | 15.3 | 03/07/94 | 12.4 |
| 01/24/92 | 15.5 | 03/15/94 | 12.5 |
| 01/31/92 | 17.9 | 03/18/94 | 12.6 |
| 02/06/92 | 18.8 | 03/21/94 | 12.7 |
| 02/20/92 | 18.8 | 04/04/94 | 12.7 |
| 03/04/92 | 18.9 | 04/13/94 | 12.8 |
| 03/14/92 | 18.5 | 04/21/94 | 12.8 |
| 04/01/92 | 18.1 | 05/05/94 | 12.5 |
| 04/21/92 | 18.1 | 05/13/94 | 12.3 |
| 05/19/92 | 17.5 | 05/16/94 | 12.0 |
| 06/09/92 | 17.1 | 05/31/94 | 11.9 |
| 06/25/92 | 16.6 | 06/06/94 | 11.8 |
| 09/12/92 | 14.5 | 06/16/94 | 11.5 |
| 09/30/92 | 13.9 | 07/05/94 | 11.0 |
| 10/03/92 | 13.8 | 07/21/94 | 10.7 |
| 11/07/92 | 13.3 | 07/28/94 | 10.4 |
| 11/18/92 | 13.2 | 08/08/94 | 10.1 |
| 12/05/92 | 13.1 | 08/13/94 | 10.0 |
| 12/22/92 | 13.3 | 08/26/94 | 9.4 |
| 01/30/93 | 13.5 | | |

## HYDROGEOLOGY

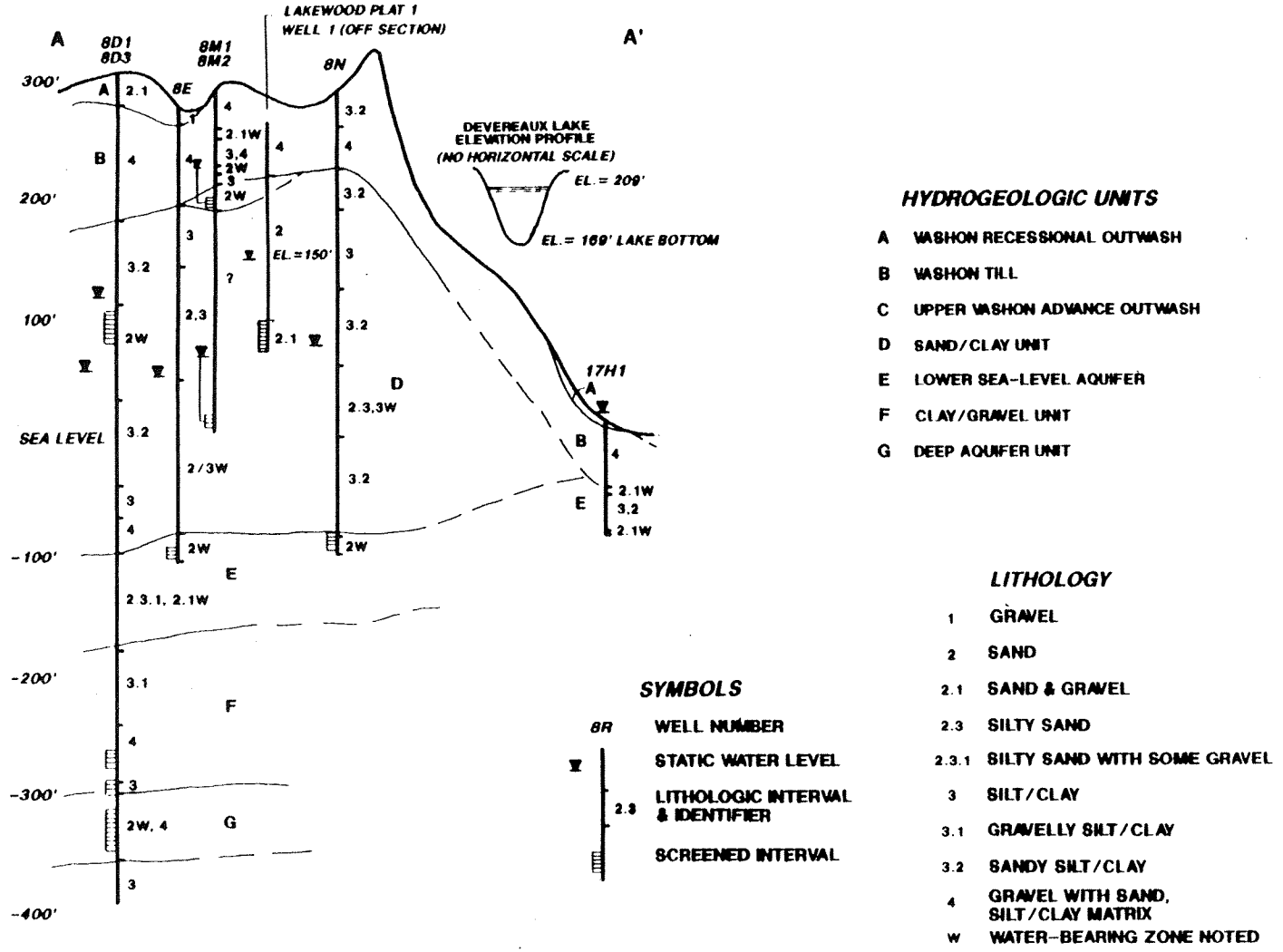
Lake Devereaux lies within the recharge area for the major supply aquifers that underlie the uplands between Hood Canal and North Bay (Sebren, 1993). In the upland interior ground water moves generally downward from the shallow aquifers that border and immediately underlie the lake, into deeper, more extensive aquifers which are the major water source for most of the domestic and irrigation water used in the area (Figure 2 and Figure 5). These deeper aquifers probably discharge directly to salt water or at springs that emanate from the hillsides bordering North Bay and Hood Canal.

In addition to ground-water inflow from shallow aquifers, Lake Devereaux is maintained in part by intermittent streams (depicted with arrows in Figure 2) that originate in the surrounding uplands to the south and west of the lake. Surface water from the west side of the watershed reaches the lake through a series of culverts that underlie the Northern Pacific Railroad tracks (Figure 2).

Observations by prior authors suggest that, on a seasonal basis, the lake both gains from and loses water to the shallow aquifers bordering and underlying it (Rongey, 1965 and Sebren, 1993). The volume and timing of this exchange is dependent on the water-level differences between the lake and local aquifers. If the lake stage exceeds the ground-water level, water will move from the lake to replenish aquifer storage. If ground-water levels exceed lake stage, the flow of water will reverse, and the lake will be replenished by ground-water discharge. The amount of water exchanged seasonally between Lake Devereaux and the local ground-water system has not been rigorously established to date.

Comparison of lake stage and ground-water-level measurements made during this study indicate that stage changes in Lake Devereaux correspond closely with changes in local ground-water levels (Figures 6 and 7). As such, water-supply development which causes a progressive lowering of ground-water levels in the aquifers underlying the lake will likely increase seepage losses through the lake bottom or reduce ground-water discharge to the lake.

# GEOLOGIC CROSS SECTION THROUGH THE LAKE DEVEREAUX VICINITY




(From Sebren, 1993)

FIGURE 6

Comparison of Water Levels in Lake Devereaux and Well AAB871

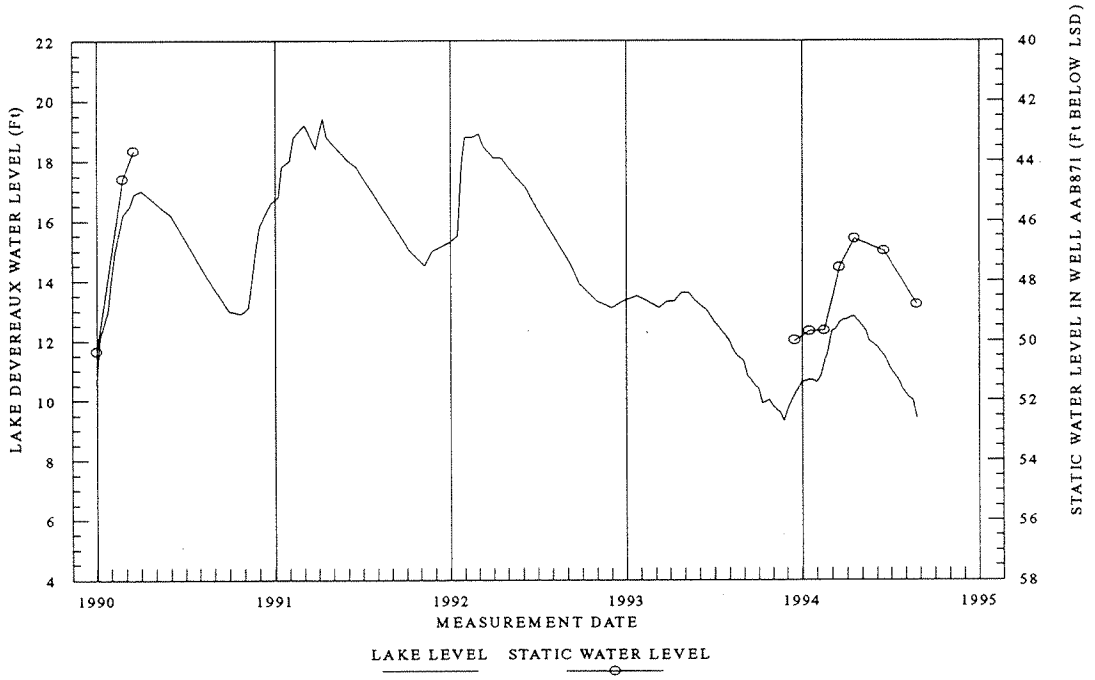
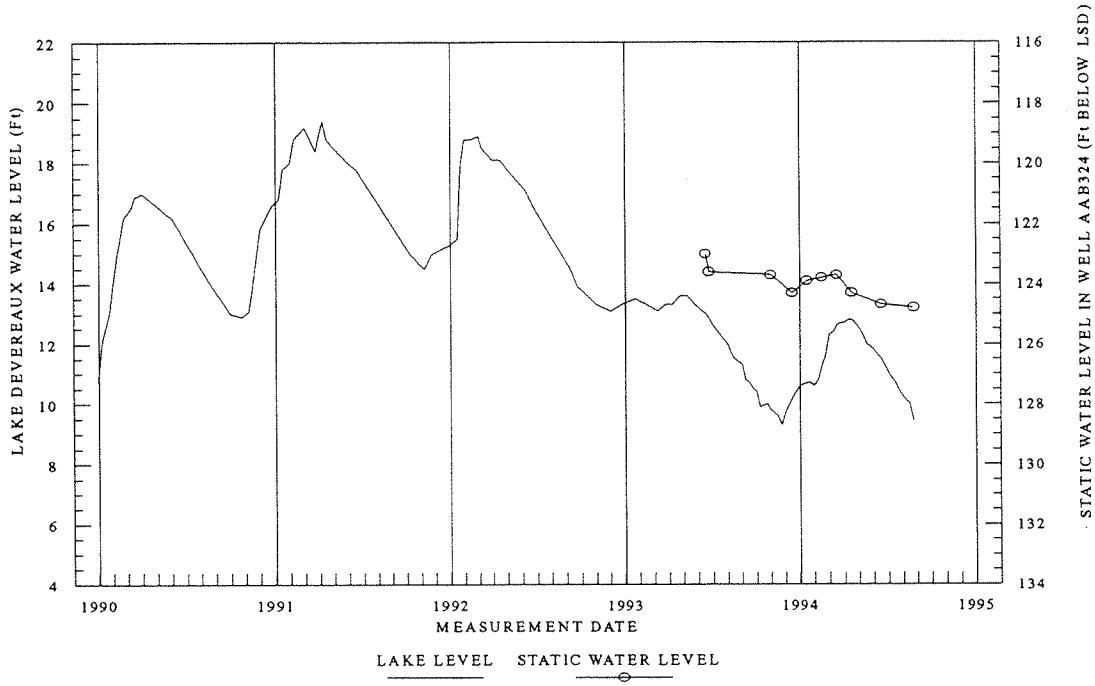



FIGURE 7

Comparison of Water Levels in Lake Devereaux and Well AAB324

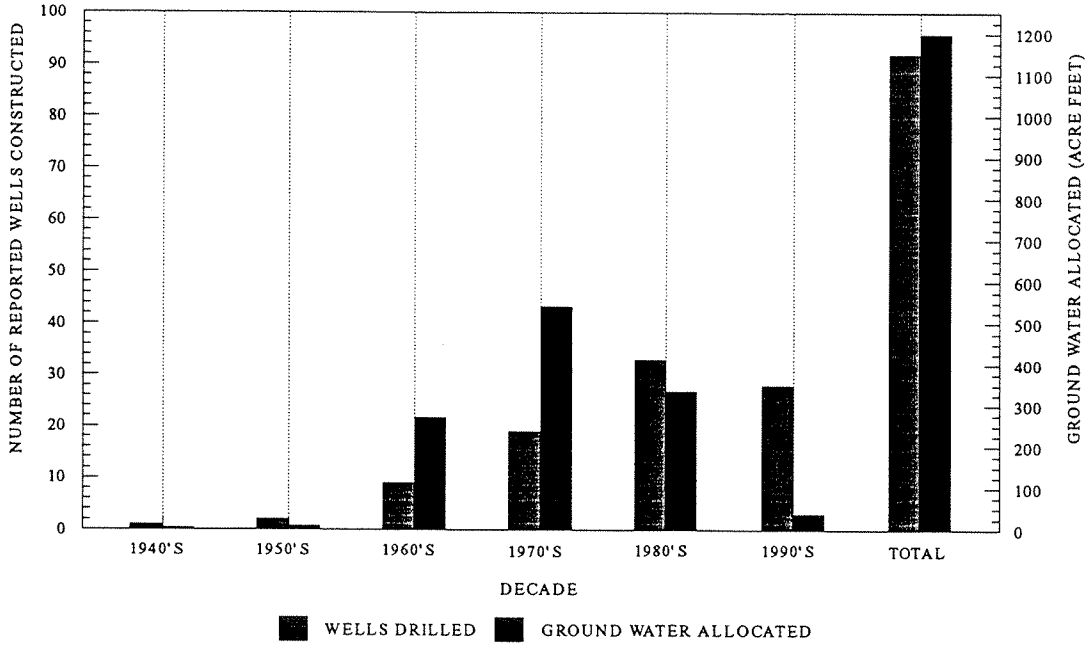


## WATER USE

In considering the potential effects of ground-water pumping on lake levels, we evaluated well-construction activity and water-right allocations from 1940 to present, for an eight square-mile area around Lake Devereaux (Figure 8). The area we evaluated encompassed Sections 5 through 8, and 17 through 20, of T. 22 N., R. 1 W.,W.M. It should be noted that well reports were not routinely filed with Ecology prior to 1973. Accordingly, the number of reports filed prior to 1973 may be a poor indicator of the actual number of wells drilled.

FIGURE 8

Ground Water Allocation and Well Construction Activity
for the Lake Devereaux Area, by Decade




### Ground-Water Allocation

To date, ground-water rights for a cumulative withdrawal of approximately 1,200 acre-feet per year (AF/year) have been authorized for the area surrounding Lake Devereaux. The permit dates for these rights indicate that major development began in the 1960's and peaked in the 1970's, when roughly 550 AF/year of ground water were allocated. Notable appropriations include allocations of 280 AF/year to Lakeland Village in the mid-1970's; 160 AF/year to the Belfair Water District in 1976; 180 AF/year to Lakeland Village in 1981 for golf-course irrigation; and 225 AF/year to the Belfair Water District in 1986.

In total, Lakeland Village has rights to use 460 AF/year of ground water, to supply the development's domestic and irrigation needs. The village pumps water from five wells, ranging in depth from 147 to 417 feet. The development meters water use from its domestic wells, but not from the two irrigation wells. However, fairly accurate estimates of irrigation pumpage are available, based on pumping times and well capacities. Based on meter data and estimates of irrigation usage, we estimate that Lakeland Village currently pumps approximately 290 acre-feet of ground-water per year.

In consort with the increase in ground-water allocations, submittal of well-construction reports increased steadily from 1940 to 1989, further suggesting a steady rate of ground- water development (Figure 8). Since 1989, the submittal of well reports has increased dramatically. The number of reports submitted between 1990 and 1993 is nearly equal in number to those submitted for the entire decade of the 1980's. While some of this increase may be attributed to better record keeping by well contractors, it is likely that most of the increase is due to an actual increase in well construction.

Surface-Water Allocation

Permitted surface-water use from Lake Devereaux and vicinity is relatively minor in comparison to ground-water use. Two water rights have been issued for diversion from Lake Devereaux proper, authorizing a total diversion of 0.21 cubic feet per second (cfs), 22.5 AF/year. Lakewood Manor Association, located on the northeast shore of the lake, has rights to 22 AF of this total.

Water Right #S2-01045, issued to Anderson & Sons (the developers of Lakeland Village), authorizes diversion from a spring-fed pond situated approximately ¼ mile south of Lake Devereaux. The diversion was originally intended to supply water for irrigation of 45 acres at Lakeland Village, although according to Mr. Anderson, it is not currently used for that purpose. Water from the pond is presently used to irrigate a portion of the Anderson farm (Anderson, 1993).

Two surface-water rights, totaling 90 AF/year, have been issued to Lakeland Village for water-level maintenance at Lake Anderson. The water sources for both of these rights are natural tributaries of Sherwood Creek.

## POSSIBLE CAUSES OF LAKE DEVEREAUX'S WATER LEVEL DECLINE

Several factors may have contributed to the recent water-level declines affecting Lake Devereaux. Most notable are the precipitation deficit that has gripped much of western Washington since 1985, and the general increase in water use for domestic supply and irrigation. We shall briefly examine each of these factors in the sections that follow.

### Precipitation Deficit

The current decline of Lake Devereaux, while severe in the minds of area residents, is not unique. Indeed, the lake has experienced at least three episodes of prolonged water-level decline in the last 50 years. These periods of decline, which occurred in the early to mid 1940's, the late 1970's to early 80's, and 1992 to present, correspond closely with periods of prolonged precipitation deficit. This correlation is readily apparent when one compares aerial photographs and anecdotal information from area residents to long-term precipitation for western Washington (Table 7 and Figure 9).

Lake Devereaux is not unique in its response to the most recent precipitation deficit. Several lakes in Pierce, Thurston, and Kitsap Counties are either dry or severely stressed. Carp Lake, an 11 acre pond near Lakewood in Pierce Co., went dry in early July, 1994, while American Lake, an 1162 acre lake just south of Carp Lake, reached a 15-year low (Ith, 07/19/1994). Stages in Lois, Long, and Patterson Lakes in Thurston County are well below normal levels (personal observation).

Doyle Pond, a 10+ acre lake to the northeast of Lake Devereaux, in Kitsap County, was 6-8 feet below normal in mid July. Its main water source has been cut off for the last 2-3 years, due to the lack of surface outflow from Holiday Lake (Cooper, 1994). Horseshoe Lake, a 40-acre lake located about 9 miles south of Port Orchard, in Kitsap County, is experiencing similar problems. In mid-July, it was reported to be dropping at one foot per week (Oakes, 07/94).

The baseflows of numerous streams in the Puget lowlands have also been below normal in recent years. Huge Creek near Wauna, is one example (Figures 1, 10, and 11). Huge Creek, like many streams in the Puget Sound lowlands, is maintained almost exclusively by ground-water discharge during the late summer. The precipitation deficit of recent years has made less water available for ground-water recharge. This has caused a synonymous reduction in ground-water discharge.

As shown in Figures 10, 11, and Appendix A, the mean monthly discharge for Huge Creek for the months of September and October has been at or below the average mean discharge for these months since 1986. This baseflow trend corresponds closely with the precipitation deficit noted for the Grapeview station (Table 6 and Figure 9).

# TABLE 7

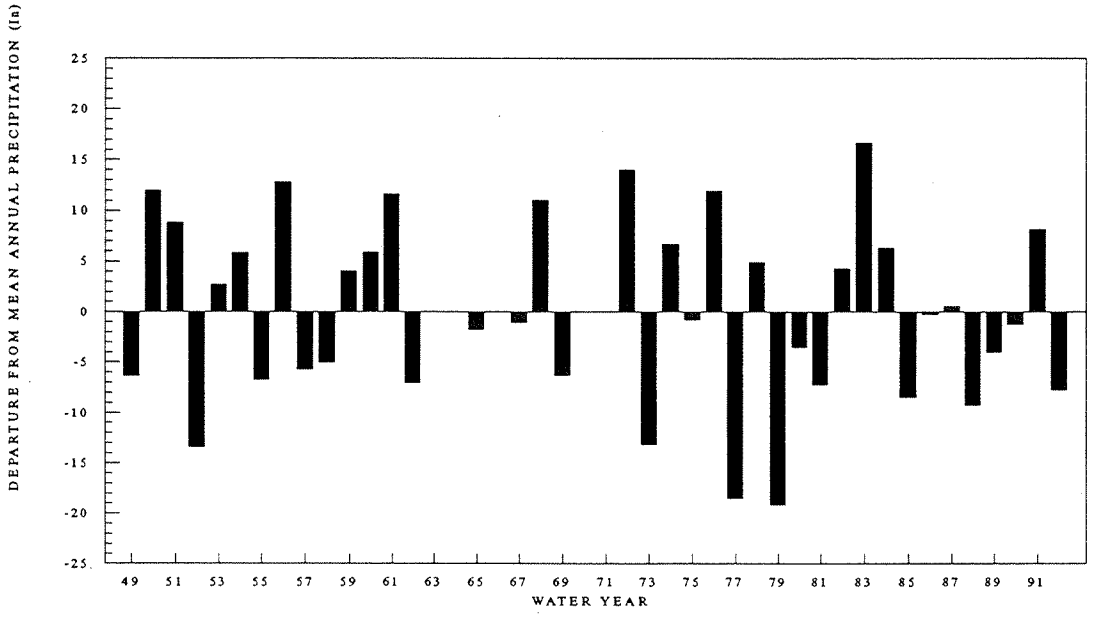
## Departure From the Mean Annual Precipitation at Buckley and Grapeview, Based on Five Year Moving Intervals

| Water Year | Annual Departure From Mean (Inches) Buckley Station | Grapeview Station | Years Summed | Five Year Cumulative Departure From Mean (Inches) Buckley Station | Grapeview Station | Status of Lake Devereaux Based on Aerial Photo (AP) Survey or Citizen Complaints (Month & Yr. of AP/Comp.) |
|---|---|---|---|---|---|---|
| 1932 | 0.27 | -- | -- | -- | -- | |
| 1933 | 9.94 | -- | -- | -- | -- | |
| 1934 | 13.41 | -- | -- | -- | -- | |
| 1935 | 2.89 | -- | -- | -- | -- | |
| 1936 | 0.70 | -- | 1932-36 | 27.21 | -- | |
| 1937 | -5.08 | -- | 1933-37 | 21.86 | -- | |
| 1938 | -1.62 | -- | 1934-38 | 10.30 | -- | |
| 1939 | -6.68 | -- | 1935-39 | -9.79 | -- | |
| 1940 | -5.27 | -- | 1936-40 | -17.95 | -- | |
| 1941 | -5.57 | -- | 1937-41 | -24.22 | -- | |
| 1942 | -5.57 | -- | 1938-42 | -24.71 | -- | 08/--/42 (AP), Lake Low |
| 1943 | -3.22 | -- | 1939-43 | -26.31 | -- | |
| 1944 | -11.65 | -- | 1940-44 | -31.28 | -- | |
| 1945 | -4.08 | -- | 1941-45 | -30.09 | -- | |
| 1946 | 6.67 | -- | 1942-46 | -17.85 | -- | |
| 1947 | 1.55 | -- | 1943-47 | -10.73 | -- | |
| 1948 | -- | -- | 1944-48 | -- | -- | |
| 1949 | -8.23 | -6.43 | 1945-49 | -- | -- | |
| 1950 | 10.42 | 11.98 | 1946-50 | -- | -- | |
| 1951 | 7.32 | 8.86 | 1947-51 | -- | -- | 08/19/51 (AP), Lake Full |
| 1952 | -11.49 | -13.49 | 1948-52 | -- | -- | |
| 1953 | -0.05 | 2.70 | 1949-53 | -2.03 | 3.62 | |
| 1954 | 9.10 | 5.79 | 1950-54 | 15.30 | 15.84 | |
| 1955 | -5.17 | -6.80 | 1951-55 | -0.29 | -2.94 | |
| 1956 | 8.28 | 12.79 | 1952-56 | 0.67 | 0.99 | |
| 1957 | -1.80 | -5.81 | 1953-57 | 10.36 | 8.67 | |
| 1958 | -6.22 | -5.12 | 1954-58 | 4.19 | 0.85 | |
| 1959 | 12.65 | 4.04 | 1955-59 | 7.74 | -0.90 | |
| 1960 | 3.03 | 5.89 | 1956-60 | 15.94 | 11.79 | |
| 1961 | 8.70 | 11.60 | 1957-61 | 16.36 | 10.60 | |
| 1962 | -8.40 | -7.10 | 1958-62 | 9.76 | 9.31 | |
| 1963 | -- | -- | 1959-63 | -- | -- | |
| 1964 | -- | -- | 1960-64 | -- | -- | |
| 1965 | 0.04 | -1.82 | 1961-65 | -- | -- | 06/02/65 (AP), Almost Full |
| 1966 | -5.14 | -- | 1962-66 | -- | -- | |
| 1967 | -2.09 | -1.10 | 1963-67 | -- | -- | |
| 1968 | 6.44 | 11.02 | 1964-68 | -- | -- | 09/04/68 (AP), Lake Full |
| 1969 | 3.77 | -6.37 | 1965-69 | 3.02 | -- | |
| 1970 | -6.28 | -- | 1966-70 | -3.30 | -- | |
| 1971 | 3.40 | -- | 1967-71 | 5.24 | -- | |
| 1972 | 12.50 | 14.00 | 1968-72 | 19.83 | -- | 05/12/72 (AP), Lake Full |
| 1973 | -10.55 | -13.27 | 1969-73 | 2.84 | -- | 07/03/73 (AP), Lake Full |
| 1974 | 7.30 | 6.71 | 1970-74 | 6.37 | -- | 06/17/74 (AP), Lake Full |
| 1975 | 4.05 | -0.85 | 1971-75 | 16.70 | -- | 09/04/75 (AP), Lake Full |
| 1976 | 10.94 | 11.92 | 1972-76 | 24.24 | 18.51 | |
| 1977 | -13.66 | -18.64 | 1973-77 | -1.92 | -14.13 | |
| 1978 | 0.51 | 4.92 | 1974-78 | 9.14 | 4.06 | 05/19/78 (AP), Lake Full |
| 1979 | -8.24 | -19.23 | 1975-79 | -6.40 | -21.88 | 06/79, Wolf Complaint |
| 1980 | 1.72 | -3.61 | 1976-80 | -8.73 | -24.64 | 07/29/80 (AP), Almost Full |
| 1981 | 4.38 | -7.30 | 1977-81 | -15.29 | -43.86 | |
| 1982 | 3.24 | 4.31 | 1978-82 | 1.61 | -20.91 | |
| 1983 | 2.13 | 16.65 | 1979-83 | 3.23 | -9.18 | |
| 1984 | 5.43 | 6.29 | 1980-84 | 16.90 | 16.34 | |
| 1985 | -10.59 | -8.55 | 1981-85 | 4.59 | 11.40 | 06/19/85 (AP), Almost Full |
| 1986 | -- | -0.28 | 1982-86 | -- | 18.42 | |
| 1987 | -6.07 | 0.55 | 1983-87 | -- | 14.66 | 08/04/87 (AP), Lake Full |
| 1988 | -5.15 | -9.33 | 1984-88 | -- | -11.32 | |
| 1989 | -3.97 | -4.08 | 1985-89 | -- | -21.69 | 09/07/89 (AP), Lake Low |
| 1990 | 6.64 | -1.33 | 1986-90 | -- | -14.47 | 1989, Many Complaints |
| 1991 | 4.05 | 8.16 | 1987-91 | -4.50 | -6.03 | 07/02/91 (AP), Lake Full |
| 1992 | -9.50 | -7.84 | 1988-92 | -7.93 | -14.42 | 09/92, Sergent Complaint |
| 1993 | --- | --- | --- | --- | --- | 10/93, Engel Complaint |

FIGURE 9

Precipitation Departure from the Annual Mean
for Water Years 1949 to 1994

Grapeview, WA.




Wauna, WA.

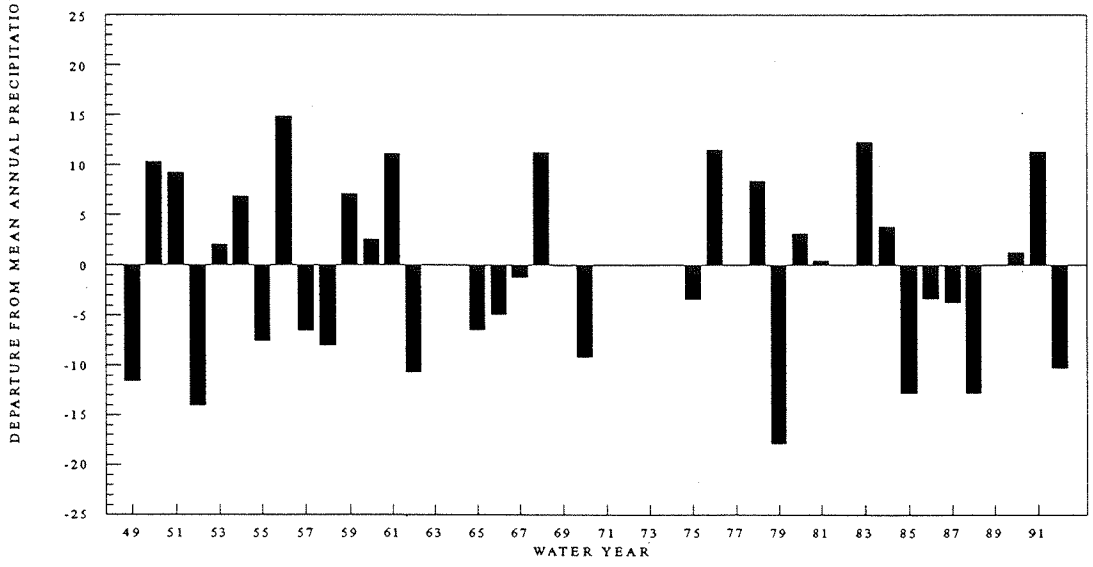
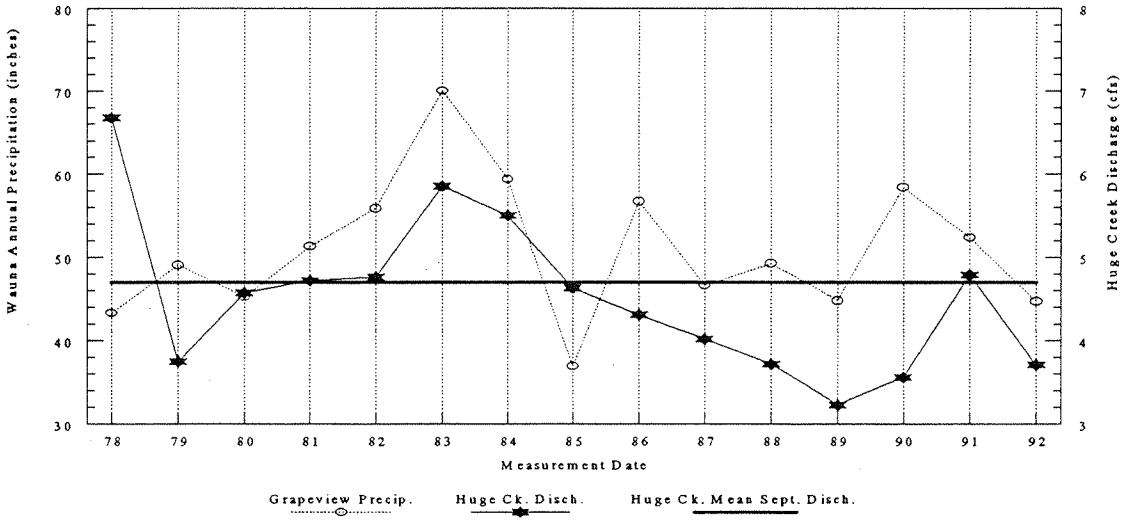


FIGURE 10

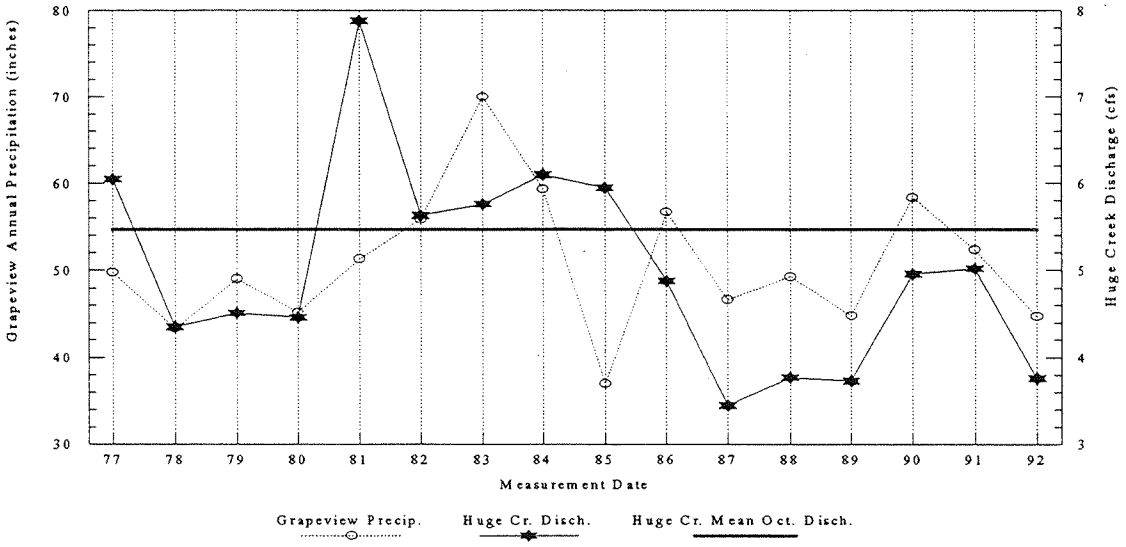
Comparison of Annual Precipitation at Grapeview and Huge Creek
Mean Monthly Discharge During Sept. for Water Years 1978 to 1992




Huge Ck. Mean Discharge for
Water Years 1947 to 1992

FIGURE 11

Comparison of Annual Precipitation at Grapeview and Huge Creek
Mean Monthly Discharge During Oct. for Water Years 1978 to 1992




Huge Ck. Mean Discharge for
Water Years 1948 to 1993

Ground-Water Use

As mentioned earlier, the effects of local ground-water pumping on the stage of Lake Devereaux have not been adequately defined. We do know that the lake and the shallow aquifers which underlie it are hydraulically coupled. These shallow aquifers in turn, are coupled to underlying deeper aquifers which supply most of the water needs for Lakeland Village, Belfair Water District, and other major water users surrounding Lake Devereaux.

Water levels in one nearby aquifer may be declining in response to ground-water pumping. Well AAB324, a non-pumped 200 foot deep well northeast of Lake Devereaux had a net water-level decline of approximately 2 feet between June 1993 to June 1994 (Figure 2 p. 3, Figure 6 p.16, and Table 5 p.13). During this same period, the water level in well AAB871, an 81-foot-deep well at the St. Albans Girl Scout Camp, rose about one foot.

If ongoing monitoring confirms a progressive lowering of ground-water levels due to pumping from the deeper aquifers underlying Lake Devereaux, then future impacts to Lake Devereaux may occur as water levels in the shallow aquifers that feed the lake equilibrate to the declining heads in deeper aquifers.

## SUMMARY AND CONCLUSIONS

Lake Devereaux, in northeast Mason County, has undergone three documented periods of extended water-level decline since 1942. In all three cases, the declines occurred during periods of prolonged precipitation deficit. Although the watershed was largely undeveloped in the early 1940's the stage declines in Lake Devereaux during the drought of that period were comparable, if not greater than, those of the early 1990's drought. This suggests that the lake's current stage declines are largely attributable to natural variations in precipitation.

From 1940 to present, ground-water allocations for domestic supply and irrigation increased from practically nothing to about 1,200 AF/year. Most of the ground water used in the Lake Devereaux area is withdrawn from `deep' aquifers that are recharged, in part, by leakage from overlying shallow aquifers that are hydraulically coupled to Lake Devereaux.

Long-term lake stage and ground-water-level information for the Lake Devereaux area is lacking. However, water-levels in one 200 foot deep non-pumped well (AAB324) declined by about two feet between June 1993 and June 1994. Over this same period, water levels in a nearby 81 foot deep well (AAB871) rose about one foot. Given the short period of record it is not possible to determine the cause of the water-level decline affecting well AAB324. If ongoing monitoring of well AAB324 and other deep wells confirms a progressive lowering of ground-water levels due to pumping, then impacts to Lake Devereaux may occur as water levels in the shallow aquifers that feed the lake equilibrate to declining heads in deeper aquifers.

## RECOMMENDATIONS FOR ADDITIONAL WORK

This study was hindered by the lack of long-term information about area ground-water levels, water-use patterns, stage information for Lake Devereaux, and other pertinent data. Such information is necessary to adequately define how changing water use and land-use practices may have affected Lake Devereaux. In order to answer such questions it will be necessary to establish an ongoing monitoring program to gather this information. The recommendations which follow are intended to focus future work in that direction.

- Establish an annual (or as necessary) maintenance program to assure that the culverts installed to pass water beneath the Bremerton and Bangor rail spur are functioning properly.

- Establish a volunteer program to monitor precipitation at several locations within the Lake Devereaux watershed. This information will be useful for defining local precipitation patterns and can be used to supplement precipitation data from the National Weather Service stations at Grapeview and Wauna.

- Meter the pumping and monitor the water levels of all major production wells within the Lake Devereaux area. Each well should be equipped with a calibrated totalizing-flow meter or equivalent. The meters should be read at least monthly or more frequently if necessary. Static (non-pumping) water levels should be measured in these same wells on at least a monthly basis. The water-level monitoring should also include a number of non-pumped wells (if possible), at various locations and depths, to help define long-term water-level trends within the watershed. All wells included in the monitoring network should be tagged and tracked using a unique well-identification number available from Ecology.

- Stage monitoring of Lake Devereaux should continue on at least a semi-monthly basis at the gage currently established at the St. Albans Girl Scout Camp.

- Enlist the services of a public or private survey crew to establish absolute elevations for the following:

    1) The culverts underlying the Bremerton and Bangor rail line,

    2) The outlet for Lake Devereaux,

    3) The staff gage at the St. Albans girl scout camp,

    4) The measuring point and land-surface elevations of all monitoring wells.

    Elevation information of the sort described above is necessary to establish water movement potential within the watershed.

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# APPENDIX A

## DISCHARGE DATA FOR HUGE CREEK, NEAR WAUNA, WA.

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - WASHINGTON 10/06/93

STATION NUMBER 12073500 HUGE CREEK NEAR WAUNA, WASH. STREAM SOURCE AGENCY USGS
LATITUDE 472322 LONGITUDE 1224152 DRAINAGE AREA 6.47 DATUM 100.00 STATE 53 COUNTY 035

DISCHARGE, CUBIC FEET PER SECOND, WATER YEARS: OCTOBER 1946 TO SEPTEMBER 1993
MONTHLY MEAN VALUES

| WATER YEAR | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1947 | --- | --- | --- | --- | --- | --- | --- | --- | --- | 4.28 | 4.24 | 4.36 |
| 1948 | 6.92 | 5.94 | 9.18 | 17.2 | 16.0 | 13.9 | 9.77 | 11.0 | 6.20 | 4.56 | 4.54 | 5.90 |
| 1949 | 4.92 | 9.14 | 21.7 | 10.2 | 28.6 | 13.4 | 8.74 | 6.83 | 5.17 | 4.44 | 4.20 | 4.30 |
| 1950 | 5.13 | 11.3 | 17.6 | 29.5 | 35.4 | 38.8 | 13.8 | 8.25 | 6.99 | 5.55 | 4.50 | 4.30 |
| 1951 | 6.48 | 15.1 | 34.1 | 34.5 | 51.7 | 17.6 | 9.30 | 7.55 | 6.71 | 5.79 | 4.82 | 5.09 |
| 1952 | 6.47 | 7.70 | 12.1 | 12.9 | 18.5 | 8.86 | 6.17 | 4.77 | 4.62 | 4.45 | 4.32 | 4.21 |
| 1953 | 4.09 | 4.13 | 4.97 | 42.7 | 25.7 | 10.6 | 8.13 | 6.10 | 5.15 | 4.50 | 4.44 | 4.72 |
| 1954 | 6.00 | 10.0 | 24.3 | 36.9 | 36.6 | 13.3 | 10.2 | 7.08 | 6.03 | 5.20 | 4.65 | 4.59 |
| 1955 | 4.55 | 13.7 | 11.8 | 10.8 | 12.9 | 9.59 | 10.5 | 6.15 | 4.90 | 4.67 | 4.35 | 4.49 |
| 1956 | 5.90 | 22.9 | 36.8 | 43.4 | 13.2 | 32.2 | 13.5 | 8.82 | 8.22 | 5.94 | 5.48 | 5.37 |
| 1957 | 8.83 | 9.92 | 20.7 | 10.4 | 17.0 | 21.3 | 10.2 | 7.25 | 6.45 | 6.03 | 5.64 | 5.30 |
| 1958 | 5.57 | 5.72 | 9.71 | 23.8 | 23.1 | 10.1 | 9.61 | 6.34 | 4.59 | 4.44 | 4.56 | 4.57 |
| 1959 | 5.36 | 9.45 | 15.1 | 37.2 | 15.4 | 10.1 | 16.4 | 12.3 | 7.27 | 5.76 | 4.83 | 5.39 |
| 1960 | 5.69 | 12.1 | 22.1 | 21.8 | 25.1 | 15.8 | 15.3 | 9.65 | 7.25 | 5.73 | 5.33 | 5.00 |
| 1961 | 7.21 | 13.8 | 10.4 | 37.9 | 54.6 | 33.0 | 12.5 | 10.8 | 8.38 | 7.31 | 6.07 | 5.55 |
| 1962 | 6.46 | 7.22 | 13.2 | 11.9 | 8.05 | 9.88 | 7.35 | 6.61 | 5.11 | 4.68 | 4.81 | 4.73 |
| 1963 | 6.05 | 17.5 | 18.2 | 14.5 | 17.0 | 8.74 | 11.2 | 6.74 | 5.58 | 4.94 | 4.54 | 4.29 |
| 1964 | 5.45 | 15.3 | 11.9 | 38.9 | 15.9 | 13.2 | 7.64 | 6.54 | 6.56 | 5.29 | 5.16 | 4.93 |
| 1965 | 5.05 | 8.31 | 19.4 | 19.9 | 17.6 | 8.43 | 7.67 | 6.48 | 4.82 | 4.31 | 4.17 | 3.79 |
| 1966 | 4.23 | 5.66 | 9.27 | 47.1 | 9.97 | 22.3 | 8.07 | 5.98 | 5.67 | 4.62 | 4.22 | 4.26 |
| 1967 | 4.51 | 6.06 | 26.2 | 35.2 | 16.9 | 14.0 | 9.16 | 7.32 | 5.89 | 5.05 | 4.38 | 4.47 |
| 1968 | 6.53 | 6.03 | 14.0 | 30.6 | 35.3 | 22.5 | 12.4 | 8.59 | 8.01 | 5.82 | 6.18 | 5.75 |
| 1969 | 6.19 | 7.91 | 21.3 | 24.3 | 24.6 | 11.5 | 10.6 | 7.34 | 5.96 | 5.27 | 4.44 | 5.44 |
| 1978 | 6.05 | 15.1 | 29.9 | 20.3 | 16.5 | 8.93 | 9.18 | 8.59 | 5.06 | 4.80 | 4.41 | 6.68 |
| 1979 | 4.35 | 5.38 | 5.34 | 5.37 | 19.5 | 15.8 | 6.54 | 5.80 | 4.91 | 4.74 | 4.40 | 3.75 |
| 1980 | 4.51 | 4.58 | 33.2 | 17.5 | 19.9 | 12.9 | 11.1 | 6.90 | 6.01 | 4.32 | 3.44 | 4.57 |
| 1981 | 4.46 | 8.27 | 23.7 | 10.7 | 26.2 | 10.3 | 9.85 | 7.11 | 6.19 | 5.01 | 4.31 | 4.72 |
| 1982 | 7.88 | 12.7 | 25.8 | 17.2 | 38.2 | 18.5 | 11.2 | 7.49 | 6.10 | 5.24 | 4.69 | 4.76 |
| 1983 | 5.63 | 7.03 | 31.5 | 32.5 | 34.0 | 28.1 | 13.9 | 8.40 | 6.91 | 6.25 | 5.47 | 5.85 |
| 1984 | 5.76 | 17.5 | 17.8 | 15.3 | 14.5 | 16.8 | 12.8 | 10.9 | 8.60 | 6.77 | 5.75 | 5.50 |
| 1985 | 6.10 | 14.4 | 17.1 | 9.86 | 10.5 | 9.26 | 7.89 | 6.17 | 5.58 | 4.60 | 4.49 | 4.63 |
| 1986 | 5.95 | 5.43 | 6.15 | 29.9 | 18.9 | 11.5 | 7.59 | 6.83 | 5.32 | 4.75 | 4.15 | 4.31 |
| 1987 | 4.88 | 12.3 | 13.4 | 20.3 | 21.9 | 29.3 | 8.87 | 7.13 | 5.44 | 4.64 | 4.06 | 4.02 |
| 1988 | 3.45 | 4.86 | 9.88 | 10.2 | 5.95 | 7.58 | 10.0 | 5.93 | 4.98 | 4.05 | 3.67 | 3.72 |
| 1989 | 3.77 | 9.13 | 6.44 | 9.56 | 8.03 | 16.0 | 12.0 | 5.84 | 4.47 | 4.00 | 3.50 | 3.23 |
| 1990 | 3.73 | 5.12 | 10.5 | 30.2 | 30.4 | 12.6 | 6.75 | 5.34 | 5.44 | 4.04 | 3.73 | 3.56 |
| 1991 | 4.96 | 29.2 | 17.2 | 18.6 | 24.5 | 20.2 | 24.6 | 8.71 | 6.35 | 4.61 | 4.50 | 4.79 |
| 1992 | 5.02 | 7.27 | 8.30 | 26.7 | 22.9 | 7.23 | 6.71 | 5.34 | 4.72 | 4.15 | 3.72 | 3.71 |
| 1993 | 3.76 | 4.94 | 5.77 | 8.49 | 5.72 | 7.51 | 10.2 | 6.87 | 5.94 | 4.98 | 4.31 | --- |
| MEAN | 5.47 | 10.2 | 17.0 | 23.0 | 22.0 | 15.6 | 10.5 | 7.40 | 5.99 | 5.01 | 4.58 | 4.70 |

# APPENDIX B

## SUMMARY OF GROUND-WATER AND SURFACE-WATER RIGHTS IN THE LAKE DEVEREAUX AREA

## GROUND-WATER RIGHTS

WRIS Number: G2-28075P
Name: CLARK BUDD Priority Date: 03/15/1991 Source: WELL
Location: 22N/01W-05 Location of Withdrawal: NE4SW4
Use: DM Instantaneous Quantity (gpm): 35 Annual Quantity (af): 2

WRIS Number: G2-27792C
Name: JOHNSTON/BARNETT Priority Date: 06/25/1990 Source: WELL
Location: 22N/01W-05 Location of Withdrawal: SW4SW4
Use: DM Instantaneous Quantity (gpm): 45 Annual Quantity (af): 5

WRIS Number: G2-28145B
Name: KRUEGER RICKY A Priority Date: 05/14/1991 Source: WELL
Location: 22N/01W-05 Location of Withdrawal: SW4NW4
Use 1: DS Instantaneous Quantity (gpm): 31 Annual Quantity (af): 1
Use 2: IR Instantaneous Quantity (gpm): 31 Annual Quantity (af): 30 Irrigated Acres: 21.0

WRIS Number: G2-27378C
Name: STAN N JOHNSTON Priority Date: 07/05/1988 Source: WELL
Location: 22N/01W-05 Location of Withdrawal: E2SW4SW4
Use: DM Instantaneous Quantity (gpm): 37 Annual Quantity (af): 5

WRIS Number: G2-26962P
Name: BELFAIR WAT DIST Priority Date: 08/19/1986 Source: WELL
Location: 22N/01W-06 Location of Withdrawal: GL-2 NW4NE4
Use: DM Instantaneous Quantity (gpm): 350 Annual Quantity (af): 225

WRIS Number: G2-24043P
Name: BELFAIR WTR DT #1 Priority Date: 01/13/1976 Source: WELL
Location: 22N/01W-06 Location of Withdrawal: NW4NE4
Use: DM Instantaneous Quantity (gpm): 200 Annual Quantity (af): 160

WRIS Number: G2*00335C Old App: 00335 Old Permit: 00288 Old Cert: 00193
Name: CALLOW C R Priority Date: 08/10/1946 Source: WELL
Location: 22N/01W-06 Location of Withdrawal: GL-2
Use 1: DM Instantaneous Quantity (gpm): 17 Annual Quantity (af): 2
Use 2: IR Instantaneous Quantity (gpm): 17 Annual Quantity (af): 3 Irrigated Acres: 1.0

WRIS Number: G2*01878C Old App: 01878 Old Permit: 01815 Old Cert: 00853
Name: THELER S B Priority Date: 03/22/1951 Source: WELL
Location: 22N/01W-06 Location of Withdrawal: GL2
Use: DS Instantaneous Quantity (gpm): 6 Annual Quantity (af): 10

WRIS Number: G2-25975C
Name: FIRWOOD HEIGHTS Priority Date: 08/07/1981 Source: WELL
Location: 22N/01W-07 Location of Withdrawal: SW4SW4
Use: DM Instantaneous Quantity (gpm): 30 Annual Quantity (af): 6

WRIS Number: G2-20378C
Name: LAKEWOOD MANOR ASSN Priority Date: 07/18/1972 Source: WELL
Location: 22N/01W-07 Location of Withdrawal: NE4SE4
Use: DM Instantaneous Quantity (gpm): 60 Annual Quantity (af): 35

WRIS Number: G2-26827C
Name: NORTHWEST WTR SYS Priority Date: 11/20/1985 Source: WELL
Location: 22N/01W-07 Location of Withdrawal: SE4NW4
Use: DM Instantaneous Quantity (gpm): 15 Annual Quantity (af): 3

WRIS Number: G2-26266C
Name: N MASON SCH DIST 403 Priority Date: 12/22/1982 Source: WELL
Location: 22N/01W-08 Location of Withdrawal: NW4NW4
Use 1: DM Instantaneous Quantity (gpm): 50 Annual Quantity (af): 22S
Use 2: IR Instantaneous Quantity (gpm): 50 Annual Quantity (af): 22S Irrigated Acres: 11.0

WRIS Number: G2-26267C
Name: N MASON SCH DIST 403 Priority Date: 12/22/1982 Source: WELL
Location: 22N/01W-08 Location of Withdrawal: NW4NW4
Use 1: DM Instantaneous Quantity (gpm): 100 Annual Quantity (af): 22
Use 2: IR Instantaneous Quantity (gpm): 100 Annual Quantity (af): 22 Irrigated Acres: 11.0

WRIS Number: G2-26265C
Name: N MASON SCH DIST 430 Priority Date: 12/22/1982 Source: WELL
Location: 22N/01W-08 Location of Withdrawal: NW4NW4
Use 1: DM Instantaneous Quantity (gpm): 27 Annual Quantity (af): 22S
Use 2: IR Instantaneous Quantity (gpm): 27 Annual Quantity (af): 22S Irrigated Acres: 11.0

WRIS Number: G2-26658C
Name: ANDERSON & SONS Priority Date: 03/07/1985 Source: WELL
Location: 22N/01W-17 Location of Withdrawal: NE4SW4
Use 1: DM Instantaneous Quantity (gpm): 130 Annual Quantity (af): 104S
Use 2: IR Instantaneous Quantity (gpm): 130 Annual Quantity (af): 104S Irrigated Acres: 52.0

WRIS Number: G2-21045C
Name: ANDERSON & SONS INC Priority Date: 05/16/1973 Source: WELL
Location: 22N/01W-17 Location of Withdrawal: SE4 SW4 SE4
Use 1: DM Instantaneous Quantity (gpm): 150 Annual Quantity (af): 180S
Use 2: IR Instantaneous Quantity (gpm): 150 Annual Quantity (af): 180S Irrigated Acres: 45.0

WRIS Number: G2-23579C
Name: MATSON & SARGENT Priority Date: 06/28/1974 Source: WELL
Location: 22N/01W-17 Location of Withdrawal: GL 2
Use 1: DM Instantaneous Quantity (gpm): 30 Annual Quantity (af): 1
Use 2: CI Instantaneous Quantity (gpm): 30 Annual Quantity (af): 45

WRIS Number: G2-26731C
Name: JACK BATY & ASSOC Priority Date: 06/20/1985 Source: WELL
Location: 22N/01W-18 Location of Withdrawal: SE4NW4
Use: DM Instantaneous Quantity (gpm): 40 Annual Quantity (af): 4

WRIS Number: G2*08417C Old App: 08417 Old Permit: 07805 Old Cert: 06043
Name: ANDERSON & SONS INC Priority Date: 12/06/1966 Source: WELL
Location: 22N/01W-19 Location of Withdrawal: SE4NE4
Use: DM Instantaneous Quantity (gpm): 40 Annual Quantity (af): 64S

WRIS Number: G2-23025C
Name: CHURCH J C OF L D S Priority Date: 07/12/1974 Source: WELL
Location: 22N/01W-19 Location of Withdrawal: SW4NW4
Use: DM Instantaneous Quantity (gpm): 100 Annual Quantity (af): 2

WRIS Number: G2-26628C
Name: ALLYN PORT OF Priority Date: 12/11/1984 Source: WELL
Location: 22N/01W-20 Location of Withdrawal: LOT 8 BL-10 PLAT OF ALLYN
Use: DM Instantaneous Quantity (gpm): 65 Annual Quantity (af): 14

WRIS Number: G2-25692C
Name: ANDERSON & SONS INC Priority Date: 09/12/1980 Source: WELL
Location: 22N/01W-20 Location of Withdrawal: SE4NW4
Use: DM Instantaneous Quantity (gpm): 200 Annual Quantity (af): 280S

WRIS Number: G2-23913C
Name: ANDERSON & SONS INC Priority Date: 07/30/1975 Source: WELL
Location: 22N/01W-20 Location of Withdrawal: SE4SE4NW4
Use: DM Instantaneous Quantity (gpm): 200 Annual Quantity (af): 36P/244S

WRIS Number: G2-25894C
Name: ANDERSON/SONS INC Priority Date: 05/13/1981 Source: WELL
Location: 22N/01W-20 Location of Withdrawal: SE4NW4
Use 1: DM Instantaneous Quantity (gpm): 400 Annual Quantity (af): 280S
Use 2: IR Instantaneous Quantity (gpm): 400 Annual Quantity (af): 180P Irrigated Acres: 90.0

WRIS Number: G2-26646C
Name: HARBOR WATER CO Priority Date: 01/24/1985 Source: WELL
Location: 22N/01W-20 Location of Withdrawal: NW4SE4
Use 1: DM Instantaneous Quantity (gpm): 100 Annual Quantity (af): 17
Use 2: CI Instantaneous Quantity (gpm): 100 Annual Quantity (af): 17

WRIS Number: G2-23808C
Name: WYNWOOD Priority Date: 04/30/1975 Source: WELL
Location: 22N/01W-20 Location of Withdrawal: BL 73 PLAT OF TOWN OF ALLYN
Use: CI Instantaneous Quantity (gpm): 100 Annual Quantity (af): 17

## SURFACE WATER RIGHTS

WRIS Number: S2-17888C
Name: LAKEWOOD MANOR ASSOCIATION Priority Date: 05/02/1963 Source: LAKE DEVEREAUX
Location: 22N/01W-07 Location of Withdrawal: LAKEWOOD PLAT M
Use: IR Instantaneous Quantity (cfs): 0.11 Annual Quantity (af): 22

WRIS Number: S2-23388C
Name: EARL WOLFE Priority Date: 11/25/1974
Source: LAKE DEVEREAUX
Location: 22N/01W-07 Location of Withdrawal: TR-14 LAKEWOOD PLAT M
Use: DS Instantaneous Quantity (cfs): .01 Annual Quantity (af): 0.5

WRIS Number: S2-01045C
Name: ANDERSON & SONS Priority Date: 06/14/1968
Source: UNNAMED LAKE
Location: 22N/01W-18 Location of Withdrawal: NW4SE4
Use: IR Instantaneous Quantity (cfs): 0.45 Annual Quantity (af): 90

WRIS Number: S2-18255C
Name: VIRGIL ANDERSON Priority Date: 11/20/1963
Source: UNNAMED STREAM (TRIBUTARY TO SHERWOOD CREEK)
Location: 22N/01W-19 Location of Withdrawal: NE4SE4
Use: R&B Instantaneous Quantity (cfs): 0.6 Annual Quantity (af): 335

WRIS Number: R2-18256C
Name: V C ANDERSON Priority Date: 11/20/1963
Source: UNNAMED STREAM (TRIBUTARY TO SHERWOOD CREEK)
Location: 22N/01W-19 Location of Withdrawal: NE4SE4
Use: R&B Annual Quantity (af): 335

WRIS Number: R2-00613C
Name: ANDERSON & SONS Priority Date: 07/06/1970
Source: UNNAMED STREAM (TRIBUTARY TO SHERWOOD CREEK) & RESERVOIR
Location: 22N/01W-20 Location of Withdrawal: W2NW4
Use: FISH PROP, WL, IR Annual Quantity (af): 18.0

WRIS Number: S2-00614C
Name: ANDERSON & SONS Priority Date: 08/25/1971
Source: UNNAMED STREAM (TRIBUTARY TO SHERWOOD CREEK) & RESERVOIR
Location: 22N/01W-20 Location of Withdrawal: W2NW4
Use: FISH PROP, WL, IR Instantaneous Quantity (cfs): 0.45 Annual Quantity (af): 90 S

Use Codes:

| | |
|---|---|
| R&B: | Recreation and beautification |
| FISH PROP: | Fish propagation |
| IR: | Irrigation |
| WL: | Wildlife propagation |
| DS: | Single domestic supply |
| DM: | Multiple domestic supply |
| CI: | Commercial and Industrial |

Annual Quantity Codes:

S: Supplemental right (does not constitute an additional allocation above existing primary rights)
P: Primary right (constitutes an additional allocation above existing rights)