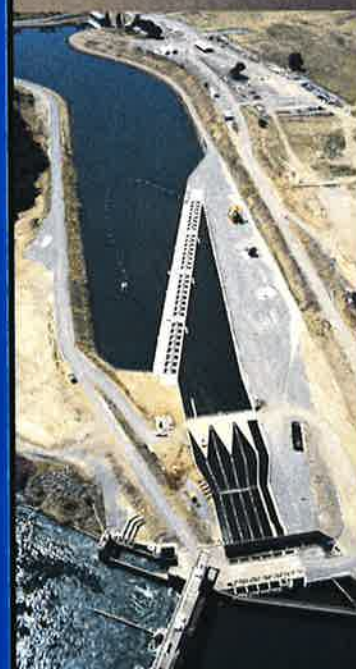
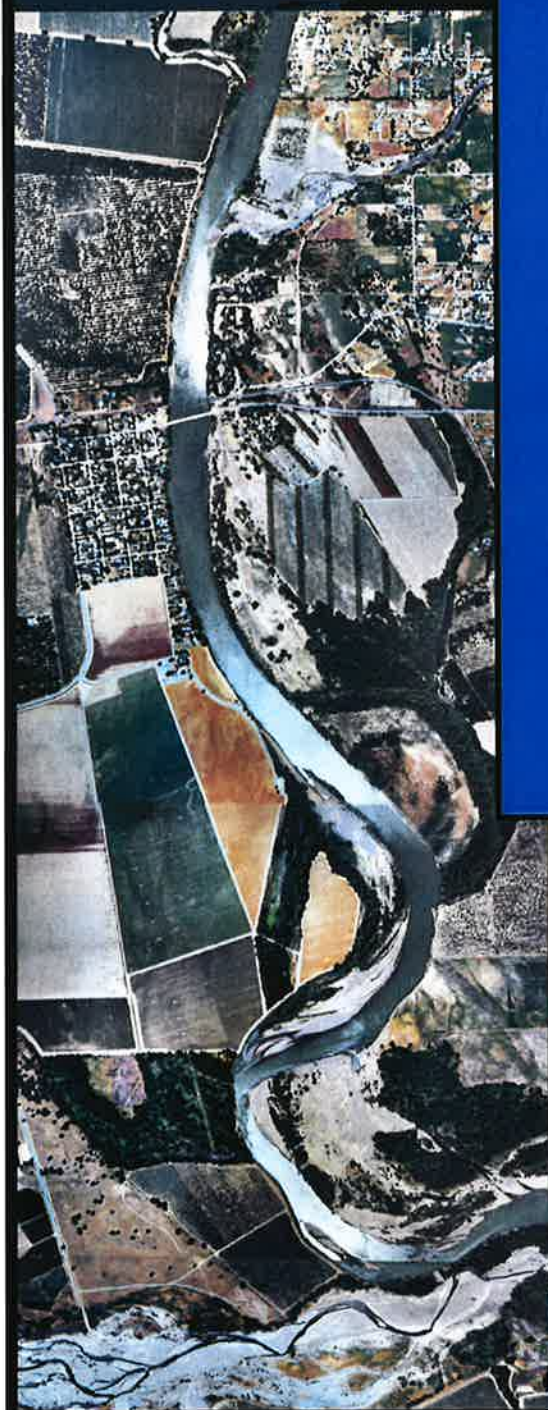




Pre-Publication Draft

**Tehama County
Groundwater Inventory**

June 2003



Prepared By:

Department of Water Resources
Northern District



TEHAMA COUNTY GROUNDWATER REPORT

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SECTION I.

TEHAMA COUNTY GROUNDWATER INVENTORY

The Tehama County Groundwater Inventory is part of a larger water resource inventory being conducted by Camp Dresser & McKee, Inc., under the direction of the Tehama County Flood Control and Water Conservation District, and in cooperation with the California Department of Water Resources, Northern District (DWR). The following report is provides a detailed discussion of Tehama County's groundwater resources and is DWR's contribution to the Tehama County Water Resource Inventory.

This groundwater inventory is presented in three sections. This section (Section 1) provides an introduction to the study areas, a presentation of the project scope, and a detailed discussion of the analytical methods used throughout the report. Section 2 presents a regional discussion of the geology and groundwater resources of Tehama County, while Section 3 provides a more detailed discussion of the groundwater resources and infrastructure of wells at the subregional and local levels.

INTRODUCTION AND SCOPE

The groundwater inventory presents the results of a countywide assessment of groundwater resources at the regional, subregional, and local levels. At the regional level the groundwater inventory is divided into four areas: the Sacramento Valley Groundwater Basin Region, the Redding Groundwater Basin Region, the Mountain West Region, and the Mountain East Region. At the subregional and local levels, the regions are further divided into inventory and sub-inventory units. The breakdown of units at the regional level serves to group areas of similar hydrology and hydrogeology, while the local breakdown at the sub-inventory unit level serves to group areas of similar land use, water use, and local water purveyor areas. The study areas are listed in Table 1 and illustrated on Plate 1, Appendix A.

Much of the information presented in this report was obtained from published reports, unpublished information, and data on file with DWR. Only a limited amount of new data were collected or developed as part of this investigation; the majority of the information provided was derived from the analysis of existing data. Due to the limited amount of groundwater data for the Mountain Regions of the county, emphasis was

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placed on the Sacramento Valley and Redding Groundwater Basin Regions of Tehama County.

REGIONS	INVENTORY UNITS	SUB-INVENTORY UNITS
Sacramento Valley GW Basin	Red Bluff East	City of Red Bluff Rawson Proberta Elder Creek El Camino Thomes Creek Red Bluff East Independent
	Red Bluff West	Rancho Tehama Red Bluff West Independent
	Corning East	City of Corning Corning Kirkwood Aaction Corning East Independent
	Corning West	
	Bend	
	Antelope	
	Dye Creek	Los Molinos Mutual Dye Creek Independent
	Los Molinos	
	Vina	Stanford Vina Deer Creek Los Molinos Independent
Redding Groundwater Basin	Bowman	Anderson-Cottonwood Bowman Independent
	Rosewood	Rio Alto Rosewood Independent
	South Battle Creek	
Mountain West		
Mountain East		Mineral Mountain East Independent

Table 1. Inventory and Sub-inventory Units for the Tehama County Groundwater Inventory Analysis.

Regional characterization of Tehama County geology and groundwater resources presented in Section 2 includes discussions of the following subject areas:

- surface and subsurface geology,
- fresh groundwater-bearing units, and
- movement of groundwater.

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When possible, a more localized and detailed characterization of groundwater resources and infrastructure are presented at the inventory and sub-inventory unit level. Local groundwater characterization at the inventory and sub-inventory unit levels presented in Section 3 will include discussions of the following subject areas:

- local hydrogeology,
- well distribution,
- groundwater levels,
- groundwater hydrographs,
- groundwater contours,
- groundwater movement,
- groundwater extraction,
- well depths,
- well yield (inventory unit level only),
- groundwater storage capacity (inventory unit level only),
- groundwater in storage (inventory unit level only), and
- changes in groundwater in storage (inventory unit level only).

METHODS

A brief overview of the methods and procedures used to determine aquifer parameters and characterize the groundwater resources in Tehama County are presented below.

REGIONAL AND LOCAL HYDROGEOLOGY

The regional geology of Tehama County is based on a geologic map developed by DWR that illustrates the surface geology of the northern Sacramento Valley, surrounding foothills, and mountainous areas. The regional geologic map is a compilation of previously developed geologic maps obtained from the following sources:

- *Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California*, Helley and Harwood, U.S. Geological Survey (Maps: California 1985);
- *Seismotectonic Evaluation, Northern Coast Ranges, California*, William Lettis and Associates, Inc. (Lettis 1999);
- *Geologic Map of California: 1969-1973*, Jennings, California Department of Conservation, Division of Mines and Geology (Maps: California 1977); and

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- *Geologic Maps of California*, Strand, California Department of Conservation, Division of Mines and Geology (Chico 1992, Redding 1962, Ukiah 1960, and Westwood 1960).

Regional geologic contacts were largely obtained from the sources cited above. Where questions arose concerning the location of geologic contacts on a local scale, the geologic contacts were field verified. The Tehama County geologic map is included as Plate 2, in Appendix A. The associated geologic legend is included as Plate 3, Appendix A.

Subsurface geology of Tehama County was interpreted by DWR from electric resistivity well data and is presented in a series of geologic cross-sections. Electric resistivity log data were obtained from Division of Oil and Gas wells, and from electric resistivity and lithology data obtained from wells drilled for DWR, municipal and private entities.

Tehama County subsurface geology, geologic stratigraphy, and hydrogeologic units are delineated by three regional geologic cross-sections. Cross-section A-A' is oriented east to west and traverses through the City of Red Bluff. Cross-section B-B' is also oriented east to west but is located in the southern portion of the county, traversing from Vina on the eastern side of the valley, through the City of Corning, to Flourney on the west side of the valley. Cross-section C-C' is oriented north to south, traversing through the center of the valley from the Tehama-Shasta county line, to northeast of Corning. The locations of the cross-sections are shown on the Tehama County geologic map in Plate 2, Appendix A. The individual cross-section maps are presented in Plates 4 through 6, Appendix A. A vertical exaggeration of 1:1,000 feet and a horizontal exaggeration of 1:10,000 feet were used to portray the topographic surface and subsurface geologic units with greater detail.

The base of fresh water shown on the cross-sections is derived from criteria established by C. F. Berkstresser, Jr. in *Base of Fresh Ground Water, Approximately 3,000 Micromhos, in the Sacramento Valley and Sacramento-San Joaquin Delta, California* (Berkstresser 1973). This report characterized fresh groundwater as having a specific conductance of less than 3,000 micromhos per centimeter. Groundwater with a specific conductance that exceeds 3,000 micromhos per centimeter is considered saline.

Regionally, the approximate base of fresh groundwater tends to correspond with the base of post-Eocene deposits. Locally, the base of fresh groundwater fluctuates depending on local changes in subsurface geology and geologic structure.

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WELL DISTRIBUTION

Since 1949, the California Water Code (Section 13751) has required water well contractors to file a well completion report with DWR. The distribution, by use, of groundwater wells in Tehama County was compiled from the well location data provided in well completion reports filed at DWR and from the field-verified locations of wells included in the groundwater monitoring database. Well locations associated with groundwater monitoring wells have been field-verified and accurately located to within about 300 feet. Well locations derived from well completion reports are recorded and plotted to the nearest township, range, and section. The location of wells derived from the well completion reports were illustrated by plotting a random distribution within each section.

Although most well completion reports accurately locate wells to the nearest section (1-mile radius), some well completion reports may inaccurately locate wells by several miles. Well distribution data listed in this report should be used as a general indicator of well location and distribution. The number and distribution of wells are grouped according to location and well type. The five well types are: domestic, irrigation, municipal, monitoring, and other. Municipal wells include wells identified on the well completion report as municipal, public or industrial. Wells identified as "other" include wells listed as stock wells, test wells, abandoned wells, or unidentified wells. Well distribution data are provided at the inventory and sub-inventory unit levels in Section 3. Summaries of well distribution by area and installation date are presented in Tables 1 and 2, Appendix B.

GROUNDWATER LEVEL

In a groundwater basin, water levels fluctuate as a result of changes in the amount of groundwater in aquifer storage. Factors that affect the amount of groundwater in storage include the annual amount of extraction and aquifer recharge. The aquifer system is recharged from subsurface inflow to the basin and percolation from precipitation, streams, and irrigation water. Aquifer discharge occurs when groundwater is extracted by wells, discharges to streams, or flows out of the groundwater basin from the subsurface. In general, dry years cause groundwater levels to decline because more water is discharged than recharged. During wet years, groundwater levels typically recover because more water is recharged than discharged.

Analysis of groundwater levels in Tehama County is based on groundwater level data collected by DWR, Tehama County and other data collection cooperators within the County. Groundwater level data is collected from a network of wells that comprise the Tehama County groundwater level monitoring grid. The Tehama County groundwater monitoring grid is shown on Plate 7, Appendix A. The groundwater level monitoring

grid consists primarily of active domestic and irrigation wells. To a lesser degree the grid also comprises idle, abandoned or dedicated monitoring wells. Dedicated monitoring wells are wells that are designed and constructed with the sole purpose of groundwater monitoring, and located to optimize data collection from a specific aquifer interval. The groundwater monitoring wells are numbered using the State Well Numbering System. The State Well Numbering System identifies each well by its location according to the township, range, section, and tract. The State Well Numbering System is shown below in Figure 1.

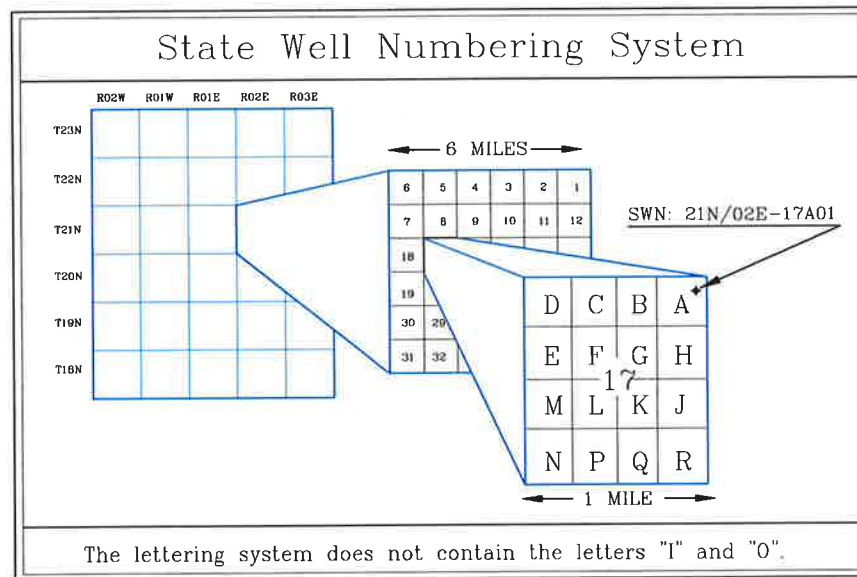


Figure 1. California State Well Numbering System.

Historic groundwater level data collected by DWR consists of measurements taken primarily on a semi-annual basis; however, some monthly recordings of groundwater levels are also available. Semi-annual groundwater level measurements are recorded in the spring when levels are typically the highest and in the fall when the levels are recovering from active summer pumping. In 1999, Tehama County, in cooperation with DWR, developed a groundwater level monitoring program and increased the measurement frequency of the existing DWR monitoring grid. Under the current program, DWR monitors groundwater levels during the spring and fall, and Tehama County monitors groundwater levels during the summer months when groundwater extraction is at its peak. Groundwater levels are typically measured to the nearest one-tenth of a foot using an electric sounder or a steel tape. Groundwater level measurements are recorded as depth below ground surface and later converted to elevation above mean sea level. The groundwater monitoring data are shared by the County and State, and are made available to the public.

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The groundwater level data were used to develop groundwater hydrographs for selected wells within Tehama County. Groundwater hydrographs are graphical plots of depth to groundwater versus time. Hydrographs presented in this report are used to help estimate historic water level trends, as well as, seasonal and long-term fluctuations in Tehama County groundwater levels. To help visualize changes in groundwater levels within the hydrograph, the individual measurement points are typically connected by a solid line. It is important to note however, that the line connecting the actual measurement points does not represent a continuous recording of groundwater levels; it serves, rather, as a visual aid and an approximation of levels between a series of known levels taken at individual points in time. Breaks or discontinuities in a hydrograph represents measurements that are missing from the regularly scheduled monitoring times.

Prior to 1999, much of the groundwater level data for Tehama County consisted of spring and fall data. Since 1999, summer measurements have been collected from many of the monitoring wells. When interpreting changes in groundwater levels over time, it is important to select the seasonal measurement period(s) that are most appropriate to answer the questions being raised. Groundwater levels are typically the highest during the spring; the measurements are taken prior to beginning of agricultural irrigation when the aquifer is stable. When analyzing the historic or long term changes in groundwater levels within the aquifer, comparison of spring to spring measurements are recommended. Summer groundwater levels are typically lowest of the year, and when compared to spring levels, are useful for determining the maximum seasonal fluctuation of groundwater levels within the aquifer. Fall groundwater levels are typically taken after the agricultural irrigation has ended, but prior to the beginning of the rainy season. Comparison of summer versus fall groundwater levels can help provide an estimate of the rate and volume of groundwater that is recharged into the aquifer due to stream infiltration and due to groundwater underflow into the basin from adjacent areas.

Hydrographs from select monitoring wells are presented under the discussion of *groundwater levels*, at the individual inventory and sub-inventory levels of the report. Hydrographs along with irrigation water source data are also provided in Plates X through X, Appendix A. Additional Tehama County hydrographs and groundwater level data can be obtained from the DWR Web site at: <http://wdl.water.ca.gov>. The on-line groundwater level data can be retrieved via a graphical map interface or by a designated basin area and state well number.

When reviewing the on-line hydrographs note that the solid blue dots indicate a static groundwater level measurement, while the red symbols indicate a measurement that has been qualified as questionable. DWR assigns a numerical code to all questionable groundwater level measurements in an effort to help increase the accuracy and quality control of data analysis. Questionable measurement codes are used to differentiate

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between static versus pumping groundwater level measurements and/or identify whether nearby wells are pumping during the measurement. A key to explaining the various types of questionable measurement codes used with the on-line hydrographs is available at DWR Web site. In the hydrographs presented in this report, symbols are used to indicate several of the more common types of questionable measurements. A legend correlating the measurement symbol to the type of questionable measurement is presented at the base of each hydrograph.

GROUNDWATER MOVEMENT

Groundwater level data were also used to develop groundwater elevation contour maps for the Sacramento Valley portion of Tehama County. Groundwater contour maps were developed using groundwater level data from Shasta, Tehama, Glenn, and Butte counties. Similar to topographic contours, the patterns and spacing of groundwater elevation contours can be used to help estimate the direction and gradient of groundwater movement. Groundwater contours can also be used to help determine and illustrate the spring-to-spring and spring-to-summer changes in groundwater elevations and the associated change in groundwater storage.

Groundwater contour maps were constructed using a computer-aided groundwater surface modeling program. The software generates approximate contour locations based on a network of triangulated grids. Accuracy of the groundwater elevation contours varies with respect to the data density, groundwater gradients, and proximity of the contours to the basin boundary. Where appropriate, additional editing of contour locations was completed using general knowledge of the region's hydrogeologic characteristics.

It is sometimes difficult for regional groundwater contours to accurately represent local conditions when the groundwater level data used for contour mapping is collected from wells constructed over varying portions of the aquifer. In Tehama County the groundwater monitoring grid is primarily comprised of active wells that vary in construction and thus represent mixed aquifer conditions (confined, unconfined, and composite). Within the same inventory unit, the depth to groundwater in a shallow well constructed in the unconfined portion of the aquifer system may be significantly different from the groundwater level of a deep well constructed in the confined portion. To help maximize the accuracy of groundwater contour mapping, only the groundwater level data from wells with the top perforations between 80 and 300 feet, and a total depth less than 600 feet, were used for contouring. The groundwater contours developed for this report provide a good regional estimate of groundwater occurrence, movement, and changes in storage within the mid-to-upper aquifer systems. However, due to the potential for local differences in the aquifer systems, care

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should be taken when using a regionally developed contour map to interpret groundwater occurrence, movement, and changes in storage on a local scale.

Discussions of groundwater movement at the inventory and sub-inventory unit levels are provided in Section 3. A groundwater elevation contour map showing the direction and movement of groundwater during the spring and summer of a normal water year are provided in Plates 8 and 9, Appendix A. A depth to groundwater contour map is provided in Plate 10, Appendix A. A groundwater level map showing the change in spring-to-summer groundwater levels in a normal year is provided in Plate 11, Appendix A.

GROUNDWATER EXTRACTION

Awareness of the amount of groundwater being extracted from a basin contributes to a better understanding of the current level of groundwater development and a further understanding of which management tools could be used to help sustain the groundwater resource. One method of determining groundwater extraction is by direct measurement, or metering, of individual production wells within the basin. However, in most areas of the Sacramento Valley, agricultural wells are not metered, and a direct measurement of groundwater extraction is not monitored. This study uses two alternative methods to estimate groundwater extraction, 1) area volume method and 2) the water balance approach. The area-volume method uses seasonal groundwater level measurement data and computer modeling software to directly calculate the change in aquifer volume and groundwater extraction. The methodology for estimating groundwater extraction using seasonal groundwater level data and area-volume calculations is presented later in this section of the report under the *Changes in Groundwater Storage*. The water balance approach uses land use surveys and municipal records to estimate groundwater extraction. The methodology for determining groundwater extraction using the water balance approach is presented below.

The annual groundwater demand was determined for normal and drought years using the water balance approach, municipal records, and land use data developed by DWR and Tehama County. In areas of the county having a mixed supply of surface water and groundwater, the difference between the agricultural demand and the surface water delivery is assumed to be equal to the amount of groundwater extraction. The annual groundwater extraction estimates are divided into summer agricultural, municipal and industrial, and environmental water use, and fall/winter environmental water use. Municipal and industrial groundwater extraction estimates for regions outside of a municipal water service area include the estimated domestic use from private wells. Within a municipal water service area, the municipal and industrial groundwater extraction estimates do not include domestic use from private wells. The estimated amount of groundwater extracted from private wells is based on population,

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population density, landscaping, and local climatic conditions. Domestic use of groundwater from rural private wells is typically minor in comparison to agricultural use.

Environmental groundwater extraction estimates include water applied for wildlife refuges, rice straw decomposition and, during dry years, includes groundwater that is extracted and applied for beneficial agricultural use in exchange for bypassed surface water used to augment in-stream fish flow.

Groundwater extraction estimates for a normal year incorporate 1999 land use and municipal extraction data projected to 2000 population and cropping trends. The groundwater extraction estimates for a normal year closely approximate the annual amount of groundwater extracted under the current level of county development. Groundwater extraction estimates for a drought year represent the potential maximum amount of groundwater extraction that can be expected to take place under the current level of development and under a worst case scenario of precipitation, evapotranspiration, runoff, and reduction in surface water deliveries to the county. A detailed description of normal and drought years is presented below. Groundwater extraction data at the inventory and sub-inventory unit levels are presented in Section 3. A summary of groundwater extraction estimates for normal year, drought year with 75% cutback of CVP water and drought year with 100% cutback of CVP water are presented in Tables 3, 4 and 5, Appendix B. A water source map for Tehama County is provided on Plate 12, Appendix A.

DETERMINATION OF NORMAL- AND DROUGHT-TYPE YEARS

An important aspect of the Tehama County groundwater inventory analysis was identifying how the groundwater basins respond to a range of climatic conditions, such as those that occur during normal versus drought years. Ideally, several water years can be selected to accurately represent and compare the annual groundwater extraction and basin response during normal and drought year conditions. However, an accurate determination of what constitutes normal versus drought conditions and the selection of years that appropriately represent each of these climatic conditions is often difficult. Many factors can affect the annual amount of groundwater that is extracted from a given area. Some of the factors that were considered when selecting a representative normal or drought year for Tehama County are listed below:

- precipitation,
- runoff from the major streams and rivers,
- evapotranspiration,
- level of agricultural and urban development, and
- surface water availability.

The precipitation record for the City of Red Bluff station is shown in Figure 2. The precipitation record for the Red Bluff station is considered representative of rainfall conditions in the valley portion of Tehama County. Figure 2 shows the average annual precipitation from 1935 to 2001. Classification of the precipitation years in Figure 2 as wet, above normal, dry, and critically dry were developed to correlate to a similar classification system used to estimate annual runoff for the Sacramento River 40-30-30 Water Supply Index.

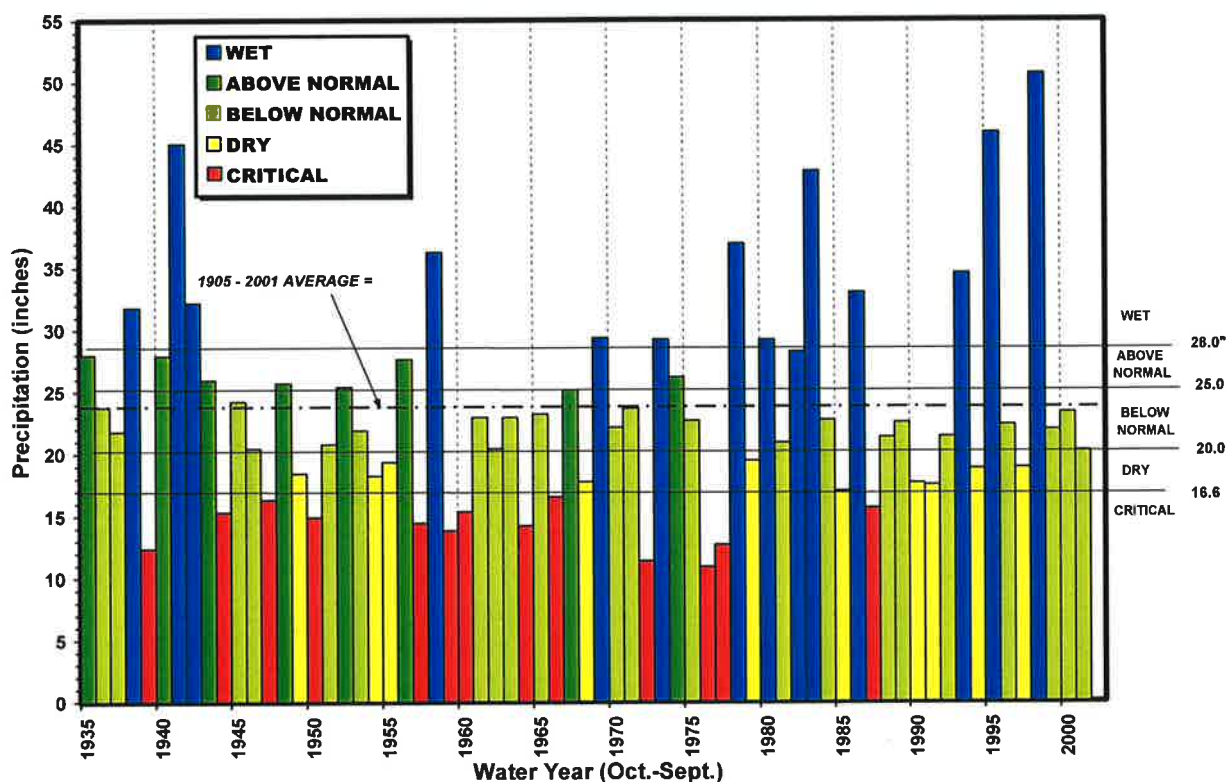


Figure 2. City of Red Bluff 1935-2001 Precipitation Record.

The annual runoff from regional surface water systems was evaluated by review of the Sacramento River 40-30-30 Water Supply Index. The Sacramento River Index is a regional indicator of the annual water supply for the northern Sacramento Valley. The index incorporates the sum of the unimpaired monthly runoff measured in the Sacramento River at Bend Bridge, the Feather River inflow to Lake Oroville, the Yuba River at Smartville, and the American River inflow to Folsom Lake. Unimpaired runoff represents the natural water production of a river basin unaltered by upstream diversions, storage, and export of water to, or import of water from, other basins. The Sacramento River Index is calculated as the sum of 40 percent (%) of the current April through June flow, 30% of the current October through March flow, and 30% of the

index for the previous water year. Based on the calculated runoff in million acre-feet, each year of the index is then classified as wet, above normal, below normal, dry, or critical. Figure 3 shows the Sacramento River Index since 1906 and the classification range for each year.

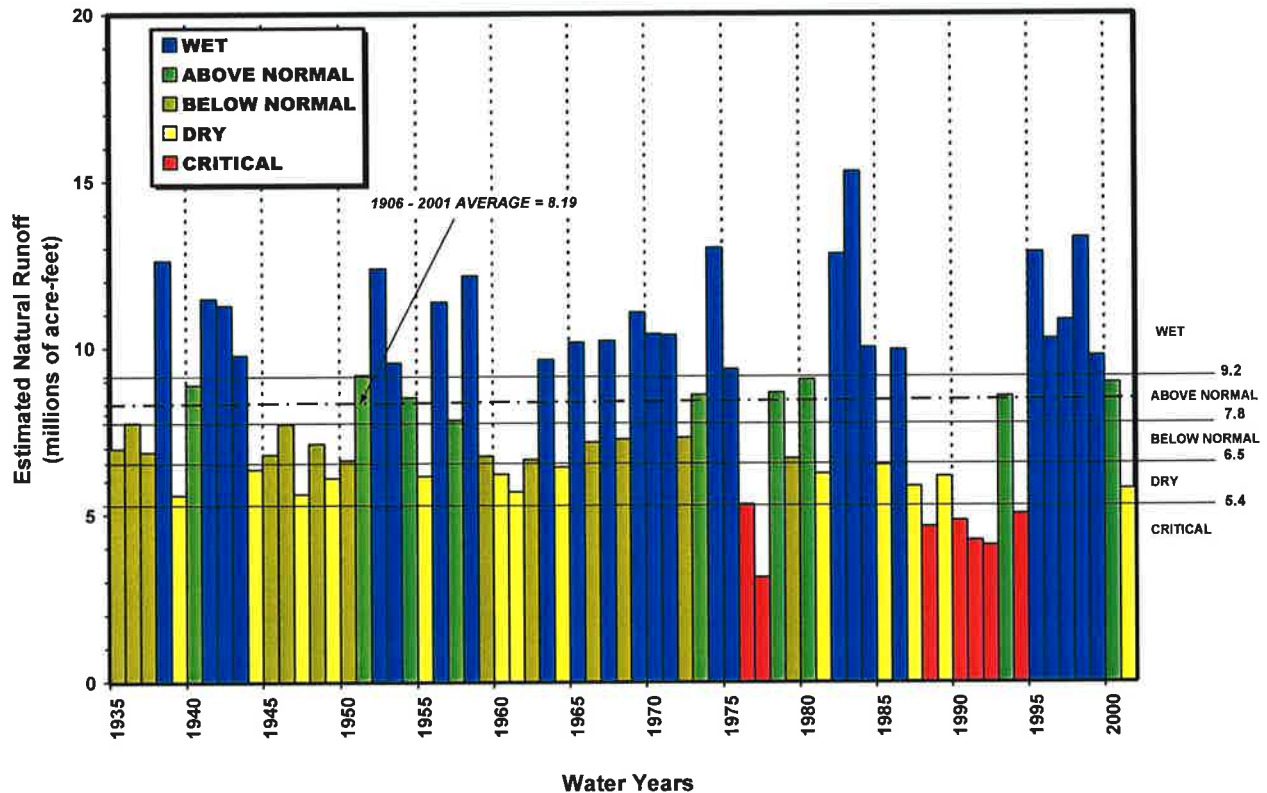


Figure 3. Sacramento River 40-30-30 Water Supply Index; 1935-2001.

The annual runoff from local streams was also evaluated to help identify water year conditions and possible variations in the eastern versus western portions of Tehama County. Figures 4 and 5 are hydrographs showing the City of Red Bluff precipitation along with the total annual flow from Thomes Creek and Deer Creek. Thomes Creek and Deer Creek are major tributaries to the Sacramento River in Tehama County. Annual flow from these two creeks is representative of hydrologic conditions in the western and eastern portions of the county.

Evapotranspiration rates, level of development and surface water supply were also examined in order to establish agricultural water use for representative years. Monthly evapotranspiration rates were derived from lysimeter and pan evaporation data collected by DWR. Crop evaporation coefficients were developed jointly by DWR and the University of California Davis Cooperative Extension. The level of development was

reviewed based on DWR land use and the Tehama County Agricultural Commissioner's data. The potential curtailment of surface water deliveries was examined based on the existing Central Valley Project agreement and settlement rights.

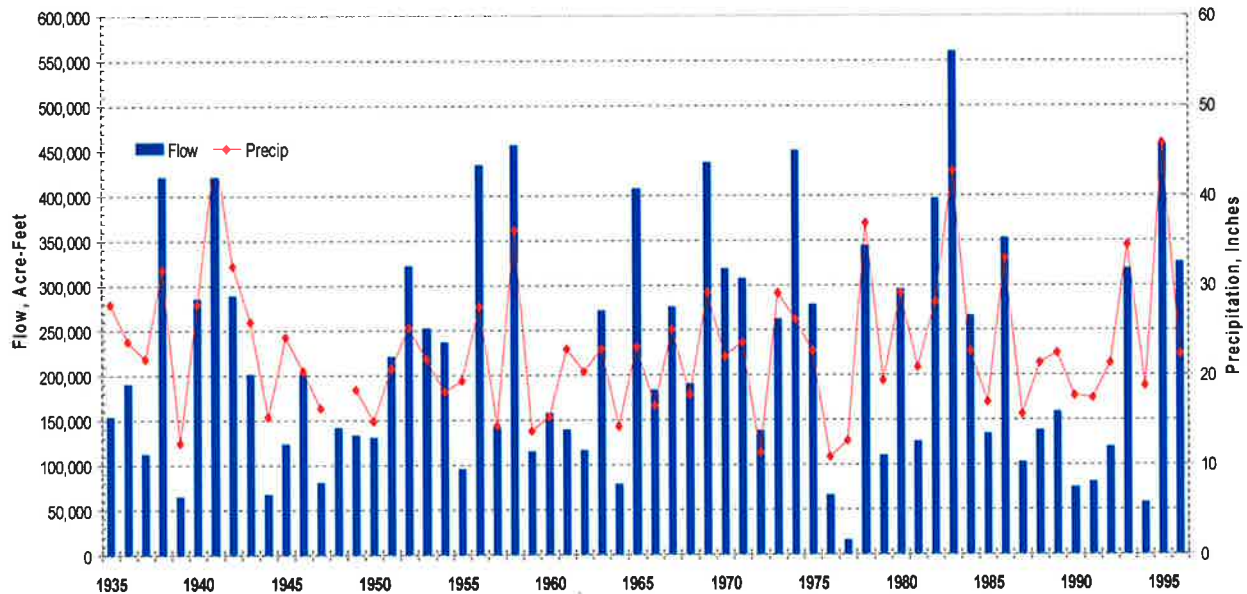


Figure 4. Thomes Creek Flow Versus Red Bluff Precipitation; 1935-1996.

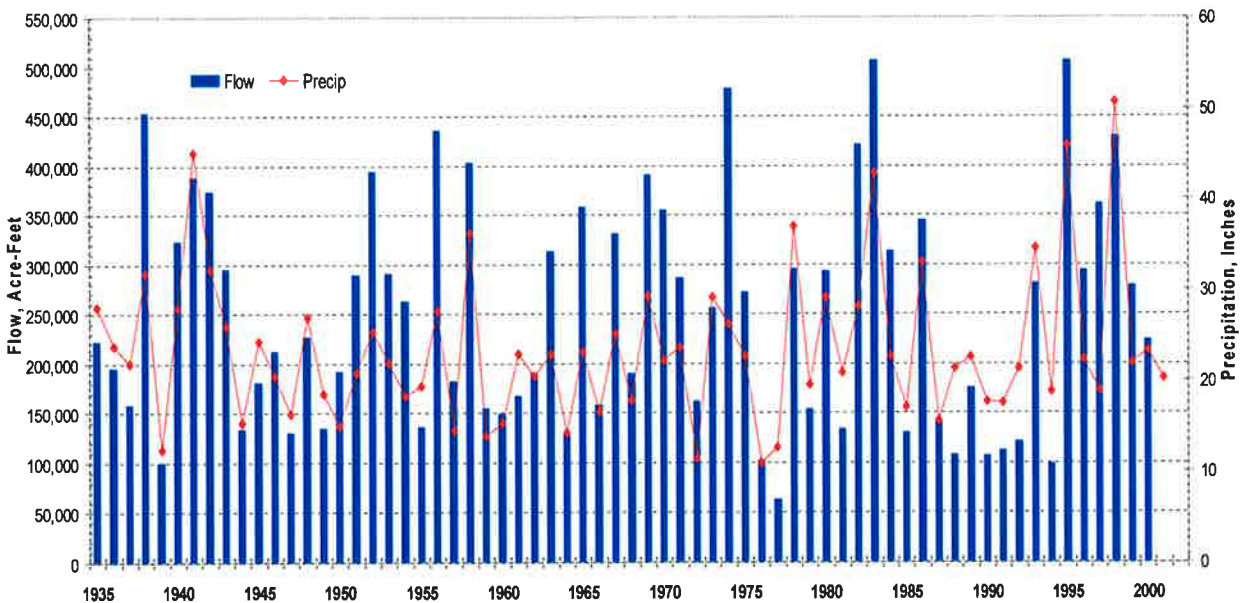


Figure 5. Deer Creek Flow Versus Red Bluff Precipitation; 1935-2001.

The normal year is intended to represent a typical water year scenario, or the amount of groundwater extraction that can be expected under normal climatic and land use conditions. Based on multiple data sources, 2000 was determined to best represent normal precipitation, evapotranspiration, runoff conditions, and full surface water availability. However, the most recently completed Tehama County land and water use survey was conducted by DWR in 1999. Using the 2000 Tehama County Agricultural Commissioner's data, the 1999 land and water use survey was updated to match 2000 cropping trends and population census.

In summary, estimates of the amount of groundwater extraction that occurs in Tehama County during a normal-year scenario were calculated based on:

- 2000 precipitation, evapotranspiration, and runoff data,
- 1999 agricultural land and water use projected to 2000 agricultural cropping trends and 2000 population census, and
- full surface water supply availability.

The drought year is intended to represent a worst-case water year scenario, or the maximum amount of groundwater extraction that can be expected to occur under natural conditions. The worst case scenario for the annual evaporation rate is best represented by 1976 data. With respect to precipitation and runoff, 1977 is considered to best represent drought-year conditions in agricultural land use areas. However, because the land and water use data from 1977 does not accurately represent the current level of agricultural and urban development, the worst case scenario is represented using 1977 precipitation and runoff data applied to the 1999 land use data normalized to 2000 agricultural cropping trends.

A worst case scenario for a drought-year surface water supply is represented by reducing surface water deliveries by an amount equal to the maximum allowable single-year cutback for Central Valley Water Project. In Tehama County, the maximum potential single-year cutback for the federally operated Tehama-Colusa Canal is 100 percent. Historically, the maximum cutback was 75 percent in 1977 and 1991. To help provide perspective of maximum potential versus historic worse case drought-year scenario for surface water supply, groundwater demand was calculated for single-year cutbacks of both 75 and 100 percent.

Worst case scenarios for municipal and industrial water requirements were best represented by applying the 1988 per-capita water use (high evaporation and low precipitation) to 2000 population estimates.

In summary, the worst case scenario for groundwater extraction in Tehama County during a drought year is based on:

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- 1977 precipitation and runoff data,
- 1976 evapotranspiration rates,
- 1999 agricultural land and water use projected to 2000 agricultural cropping trends and 2000 population census,
- a 75% reduction in CVP water deliveries, and
- a 100% reduction in CVP water deliveries, and
- 1988 per-capita municipal and industrial water uses adjusted to 2000 population census.

WELL DEPTH

The depths of existing wells in each inventory and sub-inventory unit were analyzed to provide a basis for estimating the amount of available groundwater in storage and to assess potential impacts of increased groundwater development on a region. In many parts of the Sacramento Valley, the potential impacts of groundwater extraction on shallow wells are the limiting factors in the amount of groundwater that can be extracted from a particular area. Extraction of too much groundwater can adversely affect shallow wells by causing levels to be lowered below the pump bowls or the bottom of the wells.

In areas where sufficient information was available, a well depth analysis was completed for domestic, irrigation, and municipal water wells. The well depth data were plotted in the form of histograms and cumulative frequency distribution curves for analysis and evaluation. The well depth data were collected from well completion reports filed with DWR. Well depth data at the inventory and sub-inventory unit levels are provided in Section 3 and summarized in Table 6, Appendix B.

WELL YIELD

Well yield is the maximum amount of groundwater that can be continuously extracted from a well. Well yield values are largely a function of well size, well performance, and aquifer productivity. Sources of well yield data reviewed for this investigation include well completion reports filed with DWR and published and unpublished investigations.

The well yield data listed in well completion reports are often derived by using a variety of pumping methods that often produce variable results. Well yield data listed in those reports are often collected during well drilling or development and are commonly more a function of the particular pump test method, rather than an accurate indication of maximum well yield for a given area. As such, well yield data from well completion reports should serve only as a general approximation of actual well yield.

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A more accurate estimate of well yield is provided through utility pump tests. Utility pump tests are typically performed using the existing pump motor and bowls that were specifically designed for each well. Utility pump test records are used to estimate well yield and pumping plant efficiency. Between 1989 and 1998 thousands of pump test were conducted by Pacific Gas & Electric in Tehama County. As part of this investigation, a written request was made on behalf of the DWR to Pacific Gas & Electric for Tehama County utility pump test records. The request for data was denied.

In the 1961, Olmsted and Davis from the USGS compiled utility pump test records from the 1940's in a report entitled, *Geologic Features and Ground-Water Storage Capacity of the Sacramento Valley, California*. In their report, Olmsted and Davis analyzed well yield data from large-capacity irrigation, industrial, and municipal wells in 21 study areas within the Sacramento Valley through 1948. Of the 21 study areas, two are located in the valley portion of Tehama County. Well yield data developed for the Olmsted and Davis report is presented to help characterize well production in these areas. Well yield data are provided at the inventory unit level in Section 3 and summarized in Table 7, Appendix B.

Aquifer performance testing and site specific groundwater investigations have been conducted in Tehama County by DWR. Groundwater data that is collected under a specifically funded program is usually published in the form of a DWR memorandum report or District report. Some additional groundwater information is also collected as part of local assistance work or regional data collection programs. These data are usually incorporated into DWR Bulletin 118 updates, but sometimes may remain unpublished and in draft form. As part of this investigation, published and unpublished well yield and aquifer information collected by DWR have been included under discussions of regional hydrogeology in Section 2 and, where available, under the local hydrogeology discussions in Section 3.

SPECIFIC CAPACITY

The specific capacity of a well is the pumping rate divided by the total drawdown after a specified period of pumping. Similar to well yield, specific capacity is a method of measuring well productivity. Specific capacity is usually reported in gallons per minute per foot (gpm/ft) of drawdown and amount of time elapsed since the well was pumped prior to the measurement. Sources of specific capacity data reviewed for this investigation include published and unpublished investigations and utility pump test records. Use of well completion report data was determined to be inadequate for an accurate evaluation of specific capacity on an inventory or sub-inventory level.

Specific capacity data were also collected from work conducted by Olmsted and Davis and published in their 1961 USGS report. Specific capacity data from the Olmsted and

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Davis report is provided at the inventory unit level in Section 3 and summarized in Table 7, Appendix B.

GROUNDWATER IN STORAGE

Groundwater in storage is the volume of groundwater currently in storage within the saturated portion of the aquifer. Groundwater in storage values may be reported over a range of increasing depth intervals, or over the entire aquifer (total groundwater in storage). Groundwater in storage is calculated by multiplying the specific yield of the aquifer by the saturated aquifer volume over a given depth.

Specific yield is a function of aquifer pore space and increases as the percentage of pore space to solid material increases within the aquifer. By definition, specific yield is the ratio of the volume of water a rock will yield under gravity drainage to the volume of the entire rock. Values of specific yield can be derived directly from aquifer sampling or estimated from description of aquifer units recorded in well completion reports. Estimates of specific yield used in this study were derived primarily from data developed by the USGS utilizing aquifer descriptions listed in well completion reports (Olmsted and Davis 1961). In areas where USGS specific yield estimates were not available, additional specific yield data were compiled from unpublished field investigations conducted by DWR. Updating estimates of specific yield from recent well completion reports is recommended to help improve the accuracy of groundwater storage calculations in areas of Tehama County experiencing potential development limitations due to increases in groundwater demand.

Several methods exist for determining aquifer volume over a given saturated thickness. This study used three-dimensional modeling to create an upper aquifer surface using spring 2000 groundwater level data, then calculated the area-volume difference between the spring 2000 surface and subsequent surfaces generated at depths of 50, 100 and 200 feet below spring levels. Using a similar approach, groundwater in storage over the entire freshwater portion of the aquifer (total groundwater in storage) was also calculated using the spring 2000 data for the upper surface and the base of freshwater data for the lower surface. Estimates of the base of fresh water derived from C.F. Berkstresser, Jr. (Berkstresser, 1973).

The area-volume results were then multiplied by the estimated average specific yield to obtain groundwater in storage, by inventory unit, at the selected intervals. Insufficient groundwater level data prevented calculating estimates of groundwater in storage for six of the twelve inventory units. Groundwater in storage estimates were developed for the Antelope, Dye Creek, Los Molinos, Vina, Red Bluff East, and Corning East inventory unit areas. Groundwater in storage estimates are provided at the inventory

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unit level in Section 3 and summarized in Tables 8 and 9, Appendix B. The spring 2000 groundwater contour map is provided in Plate 8, Appendix A. The base of freshwater map is provided in Plate 13, Appendix A.

Estimates of groundwater in storage were developed to help further the general academic understanding of groundwater resources in Tehama County, not as a guideline for usable aquifer capacity. Due to the numerous shallow domestic wells within the Sacramento Valley portion of Tehama County, the actual amount of usable groundwater storage will be much less than the volumes estimated over the aquifer intervals listed above. Excessive extraction or mining of groundwater can lead to increased pumping costs, dewatering of wells, increased infiltration and reduction in flow from surface water systems and potential degradation of the water quality within the aquifer.

Ultimately, determination of the “useable” groundwater in storage should be locally defined and empirically determined through active management and adequate monitoring of the groundwater resource. To help qualify considerations of useable groundwater storage, potential impacts to domestic and irrigation wells from the lowering of groundwater levels is presented in Section 3 under discussions of groundwater in storage.

The accuracy of groundwater in storage calculations varies according to the distribution and density of the groundwater elevation data, and the accuracy of specific yield estimates for the aquifer. The accuracy of specific yield values used for the groundwater in storage calculation is difficult to determine without detailed study of the aquifer systems. Overall, the accuracy of the groundwater in storage data is conservatively estimated at plus or minus 10%.

MAXIMUM GROUNDWATER STORAGE CAPACITY

Maximum groundwater storage capacity is defined as the maximum volume of fresh groundwater that is capable of being stored within the aquifer over a given area.

Calculation of groundwater storage capacity requires estimating how high groundwater levels could rise in the aquifer system before damaging the existing agriculture, urban infrastructure, or before natural discharge into surface water systems. Estimates of the maximum groundwater storage capacity were developed by reviewing groundwater level data from long-term monitoring wells to determine the highest historic groundwater level for the well. The historic high groundwater level was then subtracted from the spring 2000 groundwater level for the same well. The difference in groundwater levels between the historic high and spring 2000 were used to create a three dimensional surface representing the maximum rise in groundwater

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level from spring 2000. Similar to groundwater in storage calculations, the area-volume difference between the spring 2000 groundwater surface and the potential maximum groundwater surface were calculated by inventory unit then multiplied by the average specific yield for each inventory unit area to obtain the additional acre-feet of storage. The additional acre-feet of storage was then adding to the total groundwater in storage to determine the maximum groundwater storage capacity

Insufficient groundwater level data prevented calculating maximum groundwater storage capacity for six of the twelve inventory units. In addition, limited monitoring well coverage resulted in the need to decrease the size of the east-side inventory units to an area representing the lower elevation regions along the valley floor. Maximum groundwater in storage estimates were developed for the Antelope, Dye Creek, Los Molinos, Vina, Red Bluff East, and Corning East inventory unit areas. Estimates of the maximum groundwater storage capacity are provided at the inventory unit level in Section 3 and summarized in Table 10, Appendix B. A contour map showing the maximum potential increase in groundwater levels above spring 2000 is provided in Plate 14, Appendix A.

CHANGES IN GROUNDWATER IN STORAGE

Change in groundwater in storage is dependent on many factors, including climatic conditions, the annual rate of groundwater extraction, and the annual rate of groundwater recharge. Groundwater storage commonly fluctuates within a given year and from year to year. Groundwater in storage will typically decline during periods of drought and rebound during periods of above-normal precipitation. Within the same year, groundwater in storage will decline through the summer months with increased extraction from municipal and agricultural uses, then recover as extraction slows and seasonal precipitation increases recharge to the aquifer. In basins where the amount of annual groundwater extraction is at or below the amount of normal-year recharge, the long-term change in groundwater in storage will remain the same. In basins where the annual amount of groundwater extraction exceeds the amount of normal-year recharge, the long-term change in groundwater in storage will decline. Depletion of groundwater in storage is typically exhibited by a decline in groundwater levels during periods of normal precipitation.

The annual spring-to-spring changes in groundwater in storage for the valley portion of Tehama County were calculated over a 22-year period from 1980 to 2002. The spring-to-spring changes in groundwater in storage were calculated by using spring groundwater level measurement data to generate groundwater elevation contour maps for the spring of each year, over the 22-year period. The groundwater elevation contours were further used to develop digital three-dimensional groundwater surfaces and calculate the area-

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volume difference between the consecutive spring-to-spring surface data. Groundwater level data used for development of the spring contours were confined to wells monitoring the upper portion of the aquifer system and constructed with the top perforations between 80 and 300 feet, and a total depth less than 600 feet.

When comparing the change in storage over a period of years it is important that the area being analyzed remains consistent. However, it is common to have fluctuations in the number and density of wells that comprise the groundwater level monitoring grid. Small fluctuations in the density and distribution of monitoring wells within the center of the basin don't significantly affect the accuracy of change in storage calculations. Small fluctuations in the density and distribution of the monitoring wells along the perimeter of the grid can have very significant effects on the ability to accurately analyze and compare changes in storage over time. In Tehama County, the spring-to-spring change in storage was examined over a 22-year period. During that period, the density and distribution of groundwater level monitoring wells along the perimeter of the grid fluctuated as some wells became inaccessible and new wells were added. In order for the area used to calculate spring-to-spring change in storage to remain consistent over the 22-year period, the boundaries needed to be pulled back from the selected inventory unit areas to accommodate years of minimum density and distribution along the edges of the monitoring grid.

Insufficient density and/or distribution of groundwater level monitoring wells and lack of historic groundwater level data prevented calculation of spring-to-spring change in groundwater in storage for four of the twelve inventory units. In addition, limited groundwater level data resulted in the need to decrease the size of the eight remaining inventory units to a scale that more appropriately reflects the distribution of available data. Spring-to-spring change in groundwater in storage estimates were developed for the adjusted inventory units representing Antelope, Dye Creek, Los Molinos, Vina, Red Bluff East and Corning East, and a combined Bowman/Rosewood area.

The spring-to-spring changes in groundwater in storage data were summarized in tabular format and graphically illustrated in using cumulative spring-to-spring change in groundwater in storage graphs. The cumulative spring-to-spring change in storage graphs were developed to start with a base line of zero and a water year that reflective of normal groundwater conditions. Changes in spring-to-spring storage in subsequent years are shown as cumulative changes and are calculated based on the difference between groundwater levels during the starting base year and the spring of any given year. In most areas of Tehama County 1980 most closely resembled normal year groundwater conditions and was thus selected as the starting year. The cumulative change in spring-to-spring storage graphs provides a good quantitative estimate of the annual decline and recharge of groundwater in storage during various climatic cycles over various regions of the basin.

Estimates of the spring-to-spring changes in groundwater in storage are presented at the inventory unit level in Section 3 and summarized in Table 11, Appendix B. A map showing the adjusted inventory areas used for calculation of spring-to-spring change in groundwater in storage is provided in Plate 15, Appendix A.

In addition to the spring-to-spring change in storage, the seasonal change in groundwater in storage, associated with normal year groundwater extraction, was also calculated at the inventory unit level. Spring and summer groundwater levels typically represent the high and low points in the aquifer for the season. Using spring and summer groundwater level data from the upper portion of the aquifer system, three-dimensional groundwater elevation surfaces were generated and the area-volume differences between spring and summer groundwater surfaces were calculated. The area-volumes for each inventory unit were then multiplied by the average specific yield to obtain an estimate of seasonal groundwater extraction in the valley portion of Tehama County.

The goal of the summer monitoring period is to measure the aquifer system at the lowest point of the year, but sometimes this can be a difficult task. During the summer months when groundwater extraction and temperatures are at their peak, groundwater levels can change significantly over period of days. In addition, many of the wells on the Tehama County groundwater level monitoring grid consist of active domestic or irrigation wells that frequently operate during the summer months; pumping level data can not be used in conjunction with static water level data for seasonal change in storage calculations. To help ensure an accurate measurement of the summer low point in the aquifer, summer groundwater levels are commonly measured twice, once in July and once in August. The lower of these two measurements is used for the seasonal change in storage calculations.

Most of the Tehama County groundwater monitoring wells had readings for the both the spring and summer 2000. However, some monitoring wells from the 2000 monitoring were missing the data from either the spring or summer measurement periods. For these wells the data from prior and later years were examined, and if enough supporting data existed, an estimate of groundwater levels was developed to replace the missing data record.

Similar to previous change in storage analysis, limited density and distribution of groundwater level data prevented calculation of spring-to-summer change in groundwater storage from being calculated for six of the twelve inventory units. Seasonal (spring-to-summer) groundwater extraction estimates were calculated for the entire inventory areas representing Antelope, Dye Creek, Los Molinos, Vina, Red Bluff East and Corning East. The seasonal change in groundwater in storage estimates are provided at the inventory unit level in Section 3 and summarized in Table 12, Appendix

B. The spring-to-summer 2000 change in groundwater level map is provided in Plate 11, Appendix A.

The seasonal change in groundwater storage estimates calculated from normal year groundwater elevation data serve as a good regional approximation of storage changes occurring within the aquifer. However, the accuracy these estimates are largely dependant upon the density and distribution of the groundwater level data, the ability of the estimated values of specific yield to accurately represent existing aquifer conditions, and the ability of the groundwater level data to accurately represent unconfined dewatering of the aquifer, not pressurized changes occurring in confined portions of the aquifer. Groundwater level data used for development of the spring contours were confined to wells monitoring the upper portion of the aquifer system and constructed with the top perforations between 80 and 300 feet, and a total depth less than 600 feet. Most of the groundwater level measurements from wells falling under the above criteria will accurately represent the groundwater table and storage changes in the upper, unconfined or semi-confined portion of the aquifer. Locally however, some of the groundwater level measurements collected from these wells will reflect a pressurized or potentiometric water surface, associated with a confined portion of the aquifer system. Changes in groundwater levels from wells associated with the confined aquifer system tend to exhibit much greater seasonal fluctuations than water levels representing the unconfined aquifer system. Consequently, change in storage calculations using groundwater level data from a confined aquifer will tend to over estimate the change in storage. Potential evidence that this is occurring at some level in Tehama County can be illustrated by comparing the normal-year groundwater extraction estimates developed from land and water use data versus the seasonal groundwater extraction estimates based on groundwater level data. The seasonal groundwater extraction estimates calculated from groundwater level data are higher in five of the six inventory unit areas. The seasonal groundwater extraction estimates from land and water use data are provided in Tables 3, 4 and 5, Appendix B.

Installation of dedicated wells designed to monitor specific intervals of the aquifer would help improve the accuracy of future groundwater storage analysis. Overall, the changes in storage estimates provided in this study are considered accurate within plus or minus 10%.

SECTION 2.

REGIONAL GROUNDWATER GEOLOGY

Tehama County covers several geologic regions and a wide range of diverse groundwater-bearing units. Discussions of the regional hydrogeology are grouped into areas encompassing the inventory units within the Sacramento Valley and Redding Groundwater Basin Region, Mountain Region East and Mountain Region West. These regions are shown on the location map, Plate X, Appendix X.

The major groundwater aquifers in Tehama County lie within the larger Sacramento Valley groundwater basin. The basin extends north to south from Redding to the Sacramento-San Joaquin Delta and is bordered by the Coast Ranges to the west and the Cascade Range and Sierra Nevada to the east. It covers an area of 4,900 square miles, which includes all of Sutter County and parts of Butte, Glenn, Tehama, Colusa, Yuba, Yolo, Solano, Placer, Sacramento and Shasta counties.

The Sacramento Valley is a structural basin filled with up to 5 miles of sediment. These marine and continentally derived sediments have been deposited almost continuously from the Late Jurassic period to the present. Of these deposits, older sediments in the basin were emplaced in a marine environment and usually contain saline or brackish groundwater. Younger sediments were deposited under continental conditions and generally contain fresh groundwater. Sediments thin near the margins of the basin, exposing older metamorphic, granitic and marine sedimentary rocks underlying and bounding the Sacramento Valley sediments.

Principal hydrogeologic units of the Sacramento Valley groundwater basin consist of Pliocene sedimentary deposits, such as the Tuscan, Laguna, and Tehama formations, and Quaternary terrace deposits, such as the Riverbank and Modesto formations. The Tuscan, Laguna, and Tehama formations are the source of water for deep irrigation and municipal wells, while the Riverbank and Modesto formations yield water to the shallower domestic wells.

Tehama County is composed of a diverse mix of geologic units ranging from very productive water-bearing sedimentary units to non-water bearing metamorphic rocks. The main hydrogeologic units and source of groundwater in Tehama County are the Tuscan and Tehama Formations. Other units that supply lesser amounts of groundwater to the county are the Riverbank and Modesto formations.

Groundwater occurs under both unconfined and confined conditions in Tehama County. Unconfined conditions are present in the surficial Quaternary deposits and in the Pliocene deposits that are exposed at the surface. Confined conditions usually exist at a depth of 200 feet or more, where a confining layer rests above the underlying aquifer deposits. Although the Tuscan Formation is unconfined where it is exposed near the valley margin, at depth the Tuscan Formation is confined and forms one of the major aquifer systems in Tehama County. The Tehama Formation is also confined at depth, with coarse-grain, near-surface deposits contributing to the unconfined aquifer system.

The following is a discussion of the geologic units and their hydrogeologic properties found within the Sacramento Valley and Redding Groundwater Basin Region, Mountain Region East and Mountain Region West of Tehama County.

SACRAMENTO VALLEY AND REDDING GROUNDWATER BASIN REGIONS

The Sacramento Valley and Redding groundwater basins of Tehama County lie within the northern Sacramento Valley, as shown on Plate 1, Appendix A. Upland portions of the region average around 820 feet above mean sea level (msl) on both the east and west sides of the valley. This upland topography consists of hills gradually increasing in elevation to the west, dissected uplands, and alluvial fans of moderate relief. The land surface slopes downward toward the axis of the valley, where the elevation ranges from around 330 feet msl at the north end of the county to about 150 feet msl at the Tehama-Glenn county line. The majority of Tehama County's groundwater resources come from the Sacramento Valley Region.

A notable feature within this region is the Red Bluff Arch, which separates the Sacramento Valley groundwater basin from the Redding groundwater basin. The Red Bluff Arch is an east-northeast trending combination of folds and a fault which forms the northernmost barrier to groundwater flow in the Sacramento Valley groundwater basin.

South of Tehama County, the Orland Buttes and the Sutter Buttes provide the only significant topographic relief on the Sacramento Valley floor. The Orland Buttes are composed of Lovejoy Basalt, which originated from the area around Lovejoy Creek, near Susanville. During the Miocene period (23.8 to 5.3 millions of years before present (mybp)), basalt erupted from fissures in the earth's surface and flowed westward along ancient stream channels and areas of low relief, crossing the valley floor. Younger sediments covered the basalt and subsequent uplift along the Black Butte Thrust fault

brought the Lovejoy Basalt, and consequently, the Orland Buttes, to a current elevation of 1,037 feet msl.

The Sutter Buttes are a small-scale volcanic mountain range that intruded the valley sediments during the early Pleistocene (1.2 mybp) epoch. The intrusion buckled the valley sediments upward, forming a barrier to groundwater flow. The Sutter Buttes block the general north-to-south trend of groundwater migration, forcing groundwater to the surface. The upward movement results in a shallow groundwater table and the formation of wetlands along the west side of the Sutter Buttes.

In an effort to better understand the groundwater resources of the northern Sacramento Valley groundwater basin, DWR developed a series of maps illustrating the surface and subsurface geology. The surface geology of the Tehama County portion of these maps is shown on Plate 2, Appendix A, and in three geologic cross-sections presented on Plates 4 through 6, Appendix A. The geologic legend for the maps is shown on Plate 2, Appendix A. The cross-sectional maps also illustrate the subsurface geology, base of fresh water, geologic structure, and stratigraphic sequence beneath the Sacramento Valley portion of Tehama County. Geologic map symbols shown on Plates 2 through 6, Appendix A, are referred to in parenthesis in the next section.

Following is a discussion of the surface and subsurface geology of the Sacramento Valley and Redding groundwater basins of Tehama County. The major water-bearing units will be discussed in greater detail in the succeeding section entitled "Fresh Groundwater-Bearing Units."

SURFACE AND SUBSURFACE GEOLOGY

The regional structure of the Sacramento Valley and Redding groundwater basins consist of an asymmetrical trough tilting to the southwest with a steeply dipping western limb and a gently dipping eastern limb (Page 1986). Older granitic and metamorphic rocks underlie the valley forming the basement bedrock on which younger marine and continentally derived sediments and volcanic rock have been deposited. Along the valley axis and west of the present-day Sacramento River, basement rock is at considerable depth, ranging from 12,000 to 19,000 feet below ground surface. Immediately overlying the basement bedrock is a thick sequence of sandstone, shale, and conglomerate rocks of marine origin, ranging from Jurassic to Eocene in age. Within the Tehama County portion of the Sacramento Valley, these sediments are saline or brackish and serve as the base of fresh groundwater.

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The oldest of the Jurassic to Eocene marine sediments is known as the Great Valley Sequence (JKgvs), which is Jurassic to Cretaceous in age. Sediments of the Great Valley Sequence were originally deposited as horizontal layers, but due to compressive stress within the region, the margins of the formation have been folded and faulted upward. Post-depositional erosion cut large-scale valleys into the Great Valley Sequence; subsequent in-filling of the northernmost of these canyons created wide-scale deposition of the Lower Princeton Submarine Valley fill (Tlpsv). This unconformable relationship can be seen on cross-sections A-A', B-B' and C-C', Plates 4 through 6, Appendix A. Water contained within the Great Valley Sequence is primarily saline.

The Lower Princeton Submarine Valley fill of the Eocene epoch consists of a mixture of marine sediments and continental materials derived from the walls of the eroded submarine canyon which had been carved into the Great Valley sediments (Redwine 1972). Groundwater contained within these sediments is almost exclusively saline. The Lower Princeton Submarine Valley fill is one of several formations in the Sacramento Valley Region that exist in the subsurface but is not exposed at the surface, as shown on Plates 4 through 6, Appendix A. Information on the extent and position of this unit is limited because the majority of data concerning its existence and character come from oil and gas exploration well logs.

Other formations in the Sacramento Valley and Redding Regions of Tehama County that are encountered only in the subsurface are the Eocene Ione Formation and the Miocene Neroly Formation (ask Deb is she's taking them out of section b-b') and Upper Princeton Valley fill, as shown on Plates 4 through 6, Appendix A. Surface exposures of the Ione formation can be seen in the Sacramento Valley near Oroville, at Table Mountain where it underlies the Lovejoy Basalt.

Following deposition of the Ione Formation and prior to deposition of the Upper Princeton Valley fill, several volcanic eruptions in the Cascade Range produced a series of basalt flows that spread across the valley sediments during the Miocene epoch. These flows comprise the hard, black, microcrystalline Lovejoy Basalt. Occurrences of the Lovejoy Basalt are intermittent throughout the Sacramento Valley; the only surficial exposure in Tehama County is at the Orland Buttes in southern part of the county. Groundwater, primarily saline or brackish, is transmitted and stored within the secondary porosity created by the fracturing and jointing of the basalt.

The Miocene Upper Princeton Valley (Tupv) fill is widespread throughout the Sacramento Valley; depending on location, the fill may overlie portions of the Lower Princeton Submarine Valley fill, the Ione Formation, or the Lovejoy Basalt. This formation consists primarily of sandstone with interbedded layers of shale and

conglomerate. In contrast to the submarine depositional environment of the Lower Princeton Submarine Valley fill, the Upper Princeton Valley fill was deposited by terrestrial rivers draining the valley after the regression of marine waters (Redwine 1972). Water contained within the Upper Princeton Valley fill is primarily saline to brackish.

The Pliocene Tuscan and Tehama formations unconformably overlie the Upper Princeton Valley fill and are the major fresh groundwater-bearing units in Tehama County. Surface exposures of the Tuscan Formation are generally seen on the east side of the Sacramento Valley, while exposures of the Tehama Formation can be seen on the west side of the valley (Plate 2, Appendix A). The Sacramento River acts as a surficial divide in most places, however, north of Red Bluff near the Bend area, exposures of the Tuscan formation are also seen on the west side of the river. Evidence of subsurface interlayering of the two formations has been encountered in wells west of the Sacramento River, on the west side of the El Camino Irrigation District.

The Pliocene Tuscan Formation (Tta-Ttd) is composed of a series of volcanic mudflows, tuff breccias, tuffaceous sandstone, and volcanic ash layers. Mudflows originated in the vicinity of present-day Lassen Peak and most likely filled ancient stream channels as they flowed toward the valley. Upon reaching the valley floor, the mudflows fanned out depositing layers of sediment. The Tuscan Formation contains four separate but lithologically similar units, Units A through D, which in some areas are separated by layers of thin tuff or ash units (Maps: California 1985). These units will be discussed in greater detail in the following section.

The Plio-Pleistocene Tehama Formation (Tte) consists of massive, pale green, grey and tan sandstone and siltstone with lenses of pebble and cobble conglomerate (Helley and Harwood, 1985). Tehama sediments were deposited under fluvatile conditions whose source areas are the Coast Ranges and Klamath Mountains. These sediments are low to moderately permeable, with local areas of high permeability.

In the subsurface, the Tuscan and Tehama Formations are interlayered along the central north-south axis of the valley. The Nomlaki Tuff lies at the base of both units providing an important stratigraphic marker which suggests that the Tuscan and Tehama Formations are contemporaneous. The base of these Pliocene Formations is considered to be significant as the generally accepted base of freshwater in the Northern Sacramento Valley.

The surface geology of the Sacramento Valley and Redding portions of Tehama County is comprised primarily of alluvial deposits whose source is the eroded material derived

from surrounding mountain ranges. These sediments were deposited as alluvial fan, terrace, and basin deposits by a network of streams and rivers flowing into the Sacramento Valley. Along the front of the foothills, alluvial fan and terrace deposits of the Riverbank and Modesto formations mark the edge of the valley sedimentary units.

The Pleistocene Riverbank Formation (Qr) represents the oldest of the alluvial fan and terrace deposits. The Riverbank Formation was formed by streams carrying eroded material from the surrounding mountain ranges to the base of the foothills where it was deposited in wide alluvial fans. It is present primarily on the west side of Tehama County and in discontinuous surface exposures on the east side of the county along such streams as Acorn Hollow, Toomes Creek and Mill Creek.

In many places, the Riverbank Formation has been covered by more recent alluvial fan development. The thickness of the formation varies from less than 1 foot to over 200 feet, depending on location (Maps: California 1985). The position and thickness of the Riverbank Formation can be seen in Cross-section C-C' (Plate 6, Appendix A). The Riverbank Formation overlies the Tehama Formation in the western portion of Tehama County and the Tuscan Formation in the eastern portion of the county; overlying the Riverbank Formation in many locations is the Modesto Formation.

The alluvial fans and terrace deposits of the Pleistocene Modesto Formation (Qm) were deposited in a similar manner to those of the Riverbank Formation but mark a more recent period of erosion and deposition, from 42,000 to 14,000 years ago (Marchandt and Allwardt 1981). The terrace deposits of the Modesto Formation are exposed in many of the presently active stream-cut canyons along the foothills. Extending into the valley, Modesto Formation deposits widen into broad alluvial fans.

As with the Riverbank Formation, the thickness of the Modesto Formation varies from less than 10 feet in many of the terraces to nearly 200 feet across the valley (Maps: California 1985). The extent and thickness of the Modesto Formation can be seen in Tehama County on the three cross-sections of the Sacramento Valley. The Modesto Formation overlies the Riverbank Formation or the Tehama Formation in the western portion of Tehama County and overlies the Riverbank Formation or Tuscan Formation in the eastern portion of the county.

Overlying the alluvial fans of the Riverbank and Modesto formations are the fine silts and clays of the Holocene basin deposits (Qb). Basin deposits are the result of sediment-laden floodwater that rose above the natural levees of streams and rivers and spread out across vast low-lying areas. Basin deposits in Tehama County are seen in discontinuous exposures primarily east to southeast of Dairyville and in an isolated

instance just southeast of Corning. Large exposures of basin deposits are seen in Butte, Glenn, Colusa and Sutter counties, forming the highly productive agricultural soils characteristic of these areas.

Thickness of the basin deposits varies throughout the Sacramento Valley, from less than 10 feet along the margins of the exposure to more than 100 feet in the center of the valley; however, in Tehama County, basin deposits tend to be shallower, generally from one to 20 feet thick. Basin deposits provide limited quantities of groundwater to shallow wells due to the fine-grained nature of the sediments. The location of the basin deposits in Tehama County can be seen on the geologic map, Plate 2, Appendix A. Alluvium overlies the basin deposits along presently active stream and river channels.

Holocene alluvium (Qa) is the youngest of the geologic units present within the Sacramento Valley and Redding Regions. Alluvium consists of unweathered gravel, sand, and silt that has been transported and deposited by streams and rivers, forming natural levees primarily along the Sacramento River, and Dry, Cottonwood, Red Bank, Thomes and Stony Creek (Maps: California 1985).

Alluvial deposits primarily overlie the basin deposits and Modesto and Riverbank Formations. Due to the limited extent and thickness of the alluvium, it is not considered a significant water-bearing unit. The depth and position of alluvium can be seen on the three cross-sections and on the geologic map of Tehama County, Plates 4 through 6, Appendix A.

STRUCTURAL FEATURES

Deformational structures within the Sacramento Valley and Redding Groundwater Basin Regions of Tehama County are related to regional stress patterns due to "right-lateral transform tectonism in the San Andreas fault zone to the west, and major east-west crustal extension in the northern Basin and Range province to the east" (Harwood and Helley 1987). These deformational structures manifest themselves in the form of folds and faults throughout the northern Sacramento Valley. Two general trends are seen in Tehama County: folds and faults lying in an approximate north-northwest direction, and folds and faults oriented in an east-northeast direction.

NORTH-NORTHWEST TRENDING STRUCTURES.

The Willows-Corning fault trends roughly north-northwest through the Sacramento Valley, approximately paralleling Interstate 5. This fault is a steeply east-dipping reverse fault, with evidence of youngest deformation occurring from 1.09 to 0.45 million

years ago (mya) (Harwood and Helley 1987). Just below the Tehama County line in Glenn County, the Willows-Corning fault splays off in a west-northwesterly direction, forming the Black Butte Thrust fault. Late Cenozoic uplift along this fault is thought to have brought the Lovejoy Basalt, which comprises the Orland Buttes to the surface, as seen on Plate 2, Appendix A. The Black Butte Thrust fault and associated Orland Buttes extend into the southern portion of Tehama County.

Other north-northwest trending features are the Chico Monocline, the North and South Corning Domes, the Los Molinos Syncline, an unnamed syncline west of the Willows-Corning fault and an unnamed anticline east of the Willows-Corning fault. With the exception of the Chico Monocline, these structures trend in a more northerly direction and are thought to converge on the northwest trending Chico Monocline east of Red Bluff (Harwood and Helley 1987). The east-west trending Red Bluff Fault acts as a terminus for the north trending structures.

The Chico Monocline is a northwest-trending southwest-facing flexure that roughly follows the northeastern boundary of the Sacramento Valley Region extending from Chico to Red Bluff. North of Chico, the Chico Monocline deforms the Tuscan Formation and has a dip of up to 25 degrees where it becomes the eastward aquifer boundary (CDWR 1978). South of Chico, beds have a gentler slope of approximately 2 to 5 degrees, and evidence of the monocline disappears north of Oroville. This late Cenozoic tectonic feature was formed after deposition of the Ishi Tuff member of the Tuscan Formation, about 2.6 mya, and prior to the Deer Creek olivine basalt eruption, which has been age-dated at 1.08 ± 0.16 million years old (myo) (Maps: California 1985).

Anticlinal folding produced the North and South Corning Domes, whose surface expression can be seen in the Corning area. These domes, along with the unnamed syncline and anticline, trend parallel to the Willows-Corning Fault to the east. The Los Molinos Syncline also parallels the Willows-Corning Fault on the east side of the valley, forming "a north-northwest trending trough that locally controls the position of the Sacramento River" (Blake, et al 1995).

EAST-NORTHEAST TRENDING STRUCTURES.

The east-northeast striking Red Bluff Fault marks the structural change from the north-northwest trending features in Tehama County. North of the Red Bluff Fault, other east-northeast trending faults and folds such as the Hooker Dome, the Inks Creek Fold System and the Battle Creek Fault Zone, are evidence of the change in structural regimes, as seen on Plate 2, Appendix A. Seven Mile Dome, Tuscan Springs Dome and Salt Creek Dome are also a part of this complex system, located outside of the Sacramento Valley and Redding Groundwater Basin Regions in the Mountain Region

East. The area which encompasses these east-northeast trending structures is commonly referred to as the Red Bluff Arch.

The Red Bluff Arch has been referenced in older publications as either the area between Red Bluff Fault and the Battle Creek Fault Zone (Bulletin 118-6 1978) or as a distinct fold that crosses the Sacramento River at Iron Canyon upstream from the city of Red Bluff (Olmsted and Davis 1961). Although it is not referenced in more recent publications, the term "the Red Bluff Arch" is used in this report as a known geologic area of tectonic compression, whose combined structures create a barrier to groundwater flow between the Sacramento Valley and Redding groundwater basins.

Influence of the Red Bluff Arch on surface water drainage patterns is markedly seen on the geologic map of Tehama County at the topographic high between Hooker Creek and Blue Tent Creek (Plates 2 and 6, Appendix A). In this region, Hooker Creek and Pine Creek drain northward into Cottonwood Creek, whereas Blue Tent Creek and Dibble Creek flow in a southeasterly direction, draining into the Sacramento River. The Red Bluff Arch is also a major influence on subsurface groundwater flow, as seen on contour maps, Plates 2 and 6, Appendix A. Groundwater north of the divide flows into the Redding groundwater basin, while groundwater south of the divide recharges the Sacramento groundwater basin. Creating this area of change is a series of folds and faults that are a result of Late Cenozoic regional tectonic stress. Structures that make up the Red Bluff arch are the Red Bluff Fault and the Inks Creek Fold System.

The Red Bluff Fault strikes roughly N. 60° E., passing diagonally in the subsurface beneath the City of Red Bluff, trending southwest for approximately 15 miles. Surface expression is absent southwest of Red Bluff; however northeast of the city, the extended trend of the Red Bluff Fault traverses into the Mountain Region East area, folding the Pliocene volcanic rocks of the Tuscan Formation into the Seven Mile, Tuscan Springs and Salt Creek Domes (see Plate 2, Appendix A). The Red Bluff Fault is a normal, south-dipping fault which appears to have Late Cenozoic displacement that offsets the base of the Pliocene rocks by folding and/or faulting of about 500 feet (Blake, et al 1995).

The Inks Creek Fold System consists of a dome and a southwest plunging anticline and syncline that structurally control the major bends in the Sacramento River near Jelly's Ferry and Table Mountain. The alignment of the foremost syncline in the fold set passes through Table Mountain and extends north-eastward, creating a structural low along which Inks Creek flows. Upper strata of the Tuscan Formation are exposed along the anticlinal fold that parallels Inks Creek to the north (Helley and Harwood 1985). The axial trace of the anticline merges with the trend of the Battle Creek fault zone and dies out along the fault zone to the northeast.

West of Sacramento River, the Inks Creek Fold System is expressed as a broad area of uplift known as the Hooker Dome. The Hooker Dome has a major influence on drainage patterns especially along Hooker and Blue Tent Creeks, as seen on Plates 2 and 6, Appendix A. The age of deformation of the Inks Creek Fold System and the Hooker Dome has been correlated by Helley and Harwood, 1985, using the age of the Rockland Ash bed and deformation of the Riverbank Formation, providing an age date of 0.45 to 0.4 mya.

The eastward trending Battle Creek Fault Zone lies along the boundary between Tehama and Shasta Counties. East of the Sacramento River, the fault zone is seen as a prominent south-facing escarpment with normal displacement. West of the river, the Battle Creek Fault Zone is on strike with the valley and course of Cottonwood Creek, and in part structurally controls its direction (Blake, et al 1995; Helley and Harwood 1985). Offset on the rocks east of the Sacramento River dates movement on the Battle Creek Fault Zone as younger than 1.09 million years (my), with channeling of the Rockland Ash bed along the fault zone suggesting that faulting occurred prior to 0.45 my. (Helley and Harwood 1985).

FRESH GROUNDWATER-BEARING UNITS

On a regional scale, the base of post-Eocene continental deposits is commonly considered the approximate base of fresh groundwater in the Sacramento Valley (Page 1974). Locally, the base of fresh groundwater fluctuates depending on local changes in the subsurface geology and geologic formational structure.

The approximate base of fresh groundwater is shown on the geologic cross-sections on Plates 4 through 6, Appendix A. The base of fresh groundwater was determined through examination of electric resistivity logs, which were derived from criteria established by C.F. Berkstresser, Jr., in *Base of Fresh Ground Water, Approximately 3,000 Micromhos, in the Sacramento Valley and Sacramento-San Joaquin Delta, California*. This 1973 report determined that the base of fresh groundwater is water with a specific conductance of less than 3,000 micromhos per centimeter; water with a specific conductance that exceeds 3,000 micromhos per centimeter is considered to be saline.

In the Sacramento Valley Region of Tehama County, fresh groundwater-bearing units include the Tuscan, Tehama, Riverbank, and Modesto formations. Groundwater in these formations exists largely within the primary porosity associated with the spaces

between the individual sand and gravel deposits and within the secondary porosity associated with fractures and jointing of the more competent volcanic rocks.

A detailed discussion of the major groundwater-bearing formations within the Tehama County portion of the Sacramento Valley is presented below. Geologic surface exposures of the water-bearing formations described below are shown on the geologic plan-view map on Plate 2, Appendix A, and on the subsurface maps on Plates 4 through 6, Appendix A.

Tuscan Formation

Age and Composition. The Pliocene Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone, and volcanic ash layers. The formation is described as four separate but lithologically similar units, Units A through D, which in some areas are separated by layers of thin tuff or ash units (Maps: California 1985). Stratigraphic position and general lithologic character distinguish each unit. Unit A consists of the oldest deposits of the Tuscan Formation. Units B and C overlie Unit A in most locations in Tehama County. Unit D is the youngest unit and is exposed in the northeast portion of the Sacramento and Redding groundwater basins. Groundwater in the Sacramento Valley portion of Tehama County is contained primarily within the two middle units of the Tuscan Formation, Units B and C, and within the Tehama Formation.

Unit A is the oldest water-bearing unit of the Tuscan Formation. This unit is characterized by the presence of metamorphic clasts within the interbedded lahars, volcanic conglomerate, volcanic sandstone, and siltstone. Unit A contains the Nomlaki Tuff, a dacitic pumice tuff, at its base or within the basal portion of the unit. The presence of the Nomlaki Tuff within the basal sections of the Tuscan and Tehama formations indicates simultaneous deposition of these units. Unit A is distinguished from the other units by the presence of metamorphic clasts within the lahars and conglomerates.

Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. These evenly layered, moderately thin beds form the characteristic look of the Tuscan Formation seen in the foothills of Tehama County. Extending westward into the subsurface, the sediments of Unit B form a very productive water-bearing system. In most locations, Unit C overlies Unit B, and can be seen on the geologic map and in the cross-sections of the Sacramento Valley.

Unit C consists of massive mudflow, or lahar deposits with some interbedded volcanic conglomeratic sandstone. In the foothills, these lahars are well cemented and form the cap rock for the ridges in Tehama County. Evidence of wood fragments found in Unit C suggests fast-moving, massive mudflows at the time of deposition. In the subsurface, these low-permeability lahars form thick, confining layers for groundwater contained in the more permeable sediments of Unit B. Unit C is overlain in some locations by Unit D and can be seen on the geologic map and cross-sections of the Sacramento Valley.

Unit D is the youngest depositional unit and is characterized by large masses of grey hornblende andesite. Exposures of Unit D extend from the eastern boundary of the Sacramento Valley Region into the Mountain East Region, as seen on the geologic map and cross-section. Unit D is separated from Unit C in places by the tuff of Hogsback Ridge.

The Tuscan Formation is overlain by Holocene and Pleistocene alluvial sediments, which include the Modesto and Riverbank formations and younger stream channel and basin deposits. In most places, the Tuscan Formation unconformably overlies either Upper Cretaceous marine sedimentary rocks or the basement complex with angular unconformity (Olmsted and Davis 1961). In other areas, the Tuscan Formation rests unconformably on the Upper Princeton Submarine Valley fill. The volcanic sediments of the Tuscan Formation interfinger with the non-marine and non-volcanic sediments of the Tehama Formation in the subsurface (Lydon 1969). This contact is considered to occur at depth in the vicinity west of the Sacramento River.

Depositional Environment and Source Area. The Tuscan was deposited as a series of volcanic lahars over a period of about one million years (Lydon 1969). The source areas of the lahars were eroded volcanoes historically located northwest and south of Lassen Peak. Mudflows most likely followed ancient stream channels and valleys while traveling in a southwestward direction. Upon reaching the valley floor, the flows fanned out causing deposition of sediments to vary in thickness and in topographic elevation. As areas of the well-cemented volcanic lahars were eroded and redeposited, aquifer material on the valley floor resulted in a heterogeneous and, in some areas, unconsolidated mass of sediments.

Extent and Thickness. The Tuscan Formation extends from east of Redding to Oroville and from the base of the Cascade Range and Sierra Nevada into the subsurface about 5 miles west of the Sacramento River (Page 1986). The maximum thickness of the formation ranges from about 1,700 feet in the east, thinning to approximately 300 feet at the westward extent (Lydon 1969). Mapped thickness of the individual units on the cross-sections suggests that the thickness of the Tuscan Formation may be higher when

all units are present: Unit A has an average mapped thickness of 250 feet, the thickness of Unit B can range up to 1,200 feet in places, Unit C has a mapped thickness of up to 600 feet and Unit D has a thickness ranging from 30 to 160 feet, for a total approximate thickness of up to 2,200 feet.

Water-bearing Properties. Groundwater in the Sacramento Valley and Redding Groundwater Basin Region is contained primarily within the pore spaces of the reworked sand and gravel layers of the Tuscan Formation. Much of the groundwater is confined under pressure by layers of impermeable clays, lahars, or tuff breccia. Volcanic sands of the Tuscan Formation can yield high amounts of water to wells in many areas of the eastern Sacramento Valley.

Groundwater encountered within Unit A is associated with primary porosity of the conglomerate and sandstone layers and with secondary porosity associated with the fractured tuff breccia. Within Unit B, the interbedded, permeable layers of reworked sand and gravel become a conduit for groundwater movement, transmitting water into the aquifer from recharge areas in the Cascade foothills. The permeable layers of the Unit B sediments comprise the main aquifer material for groundwater storage in the valley. The fine-grained, consolidated lahars of Unit C form thick, low-permeability, confining layers for groundwater contained in the more permeable sediments of Unit B. Unit D has a very low permeability; any water associated with the unit is most likely due to secondary permeability from fractures and jointing.

A constant discharge aquifer performance test was conducted in the Dye Creek Sub-Inventory Unit in November of 1989 by the CA DWR. The test lasted 7 days and the aquifer was allowed to recover 7 days. The test well was screened from 340-590 feet and was pumped at 2,000 gallons per minute (gpm) for the duration of the test. Test results indicate that the transmissivity of the lower-confined aquifer was 126,000 gallons per day per foot (gpd/ft) with a storativity of 0.0025; the transmissivity and storativity in the fully-penetrating portion of the well were 58,600 gpd/ft and 0.0025, respectively. The specific capacity was calculated at 18.38 gpm per foot of drawdown and the hydraulic conductivity (averaged over the full thickness of the aquifer) was 319 gallons per minute per square foot (gpd/ft²).

A field study of the hydrogeologic properties of the Tuscan Formation in the Vina Sub-Inventory Unit was conducted in the spring of 2000 by the CA DWR. Three separate constant discharge aquifer performance tests were conducted in the Deer Creek area; effects of the pumping well (screened from 130 to 490 feet) on observation wells screened in the "shallow zone" (70 to 530 feet) and observation wells screened in the "deep zone" (530 to 790 feet) were analyzed with the following results. Test results

showed that the shallow zone transmissivity ranged from 103,894 to 418,746 gpd/ft, and the deep zone transmissivity ranged from 60,495 to 373,893 gpd/ft, best describing the Tuscan Formation in this area as a confined or leaky aquifer (CA DWR, Dunbar 2000). The specific capacity of this well was 41.36 gpm per foot of drawdown.

In February 2003, a constant discharge test was also performed in the Deer Creek area of the Vina Sub-Inventory Unit. The test was conducted by the CA DWR on a well screened from 620 to 920 feet at a pumping rate of 2,000 gpm. The calculated transmissivity was 40,505 gpd/ft and the specific capacity was 16.6 gpm per foot of drawdown.

A study was done by the US Bureau of Reclamation in 1977 that compares transmissivity, specific capacity and well potential (see Figure X, Plate X). According to this study, irrigation wells with specific capacity values between 10 and 100 gpm/ft, which are screened in aquifers with transmissivities between 10,000 and 100,000 gpd/ft, have a "Fair" to "Good" water producing potential. Irrigation wells with specific capacity values between 100 and 1,000 gpm/ft and are screened in aquifers with transmissivities between 100,000 and 1,000,000 gpd/ft have a "Good" to "Very Good" water producing potential. If the transmissivity data from the Dye Creek well was averaged over the length of the screened interval, (transmissivity equaling 92,300 gpm/ft), the comparison of data from the above aquifer performance tests indicate that the Tuscan Formation in these areas have a fair to good water producing potential.

Tehama Formation

Age and Composition. The Tehama Formation of Plio-Pleistocene age consists of massive, pale green, grey and tan sandstone and siltstone with lenses of pebble and cobble conglomerate (Helley and Harwood 1985). Interstratified beds and lenses of fine gravel are cross-bedded with fore-set beds on the east, indicating deposition of streams from the west (Russell 1931). Beneath the floor of the Sacramento Valley, the Tehama formation interfingers with the Tuscan Formation just west of the Sacramento River. It is unconformably overlain by the Riverbank and Modesto Formations and unconformably underlain by Cretaceous rocks, the Nomlaki Tuff, the Upper Princeton Valley fill or Tuscan Formation Unit C.

Depositional Environment and Source Area. During the Pliocene to Pleistocene epoch, sediments were deposited in a broad, low-lying valley of very low relief on a flood plain and in stream channels (Redwine 1972). The source areas for these sediments are the Coast Ranges to the west and the Klamath Mountains to the northwest,

determinations of which were based on rock type and grain size distribution fining towards the east (Bulletin 118-6 1978).

Extent and Thickness. The extent of the Tehama Formation ranges from north of Redding to Vacaville; and from the western portion of the Sacramento Valley east to Sacramento River. The majority of exposures of the Tehama can be seen in the west-central portion of Tehama County. Thicknesses range from about 2,000 feet in Tehama County to about 3,000 feet in the south-central part of the Sacramento Valley (Olmsted and Davis 1962).

Water-bearing Properties. Because the Tehama Formation consists of massive amounts of sandy-silt, silty-clay and lenses of poorly-consolidated sand and gravel, permeabilities are low to moderate, with localized areas of high permeability. Bulletin 118-6, 1976 states that in the upland area west of Red Bluff and Corning, wells drilled to depths of 430 feet yield 475 to 950 gpm, while wells near the western basin boundary yield a maximum of 475 gpm. Specific capacities on most wells are less than 34 gpm per foot of drawdown. Evidence of the lithologic variability within the Tehama Formation is illustrated in two areas of Tehama County, the El Camino Irrigation District and the Rancho Tehama Reserve area.

The western portion of the El Camino Irrigation District is an example of an area with localized coarse-grained deposits. Situated in the southeastern part of the Red Bluff East Sub-Inventory Unit, "wells in the district produce large volumes of irrigation water from the permeable sand and gravel beds, which may be interfingered in part with volcanic sediments of the Tuscan Formation" (Olmsted and Davis 1961). According to USGS Water-Supply Paper 1497, data from 20 wells indicate that well depths in the El Camino ID range from 268 feet to 1,001 feet, averaging 506 feet. Discharge ranges from 540 to 2260 gpm, averaging 1080 gpm, and specific capacities range from 32 to 179 gpm, and average 76 gpm per foot of drawdown. These high well yields are atypical of the Tehama Formation, reflecting the variability of the thickness of the gravel lenses within the formation.

The west side of the Sacramento Valley and Redding Groundwater Basin Region portrays the more common aquifer characteristics of the Tehama Formation. In 1993, an evaluation of groundwater resources in the Rancho Tehama area of the Red Bluff West Sub-Inventory Unit indicates that of 94 wells reviewed, well depths ranged from 91 feet to 520 feet, with an average of 286 feet. Well yields, or discharge rates, on 73 wells reviewed averaged 41 gpm, and ranged from 5 to 110 gpm. Results from a five-day constant discharge aquifer test performed in July, 1989 indicate an average transmissivity of 32,474 gpd/ft and an average storativity of 8.9 0E-04. The hydraulic

conductivity was calculated at 900 gpd/ft², which corresponds to a sand and gravel mixture (McManus 1993). An average specific yield estimated on 94 wells covering all screened intervals was 5.7%, which corresponds to a sandy clay material (McManus 1993). The overlap in aquifer material was explained by McManus this way: “specific yield calculations represent an averaged value over the entire well, and values of hydraulic conductivity relate more specifically to the higher permeability of the water bearing units.” Results from this study suggest that this area of the Tehama Formation may be a low to moderately-low water-producing aquifer.

Riverbank Formation

Age and Composition. The Riverbank Formation was deposited between 450,000 and 130,000 years ago, forming wide alluvial fans and terrace deposits. Stream terrace deposits of the formation appear topographically above the younger Modesto Formation terrace deposits. The Riverbank Formation consists of weathered reddish gravel, sand and silt, with the color attributed to post-depositional weathering of the formation. The topographic location and weathered red color distinguish the Riverbank from more recent alluvial fan and terrace deposits (Maps: California 1985).

Depositional Environment and Source Area. The Riverbank Formation consists of gravel, sand, and silt eroded from the surrounding Coast, Klamath, Cascade and the Sierra Nevada mountain ranges. These materials form the terrace deposits seen along presently active streams and the dissected alluvial fans in the Sacramento Valley. The source areas of the formation are determined from the mineral constituents of the deposits. Near Sacramento, the deposits are primarily arkosic; however, mafic content of igneous rock fragments increases northward.

Extent and Thickness. Exposures of the Riverbank Formation are observed from the Redding Basin to south of the Sutter Buttes. The thickness of the formation ranges from less than 1 foot to over 200 feet, depending on location. More recent depositions of the Modesto Formation and basin deposits have produced the limited surface exposure of this formation.

Water-bearing Properties. The thickness of the Riverbank Formation can be a limiting factor to the water-bearing capabilities of the formation. The Riverbank Formation is moderately to highly permeable and yields moderate quantities of water to domestic and shallow irrigation wells. It also provides water to deeper irrigation wells that have multiple zones of perforation. Well yields are higher in areas where concentrations of gravel and sand are present. Groundwater occurs generally under unconfined conditions.

Modesto Formation

Age and Composition. Radiocarbon dating indicates that the Modesto Formation is Pleistocene in age with the upper and lower members dated at 14,000 and 42,000 years old, respectively (Marchandt and Allwardt 1981). The formation consists of tan and light grey, gravelly sand, silt, and clay. Where it overlies the Tuscan Formation, the clasts within the Modesto are distinctly red, brown or black. The upper member shows no indication of weathering, while the lower member shows slight weathering (Maps: California 1985).

Depositional Environment and Source Area. The depositional environment of the Modesto Formation is similar to that of the Riverbank Formation, consisting of gravel, sand, and silt eroded from the surrounding Coast, Klamath, Cascade and the Sierra Nevada mountain ranges. The Modesto formation forms coalescing alluvial fans and stream-bank terraces. Exposures of the formation are present along most of the major streams and along the Sacramento River within Tehama County.

Extent and Thickness. The Modesto Formation is widespread throughout the Sacramento Valley, occurring from Redding southward into the San Joaquin Valley. The most notable occurrences are found along the Sacramento and Feather rivers. Similar to the Riverbank, the Modesto Formation ranges in thickness from less than 10 feet in many of the terraces and along the margins of the valley to nearly 200 feet across the valley floor (Maps: California 1985).

Water-bearing Properties. Like the Riverbank Formation, the thickness of the Modesto Formation limits the water-bearing capabilities of the formation. These deposits provide water to domestic and shallow irrigation wells, as well as to deeper wells with multiple zones of perforations. In locations where gravel and sand predominate, groundwater yields are moderate. Lesser yields are found in areas with high silt and clay content. Groundwater occurs generally under unconfined conditions.

MOVEMENT OF GROUNDWATER

Groundwater movement in the Sacramento Valley Region was evaluated utilizing groundwater elevation contours developed for Tehama County. The contours shown on Plates 8 and 9, Appendix A, were developed using spring and summer 2000 groundwater level data collected by DWR and local cooperators. The flow arrows on Plate 8 and 9 indicate the general direction of groundwater movement during spring and summer.

The directional flow arrows illustrate that regional groundwater movement in Tehama County follows topography, from high to low elevations flowing toward the Sacramento River.

Los Molinos Syncline, basement, etc...Add more...after look at contour maps

Do we want to include this?:

A notable anomaly in the Sacramento Valley is seen in the southwest portion of Butte County. In this area, groundwater converges under the Butte Sink and Biggs-West Gridley area. The Sutter Buttes and the buried Colusa Dome located west of the Sutter Buttes deform the valley sediments, causing this anomalous flow pattern. Another change occurs in the groundwater flow along the Sacramento River near Princeton. North of this location, the groundwater flows toward the Sacramento River, where it drains groundwater from the northern Sacramento Valley. South of Princeton, groundwater flows away from the river, thereby recharging the groundwater system.

MOUNTAIN REGION EAST

The Mountain Region East extends from the Sacramento Valley Region to the eastern boundary of Tehama County. The region ranges in elevation from 7,867 feet msl at Butt Mountain near the eastern border of the county to about 650 feet msl near Pine Creek at the southern boundary with the Sacramento Valley Region. Groundwater yields occur through a combination of primary and/or secondary porosity.

Portions of the Mountain Region East act as recharge areas for the Tehama County portion of the Sacramento Valley groundwater basin aquifer. Groundwater recharge occurs in the form of precipitation and deep percolation of runoff from nearby creeks, streams, and reservoirs.

Following is a summary of the geology in the Mountain Region East of Tehama County that focuses on the fresh groundwater-bearing units of the region. The description of the surface geology is based on the geologic map of Tehama County developed by DWR that is shown on Plate 2, Appendix A. Geologic map symbols for Plates 2 through 4, Appendix A, are referenced in parenthesis.

SURFACE AND SUBSURFACE GEOLOGY

The Mountain Region East is comprised mainly of Tertiary andesite and basalt in the eastern part of the region and Pliocene volcanic lahars in the central to western portion of the region (see Plates 2, 4 and 5, Appendix A). Older Jurassic-Cretaceous rock outcrops are seen in isolated instances along Mill Creek and Deer Creek. Other deposits include Quaternary basalt flows in the northern part of the region and Quaternary alluvium in the northeastern portions of the Mountain Region East.

Jurassic and Cretaceous marine sedimentary rocks (JKgvs) seen in outcrop in the Mountain Region East tend to contain brackish water and do not contribute to the region's fresh groundwater system. These older sediments were deposited in a fore-arc basin setting around 200 mya. Due to regional compressive stress, the outer margins of the fore-arc basin were uplifted creating a trough-like structure, exposing segments of the Jurassic-Cretaceous aged rocks in Mill and Deer Creeks.

A series of Tertiary continental deposits unconformably overlie Jurassic-Cretaceous marine deposits. Early Tertiary volcanic andesite and basalt (Tv), and Quaternary volcanic andesite and basalt (Qv) exhibit very little, if any, primary porosity. However, due to secondary porosity, small amounts of water can be found within the fractures and joints of these dense, hard rocks. Pliocene sediments of the Tuscan Formation (Ttc and Ttd) exposed in the central to western portion of the region tend to contain fresh groundwater mainly due to secondary porosity. Although the Tuscan Formation is one of the main groundwater-bearing units for the Sacramento Valley and Redding Region, it is tightly cemented and consolidated in the Mountain Region East and supplies only limited amounts of water. Where groundwater does occur, it is limited to the fractures and joints within the volcanic mudflows and breccias.

The Pliocene Tuscan Formation is composed of a series of volcanic mudflows, tuff breccias, tuffaceous sandstone, and volcanic ash layers. Mudflows originated in the vicinity of present-day Lassen Peak and most likely filled ancient stream channels as they flowed toward the valley. Upon reaching the valley floor, the mudflows fanned out depositing layers of sediment. The Tuscan Formation contains four separate but lithologically similar units, Units A through D, which in some areas are separated by layers of thin tuff or ash units (Maps: California 1985). These units will be discussed in greater detail in the following section.

Surficial Quaternary alluvial sediments are found along some drainages in the northeastern part of the region and supply modest amounts of groundwater to shallow domestic wells. These sediments ranging in size from boulders to sand and silt were deposited along streams and creeks and provide low to moderate amounts of groundwater to wells. Alluvial deposits can be seen along many of the mountain

valleys and creeks in the northeastern portion of the region such as at Childs Meadows, Deer Creek Meadows, Battle Creek Meadows and along Paynes, Rice, Warner and Willow Creeks (see Plate 2, Appendix A).

STRUCTURAL FEATURES

Geologic structures in the Mountain Region East include the northwest trending Chico Monocline and Cohasset Ridge Fault and the northeast trending the Seven Mile Dome, Tuscan Springs Dome and Salt Creek Dome. Although the Battle Creek Fault Zone is located just outside of the northern boundary of the Mountain Region East, it is of geologic interest and will be mentioned briefly. The Chico Monocline coincides with the western boundary and the Battle Creek Fault Zone with the northern boundary of the Mountain Region East, seen on Plate 2, Appendix A.

NORTH-NORTHWEST TRENDING STRUCTURES.

The Chico Monocline is a northwest-trending, southwest-facing flexure that roughly follows the western boundary of the Mountain Region East, extending from Chico to Red Bluff. South of Red Bluff, the Chico Monocline deforms the Tuscan Formation and has a dip of up to 25 degrees where it becomes an eastward aquifer boundary (CDWR 1978). South of Chico, beds have a gentler slope of approximately 2 to 5 degrees, and evidence of the monocline disappears. This late Cenozoic tectonic feature was formed after deposition of the Ishi Tuff member of the Tuscan Formation about 2.6 mya, and prior to the Deer Creek olivine basalt eruption, which has been age-dated at 1.08 ± 0.16 myo (million years old) (Maps: California 1985).

The Cohasset Ridge Fault is the northernmost extension of the Foothill Fault Zone which extends from Butte County northward into Tehama County, roughly paralleling the Chico Monocline, as shown on Plate 2, Appendix A. The Cohasset Ridge Fault can be traced north of Deer Creek through an intensely fractured zone in the Tuscan Formation to the vicinity of Mill Creek, where it becomes obscured by a complex pattern of west- and northwest-trending arcuate faults (Helley and Harwood 1987). This northwest-trending fault is a steeply east-dipping to vertical fault that has experienced up to 100 feet of movement in the past 2.4 million years (Maps: California 1985).

EAST-NORTHEAST TRENDING STRUCTURES.

Located within the Mountain Region East are the Seven Mile Dome, Tuscan Springs Dome and Salt Creek Dome, which continue along the same general trend as the Red Bluff Fault (see Plate 2, Appendix A). The extended trend of the Red Bluff Fault

traverses into the Mountain Region East area, folding the Pliocene volcanic rocks of the Tuscan Formation into the Seven Mile, Tuscan Springs and Salt Creek Domes (see Plate 2, Appendix A). Age of the deformation creating the domes is thought to have occurred during the same stage that produced the Inks Creek fold system and the Battle Creek Fault Zone, 0.4 to 0.45 mya (Helley and Harwood 1987).

The eastward-trending Battle Creek Fault Zone lies along the boundary between Tehama and Shasta Counties. East of the Sacramento River, the fault zone is seen as a prominent south-facing escarpment with normal displacement. West of the river, the Battle Creek Fault Zone is on strike with the valley and course of Cottonwood Creek, and in part structurally controls its direction (Blake, et al 1995; Helley and Harwood 1985). Offset on sediments east of the Sacramento River dates movement on the Battle Creek Fault Zone as younger than 1.09 my, with channeling of the Rockland Ash bed along the fault zone suggesting that faulting occurred prior to 0.45 my (Helley and Harwood 1987).

FRESH GROUNDWATER-BEARING UNITS

The Tuscan Formation is the major source of groundwater in the Mountain Region East. Groundwater occurs in the fractures and joints of the volcanic mudflows, as well as in the weathered horizons between buried mudflows (Slade 2000 – 3 reports). Lesser amounts of groundwater are found in the alluvium, which is a localized source of groundwater and supplies moderate amounts of water to shallow wells.

Following is a detailed description of the major groundwater-bearing unit found in the Mountain Region East.

Tuscan Formation

Age and Composition. The Pliocene Tuscan Formation is composed of tuff breccia, lapilli, tuff, and volcanic conglomerate, sand, and silt (Lydon 1969). The formation is described as four separate, but lithologically similar units, Units A through D, which are separated in some areas by layers of thin tuff or ash units (Maps: California 1985). In the Mountain Region East, all four units are exposed at the surface.

Unit A is the oldest water-bearing unit of the Tuscan Formation and consists of fragmented metamorphic rocks found within the interbedded lahars, volcanic conglomerate, sandstone, and siltstone.

Unit B is differentiated from Unit A by its lack of metamorphic content. Unit B is defined along the Chico Monocline by a series of interbedded lahars, volcanic conglomerate, sandstone, and siltstone. It is characterized on resistivity curves by its distinctive and consistently high deflections, as shown in the cross-section maps on Plates 4 and 5, Appendix A. It is differentiated from Unit C by its coarser-grained sediments, thereby providing it with a higher groundwater storage capacity.

Unit C is characterized by its fine-grained, more consolidated nature. Unit C consists of lahars with some interbedded volcanic conglomerate and sandstone. Evidence of wood fragments found in Unit C suggests fast-moving, massive mudflows at the time of deposition. Unit C is the exposed cap rocks on the hills east of Chico and becomes a confining layer to Unit B in the subsurface.

Unit D is the youngest depositional unit and is characterized by large masses of grey hornblende andesite. Exposures of Unit D extend from the eastern boundary of the Sacramento Valley Region into the Mountain East Region as seen on the geologic map and cross-section. Unit D is separated from Unit C in places by the tuff of Hogsback Ridge.

Depositional Environment and Source Area. The Tuscan was deposited as a series of mudflows, or lahars, over a period of about one million years (Lydon 1969). Eroded volcanoes historically located northwest and south of Lassen Peak were the source areas for the lahars. Mudflows most likely followed ancient stream channels and valleys while traveling in a southwestward direction. The flows then fanned out on reaching the valley floor, causing deposition to vary in thickness and in topographic elevation. As areas of the well-cemented volcanic lahars were eroded and redeposited, aquifer materials deposited on the valley floor resulted in a heterogeneous and, in some areas, an unconsolidated mass of sediments.

Extent and Thickness. The Tuscan Formation extends from east of Redding to Oroville and from the base of the Cascade Range and Sierra Nevada into the subsurface about 5 miles west of the Sacramento River (Page 1986). The maximum thickness of the formation ranges from about 1,700 feet in the east, thinning to approximately 300 feet at the westward extent (Lydon 1969). Mapped thickness of the individual units on the cross-sections suggests that the thickness of the Tuscan Formation may be higher when all units are present: Unit A has an average mapped thickness of 250 feet, the thickness of Unit B can range up to 1,200 feet in places, Unit C has a mapped thickness of up to 600 feet and Unit D has a thickness ranging from 30 to 160 feet, for a total approximate thickness of up to 2,200 feet.

Water-bearing Properties. Exposures of the Tuscan Formation in the Mountain Region East act as a recharge area for the aquifer system in the Sacramento Valley. Groundwater intercepted in wells in this region is generally of an unconfined nature, with groundwater levels reflecting rainfall patterns. Most groundwater in the formation is confined under pressure by layers of impermeable clays and tuff breccia (CDWR 1978). On average, specific yields for the Tuscan Formation range from 900 to 3,000 gpm (CDWR 1978). However, specific yields are much lower in the Mountain Region East.

Although aquifer performance test data is not available for the Mountain Region East, work has been done on the Tuscan Formation in the upland Foothill Region of Butte County by Slade and Associates, LLC in June of 2000. The foothill area is geologically and topographically similar to the western portion of the Mountain Region East. Results from this study indicate that transmissivity values in the Tuscan Formation are approximately 10,000 gpd/ft in areas adjacent to Clark Road in Paradise. However, in the Lime Saddle area, Slade determined that transmissivity values in the confined portion of the Tuscan Formation are an extremely low 1,100 gpd/ft (Slade July 2000). Another study, also conducted by Slade and Associates, LLC (Slade Oct. 2000), estimated transmissivity based on PG&E pump test data for the Magalia area. Estimates from the PG&E pump test data indicate a transmissivity range of 10,000 to 20,000 gpd/ft for the Tuscan Formation. (Slade June 2000)

MOVEMENT OF GROUNDWATER

There are limited data to accurately determine the direction and rate of groundwater movement in the Mountain Region East. In general, groundwater generally moves down-gradient, following the contour of the topographic surface. In the Mountain Region East, this can be interpreted as groundwater flowing from high to low elevations, following drainages toward the center of the valley, where it tends to follow the course and direction of the Sacramento River.

MOUNTAIN REGION WEST

The Mountain Region West is the westernmost region in Tehama County. There are no appreciable geologic units supplying groundwater to the region. Where groundwater is encountered, it is mainly derived from secondary porosity associated with fracturing and jointing of pre-Tertiary rock, or from Pliocene or Quaternary alluvial deposits along stream channels. Elevations range from 8,090 feet at Mt. Linn in the South Yolla Bolly

Mountains to around 650 feet at the southwestern-most boundary of the Mountain Region West near the confluence of Kendrick and Stony Creeks.

Following is an overview of the surface and subsurface geology and a discussion of the groundwater-bearing units of the Mountain Region West. The surface geology is based on a compilation of geologic maps developed by DWR, which are shown on Plate 2, Appendix A.

SURFACE AND SUBSURFACE GEOLOGY

Mesozoic marine sedimentary, greywacke, metasedimentary, metavolcanic and ultramafic rocks make up the majority of the surface and subsurface geology of the Mountain Region West. Mesozoic rocks encompass Jurassic and Cretaceous rocks ranging in age from 245 to 65 million years before present (mybp). Tertiary deposits include those parts of the Tehama Formation that extend westward across the Sacramento and Redding Groundwater Basin boundary into the Mountain Region West; Quaternary Riverbank and Modesto Formation alluvial deposits are also found along the basin margin.

Primary porosity is virtually nonexistent in the Mesozoic rocks due to the amount of cementation, consolidation, crystallization, or metamorphism that has occurred (Slade 2000 – 3 reports). Groundwater that is available is obtained through secondary porosity attributed to the fracturing and faulting of the rock. Tertiary and Quaternary sediments contain localized areas of groundwater through primary porosity. Generally, small yields of water are available to domestic and shallow irrigation wells under unconfined conditions.

Ultramafic rocks (um) composed of serpentine, peridotite, gabbro, and diabase are exposed in the south-central and northwestern portions of the Mountain Region West (Plate 2, Appendix A). Mixed rocks (m) seen in the western part of the region are composed of undifferentiated metasedimentary and metavolcanic rocks. The Jurassic to Cretaceous aged Franciscan Formation (JKf), seen in the southwestern portion of Tehama County, is composed mainly of thick accumulations of greywacke, with minor amounts of dark shale, occasional limestone and radiolarian chert. The limited amount of groundwater encountered in this type of geologic environment is derived mainly through secondary porosity associated with fractured and jointed rock.

Minor exposures of Tertiary and Quaternary sediments are found along the eastern margin of the Mountain Region West. The Plio-Pleistocene Tehama Formation (Tte)

consists of massive, pale green, grey and tan sandstone and siltstone with lenses of pebble and cobble conglomerate (Helley and Harwood 1985). Tehama sediments were deposited under fluvatile conditions whose source areas are the Coast Ranges and Klamath Mountains. These sediments are low to moderately permeable, with local areas of high permeability.

The Pleistocene Riverbank Formation (Qr) represents the oldest of the alluvial fan and terrace deposits. The Riverbank Formation was formed by streams carrying eroded material from the Cascade Range, Sierra Nevada, and foothill areas to the base of the foothills where it was deposited in wide alluvial fans. In many places, the Riverbank Formation has been covered by more recent alluvial fan development. The thickness of the formation varies from less than 1 foot to over 200 feet, depending on location (Maps: California 1985).

The Modesto Formation (Qm) overlies the Riverbank and Tehama Formations in the western portion of Tehama County and overlies the Riverbank Formation or Tuscan Formation in the eastern portion of the county. The alluvial fans and terrace deposits of the Pleistocene Modesto Formation were deposited in a similar manner to those of the Riverbank Formation but mark a more recent period of erosion and deposition, from 42,000 to 14,000 years ago (Marchandt and Allwardt 1981). As with the Riverbank Formation, the thickness of the Modesto Formation varies from less than 10 feet in many of the terraces to nearly 200 feet across the valley (Maps: California 1985). The extent and thickness of the Modesto Formation can be seen in Tehama County on the three cross-sections of the Sacramento Valley.

STRUCTURAL FEATURES

Geologic structures in the Mountain Region West include several regional northwest trending faults such as the Cold Fork Fault Zone, the Elder Creek Fault, the Paskenta Fault Zone, the South Fork Mountain Fault and the Coast Range Fault Zone. A few unnamed, east-northeast trending faults have been mapped in the northern part of the Mountain Region West, seen on Plate 2, Appendix A.

The Cold Fork Fault Zone is a series of northwest trending anastomosing faults with offsets of 0.5 miles or less, whose movement occurred during the Cenozoic (DWR 1990). The Elder Creek Fault Zone trends northwest-southeast and is believed to be a surficially inactive fault. The Paskenta Fault Zone is also a northwest-trending fault; based on geomorphic profiles of the upper surface of the Tehama Formation by William Lettis and Associates, 2001, it has been concluded that it is not an active seismic source.

The Coast Range Fault Zone is the structural contact between the Franciscan Formation and the ultra-mafic rocks of the Coast Range Ophiolite; trends vary from west to northwest on the northern part of the fault to north-south on the southern portion of the fault (DWR, 1990). Previous investigations indicate that no movement has occurred on the fault zone since late Pliocene time (William Lettis and Associates 2001). North of Red Bluff, the boundary becomes the South Fork Mountain Thrust Fault, separating the Klamath Mountains from the Coast Ranges (Norris and Webb 1990).

FRESH GROUNDWATER-BEARING UNITS

Groundwater-bearing units in the Mountain Region West are negligible. Where groundwater does occur, it is limited to isolated areas of Tertiary and Quaternary deposits located along streams, or to the fractures and joints within the Pre-Tertiary rocks.

Following is a description of the Tertiary and Quaternary deposits found in the Mountain Region West.

Tehama Formation

Age and Composition. The Tehama Formation of Plio-Pleistocene age consists of massive, pale green, grey and tan sandstone and siltstone with lenses of pebble and cobble conglomerate (Helley and Harwood 1985). Interstratified beds and lenses of fine gravel are cross-bedded with fore-set beds on the east, indicating deposition of streams from the west (Russell 1931). Beneath the floor of the Sacramento Valley, the Tehama formation interfingers with the Tuscan in northern portion of the Sacramento Valley. It is unconformably overlain by the Red Bluff, Riverbank and Modesto Formations and unconformably underlain by either Cretaceous rocks along the western margins of the valley, the Nomlaki Tuff throughout the valley, or the Upper Princeton Valley fill in the northern part of the Sacramento Valley.

Depositional Environment and Source Area. During the Pliocene to Pleistocene epoch, sediments were deposited in a broad, low-lying valley of very low relief on a flood plain and in stream channels (Redwine 1972). The source areas for these sediments are the Coast Ranges to the west and the Klamath Mountains to the northwest based on rock type and grain size distribution fining towards the east (Bulletin 118-6 1978).

Extent and Thickness. The extent of the Tehama Formation ranges from north of Redding to Vacaville; and from the western portion of the Sacramento Valley east to Sacramento River. The majority of exposures of the Tehama can be seen in the west-central portion of Tehama County. Thicknesses range from about 2,000 feet in Tehama County to about 3,000 feet in the south-central part of the Sacramento Valley (Olmsted and Davis 1962). As the elevation rises along the western edge of the Sacramento Valley region, the Tehama Formation thins out to isolated exposures located within the Mountain Region West.

Water-bearing Properties. The Tehama Formation is thin and discontinuous in the Mountain Region West, with groundwater occurring mainly in the unconfined sediments along stream channels. Following is a review of the aquifer properties of the Tehama Formation that were gathered from studies done in the Sacramento Valley Groundwater Region portion of Tehama County. Note that the aquifer characteristics of the Tehama Formation in this region may not reflect those of the Sacramento Valley Region, due to its discontinuous and thin nature in this area.

Because the Tehama Formation consists of massive amounts of sandy-silt, silty-clay and lenses of poorly-consolidated sand and gravel, permeabilities are low to moderate, with localized areas of high permeability. Bulletin 118-6, 1976 states that in the upland area west of Red Bluff and Corning, wells drilled to depths of 430 feet yield 475 to 950 gpm, while wells near the western basin boundary yield a maximum of 475 gpm. Specific capacities on most wells are less than 34 gpm per foot of drawdown. Evidence of the lithologic variability within the Tehama Formation is illustrated in two areas of Tehama County: the El Camino Irrigation District and the Rancho Tehama Reserve area.

The western portion of the El Camino Irrigation District is an example of an area with localized coarse-grained deposits. Situated in the southeastern part of the Red Bluff East Sub-Inventory Unit, "wells in the district produce large volumes of irrigation water from the permeable sand and gravel beds, which may be interfingered in part with volcanic sediments of the Tuscan Formation" (Olmsted and Davis 1961). According to USGS Water-Supply Paper 1497, data on 20 wells indicate that well depths in the El Camino ID range from 268 feet to 1,001 feet, averaging 506 feet. Discharge ranges from 540 to 2260 gpm, averaging 1080 gpm, and specific capacities range from 32 to 179 gpm, and average 76 gpm per foot of drawdown. These high well yields are atypical of the Tehama Formation, reflecting the variability of the thickness of the gravel lenses within the formation.

The west side of the Sacramento Valley Groundwater Region portrays the more common aquifer characteristics of the Tehama Formation. In 1993, an evaluation of

groundwater resources in the Rancho Tehama area of the Red Bluff West Sub-Inventory Unit indicates that of 94 wells reviewed, well depths ranged from 91 feet to 520 feet, with an average of 286 feet. Well yields, or discharge rates, on 73 wells reviewed averaged 41 gpm, and ranged from 5 to 110 gpm. Results from a five-day constant discharge aquifer test performed in July, 1989 indicate an average transmissivity of 32,474 gpd/ft and an average storativity of 8.9×10^{-4} . An average specific yield estimated on 94 wells covering all screened intervals was 5.7%, which corresponds to a sandy clay material (McManus, 1993). In general, transmissivities greater than 100,000 gpd/ft, represent good water producing aquifers (Freeze and Cherry 1979). Results from this study suggest that this area of the Tehama Formation is a low to moderately-low water-producing aquifer.

Riverbank Formation

Age and Composition. The Riverbank Formation was deposited between 450,000 and 130,000 years ago, forming wide alluvial fans and terrace deposits. Stream terrace deposits of the formation appear topographically above the younger Modesto Formation terrace deposits. Due to post-depositional weathering of the Riverbank Formation, deposits exhibit a reddish color. The topographic location and weathered red color distinguish the Riverbank from more recent alluvial fan and terrace deposits (Maps: California 1985).

Depositional Environment and Source Area. The Riverbank Formation consists of gravel, sand, and silt eroded from the surrounding Coast, Klamath, and Cascade ranges and the Sierra Nevada and deposited in the Sacramento Valley. The source area determines the mineral constituents of the deposits. Near Sacramento, the deposits are primarily arkosic; however, mafic content of igneous rock fragments increases northward.

Extent and Thickness. Exposures of the Riverbank Formation within Tehama County are observed primarily on the west side of the Sacramento River. The thickness of the formation ranges from less than 1 foot to over 200 feet, depending on location. In the Mountain Region West, the Riverbank formation is found in the southwestern portion of the region.

Water-bearing Properties. The thickness of the Riverbank Formation can be a limiting factor to the water-bearing capabilities of the formation. The Riverbank Formation is moderately to highly permeable and yields moderate quantities of water to domestic and shallow irrigation wells. It also provides water to deeper irrigation

wells that have multiple zones of perforation. Well yields are higher in areas where concentrations of gravel and sand are present. Groundwater occurs generally under unconfined conditions.

Modesto Formation

Age and Composition. Radiocarbon dating indicates that the Modesto Formation is Pleistocene in age with the upper and lower members dated at 14,000 and 42,000 years old, respectively (Marchandt and Allwardt 1981). The formation consists of tan and light grey, gravelly sand, silt, and clay. Where it overlies the Tuscan Formation, the clasts within the Modesto are distinctly red, brown or black. The upper member shows no indication of weathering, while the lower member shows slight weathering (Maps: California 1985).

Depositional Environment and Source Area. The Modesto Formation consists of gravel, sand, and silt eroded from the surrounding Coast, Klamath, and Cascade ranges and the Sierra Nevada and deposited in the Sacramento Valley. The Modesto forms coalescing alluvial fans and stream bank terraces.

Extent and Thickness. The Modesto Formation is widespread throughout the Sacramento Valley, occurring from Redding southward into the San Joaquin Valley. The most notable occurrences are found along the Sacramento and Feather rivers. Similar to the Riverbank, the Modesto Formation ranges in thickness from less than 10 feet in many of the terraces and along the margins of the valley to nearly 200 feet across the valley floor (Maps: California 1985). Exposures of the Modesto Formation are present in the southwestern portion of the Mountain Region West.

Water-bearing Properties. Like the Riverbank Formation, the thickness of the Modesto Formation limits the water-bearing capabilities of the formation. These deposits provide water to domestic and shallow irrigation wells, as well as to deeper wells with multiple zones of perforations. In locations where gravel and sand predominate, groundwater yields are moderate. Lesser yields are found in areas with high silt and clay content. Groundwater occurs generally under unconfined conditions.

MOVEMENT OF GROUNDWATER

There are limited data to accurately determine the direction and rate of groundwater movement in the Mountain Region. In general, groundwater generally moves down gradient following the contour of the topographic surface. In the Mountain Region

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West, this can be interpreted as groundwater flowing from high to low elevations following drainages toward the center of the valley, where it tends to track the course and direction of the Sacramento River.

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
23N02W16B01M	Irrigation	Confined	1949-2002	10-15	15-22	-
23N02W34A01M	Irrigation	Composite	1949-2002	5-10	10-20	10-20
23N02W34A03M	Irrigation	Unconfined	2000-2002	-	-	-
23N02W34N01M	Industrial	Unconfined	2000-2002	-	-	-
23N03W05G01M	Domestic	Unconfined	1946-2002	8-12	15-20	10-15
23N03W12L01M	Irrigation	Composite	1973-2002	5-8	10-15	8-10
23N03W16F02M	Irrigation	Semi-confined	1993-2002	-	-	-
23N03W16H01M	Domestic	Semi-confined	1993-2002	-	-	-
23N03W22Q01M	Irrigation	Confined	1955-2002	15-20	15-20	10-15
23N03W24A02M	Irrigation	Composite	1941-2002	15-22	15-22	15-22
23N03W24A03M	Domestic	Confined	2000-2002	-	-	-
23N04W13G01M	Irrigation		1993-2002	-	-	-
24N01W05J01M	Domestic	Confined	1973-2002	0	7	2
24N01W05Q02M	Domestic	Composite	1973-2002	-	-	-
24N01W18N01M	Domestic	Unconfined	1965-2002	1-2	1-4	3-6
24N02W12J01M	Domestic	Unconfined	1973-2002	1-2	1-2	1-2
24N02W20B01M	Domestic	Unconfined	2000-2002	-	-	-
24N02W23G01M	Irrigation	Composite	1953-2002	1-2	1-2	3-6
24N02W29E01M	Irrigation	Composite	1947-2002	10-15	15-30	20-25
24N02W30P02M	Irrigation	Semi-confined	1992-2002	20-25	-	-
24N03W01B01M	Domestic	Semi-confined	1973-2002	8-12	15-20	15-20
24N03W02R01M	Irrigation	Composite	1947-2002	7-9	10-15	20-30
24N03W03R02M	Domestic	Unconfined	2000-2002	-	-	-
24N03W14B01M	Industrial	Semi-confined	2001-2002	-	-	-
24N03W16A01M	Irrigation	Composite	1947-2002	12-17	18-25	10-13
24N03W17M01M	Domestic	Unconfined	1973-2002	7-8	10-12	8-9
24N03W20N01M	Irrigation	Composite	1973-2002	10	10	13-17
24N03W26K01M	Domestic	Composite	1947-2002	20-25	20-30	20-25
24N03W35P04M	Irrigation	Unconfined	1950-2002	15-20	20-25	15-20
24N03W35P05M	Domestic	Unconfined	2000-2002	-	-	-
24N04W02N01M	Domestic	Unconfined	1946-2002	8	10	10
24N04W14N02M	Domestic	Composite	1952-2002			
24N04W33P01M	Irrigation	Confined	2000-2002	-	-	-
25N02W04Q01M	Domestic	Unconfined	2000-2002	-	-	-
25N02W09G01M	Domestic	Unconfined	1973-2002	2-3	3-4	5-7
25N02W21B01M	Irrig./Dom.	Unconfined	1973-2002	2-3	1-2	5-6
25N02W30G01M	Stock	Unconfined	1949-2002	5	3	8
25N02W34K01M	Irrigation	Composite	1962-2002	2-3	2-3	2-3

Table 1. Tehama Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
25N03W08E01M	Irrigation	Composite	1977-2002	10-15	-	10-15
25N03W10L01M	Observation	Confined	1953-2002	50	55	40
25N03W10L02M	Observation	Unconfined	1994-2002	-	-	-
25N03W10L03M	Observation	Confined	1953-2002	50	55	45
25N03W10L04M	Observation	Unconfined	1953-2002	5	8	11
25N03W10L05M	Observation	Unconfined	1953-2002	11	6	15
25N03W11F01M	Irrigation	Confined	1923-2002	10-15	20-25	30-40
25N03W13J01M	Irrigation	Composite	1952-2002	9	12-16	10
25N03W15A01M	Irrigation	Composite	1952-2002	10-13	10-14	5-7
25N03W19N01M	Irrigation	Confined	1965-2002	15-20	20-25	10-15
25N03W22L01M	Irrigation	Composite	1927-2002	10-13	25-40	8-10
25N04W23N01M	Irrigation	Composite	1973-2002	5	10-15	10
26N02W14G01M	Irrigation	Unconfined	1948-2002	1-2	1-4	1-3
26N02W14R01M	Irrigation	Composite	1992-2002	-	-	-
26N02W15C01M	Domestic	Unconfined	2000-2002	-	-	-
26N02W16C01M	Domestic	Unconfined	1980-2002	5	3	8-10
26N02W17E01M	Irrigation	Unconfined	1973-2002	2-3	1-3	3-8
26N02W21Q01M	Domestic	Unconfined	1965-2002	5-8	9-11	9-11
26N02W22G01M	Irrigation	Confined	1989-2002	1-3	1-3	1-3
26N02W29N01M	Irrigation	Unconfined	1965-2002	3-4	3-6	3-4
26N02W29R01M	Observation	Confined	1965-2002	0	0	0
26N02W29R02M	Observation	Confined	1965-2002	3-5	5-8	3-5
26N03W04L01M	Domestic	Unconfined	2000-2002	-	-	-
26N03W08N01M	Domestic	Composite	1949-2002	3-5	7-9	3-5
26N03W11F01M	Irrigation	Composite	1947-2002	6	10-12	5-8
26N03W17B01M	Domestic	Semi-Confined	2000-2002	-	-	-
26N03W21P01M	Irrigation	Confined	1952-2002	40	40-50	-
26N03W24F01M	Unused	Unconfined	1947-2002	2-3	3-5	1-2
26N03W24M01M	Irrigation	Unconfined	2000-2002	-	-	-
26N03W34P01M	Irrigation	Composite	1921-2002	8-20	10-40	10-20
26N04W01L01M	Domestic	Confined	1978-2002	8-12	20-25	10-12
26N04W25J01M	Domestic	Semi-confined	1973-2002	-	-	-
26N04W26K01M	Irrigation	Confined	1991-2002	35	35	35
26N04W27N01M	Irrigation		1993-2002	-	-	-
27N02W30C02M	Domestic	Composite	1961-2002	4-5	2-3	7-9
27N02W31C01M	Irrigation	Composite	1958-2002	3-5	5-8	5-8
27N03W10B01M	Domestic	Semi-confined	1970-2002	5-6	9-11	9-11
27N03W10N01M	Irrigation	Composite	1953-2002	-	-	-
27N03W16J01M	Irrigation	Composite	1952-2002	-	-	-

Table 1. (continued). Tehama Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
27N03W16K03M	Dom./Ind.	Unconfined	2000-2002	-	-	-
27N03W16N02M	Domestic	Semi-confined	1973-2002	5-6	8-10	9-10
27N03W20C01M	Domestic	Unconfined	1952-2002	1-3	1-3	1-3
27N03W23D01M	Irrigation	Composite	1948-2002	3	3	5
27N03W27G01M	Domestic	Composite	1952-2002	-	5-10	-
27N03W28A01M	Domestic	Unconfined	1952-2002	5	5-10	5
27N03W36C01M	Unused	Unconfined	1962-2002	-	-	-
27N04W05G02M	Domestic	Composite	1983-2002	8	12	8
27N04W35E01M	Domestic	Confined	1965-2002	10-15	15-20	20-25
27N04W36G01M	Domestic	Unconfined	1989-2002	4	4	4
28N04W04P01M	Domestic	Confined	1994-2002	6	-	-
28N05W13D01M	Domestic	Confined	1994-2002	5	-	-
29N04W15E02M	Irrigation	Composite	1947-2002	3	1-2	3-5
29N04W15M01M	Domestic	Unconfined	2000-2002	-	-	-
29N04W27A01M	Domestic	Confined	1994-2002	3	-	-
29N04W28D01M	Domestic	Semi-confined	1978-2002	3	5	3
29N04W30L01M	Irrigation	Composite	1956-2002	3-5	5-6	3-6
29N04W35B01M	Test	Semi-confined	1965-2002	1	1	1
29N05W14L01M	Domestic	Semi-confined	1978-2002	8	15	12
29N05W16R01M	Irrigation	Composite	1956-2002	7-8	6-8	5-10
29N05W21H01M	Domestic	Confined	2000-2002	-	-	-
29N05W26N01M	Irrigation	Composite	1955-2002	4-8	10-20	8-13
29N05W33A01M	Observation	Confined	2000-2002	-	-	-
29N05W33A02M	Observation	Confined	2000-2002	-	-	-
29N05W33A03M	Observation	Confined	2000-2002	-	-	-
29N05W33A04M	Observation	Semi-Confined	2000-2002	-	-	-
29N05W33A05M	Observation	Unconfined	2000-2002	-	-	-

Table 1. (continued). Tehama Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
25N02W30G01M	Stock	Unconfined	1949-2002	5	3	8
25N03W08E01M	Irrigation	Composite	1977-2002	10-15	-	10-15
25N03W10L01M	Observation	Confined	1953-2002	50	55	40
25N03W10L02M	Observation	Unconfined	1994-2002	-	-	-
25N03W10L03M	Observation	Confined	1953-2002	50	55	45
25N03W10L04M	Observation	Unconfined	1953-2002	5	8	11
25N03W10L05M	Observation	Unconfined	1953-2002	11	6	15
25N03W11F01M	Irrigation	Confined	1923-2002	10-15	20-25	30-40
25N03W13J01M	Irrigation	Composite	1952-2002	9	12-16	10
25N03W15A01M	Irrigation	Composite	1952-2002	10-13	10-14	5-7
25N03W19N01M	Irrigation	Confined	1965-2002	15-20	20-25	10-15
25N03W22L01M	Irrigation	Composite	1927-2002	10-13	25-40	8-10
25N04W23N01M	Irrigation	Composite	1973-2002	5	10-15	10
26N02W29N01M	Irrigation	Unconfined	1965-2002	3-4	3-6	3-4
26N02W29R01M	Observation	Confined	1965-2002	0	0	0
26N02W29R02M	Observation	Confined	1965-2002	3-5	5-8	3-5
26N03W04L01M	Domestic	Unconfined	2000-2002	-	-	-
26N03W08N01M	Domestic	Composite	1949-2002	3-5	7-9	3-5
26N03W11F01M	Irrigation	Composite	1947-2002	6	10-12	5-8
26N03W17B01M	Domestic	Semi-Confined	2000-2002	-	-	-
26N03W21P01M	Irrigation	Confined	1952-2002	40	40-50	-
26N03W24F01M	Unused	Unconfined	1947-2002	2-3	3-5	1-2
26N03W24M01M	Irrigation	Unconfined	2000-2002	-	-	-
26N03W34P01M	Irrigation	Composite	1921-2002	8-20	10-40	10-20
26N04W01L01M	Domestic	Confined	1978-2002	8-12	20-25	10-12
26N04W25J01M	Domestic	Semi-confined	1973-2002	-	-	-
26N04W26K01M	Irrigation	Confined	1991-2002	35	35	35
26N04W27N01M	Irrigation		1993-2002	-	-	-
27N04W35E01M	Domestic	Confined	1965-2002	10-15	15-20	20-25
27N04W36G01M	Domestic	Unconfined	1989-2002	4	4	4

Table 2. Red Bluff East Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
27N04W05G02M	Domestic	Composite	1983-2002	8	12	8

Table 3. Red Bluff West Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
23N02W16B01M	Irrigation	Confined	1949-2002	10-15	15-22	-
23N02W34A01M	Irrigation	Composite	1949-2002	5-10	10-20	10-20
23N02W34A03M	Irrigation	Unconfined	2000-2002	-	-	-
23N02W34N01M	Industrial	Unconfined	2000-2002	-	-	-
23N03W05G01M	Domestic	Unconfined	1946-2002	8-12	15-20	10-15
23N03W12L01M	Irrigation	Composite	1973-2002	5-8	10-15	8-10
23N03W16F02M	Irrigation	Semi-confined	1993-2002	-	-	-
23N03W16H01M	Domestic	Semi-confined	1993-2002	-	-	-
23N03W22Q01M	Irrigation	Confined	1955-2002	15-20	15-20	10-15
23N03W24A02M	Irrigation	Composite	1941-2002	15-22	15-22	15-22
23N03W24A03M	Domestic	Confined	2000-2002	-	-	-
23N04W13G01M	Irrigation		1993-2002	-	-	-
24N02W20B01M	Domestic	Unconfined	2000-2002	-	-	-
24N02W29E01M	Irrigation	Composite	1947-2002	10-15	15-30	20-25
24N02W30P02M	Irrigation	Semi-confined	1992-2002	20-25	-	-
24N03W01B01M	Domestic	Semi-confined	1973-2002	8-12	15-20	15-20
24N03W02R01M	Irrigation	Composite	1947-2002	7-9	10-15	20-30
24N03W03R02M	Domestic	Unconfined	2000-2002	-	-	-
24N03W14B01M	Industrial	Semi-confined	2001-2002	-	-	-
24N03W16A01M	Irrigation	Composite	1947-2002	12-17	18-25	10-13
24N03W17M01M	Domestic	Unconfined	1973-2002	7-8	10-12	8-9
24N03W20N01M	Irrigation	Composite	1973-2002	10	10	13-17
24N04W14N02M	Domestic	Composite	1952-2002			
24N03W26K01M	Domestic	Composite	1947-2002	20-25	20-30	20-25
24N03W35P04M	Irrigation	Unconfined	1950-2002	15-20	20-25	15-20
24N03W35P05M	Domestic	Unconfined	2000-2002	-	-	-
24N04W02N01M	Domestic	Unconfined	1946-2002	8	10	10
24N04W33P01M	Irrigation	Confined	2000-2002	-	-	-

Table 4. Corning East Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
26N02W14G01M	Irrigation	Unconfined	1948-2002	1-2	1-4	1-3
26N02W14R01M	Irrigation	Composite	1992-2002	-	-	-
26N02W22G01M	Irrigation	Confined	1989-2002	1-3	1-3	1-3

Table 5. Dye Creek Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
27N03W10B01M	Domestic	Semi-confined	1970-2002	5-6	9-11	9-11
27N03W10N01M	Irrigation	Composite	1953-2002	-	-	-
27N03W16J01M	Irrigation	Composite	1952-2002	-	-	-
27N03W16K03M	Dom./Ind.	Unconfined	2000-2002	-	-	-
27N03W16N02M	Domestic	Semi-confined	1973-2002	5-6	8-10	9-10
27N03W20C01M	Domestic	Unconfined	1952-2002	1-3	1-3	1-3
27N03W23D01M	Irrigation	Composite	1948-2002	3	3	5
27N03W27G01M	Domestic	Composite	1952-2002	-	5-10	-
27N03W28A01M	Domestic	Unconfined	1952-2002	5	5-10	5

Table 6. Antelope Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
26N02W15C01M	Domestic	Unconfined	2000-2002	-	-	-
26N02W16C01M	Domestic	Unconfined	1980-2002	5	3	8-10
26N02W21Q01M	Domestic	Unconfined	1965-2002	5-8	9-11	9-11
25N02W09G01M	Domestic	Unconfined	1973-2002	2-3	3-4	5-7
25N02W21B01M	Irrig./Dom.	Unconfined	1973-2002	2-3	1-2	5-6
25N02W34K01M	Irrigation	Composite	1962-2002	2-3	2-3	2-3
26N02W17E01M	Irrigation	Unconfined	1973-2002	2-3	1-3	3-8
27N02W30C02M	Domestic	Composite	1961-2002	4-5	2-3	7-9
27N03W36C01M	Unused	Unconfined	1962-2002	-	-	-

Table 7. Los Molinos Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
24N01W05J01M	Domestic	Confined	1973-2002	0	7	2
24N01W05Q02M	Domestic	Composite	1973-2002	-	-	-
24N01W18N01M	Domestic	Unconfined	1965-2002	1-2	1-4	3-6
24N02W12J01M	Domestic	Unconfined	1973-2002	1-2	1-2	1-2
24N02W23G01M	Irrigation	Composite	1953-2002	1-2	1-2	3-6

Table 8. Vina Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
28N04W04P01M	Domestic	Confined	1994-2002	6	-	-
28N05W13D01M	Domestic	Confined	1994-2002	5	-	-
29N04W15E02M	Irrigation	Composite	1947-2002	3	1-2	3-5
29N04W15M01M	Domestic	Unconfined	2000-2002	-	-	-
29N04W27A01M	Domestic	Confined	1994-2002	3	-	-
29N04W28D01M	Domestic	Semi-confined	1978-2002	3	5	3
29N04W30L01M	Irrigation	Composite	1956-2002	3-5	5-6	3-6
29N04W35B01M	Test	Semi-confined	1965-2002	1	1	1
29N05W14L01M	Domestic	Semi-confined	1978-2002	8	15	12
29N05W16R01M	Irrigation	Composite	1956-2002	7-8	6-8	5-10
29N05W21H01M	Domestic	Confined	2000-2002	-	-	-
29N05W26N01M	Irrigation	Composite	1955-2002	4-8	10-20	8-13
29N05W33A01M	Observation	Confined	2000-2002	-	-	-
29N05W33A02M	Observation	Confined	2000-2002	-	-	-
29N05W33A03M	Observation	Confined	2000-2002	-	-	-
29N05W33A04M	Observation	Semi-Confined	2000-2002	-	-	-
29N05W33A05M	Observation	Unconfined	2000-2002	-	-	-

Table 9. Bowman Wells

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
24N01W04L01M	Irrigation	Semi-Confined	1998-2002	-	-	-
24N01W04N01M	Domestic	Semi-Confined	1998-2002	-	-	-
24N01W05C01M	Irrigation	Composite	1998-2002	-	-	-
24N01W05D01M	Domestic	Unconfined	1999-2002	-	-	-
24N01W05G01M	Irrigation	Confined	1998-2002	-	-	-
24N01W05G02M	Unused	Unconfined	1998-2002	-	-	-
24N01W05J03M	Observation	Confined	1999-2002	-	-	-
24N01W05J04M	Observation	Confined	1999-2002	-	-	-
24N01W05K01M	Irrigation	Composite	1998-2002	-	-	-
24N01W05K02M	Irrigation	Confined	1998-2002	-	-	-
24N01W05K03M	Domestic	Unconfined	1998-2002	-	-	-
24N01W05M01M	Domestic	Unconfined	1998-2002	-	-	-
24N01W05M02M	Irrigation	Unconfined	1998-2002	-	-	-
24N01W05N01M	Domestic	Unconfined	1998-2002	-	-	-
24N01W05Q03M	Domestic	Composite	1998-2002	-	-	-
24N01W05Q04M	Domestic	Composite	1998-2002	-	-	-
24N01W05R02M	Domestic	Confined	1998-2002	-	-	-
24N01W06A02M	Irrigation	Composite	1998-2002	-	-	-
24N01W06J01M	Domestic	Unconfined	1998-2002	-	-	-
24N01W06J02M	Domestic	Unconfined	1998-2002	-	-	-
24N01W07G01M	Irrigation	Composite	1998-2002	-	-	-
24N01W07J01M	Domestic	Composite	1998-2002	-	-	-
24N01W08B01M	Domestic	Composite	1998-2002	-	-	-
24N01W08C01M	Domestic	Semi-Confined	1998-2002	-	-	-
24N01W08M01M	Domestic	Unconfined	1999-2002	-	-	-
24N02W01J01M	Irrigation	Composite	1998-2002	-	-	-
24N02W01L01M	Observation	Confined	1999-2002	-	-	-
24N02W01L02M	Observation	Confined	1999-2002	-	-	-
24N02W01Q01M	Irrigation	Composite	1998-2002	-	-	-
24N02W01R01M	Observation	Confined	1999-2002	-	-	-
24N02W01R02M	Observation	Confined	1999-2002	-	-	-
24N02W02E01M	Irrigation	Confined	1998-2002	-	-	-
24N02W03B01M	Irrigation	Composite	1998-2002	-	-	-
24N02W03B02M	Industrial	Composite	1998-2002	-	-	-
24N02W03C01M	Irrigation	Unconfined	1998-2002	-	-	-
24N02W11R01M	Irrigation	Unconfined	1998-2002	-	-	-
24N02W12A01M	Irrigation	Confined	1998-2002	-	-	-
24N02W12P01M	Observation	Composite	1999-2002	-	-	-

Table 10. Deer Creek Special Project

State Well Number	Well Use	Aquifer System	Period of Record	Annual GW Fluctuation: Normal Years (feet)	Annual GW Fluctuation: Drought years (feet)	Annual GW Fluctuation: Wet Years (feet)
24N02W12P02M	Observation	Confined	1999-2002	-	-	-
24N02W13A01M	Irrigation	Composite	1998-2002	-	-	-
24N02W13C01M	Domestic	Unconfined	1998-2002	-	-	-
24N02W13D01M	Irrigation	Composite	1998-2002	-	-	-
24N02W13F01M	Irrigation	Composite	1998-2002	-	-	-
24N02W13N01M	Irrigation	Composite	1998-2002	-	-	-
24N02W13N02M	Stock	Unconfined	1998-2002	-	-	-
24N02W14C01M	Irrigation	Composite	1998-2002	-	-	-
24N02W14E02M	Irrigation	Composite	1998-2002	-	-	-
24N02W14R02M	Industrial	Composite	1998-2002	-	-	-
24N02W22A01M	Domestic	Semi-Confined	1998-2002	-	-	-
24N02W22A02M	Irrigation	Composite	1998-2002	-	-	-
24N02W22J01M	Irrigation	Composite	1998-2002	-	-	-
24N02W22R01M	Domestic	Composite	1998-2002	-	-	-
24N02W23B01M	Irrigation	Confined	2002-2002	-	-	-
24N02W23B02M	Domestic	Semi-Confined	1998-2002	-	-	-
24N02W23C01M	Domestic	Unconfined	1998-2002	-	-	-
24N02W23D01M	Irrigation	Composite	1998-2002	-	-	-
24N02W24D01M	Irrigation	Confined	1998-2002	-	-	-
24N02W24E01M	Domestic	Unconfined	1998-2002	-	-	-
24N02W24N02M	Irrig./Dom.	Unconfined	1998-2002	-	-	-
24N02W25G01M	Irrigation	Semi-Confined	1998-2002	-	-	-
24N02W25K01M	Domestic	Unconfined	1998-2002	-	-	-
24N02W25L01M	Irrigation	Composite	1998-2002	-	-	-
24N02W25L02M	Irrigation	Composite	1998-2002	-	-	-
24N02W25Q01M	Irrigation	Composite	1998-2002	-	-	-
24N02W26A04M	Domestic	Unconfined	1998-2002	-	-	-
24N02W35A01M	Irrigation	Confined	1998-2002	-	-	-
25N01W32P01M	Observation	Confined	1999-2002	-	-	-
25N01W32P02M	Observation	Confined	1999-2002	-	-	-
25N01W32P03M	Observation	Confined	1999-2002	-	-	-
25N01W33J01M	Domestic	Semi-Confined	1998-2002	-	-	-
25N01W34N01M	Domestic		1998-2002	-	-	-
25N01W34N02M	Observation	Semi-Confined	1999-2002	-	-	-
25N01W34N03M	Observation	Confined	1999-2002	-	-	-

Table 10. (continued). Deer Creek Special Project

SACRAMENTO VALLEY REGION

WELL DEPTH

Well depth and well use data for the Sacramento Valley Region were collected from well completion reports filed with DWR. A total of 7,678 well records with depth data were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic, irrigation, and municipal wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Sacramento Valley area are presented in Figures ##, ##, and ##. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the wells within the region.

Table #, Appendix #, shows that the average depth of domestic wells in the Sacramento Valley portion of Tehama County is about 165 feet. Table ## also shows that wells drilled for irrigation and municipal uses have a greater average depth than domestic wells with an average depth of 262 feet.

Figure ## shows the cumulative frequency distribution for domestic wells in the Sacramento Valley Region. A total of 6,339 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depth interval. The depths of domestic wells range from 16 to 884 feet.

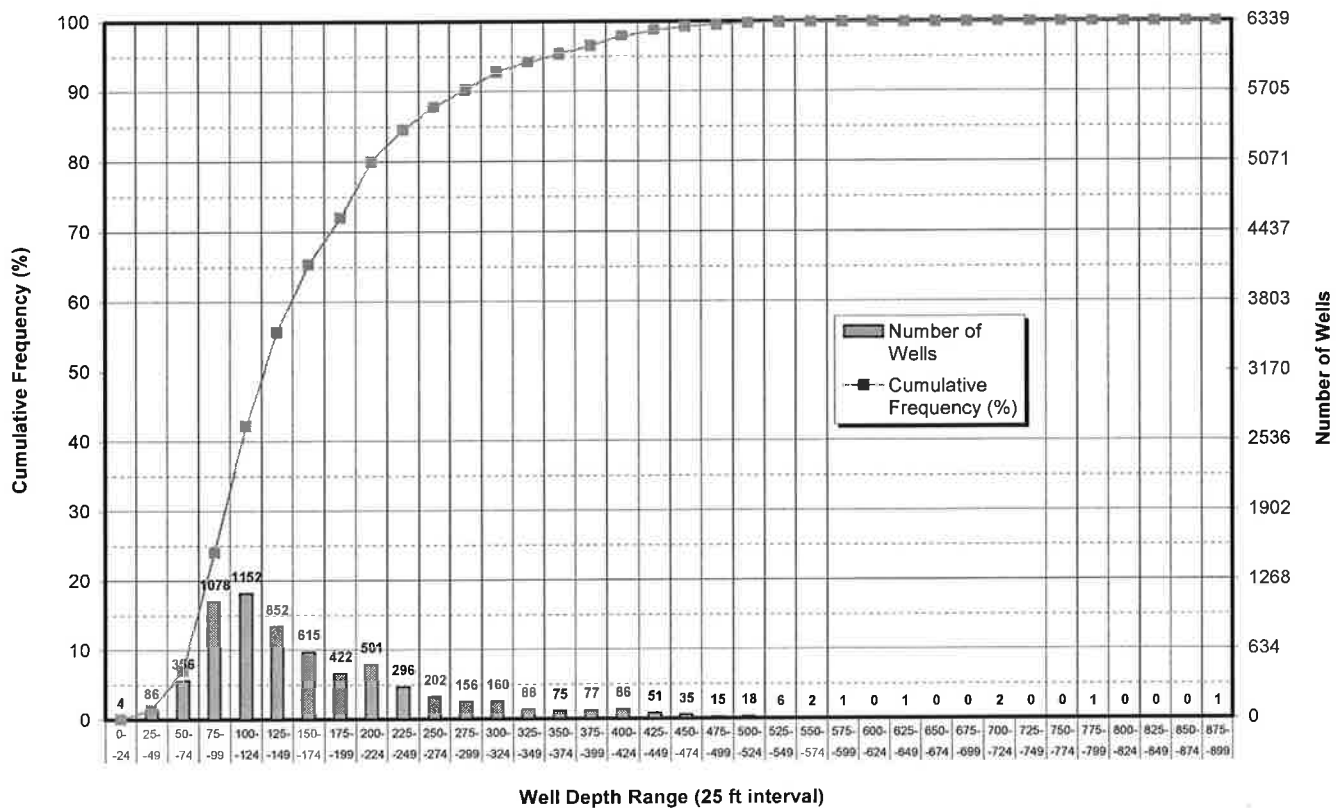


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Sacramento Valley Portion of Tehama County.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. A positively skewed distribution indicates that average well depth is deeper than the most frequently occurring well depth or the depth class interval with the greatest number of wells. The histogram also shows moderate variability in well depths.

The frequency distribution of domestic well depth data for the Sacramento Valley Region is summarized as follows:

- 50% of the domestic wells are installed to a depth of 140 feet or less,
- 20% of the wells are installed to a depth of 92 feet or less, and
- 10% of the wells are installed to a depth of 80 feet or less.

Figure ## illustrates the cumulative frequency distribution for irrigation wells in the Sacramento Valley Region. A total of 1,245 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depth interval. The depths of irrigation wells range from 27 to 1,001 feet.

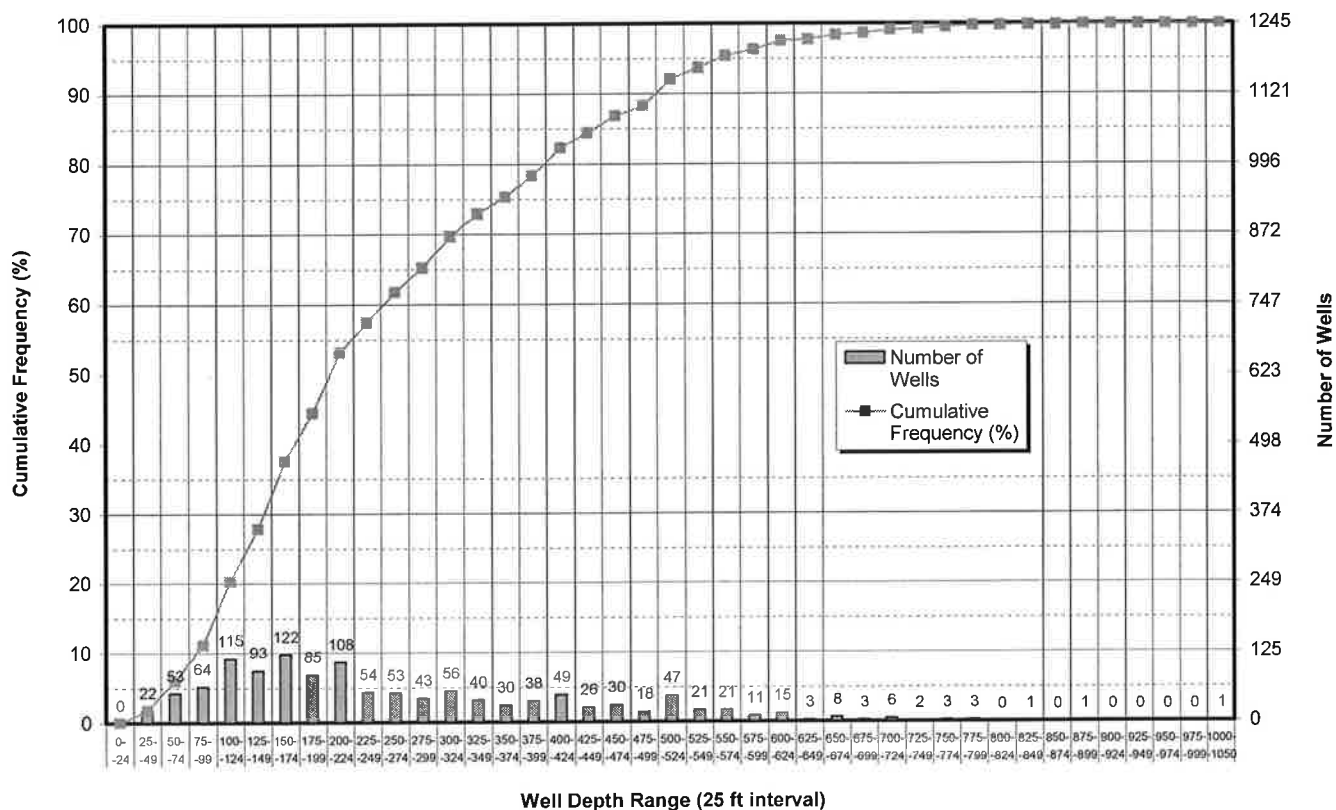


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Sacramento Valley Portion of Tehama County.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. A positively skewed distribution indicates that average well depth is deeper than the most frequently occurring well depth or the depth class interval with the greatest number of wells. The histogram also shows high variability in well depths.

The frequency distribution of irrigation well depth data for the Sacramento Valley Region is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 215 feet or less,
- 20% of the wells are installed to a depth of 123 feet or less, and
- 10% of the wells are installed to a depth of 94 feet or less.

Figure ## illustrates the cumulative frequency distribution of municipal wells in the Sacramento Valley Region. A total of 94 municipal wells were evaluated in terms of cumulative frequency distribution with respect to well depth interval. Municipal well depths range from 22 to 830 feet.

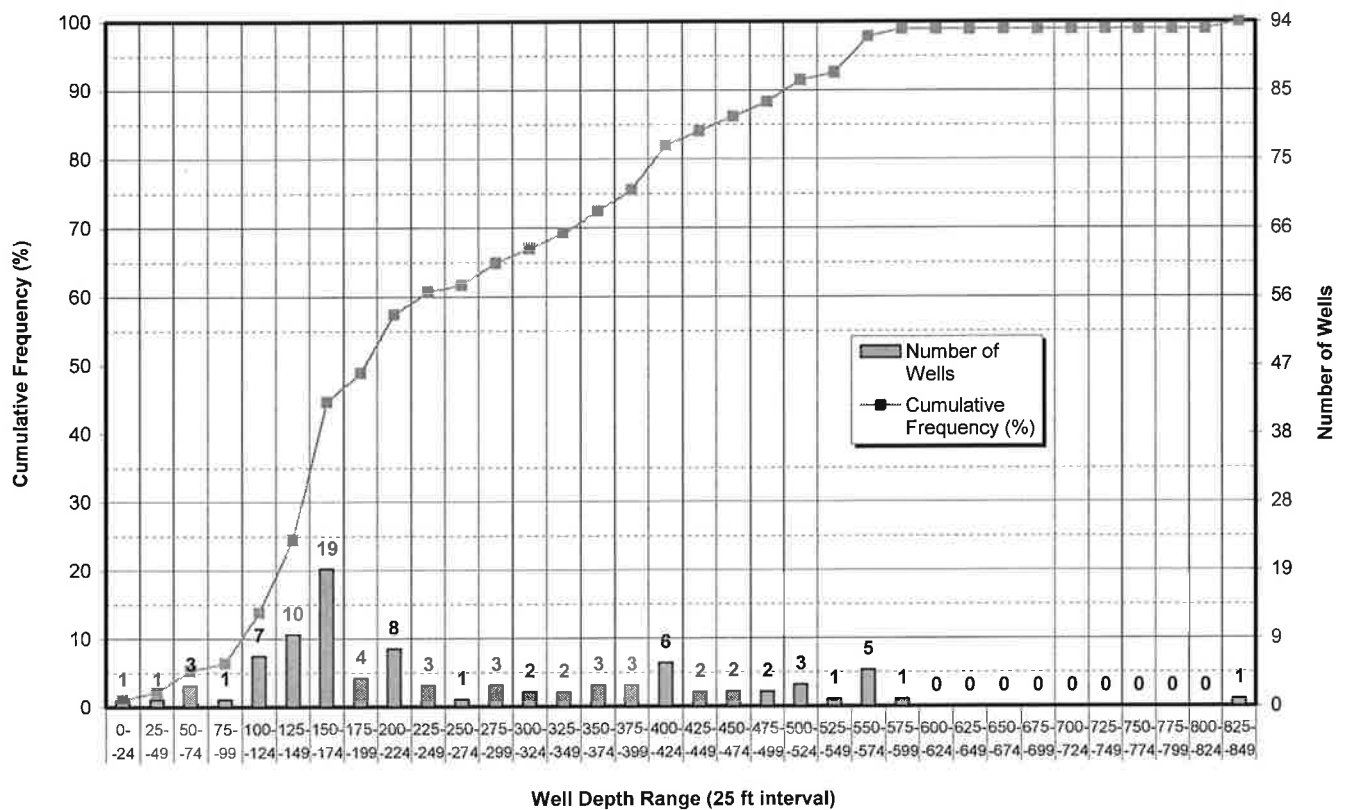


Figure ##. Cumulative Frequency Distribution of Municipal Wells, Sacramento Valley Portion of Tehama County.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. A positively skewed distribution indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability in well depths.

The frequency distribution of municipal well depth data for the Sacramento Valley Region is summarized as follows:

- 50% of the municipal wells are installed to a depth of 200 feet or less,
- 20% of the wells are installed to a depth of 140 feet or less, and
- 10% of the wells are installed to a depth of 110 feet or less.

RED BLUFF EAST INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Red Bluff East Inventory Unit were collected from well completion reports filed with DWR. A total of 1,426 well records for the Red Bluff East Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic, irrigation and municipal wells showing the number of wells constructed for each 25 foot depth interval. Cumulative frequency curves associated with the Red Bluff East Inventory Unit are presented in Figures ##, ##, and ##. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the wells within the inventory unit.

Table #, Appendix #, shows that the majority of wells in the Red Bluff East Inventory Unit are for domestic use. The average domestic well depth is about 163 feet. Table # also shows that wells drilled for irrigation and municipal uses tend to be deeper than those for domestic use. The average irrigation well depth for the Red Bluff East Inventory Unit is 321 feet. The average municipal well depth is 312 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Red Bluff East Inventory Unit. A total of 1,137 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 40 to 700 feet.

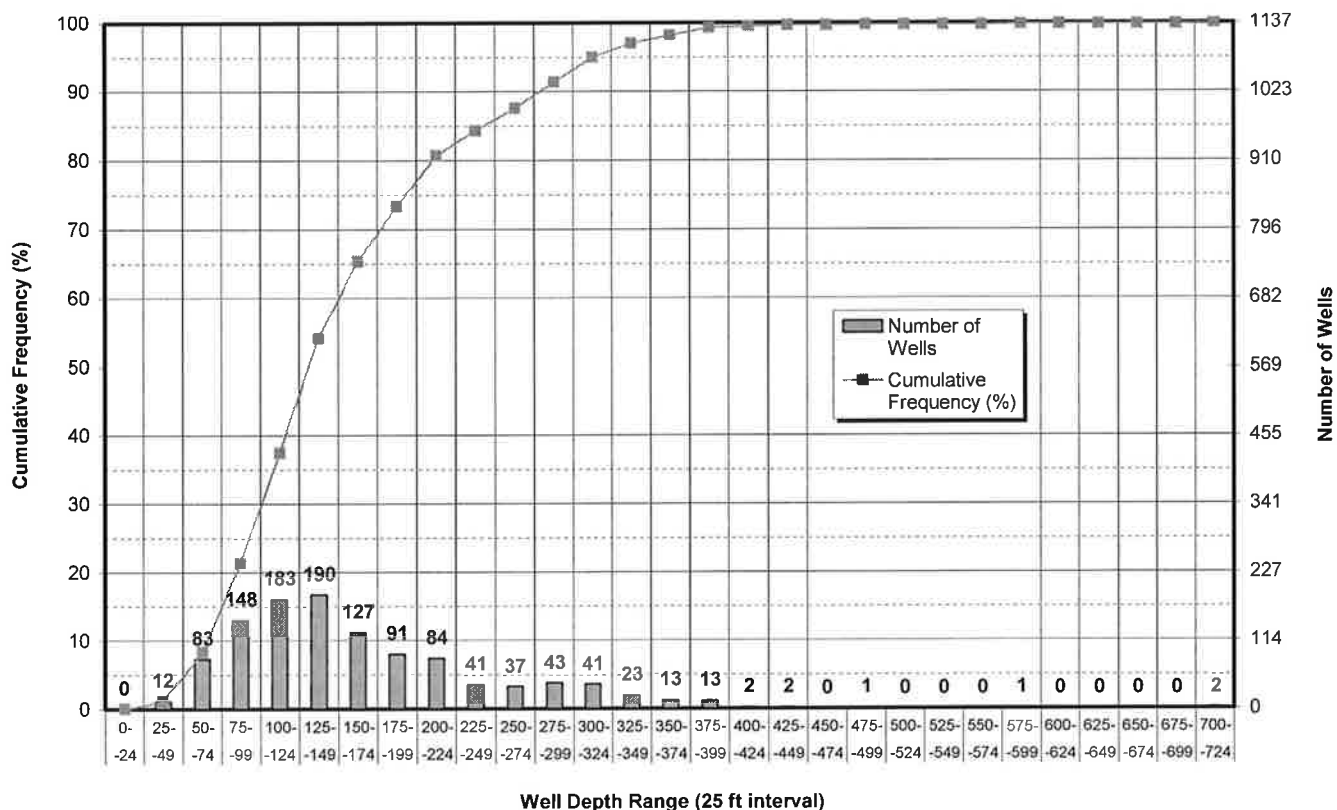


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Red Bluff East Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows that well depths have high variability.

The frequency distribution of domestic well depth data for the Red Bluff East Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 141 feet or less,
- 20% of the wells are installed to a depth of 96 feet or less, and
- 10% of the wells are installed to a depth of 80 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Red Bluff East Inventory Unit. A total of 253 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depths from 48 to 1,001 feet.

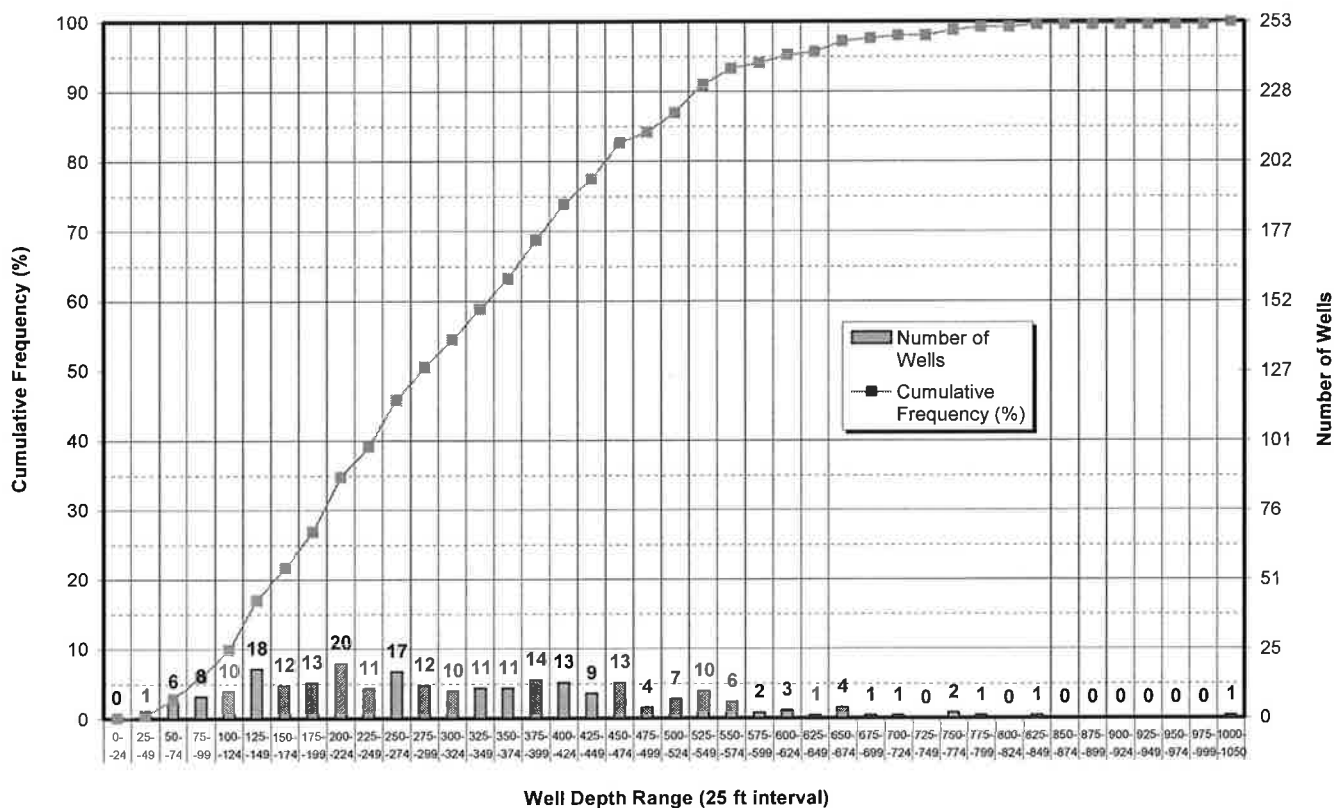


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Red Bluff East Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with slight negative skewness. Negatively-skewed distribution of irrigation well data is due to the number of wells constructed to deeper depth intervals. The histogram also shows that well depths are highly variable.

The frequency distribution of irrigation well depth data for the Red Bluff East Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 290 feet or less,
- 20% of the wells are installed to a depth of 165 feet or less, and
- 10% of the wells are installed to a depth of 126 feet or less.

Figure ## illustrates the cumulative frequency distribution of municipal well depth data for the Red Bluff East Inventory Unit. A total of 37 wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depths from 108 to 580 feet.

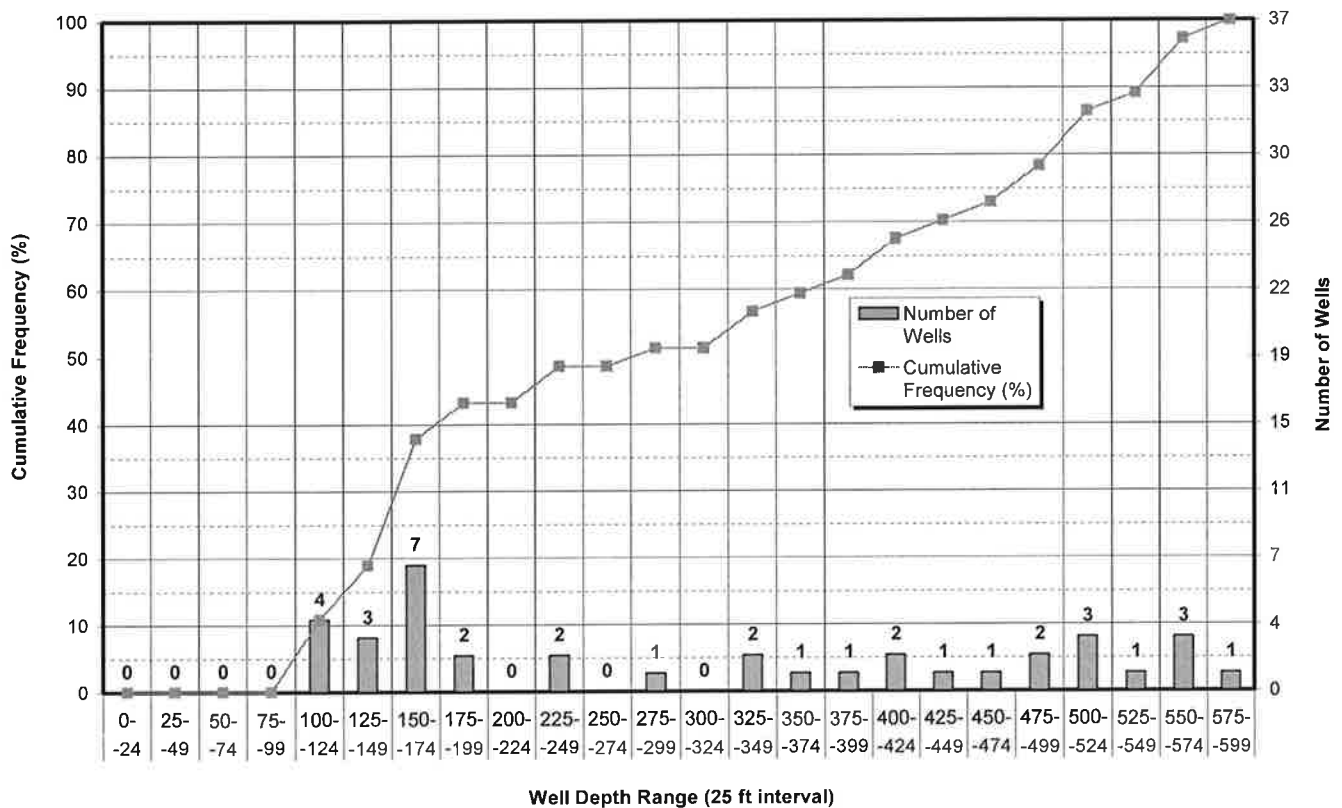


Figure ##. Cumulative Frequency Distribution of Municipal Wells, Red Bluff East Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of municipal well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows that well depths have high variability.

The frequency distribution of municipal well depth data for the Red Bluff East Inventory Unit is summarized as follows:

- 50% of the municipal wells are installed to a depth of 289 feet or less
- 20% of the wells are installed to a depth of 152 feet or less, and
- 10% of the wells are installed to a depth of 120 feet or less.

City of Red Bluff Sub-inventory Unit

WELL DEPTH

Well depth and well use data for the City of Red Bluff Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 198 well records were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot depth interval. The cumulative frequency curve associated with the City of Red Bluff Sub-Inventory Unit is presented in Figure ##. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the inventory unit.

Table #, Appendix #, shows that the majority of wells in the City of Red Bluff Sub-Inventory Unit are for domestic use. The average domestic well depth is about 140 feet. Table # also shows that wells drilled for irrigation and municipal uses tend to be deeper than those for domestic use. The 14 irrigation wells range in depth from 70 to 650 feet and average 216 feet. The 16 municipal wells range in depth from 52 to 580 feet and average 351 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the City Red Bluff Sub-Inventory Unit. A total of 168 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 30 to 381 feet.

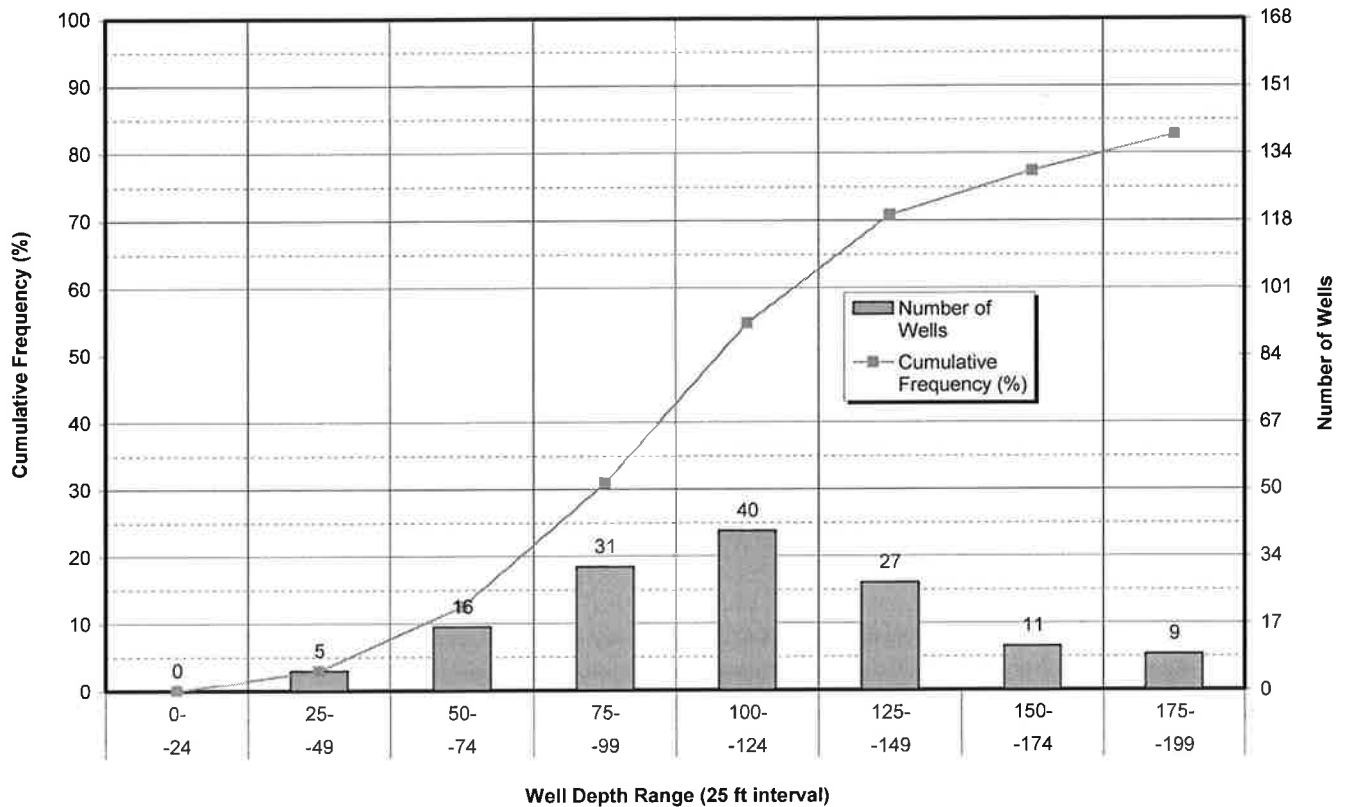


Figure ##. Cumulative Frequency Distribution of Domestic Wells, City of Red Bluff Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution. The histogram also shows that well depths have low variability.

The frequency distribution of municipal well depth data for the City of Red Bluff Sub-Inventory Unit is summarized as follows:

- 50% of the municipal wells are installed to a depth of 120 feet or less
- 20% of the wells are installed to a depth of 80 feet or less, and
- 10% of the wells are installed to a depth of 68 feet or less.

Rawson Water District Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Rawson Water District Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 89 well records for the Rawson Water District Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as presented in Figure ##. Cumulative frequency distribution analyses of irrigation and municipal wells for the Rawson Water District Sub-Inventory Unit were not developed due to the low number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Rawson Water District Sub-Inventory Unit are for domestic use. The average domestic well depth is about 174 feet. Table # also shows that wells drilled for irrigation and municipal uses tend to be deeper than those for domestic use. The nine irrigation wells ranged in depth from 132 to 620 feet and averaged 338 feet. The depth of the single municipal well is 378 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Rawson Water District Sub-Inventory Unit. A total of 79 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 60 to 408 feet.

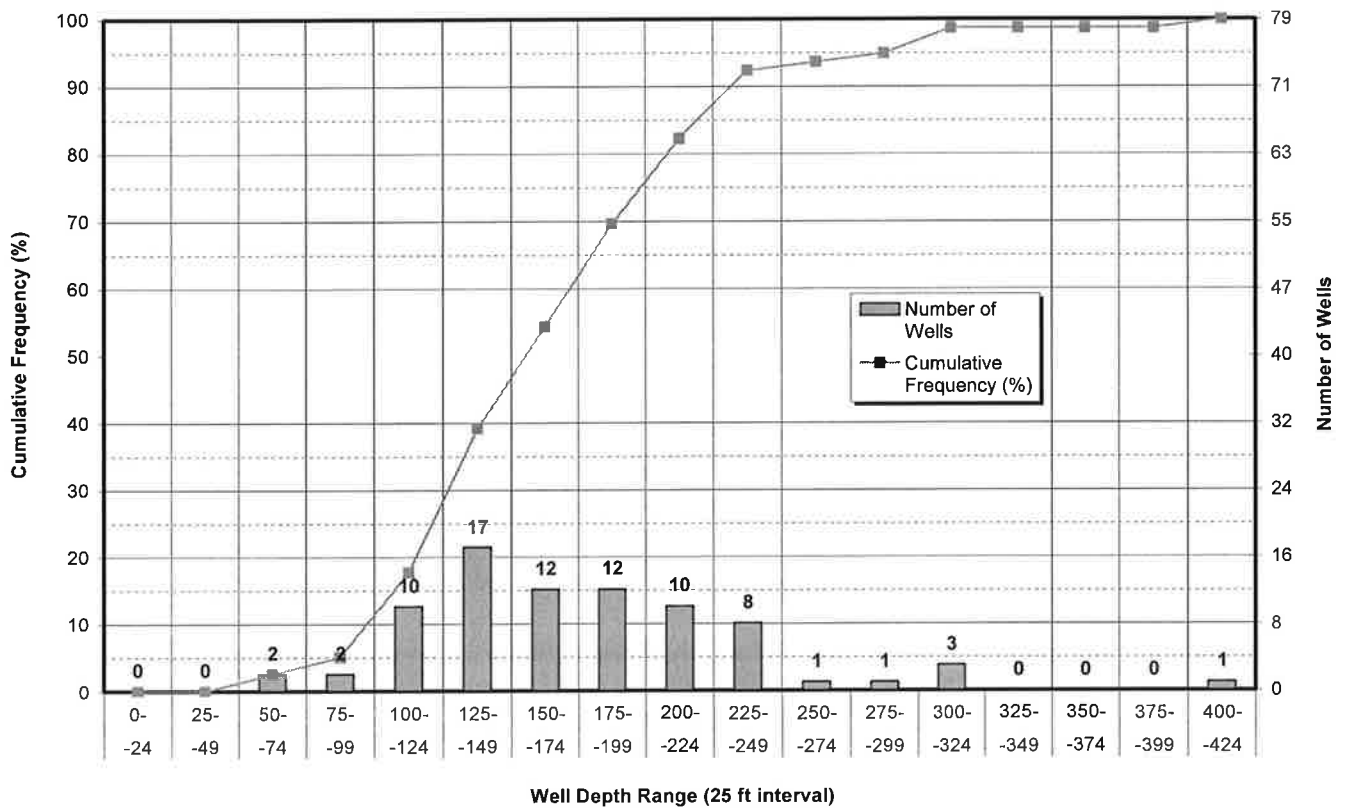


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Rawson Water District Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution and shows moderate variability for well depths. The histogram also shows low variability in well depths.

The frequency distribution of domestic well depth data for the Rawson Water District Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 156 feet or less,
- 20% of the wells are installed to a depth of 128 feet or less, and
- 10% of the wells are installed to a depth of 120 feet.

Proberta Water District Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Proberta Water District Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 46 well records for the Proberta Water District Sub-Inventory Unit were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as presented in Figure ##. Cumulative frequency distribution analysis of irrigation wells for the Proberta Water District Sub-Inventory Unit was not developed due to the low number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Proberta Water District Sub-Inventory Unit are for domestic use. The average domestic well depth is about 128 feet. Table # also shows that wells drilled for irrigation tend to be deeper than those for domestic use. The 15 irrigation wells ranged in depth from 48 to 470 feet and averaged 264 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Proberta Water District Sub-Inventory Unit. A total of 31 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 57 to 296 feet.

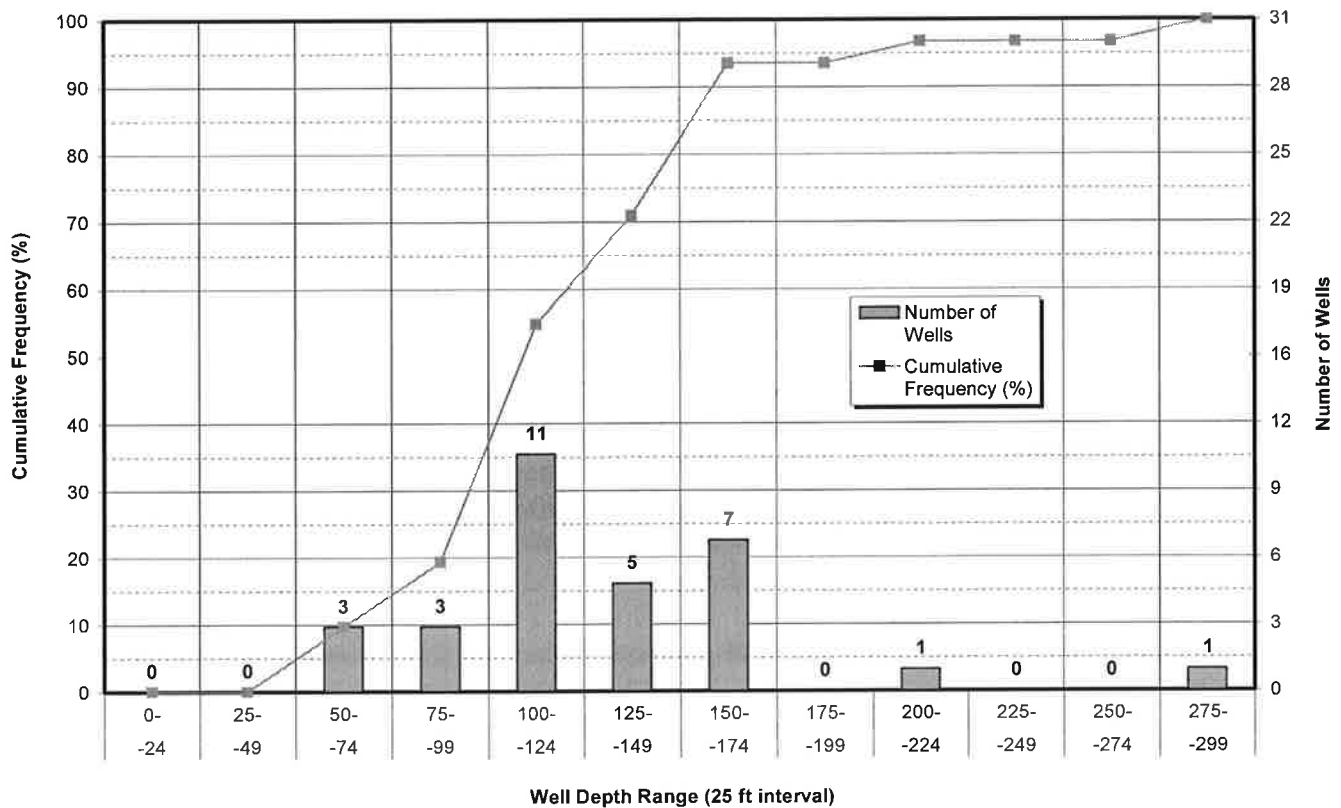


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Proberta Water District Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with positive skewness. The histogram also shows low variability for well depths.

The frequency distribution of domestic well depth data for the Proberta Water District Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 120 feet or less,
- 20% of the wells are installed to a depth of 100 feet or less, and
- 10% of the wells are installed to a depth of 76 feet or less.

Elder Creek Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Elder Creek Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 79 well records for the Elder Creek Sub-Inventory Unit were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as presented in Figure ##. Cumulative frequency distribution analysis of irrigation wells for the Elder Creek Sub-Inventory Unit was not developed due to the low number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Elder Creek Sub-Inventory Unit are for domestic use. The average domestic well depth is about 123 feet. Table # also shows that wells drilled for irrigation tend to be deeper than those for domestic use. The 27 irrigation wells ranged in depth from 170 to 700 feet and averaged 410 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Elder Creek Sub-Inventory Unit. A total of 52 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 52 to 276 feet.

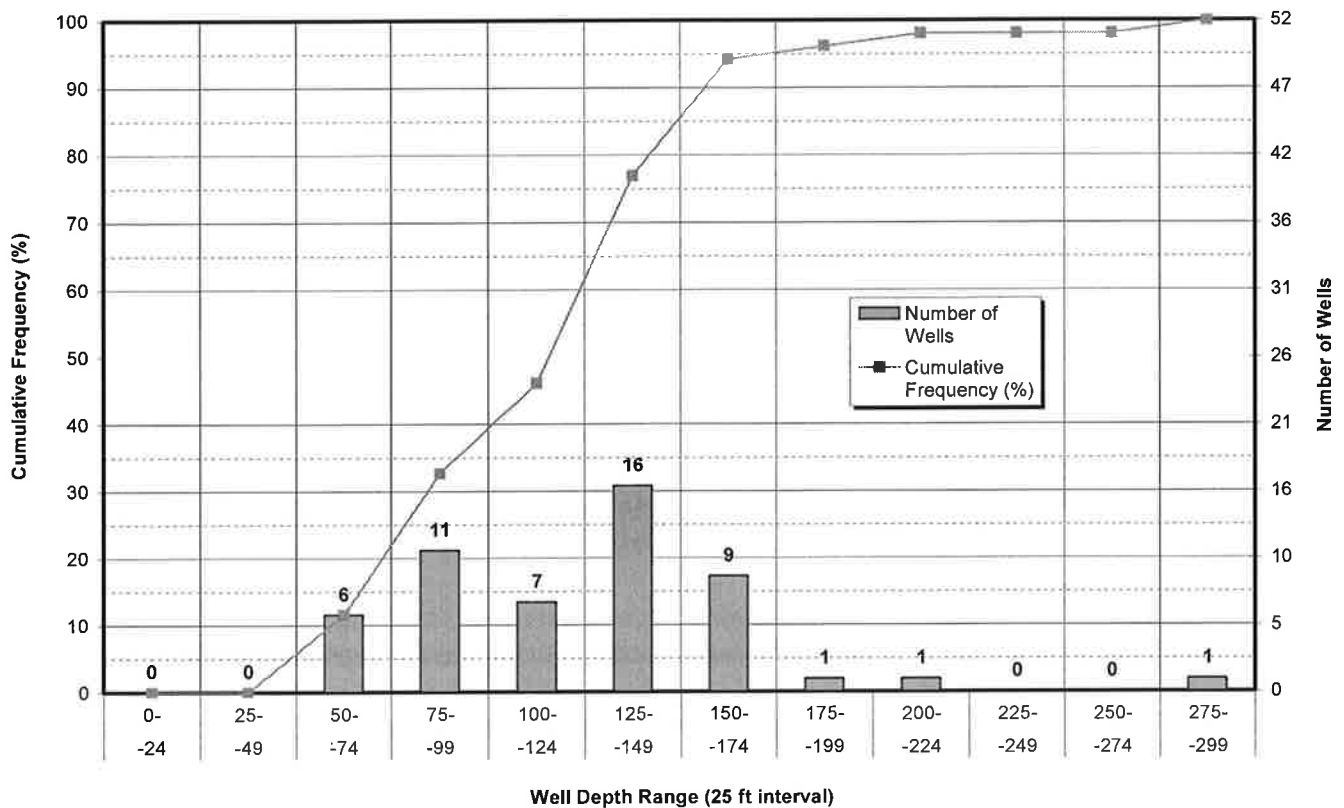


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Elder Creek Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with slight positive skewness. The histogram also shows relatively low variability in well depths.

The frequency distribution of domestic well depth data for the Elder Creek Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 130 feet or less,
- 20% of the wells are installed to a depth of 85 feet or less, and
- 10% of the wells are installed to a depth of 68 feet or less.

El Camino Irrigation District Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the El Camino Irrigation District Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 281 well records for the El Camino Irrigation District Sub-Inventory Unit were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the El Camino Irrigation District Sub-Inventory Unit are presented in Figures ## and ##. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the El Camino Irrigation District Sub-Inventory Unit are for domestic use. The average domestic well depth is about 122 feet. Table # also shows that wells drilled for irrigation tend to be deeper than those for domestic use. The average irrigation well depth for the El Camino Irrigation District Sub-Inventory Unit is 383 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the El Camino Irrigation District Sub-Inventory Unit. A total of 224 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 40 to 425 feet.

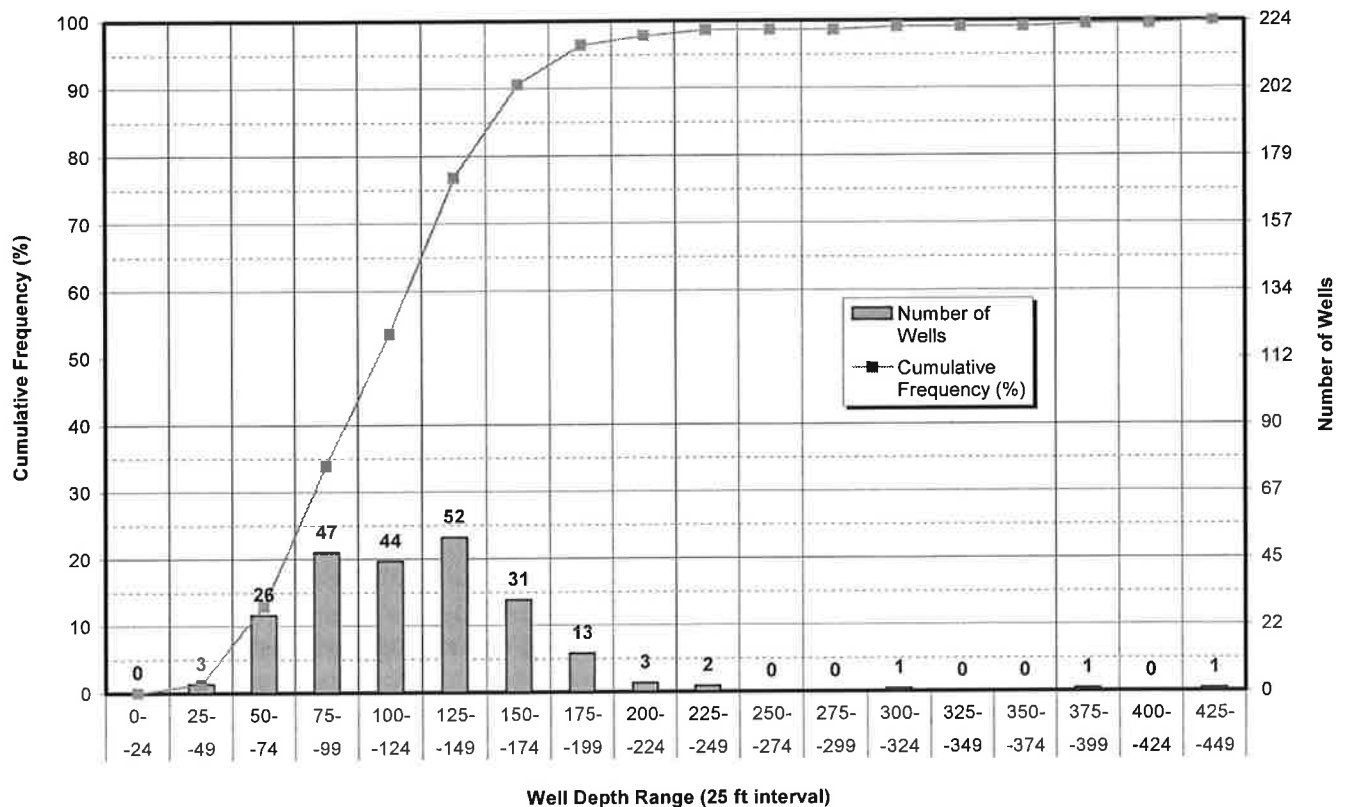


Figure ##. Cumulative Frequency Distribution of Domestic Wells, El Camino Irrigation District Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with negative skewness due to the number of wells constructed to deeper depth intervals. The histogram also shows low variability in well depths.

The frequency distribution of domestic well depth data for the El Camino Irrigation District Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 120 feet or less,
- 20% of the wells are installed to a depth of 83 feet or less, and
- 10% of the wells are installed to a depth of 70 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the El Camino Irrigation District Sub-Inventory Unit. A total of 57 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depth from 59 to 1001 feet.

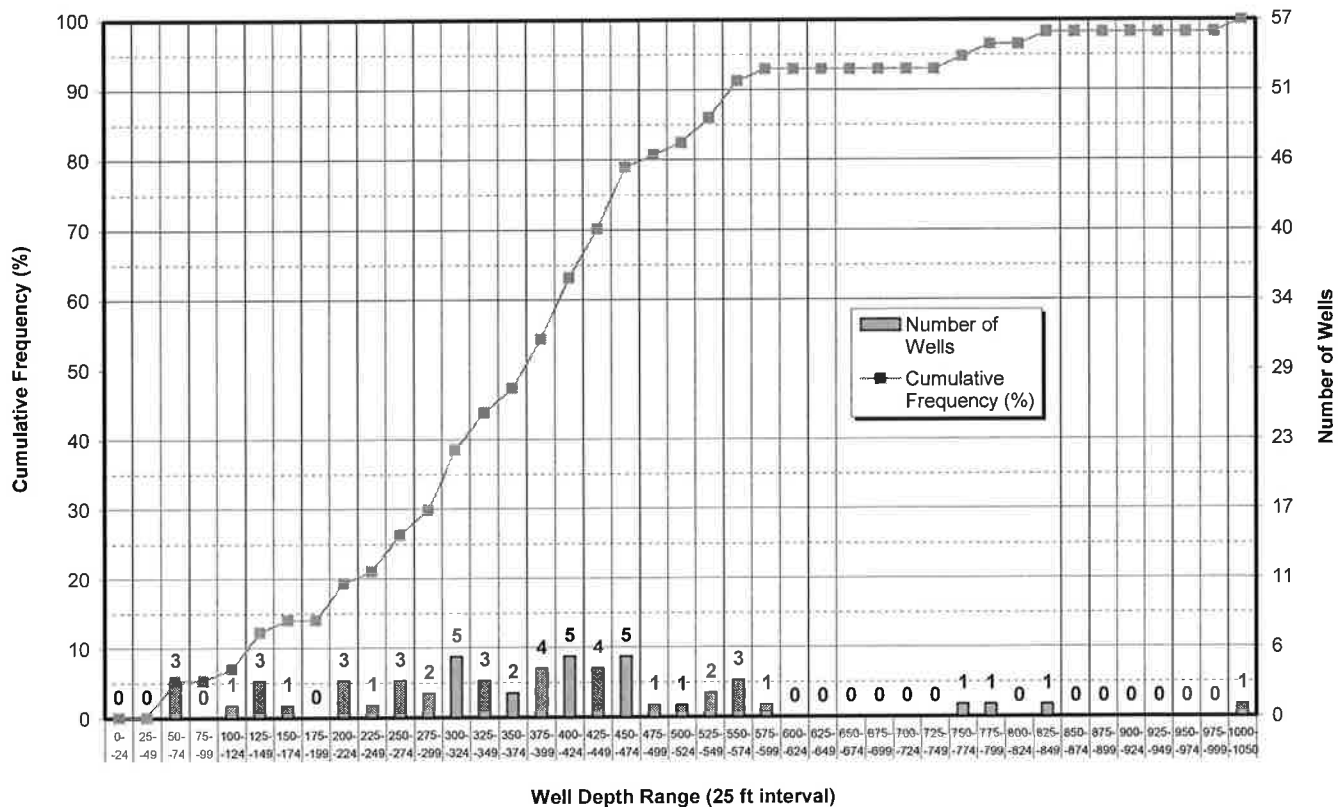


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, EI Camino Irrigation District Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with positive skewness. Positive-skewed distribution of irrigation well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows moderate to high variability in well depths.

The frequency distribution of irrigation well depth data for the EI Camino Irrigation District Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 390 feet or less,
- 20% of the wells are installed to a depth of 230 feet or less, and
- 10% of the wells are installed to a depth of 145 feet or less.

Thomes Creek Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Thomes Creek Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 82 well records were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval. The cumulative frequency curve associated with the Thomes Creek Sub-Inventory Unit is presented in Figure ##. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Thomes Creek Sub-Inventory Unit are for domestic use. The average domestic well depth is about 140 feet. Table # also shows that wells drilled for irrigation tend to be deeper than those for domestic use. The 29 irrigation wells range in depth from 40 to 645 feet and average 301 feet. The two municipal wells are constructed to 130 and 440 feet, averaging 285 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Thomes Creek Sub-Inventory Unit. A total of 51 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 44 to 210 feet.

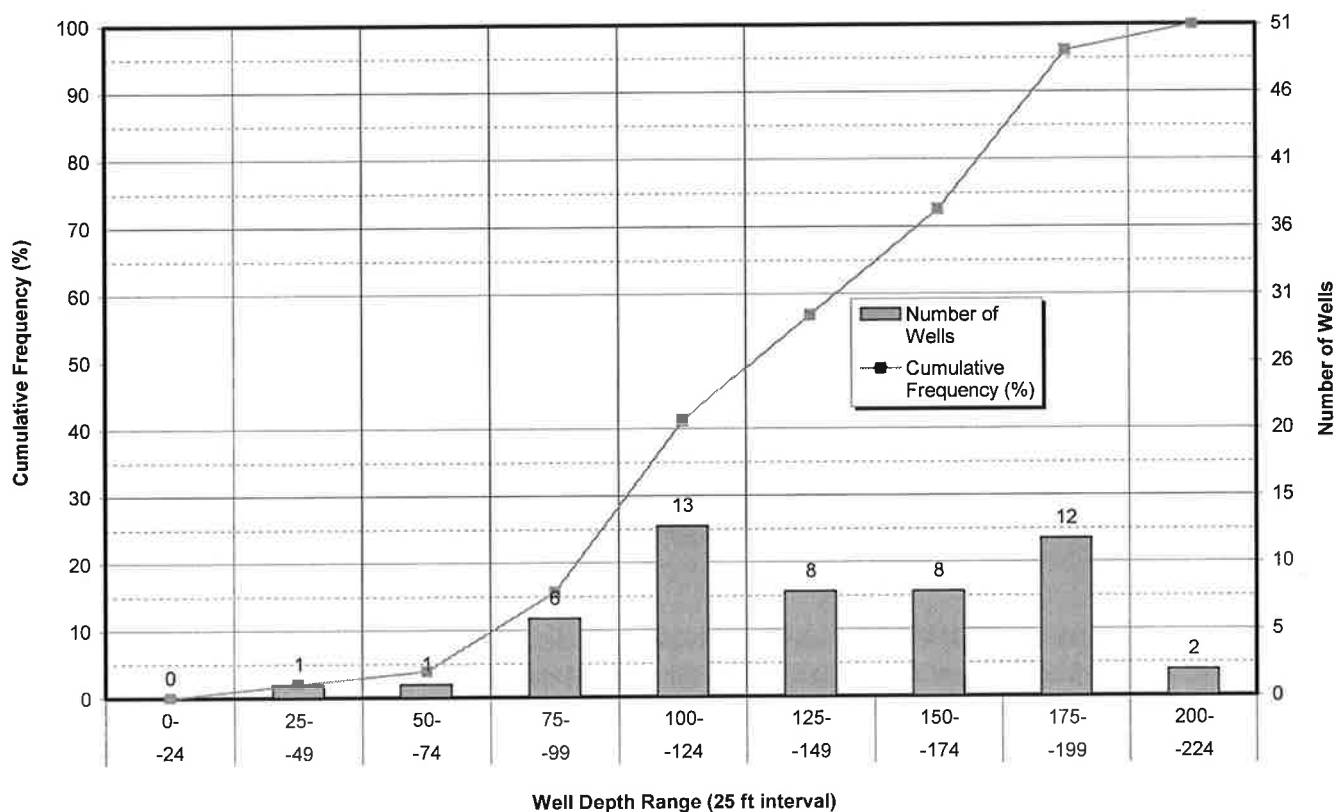


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Thomes Creek Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with negative skewness due to the number of wells constructed to deeper depth intervals. The histogram also shows low variability in well depths.

The frequency distribution of domestic well depth data for the Thomes Creek Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 140 feet or less,
- 20% of the wells are installed to a depth of 107 feet or less, and
- 10% of the wells are installed to a depth of 86 feet or less.

Red Bluff East Independent Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Red Bluff East Independent Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 809 well records for the Red Bluff East Independent Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Red Bluff East Independent Sub-Inventory Unit are presented in Figures ## and ##. A cumulative frequency distribution analysis for municipal wells was not developed due to the low number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells in the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Red Bluff East Independent Sub-Inventory Unit are for domestic use. The average domestic well depth is about 179 feet. Table # also shows that wells drilled for irrigation and municipal uses tend to be deeper than those for domestic use. The average irrigation well depth is 282 feet. The 20 municipal wells range in depth from 55 to 765 feet and average 275 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Red Bluff East Independent Sub-Inventory Unit. A total of 662 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 44 to 700 feet.

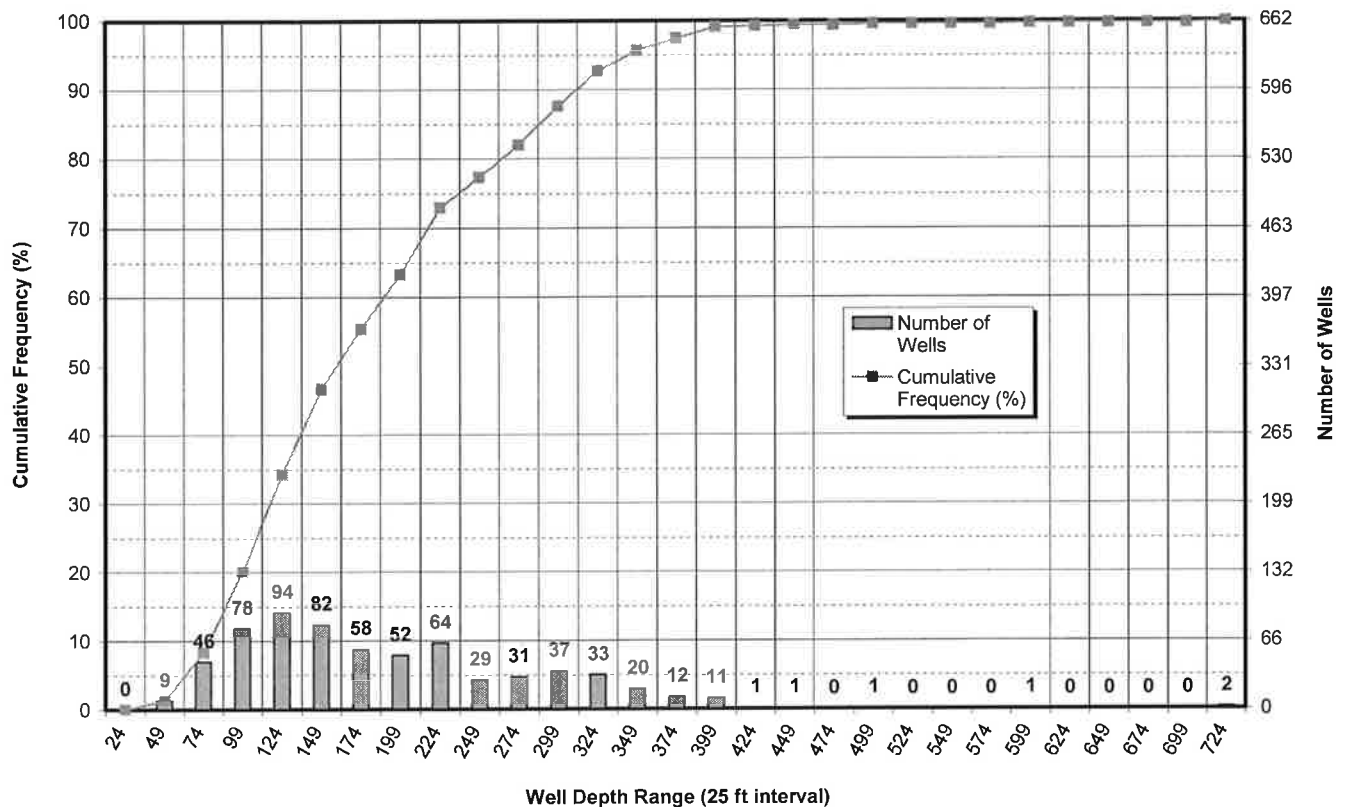


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Red Bluff East Independent Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is a normal distribution that has slight positive skewness. The histogram also shows high variability in well depths.

The frequency distribution of domestic well depth data for the Red Bluff Independent East Sub-Inventory is summarized as follows:

- 50% of the domestic wells are installed to a depth of 160 feet or less,
- 20% of the wells are installed to a depth of 100 feet or less, and
- 10% of the wells are installed to a depth of 80 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Red Bluff Independent Sub-Inventory Unit. A total of 127 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depth from 55 to 765 feet.

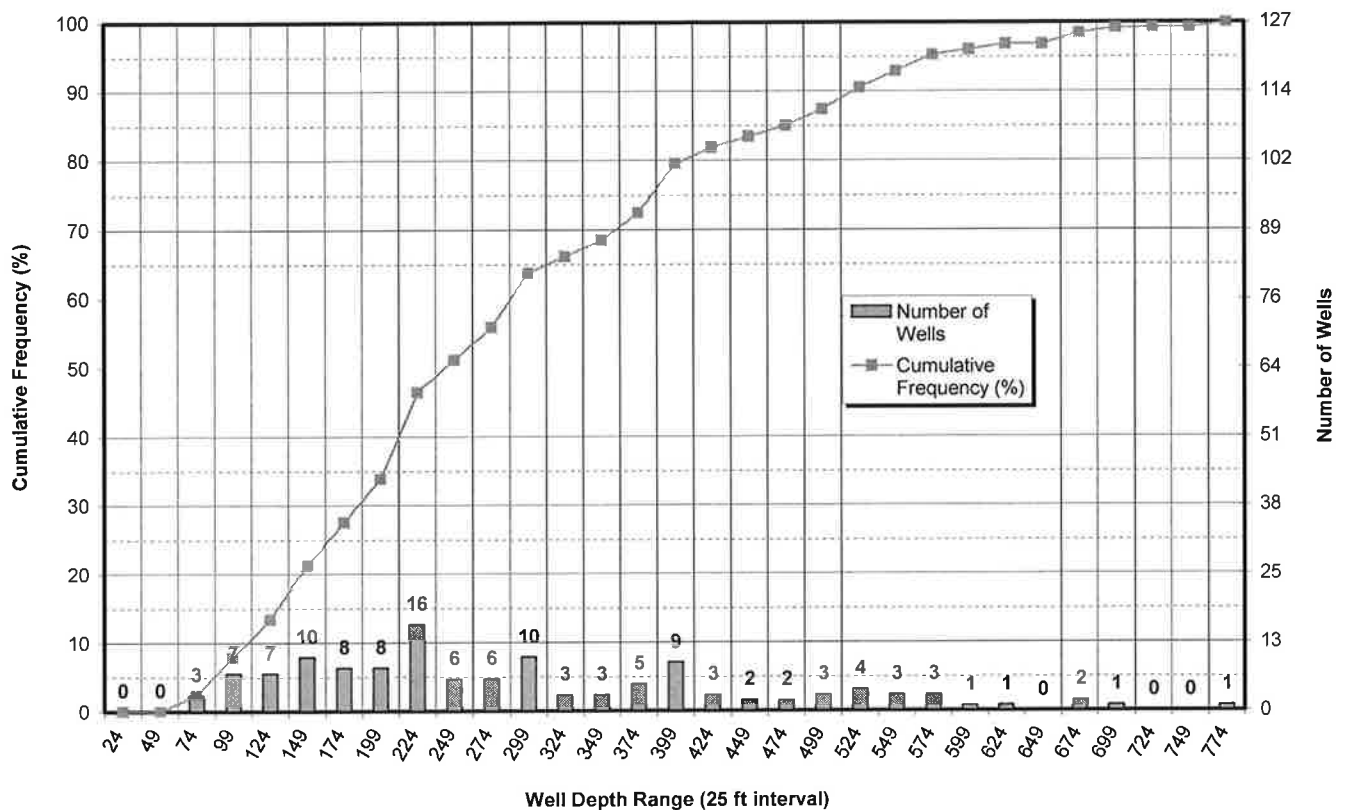


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Red Bluff East Independent Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is a normal distribution that has positive skewness. Positive-skewed distribution of irrigation well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability in well depths.

The frequency distribution of irrigation well depth data for the Red Bluff East Independent Sub-Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 243 feet or less,
- 20% of the wells are installed to a depth of 148 feet or less, and
- 10% of the wells are installed to a depth of 104 feet or less.

RED BLUFF WEST INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Red Bluff West Inventory Unit were collected from well completion reports filed with DWR. A total of 2,189 well records for the Red Bluff West Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Red Bluff West Inventory Unit are presented in Figures ## and ##. A cumulative frequency distribution curve was not developed for municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells within the inventory unit.

Table #, Appendix #, shows that the majority of wells in the Red Bluff West Inventory Unit are for domestic use. The average domestic well depth is about 229 feet. Table # also shows that wells drilled for irrigation and municipal uses are slightly deeper than those for domestic use. The average irrigation well depth for the Red Bluff West Inventory Unit is 263 feet. The seven municipal wells range in depth from 160 to 410 feet and average 285 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Red Bluff West Inventory Unit. A total of 2,119 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 20 to 780 feet.

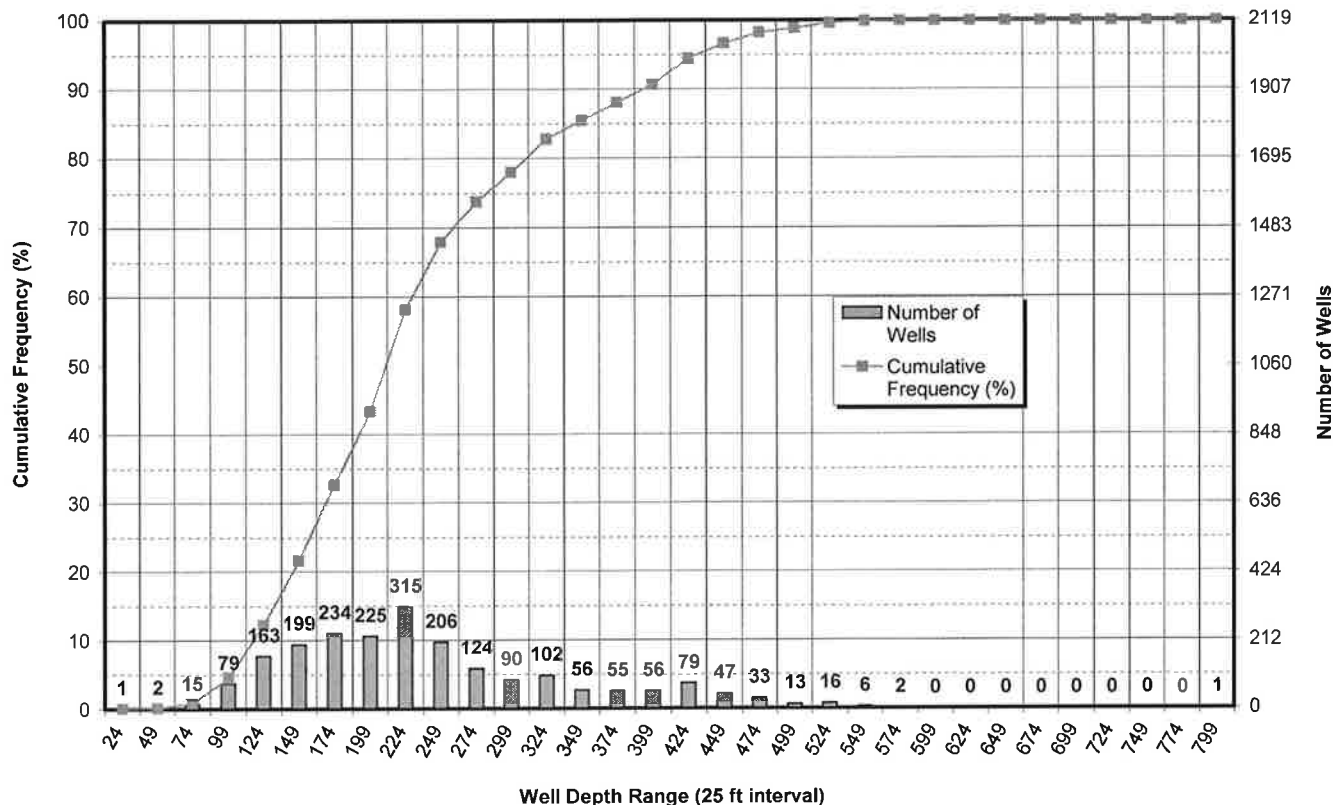


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Red Bluff West Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution that has positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability in well depths.

The frequency distribution of domestic well depth data for the Red Bluff West Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 210 feet or less,
- 20% of the wells are installed to a depth of 144 feet or less, and
- 10% of the wells are installed to a depth of 120 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Red Bluff West Inventory Unit. A total of 263 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depth from 59 to 580 feet.

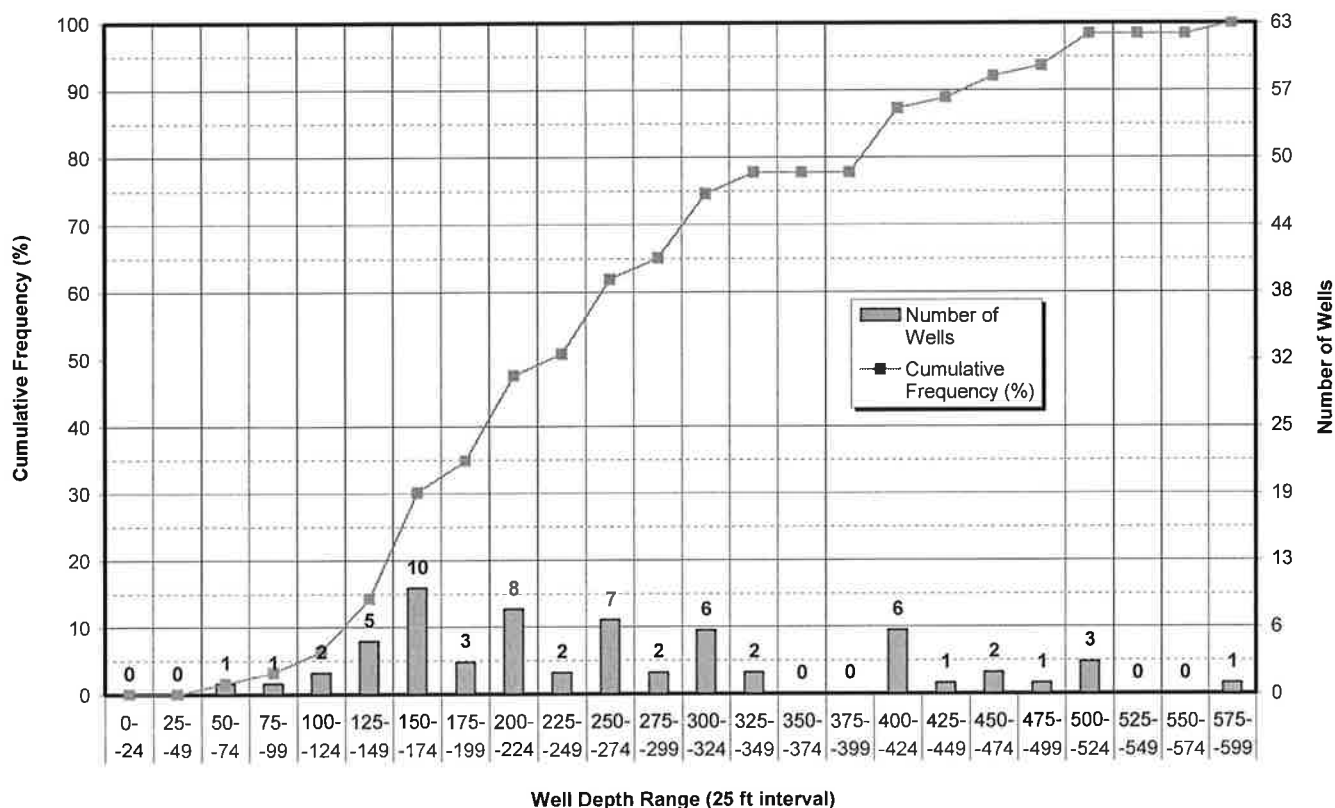


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Red Bluff West Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with positive skewness. Positively-skewed distribution of irrigation well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability in well depths.

The frequency distribution of irrigation well depth data for the Red Bluff West Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 244 feet or less,
- 20% of the wells are installed to a depth of 152 feet or less, and
- 10% of the wells are installed to a depth of 140 feet or less.

Rancho Tehama Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Rancho Tehama Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 615 well records for the Rancho Tehama Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval and is shown in Figure ##. Cumulative frequency distribution curves were not developed for irrigation and municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Rancho Tehama Sub-Inventory Unit are for domestic use. The average domestic well depth is about 257 feet. The six irrigations range from 150 to 500 feet and average 296 feet. The single municipal well is 160 feet deep.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Rancho Tehama Sub-Inventory Unit. A total of 608 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 20 to 520 feet.

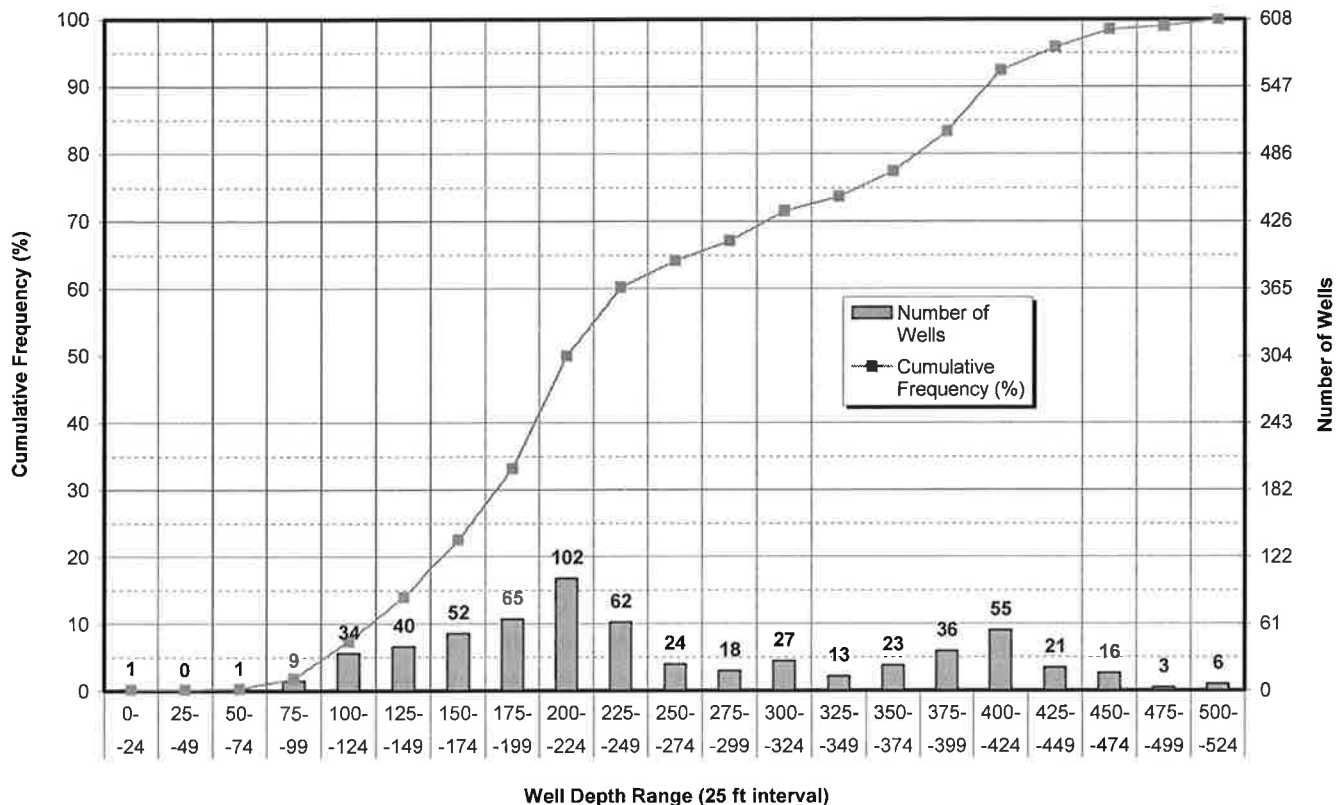


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Rancho Tehama Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability in well depths.

The frequency distribution of domestic well depth data for the Rancho Tehama Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 225 feet or less,
- 20% of the wells are installed to a depth of 166 feet or less, and
- 10% of the wells are installed to a depth of 139 feet or less.

Red Bluff West Independent Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Red Bluff West Independent Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 1,574 well records for the Red Bluff West Independent Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Red Bluff West Independent Sub-Inventory Unit are presented in Figures ## and ##. A cumulative frequency distribution curve was not developed for municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells in the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Red Bluff West Independent Sub-Inventory Unit are for domestic use. The average domestic well depth is about 217 feet. Table # also shows that wells drilled for irrigation and municipal are slightly deeper than those for domestic use. The average irrigation well depth for the Red Bluff West Independent Sub-Inventory Unit is 260 feet. The six municipal wells range in depth from 169 to 410 feet and average 306 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Red Bluff West Independent Sub-Inventory Unit. A total of 1,511 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 40 to 780 feet.

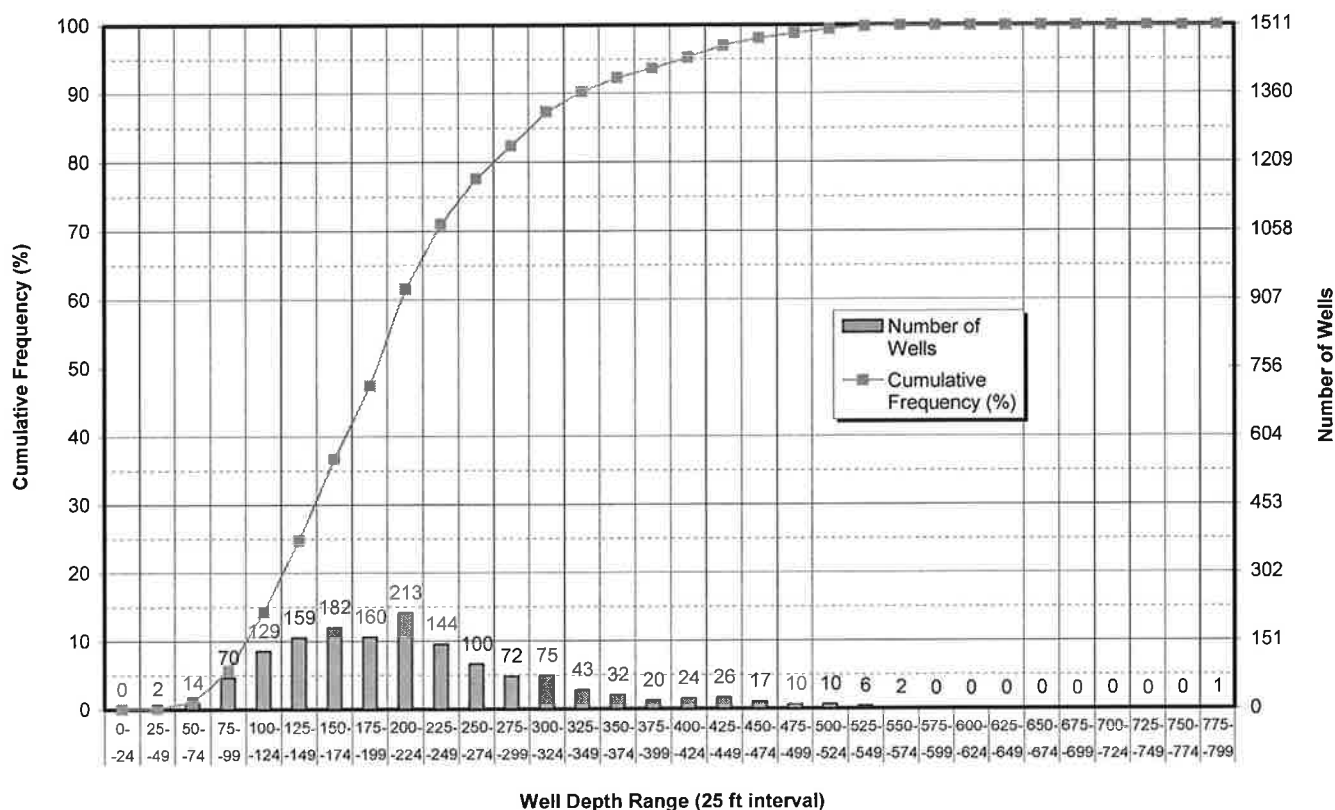


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Red Bluff West Independent Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows moderate variability in well depths.

The frequency distribution of domestic well depth data for the Red Bluff West Independent Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 200 feet or less,
- 20% of the wells are installed to a depth of 140 feet or less, and
- 10% of the wells are installed to a depth of 113 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Red Bluff West Independent Sub-Inventory Unit. A total of 57 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depth from 59 to 580 feet.

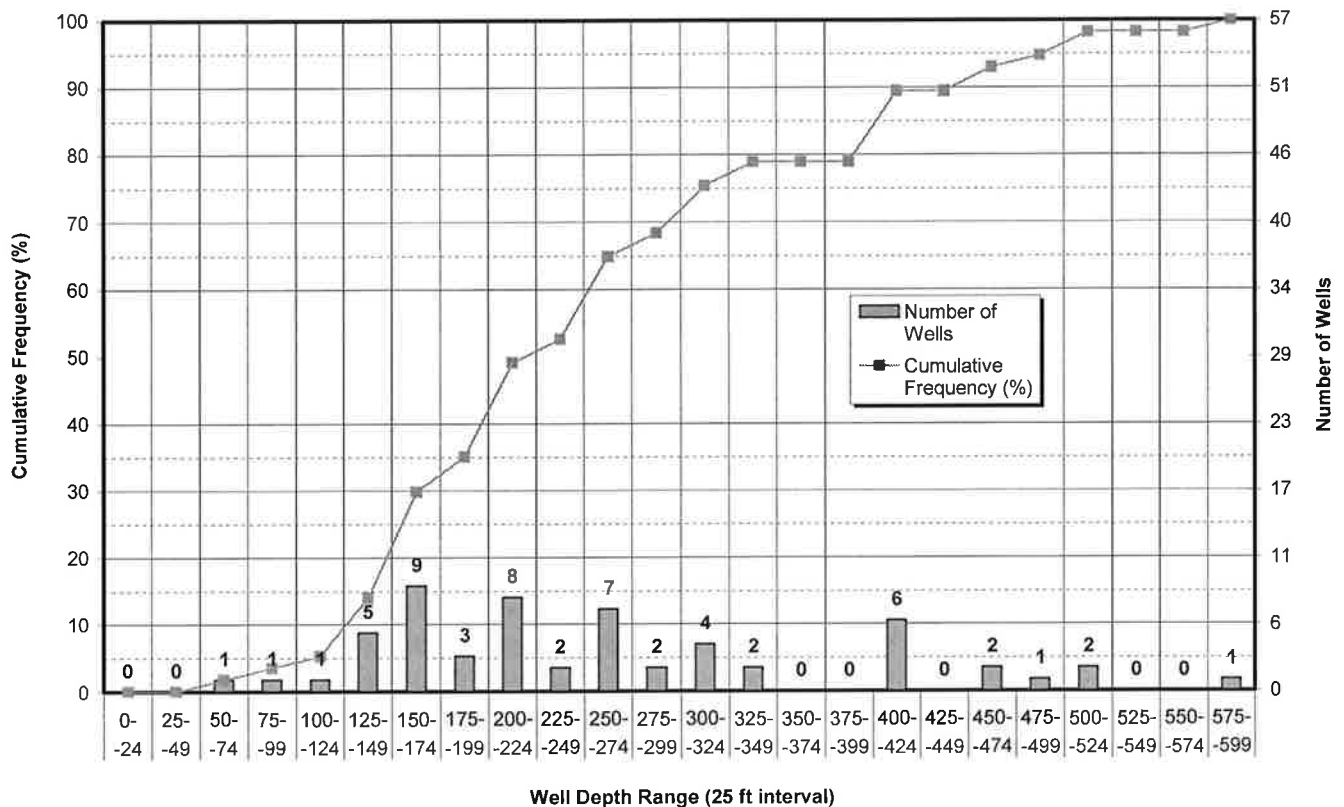


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Red Bluff West Independent Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows moderate variability in well depths.

The frequency distribution of irrigation well depth data for the Red Bluff West Independent Sub-Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 232 feet or less,
- 20% of the wells are installed to a depth of 155 feet or less, and
- 10% of the wells are installed to a depth of 140 feet or less.

CORNING EAST INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Corning East Inventory Unit were collected from well completion reports filed with DWR. A total of 2,033 well records for the Corning East Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Corning East Inventory Unit are presented in Figures ## and ##. A cumulative frequency distribution curve was not developed for municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells in the inventory unit.

Table #, Appendix #, shows that the majority of wells in the Corning East Inventory Unit are for domestic use. The average domestic well depth is about 137 feet. Table # also shows that wells drilled for irrigation and municipal uses are slightly deeper than those for domestic use. The average irrigation well depth for the Corning East Inventory Unit is 248 feet. The 26 municipal wells range from 22 to 830 feet in depth and average 140 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Corning East Inventory Unit. A total of 1,377 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 32 to 633 feet.

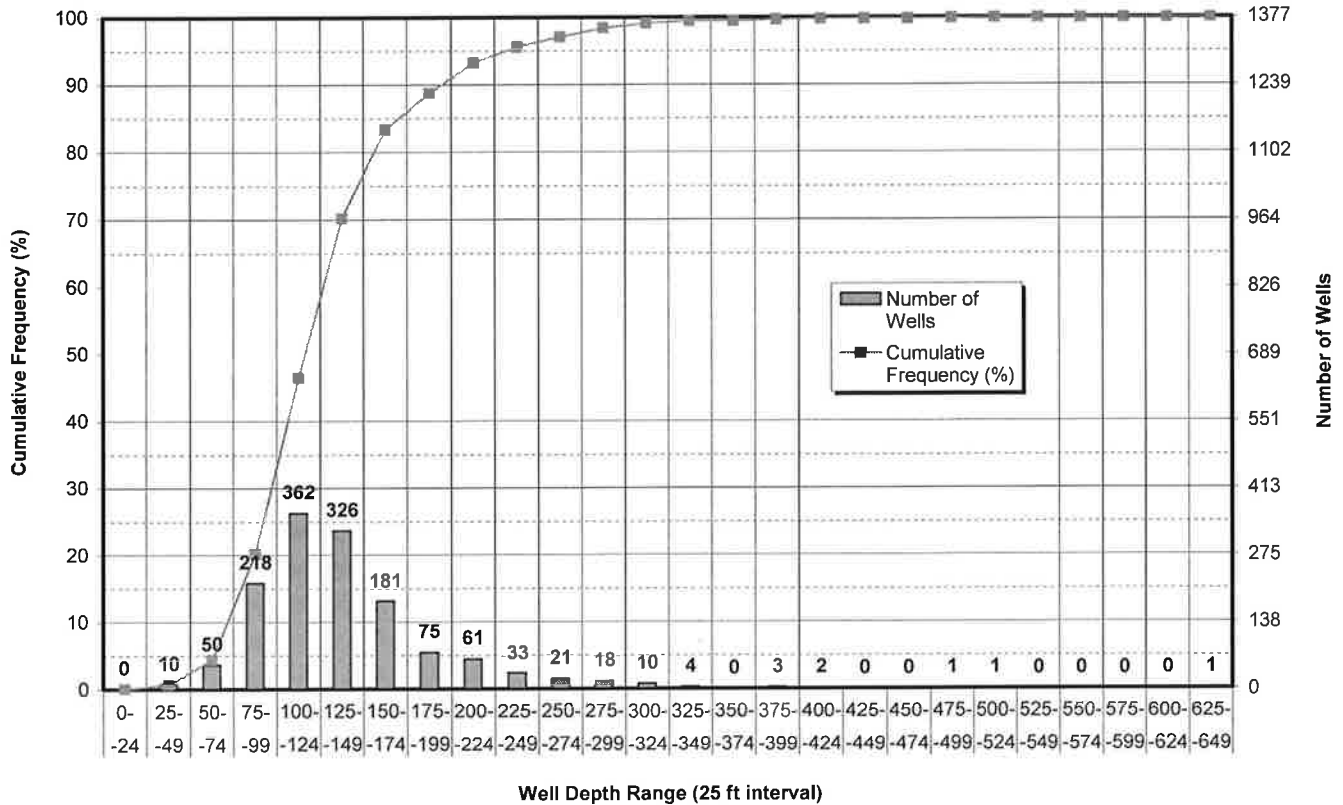


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Corning East Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram has a symmetrical distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability in well depths.

The frequency distribution of domestic well depth data for the Corning East Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 130 feet or less,
- 20% of the wells are installed to a depth of 100 feet or less, and
- 10% of the wells are installed to a depth of 87 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Corning East Inventory Unit. A total of 630 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depth from 27 to 780 feet.

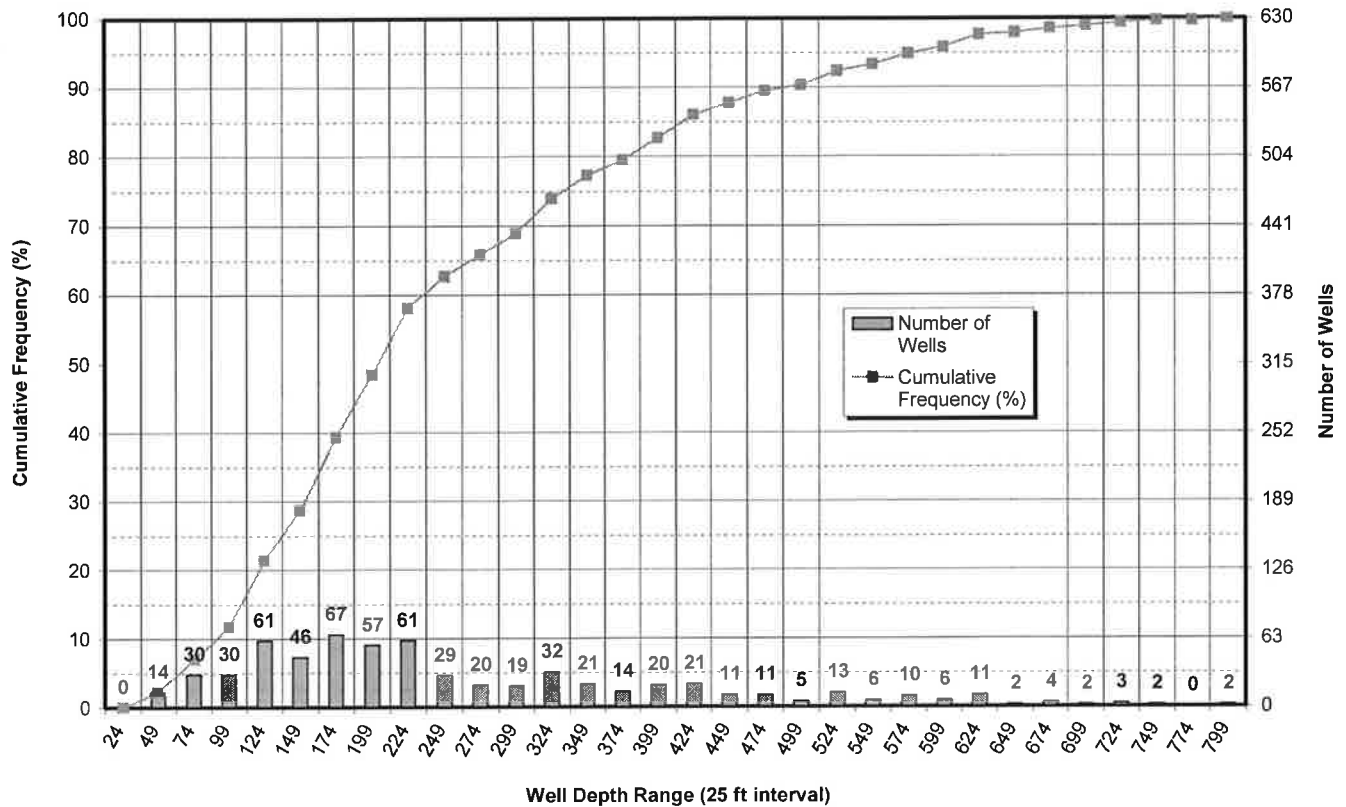


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Corning East Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability in well depths.

The frequency distribution of irrigation well depth data for the Corning East Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 204 feet or less,
- 20% of the wells are installed to a depth of 120 feet or less, and
- 10% of the wells are installed to a depth of 88 feet or less.

City Of Corning Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the City of Corning Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 102 well records for the City of Corning Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the City of Corning Sub-Inventory Unit are presented in Figures ## and ##. A cumulative frequency curve for municipal wells was not developed due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the City of Corning Sub-Inventory Unit are for domestic use. The average domestic well depth is about 139 feet. Table # also shows that wells drilled for irrigation are slightly deeper than those for domestic use. The average irrigation well depth for the City of Corning Sub-Inventory Unit is 189 feet. The nine municipal wells range from 124 to 830 feet in depth and average 330 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the City of Corning Sub-Inventory Unit. A total of 61 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 56 to 265 feet.

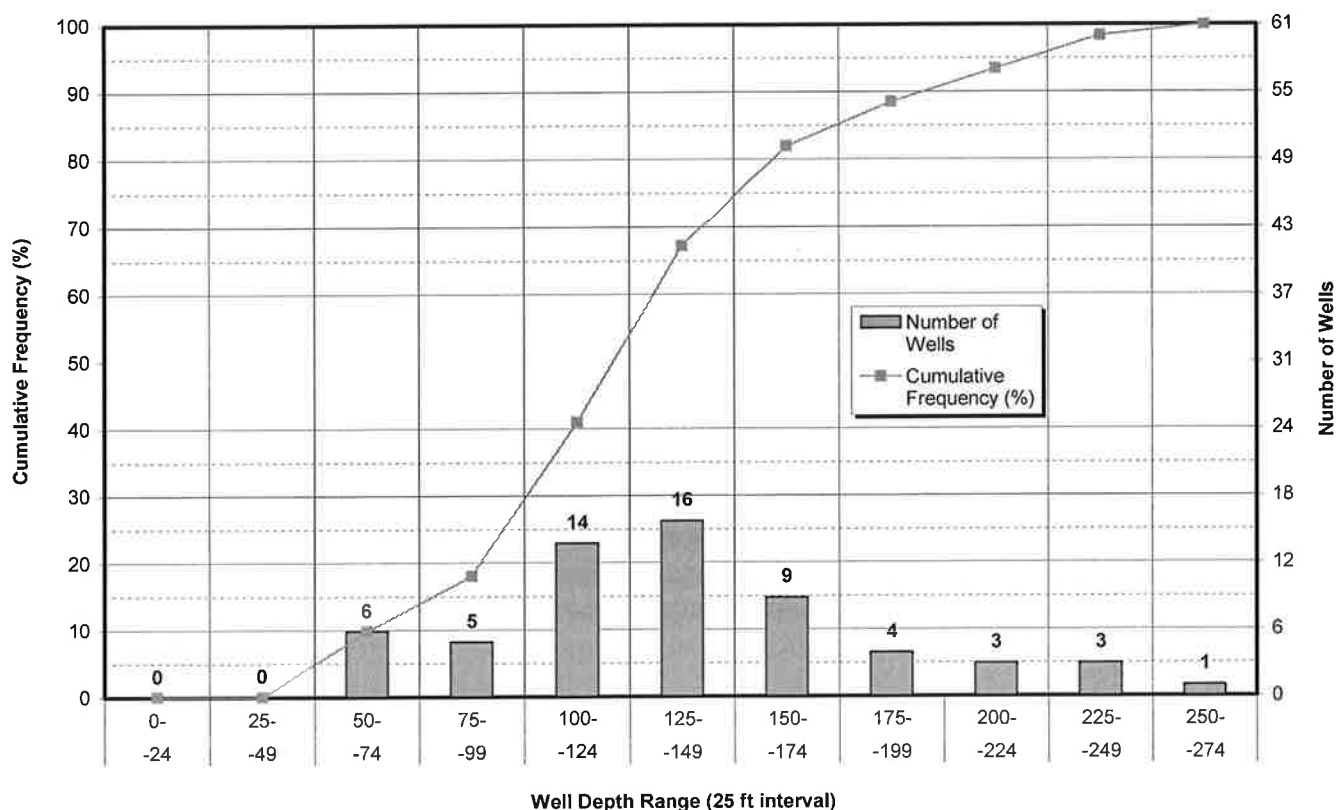


Figure ##. Cumulative Frequency Distribution of Domestic Wells, City of Corning Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability in well depths.

The frequency distribution of domestic well depth data for the City of Corning Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 135 feet or less,
- 20% of the wells are installed to a depth of 116 feet or less, and
- 10% of the wells are installed to a depth of 75 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the City of Corning Sub-Inventory Unit. A total of 32 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depth from 70 to 356 feet.

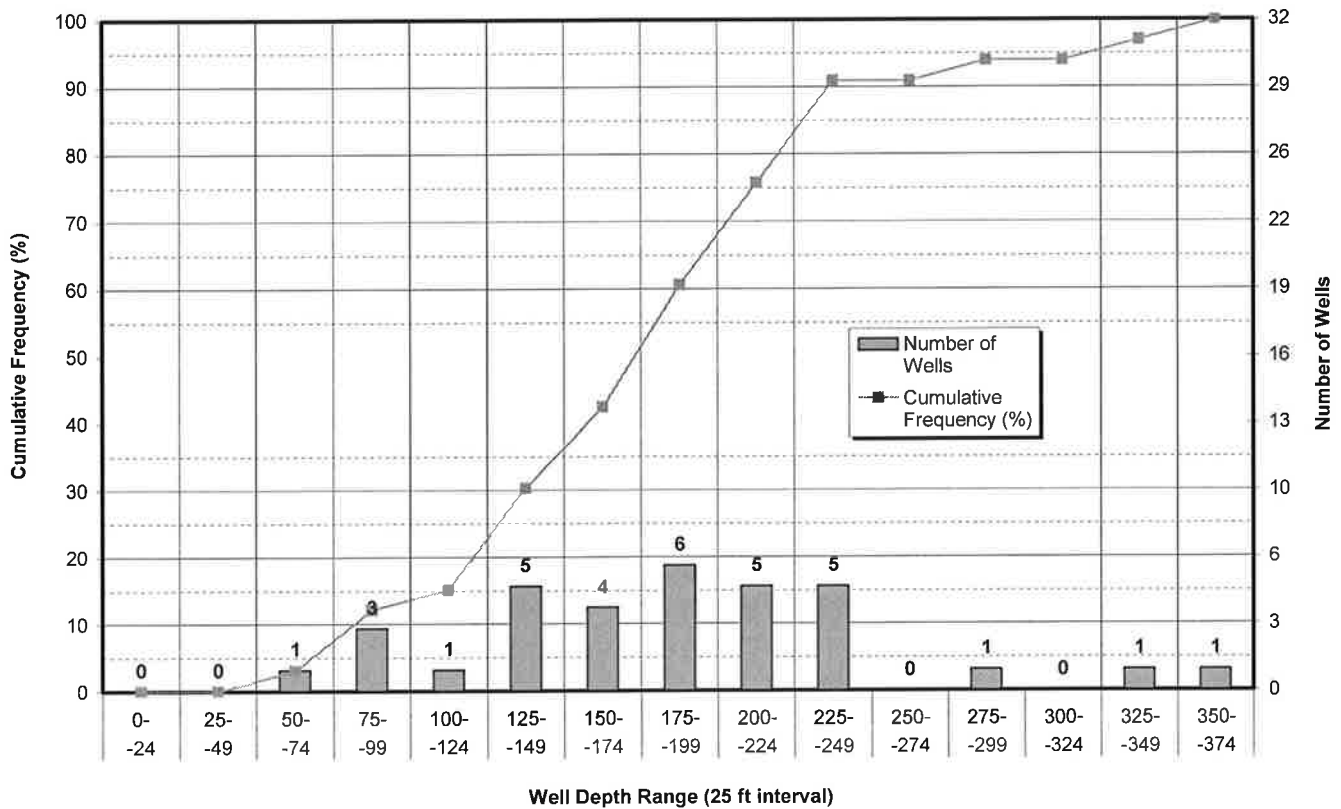


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, City of Corning Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with negative skewness due to the number of wells constructed to deeper well depths. The histogram also shows low variation with respect to well depths.

The frequency distribution of irrigation well depth data for the City of Corning Sub-Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 188 feet or less,
- 20% of the wells are installed to a depth of 136 feet or less, and
- 10% of the wells are installed to a depth of 114 feet or less.

Corning Water District Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Corning Water District Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 404 well records for the Corning Water District Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Corning Water District Sub-Inventory Unit are presented in Figures ## and ##. A cumulative frequency curve for municipal wells was not developed due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Corning Water District Sub-Inventory Unit are for domestic use. The average domestic well depth is about 141 feet. Table # also shows that wells drilled for irrigation and municipal uses are slightly deeper than those for domestic use. The average irrigation well depth for the Corning Water District Sub-Inventory Unit is 266 feet. The five municipal wells range in depth from 140 to 306 feet and average 189 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Corning Water District Sub-Inventory Unit. A total of 260 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 48 to 476 feet.

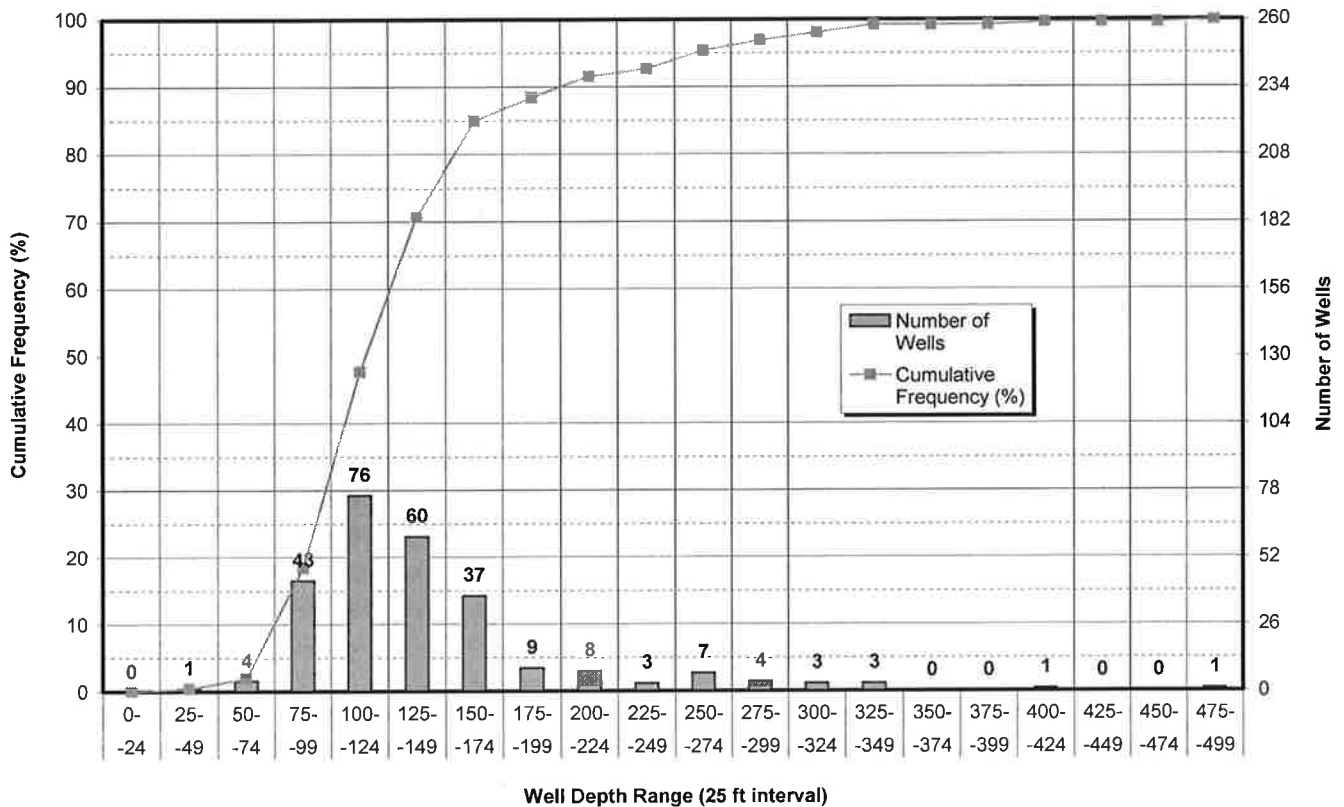


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Corning Water District Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a symmetrical distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability in well depths.

The frequency distribution of domestic well depth data for the Corning Water District Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 125 feet or less,
- 20% of the wells are installed to a depth of 100 feet or less, and
- 10% of the wells are installed to a depth of 93 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Corning Water District Sub-Inventory Unit. A total of 139 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depth from 36 to 780 feet.

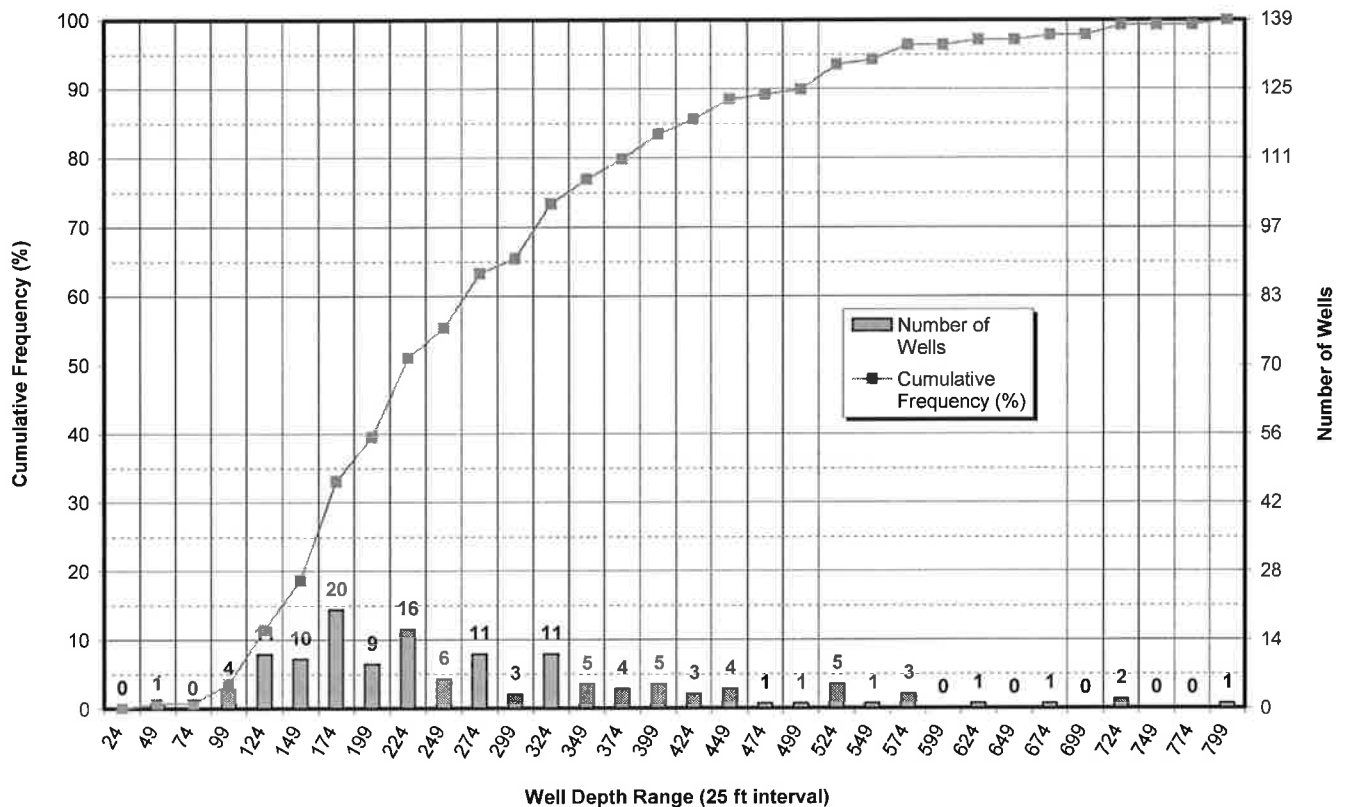


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Corning Water District Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability in well depths.

The frequency distribution of irrigation well depth data for the Corning Water District Sub-Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 220 feet or less,
- 20% of the wells are installed to a depth of 152 feet or less, and
- 10% of the wells are installed to a depth of 115 feet or less.

Kirkwood Water District Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Kirkwood Water District Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 55 well records for the Kirkwood Water District Sub-Inventory Unit were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval. The cumulative frequency curve is shown in Figure ##. A cumulative frequency distribution curve was not developed for irrigation wells due to the limited number of wells. The frequency distribution by well depth for domestic wells was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Kirkwood Water District Sub-Inventory Unit are for domestic use. The average domestic well depth is about 120 feet. The nine irrigation wells range from 94 to 400 feet and average 238 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Kirkwood Water District Sub-Inventory Unit. A total of 46 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 55 to 250 feet.

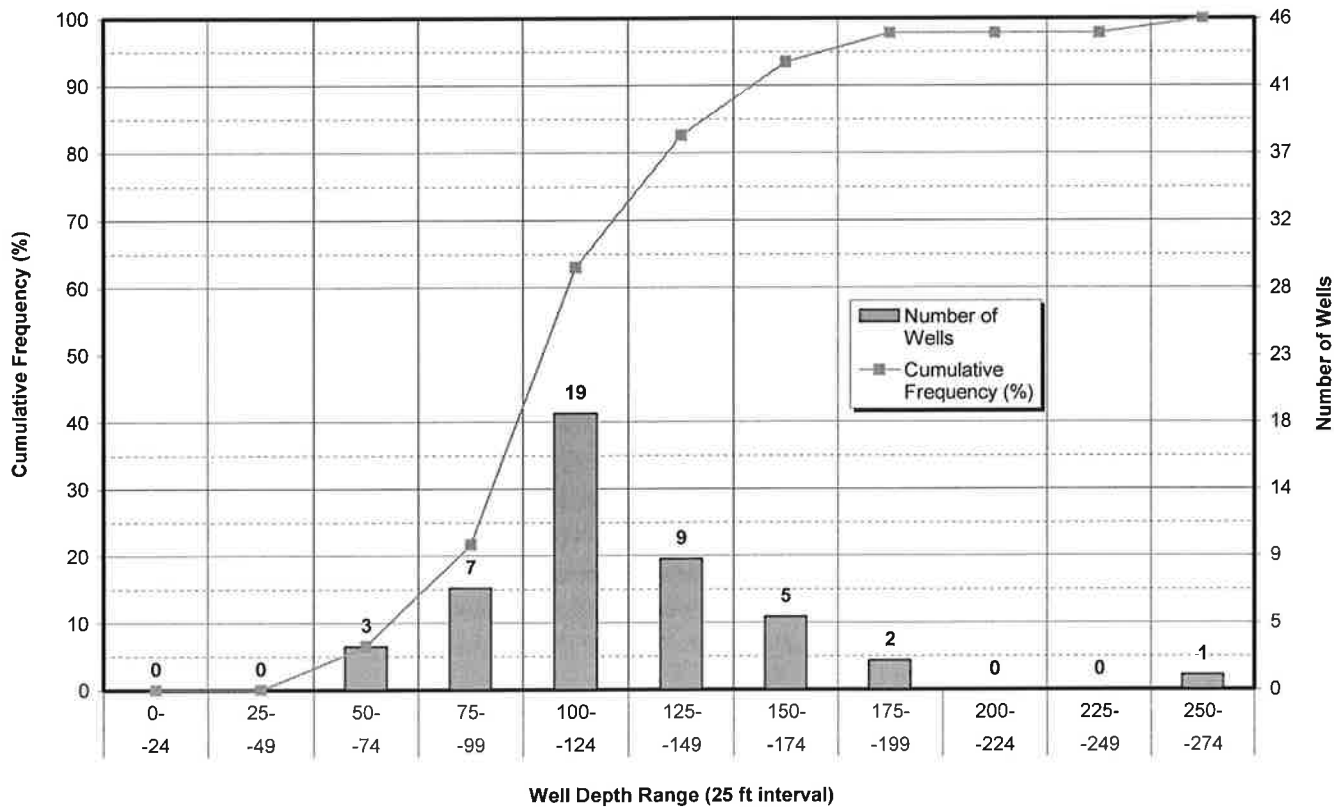


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Kirkwood Water District Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability with respect to well depths.

The frequency distribution of domestic well depth data for the Kirkwood Water District Sub-Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 111 feet or less,
- 20% of the wells are installed to a depth of 99 feet or less, and
- 10% of the wells are installed to a depth of 85 feet or less.

Aaction Tree Farm Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Aaction Tree Farm Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 33 well records for the Aaction Tree Farm Sub-Inventory Unit were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. Cumulative frequency distribution analyses were not developed due to the low number of wells.

Table #, Appendix #, shows that the majority of wells in the Aaction Tree Farm Sub-Inventory Unit are for irrigation. Irrigation wells number 25 and range in depth from 280 to 730 feet. The average irrigation well depth is about 551 feet. Eight domestic wells were identified ranging in depth from 100 to 500 feet. The average domestic well depth is about 216 feet.

Corning East Independent Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Corning East Independent Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 1,384 well records for the Corning East Independent Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Corning East Independent Sub-Inventory Unit are presented in Figures ## and ##. A cumulative frequency curve for municipal wells was not developed due to the limited number of wells. The frequency distribution by well depth for domestic and irrigation wells was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells within the region.

Table #, Appendix #, shows that the majority of wells in the Corning East Independent Sub-Inventory Unit are for domestic use. The average domestic well depth is about 137 feet. Table # also shows that wells drilled for irrigation and municipal uses are deeper than those for domestic use. The average irrigation well depth for the Corning East Independent Sub-Inventory Unit is 226 feet. The 12 municipal wells range in depth from 22 to 450 feet and average 196 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Corning East Independent Sub-Inventory Unit. A total of 964 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 32 to 633 feet.

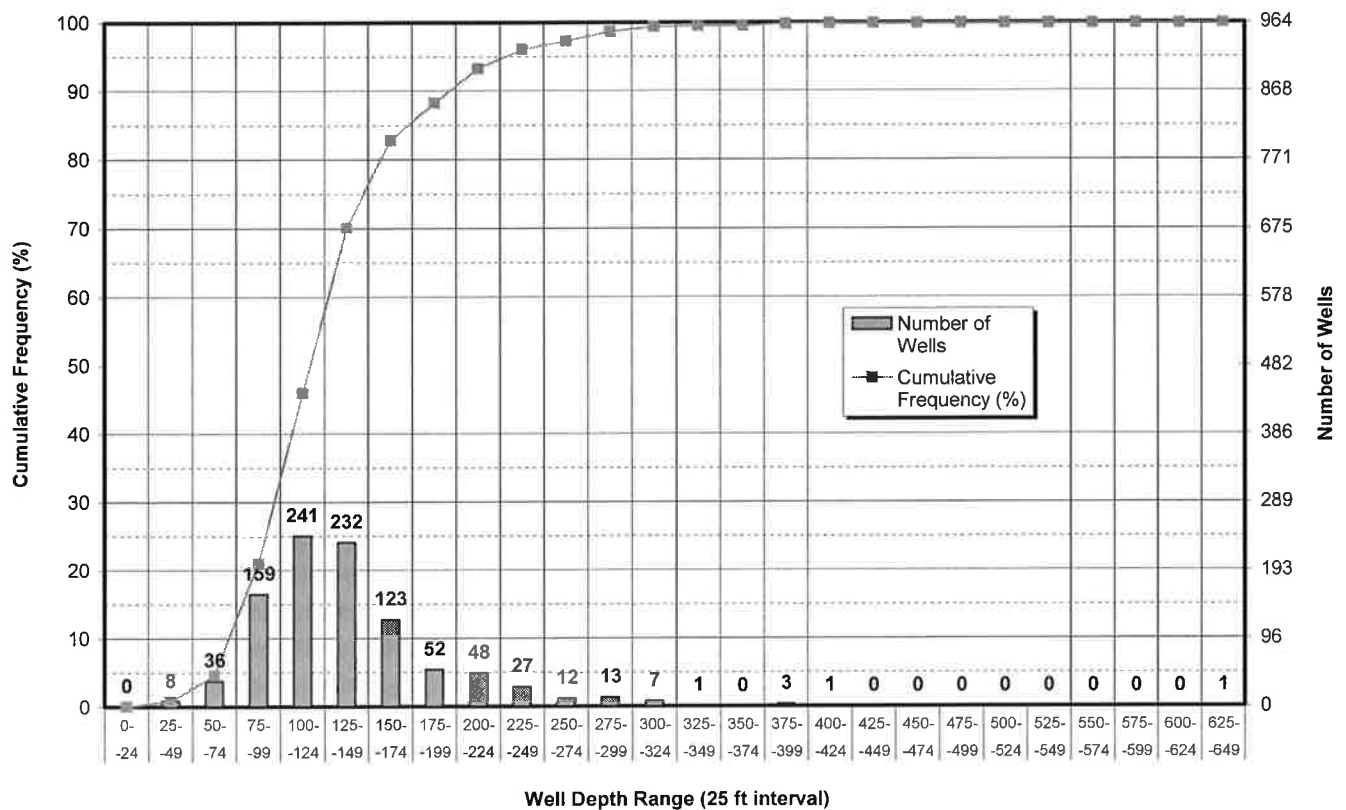


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Corning East Independent Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability with respect to well depths.

The frequency distribution of domestic well depth data for the Corning East Independent Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 130 feet or less,
- 20% of the wells are installed to a depth of 98 feet or less, and
- 10% of the wells are installed to a depth of 83 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Corning East Independent Sub-Inventory Unit. A total of 408 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depths from 27 to 780 feet.

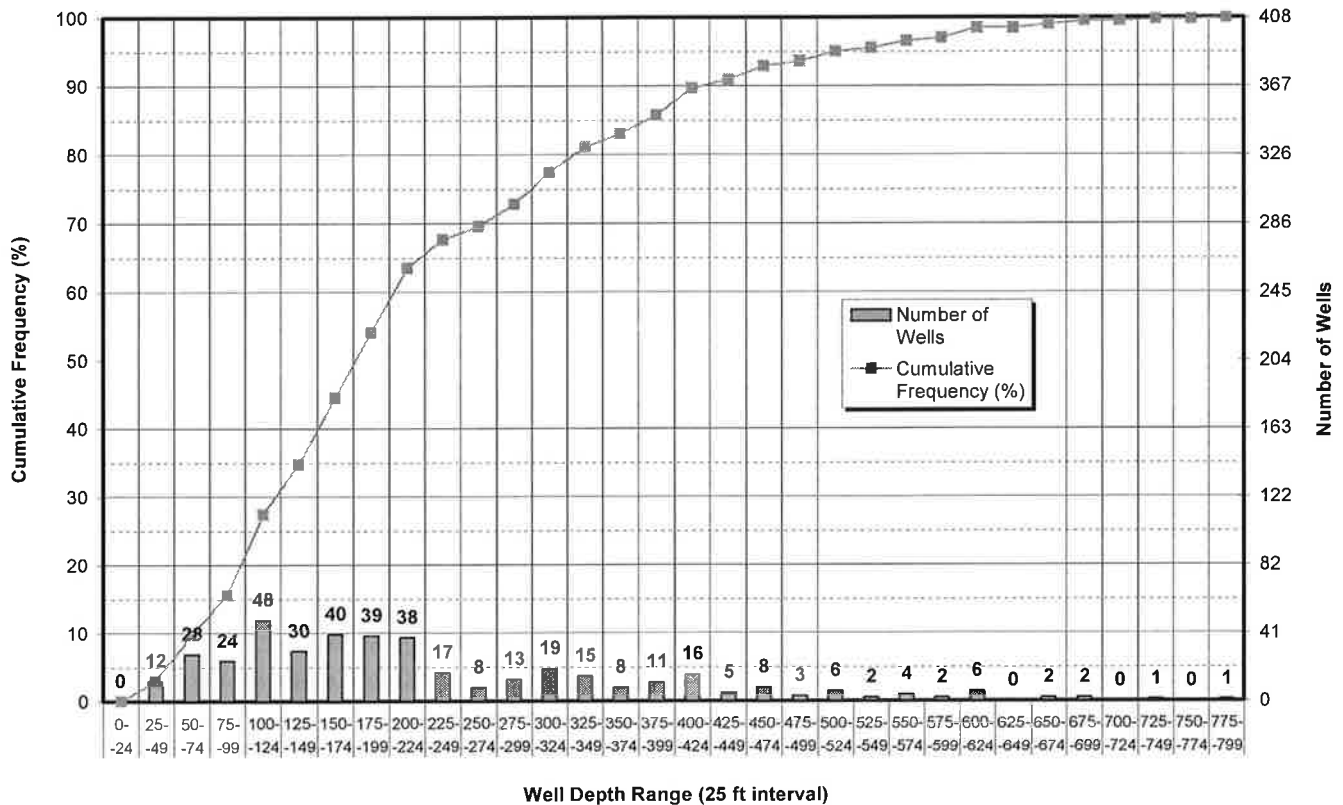


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Corning East Independent Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability with respect to well depths.

The frequency distribution of irrigation well depth data for the Corning East Sub-Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 185 feet or less,
- 20% of the wells are installed to a depth of 105 feet or less, and
- 10% of the wells are installed to a depth of 76 feet or less.

CORNING WEST INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Corning West Inventory Unit were collected from well completion reports filed with DWR. A total of 74 well records for the Corning West Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as shown in Figure ##. Cumulative frequency distribution curves were not developed for irrigation and municipal wells due to the limited number of wells. The frequency distribution by well depth for domestic wells was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the inventory unit.

Table #, Appendix #, shows that the majority of wells in the Corning West Inventory Unit are for domestic use. The average domestic well depth is about 204 feet. The 14 irrigation wells range in depth from 120 to 880 feet and average 377 feet. The single municipal well is constructed to a depth of 285 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Corning West Inventory Unit. A total of 60 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 16 to 405 feet.

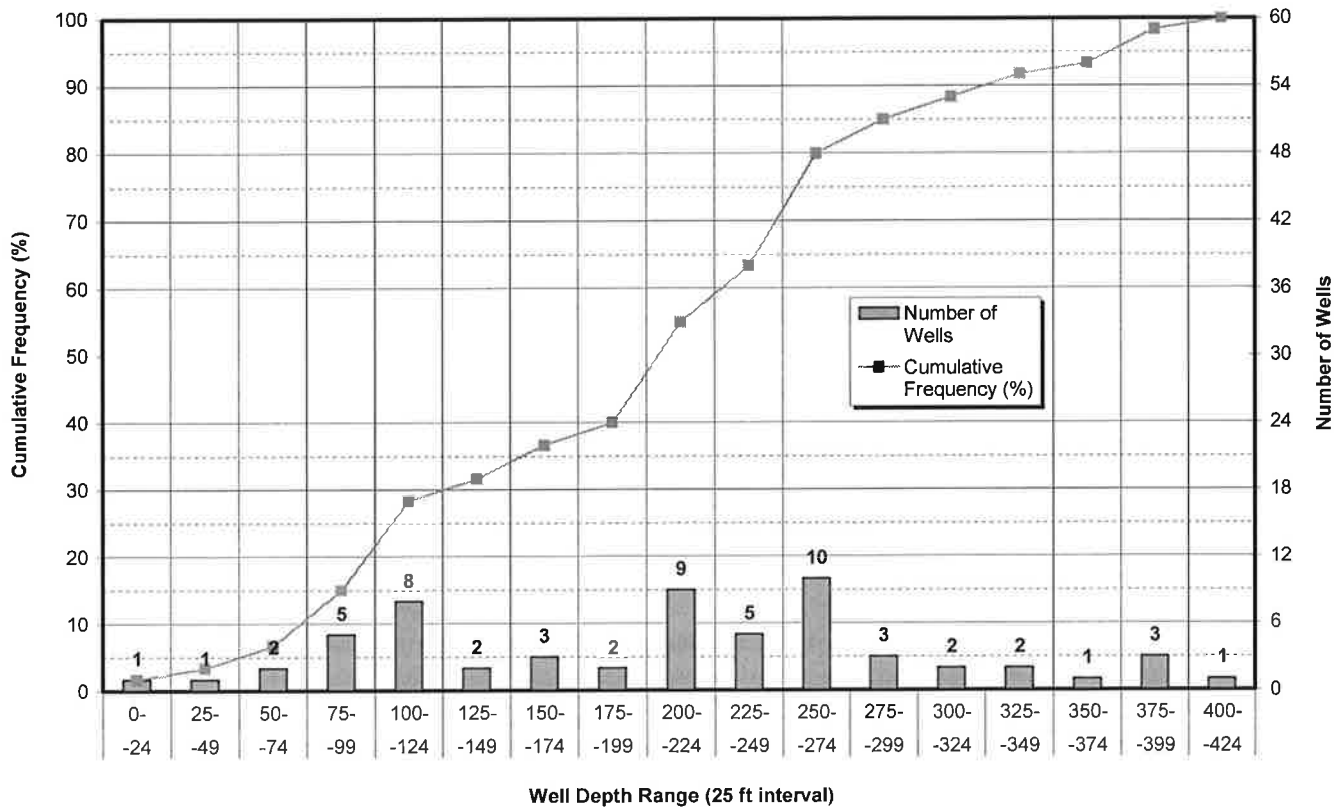


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Corning West Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability with respect to well depths.

The frequency distribution of domestic well depth data for the Corning West Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 208 feet or less,
- 20% of the wells are installed to a depth of 100 feet or less, and
- 10% of the wells are installed to a depth of 80 feet or less.

BEND INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Bend Inventory Unit were collected from well completion reports filed with DWR. A total of 163 well records for the Bend Inventory Unit were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as shown in Figure ##. A cumulative frequency distribution curve was not developed for irrigation wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the inventory unit.

Table #, Appendix #, shows that the majority of wells in the Bend Inventory Unit are for domestic use. The average domestic well depth is about 145 feet. The 19 irrigation wells range in depth from 68 to 320 feet and average 166 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Bend Inventory Unit. A total of 144 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 20 to 884 feet.

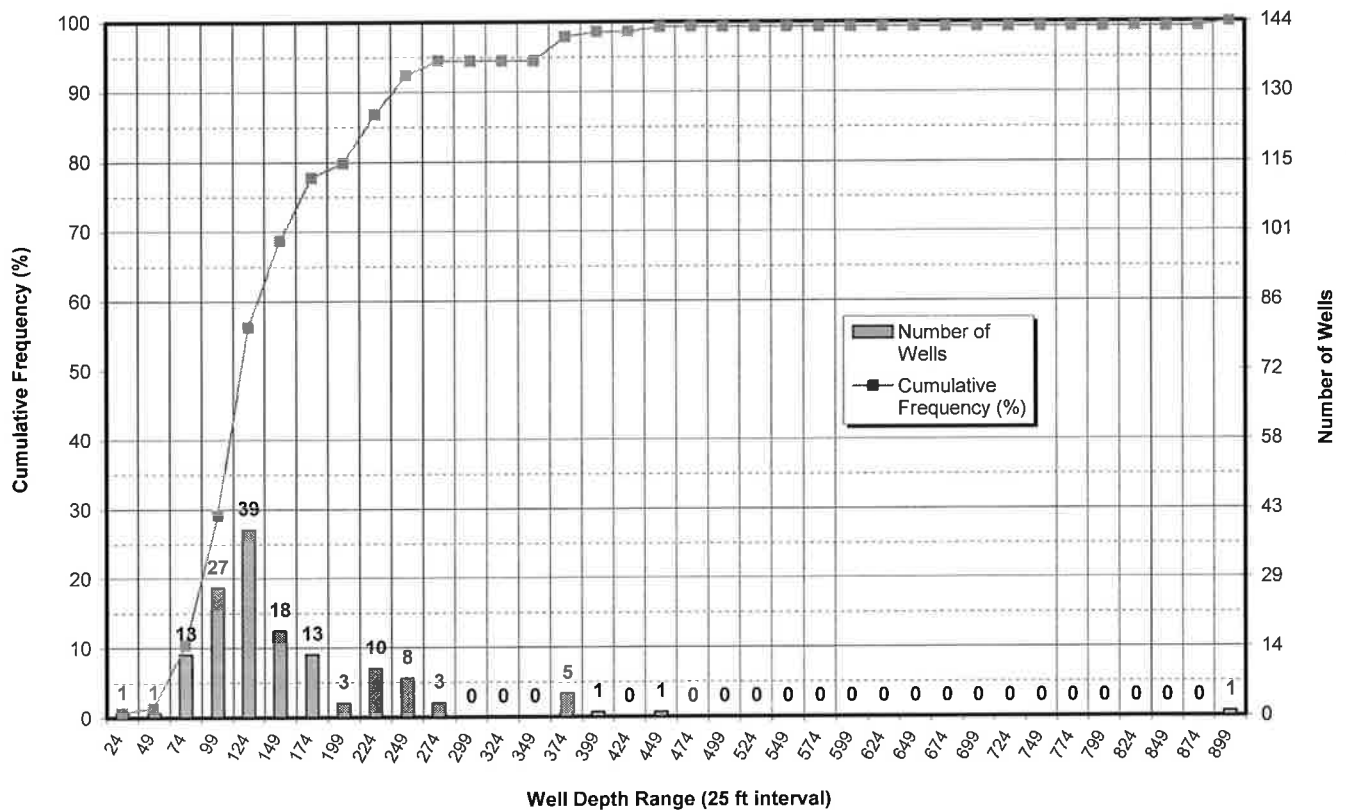


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Bend Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low to moderate variability with respect to well depths.

The frequency distribution of domestic well depth data for the Bend Inventory Unit shows is summarized as follows:

- 50% of the domestic wells are installed to a depth of 120 feet or less,
- 20% of the wells are installed to a depth of 85 feet or less, and
- 10% of the wells are installed to a depth of 72 feet or less.

ANTELOPE INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Antelope Inventory Unit were collected from well completion reports filed with DWR. A total of 893 well records for the Antelope Inventory Unit were evaluated and classified into three well types: domestic, irrigation and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Antelope Inventory Unit are presented in Figures ## and ##. A cumulative frequency curve for municipal wells was not developed due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells within the inventory unit.

Table #, Appendix #, shows that the majority of wells in the Antelope Inventory Unit are for domestic use. The average domestic well depth is about 105 feet. Table # also shows that wells drilled for irrigation and municipal uses are deeper than those for domestic use. The average irrigation well depth for the Antelope Inventory Unit is 189 feet. The 11 municipal wells range from 52 to 555 feet and average 195 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Antelope Inventory Unit. A total of 770 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 30 to 450 feet.

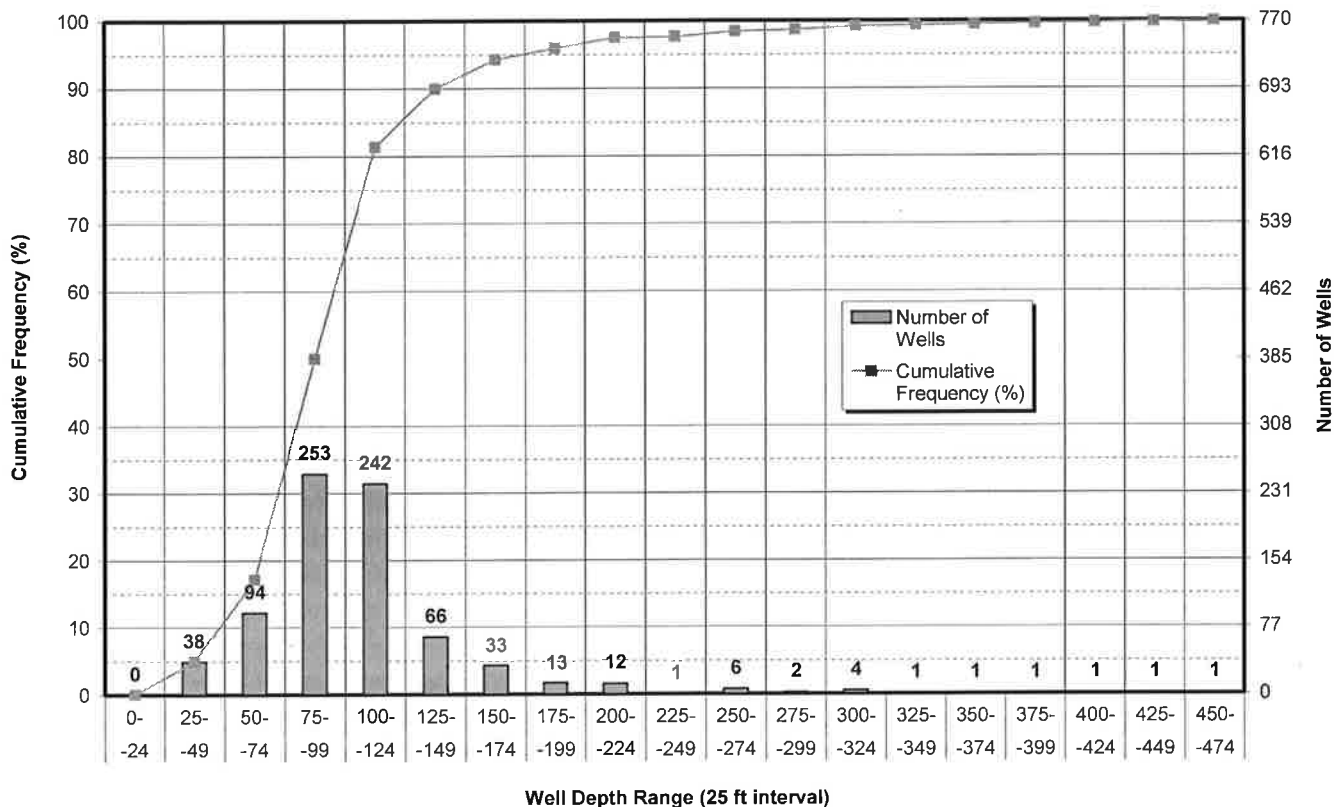


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Antelope Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is more symmetrical in distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability with respect to well depths.

The frequency distribution of domestic well depth data for the Antelope Inventory Unit shows can be described as follows:

- 50% of the domestic wells are installed to a depth of 100 feet or less,
- 20% of the wells are installed to a depth of 80 feet or less, and
- 10% of the wells are installed to a depth of 60 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Antelope Inventory Unit. A total of 112 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depths from 40 to 600 feet.

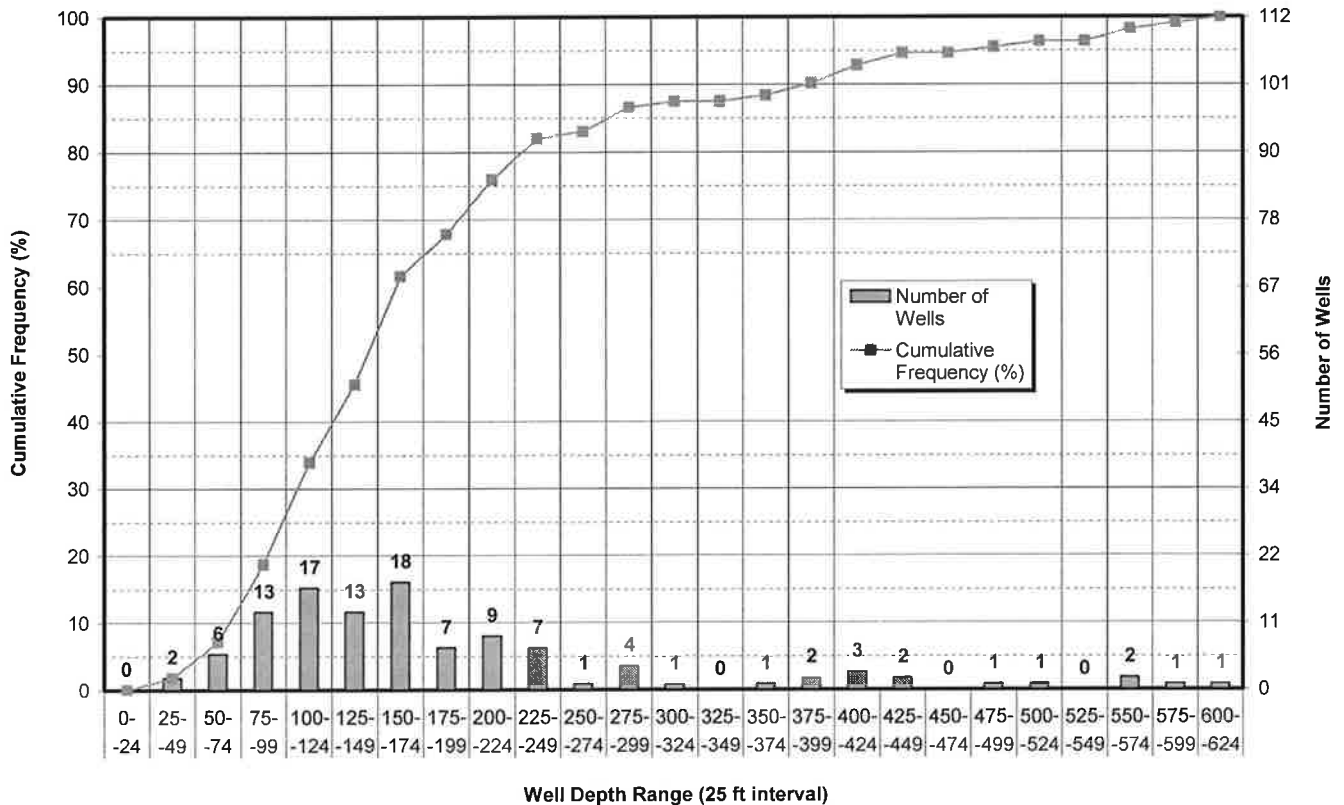


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Antelope Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows moderate variability with respect to well depths.

The frequency distribution of irrigation well depth data for the Antelope Inventory Unit can be described as follows:

- 50% of the irrigation wells are installed to a depth of 154 feet or less,
- 20% of the wells are installed to a depth of 100 feet or less, and
- 10% of the wells are installed to a depth of 80 feet or less.

DYE CREEK INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Dye Creek Inventory Unit were collected from well completion reports filed with DWR. A total of 366 well records for the Dye Creek Inventory Unit were evaluated and classified into three well types: domestic, irrigation and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. A cumulative frequency curve for municipal wells was not developed due to the limited number of wells. Cumulative frequency curves associated with the Dye Creek Inventory Unit are presented in Figures ## and ##. A cumulative frequency curve for municipal wells was not developed due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells in the inventory unit.

Table #, Appendix #, shows that the majority of wells in the Dye Creek Inventory Unit are for domestic use. The average domestic well depth is about 95 feet. Table # also shows that wells drilled for irrigation and municipal uses are deeper than those for domestic use. The average irrigation well depth for the Dye Creek Inventory Unit is 167 feet. The average municipal well depth is 113 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Dye Creek Inventory Unit. A total of 314 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 19 to 220 feet.

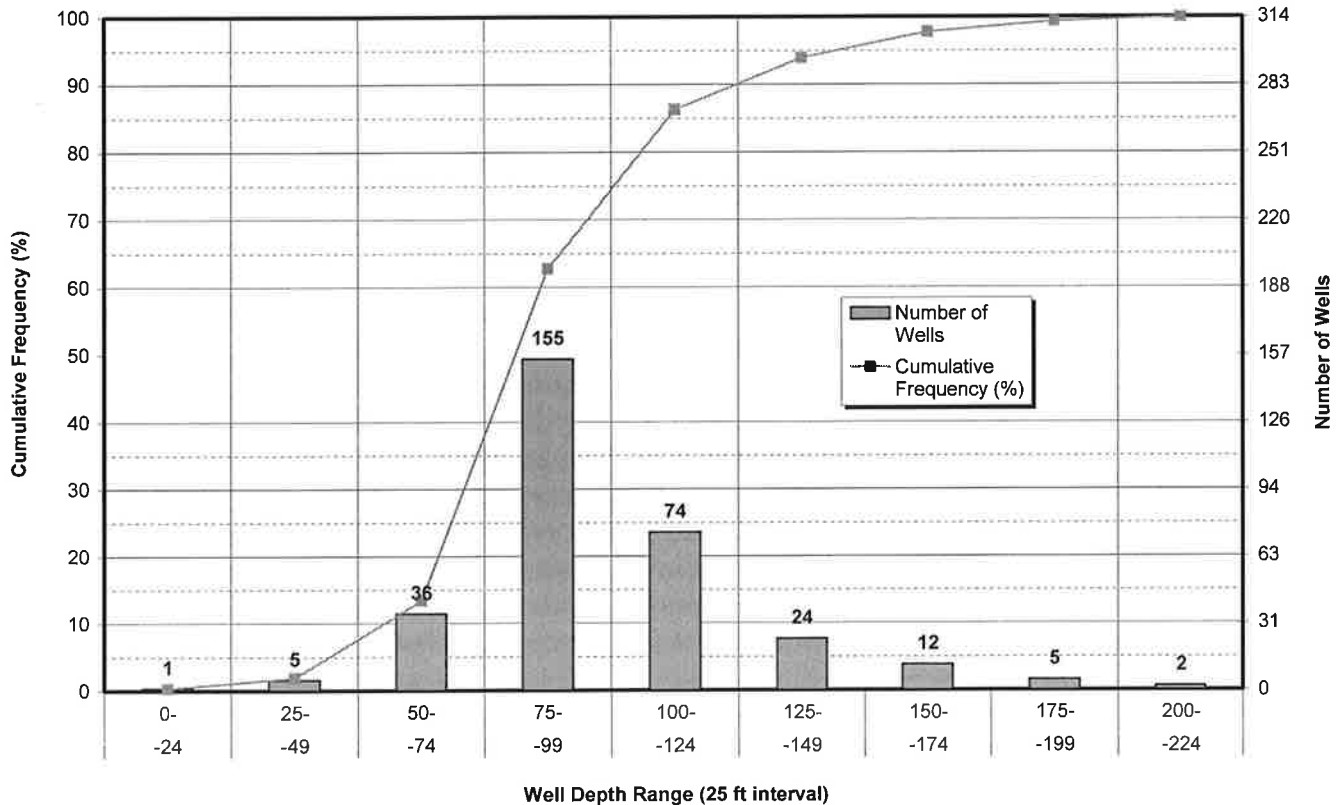


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Dye Creek Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability with respect to well depths.

The frequency distribution of domestic well depth data for the Dye Creek Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 89 feet or less,
- 20% of the wells are installed to a depth of 79 feet or less, and
- 10% of the wells are installed to a depth of 68 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Dye Creek Inventory Unit. A total of 50 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depths from 50 to 597 feet.

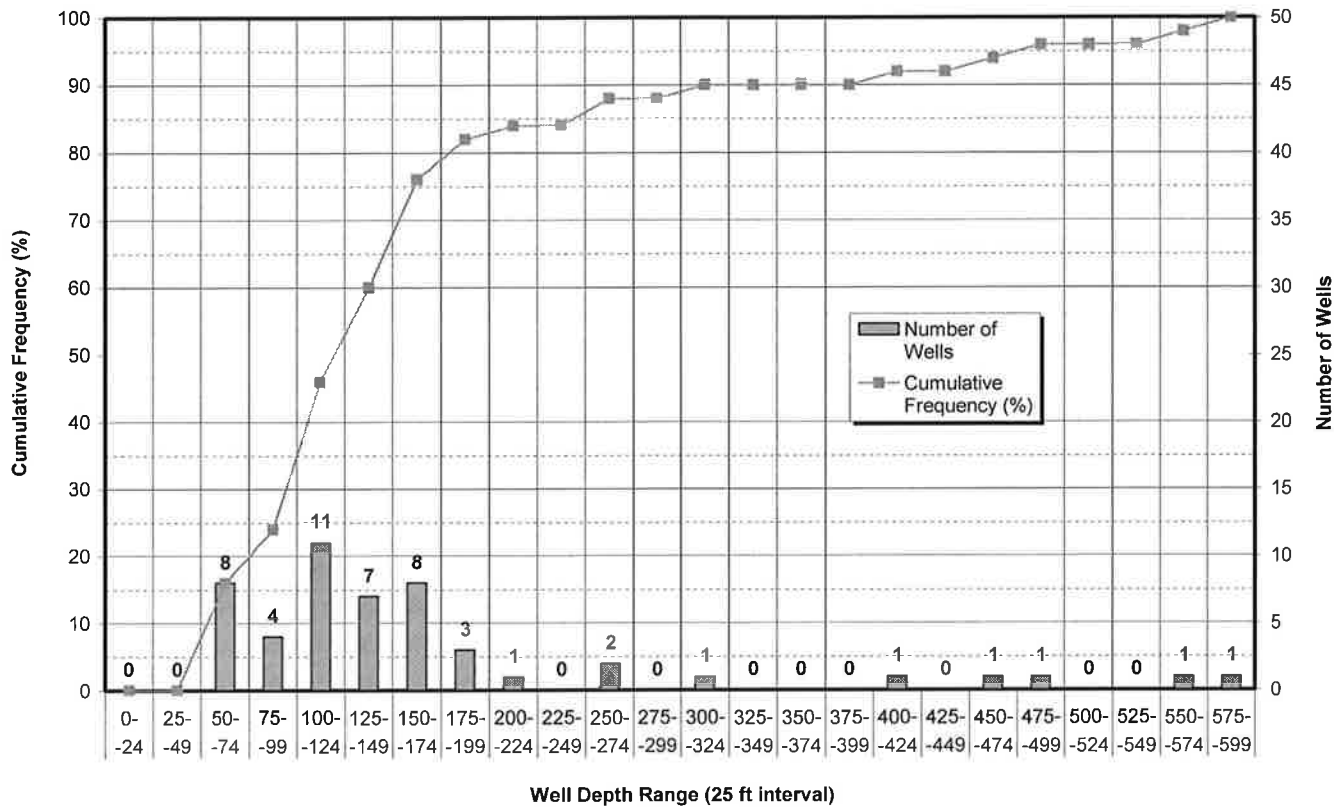


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Dye Creek Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability with respect to well depths.

The frequency distribution of irrigation well depth data for the Dye Creek Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 126 feet or less,
- 20% of the wells are installed to a depth of 80 feet or less, and
- 10% of the wells are installed to a depth of 60 feet or less.

Los Molinos Mutual Water Company Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Los Molinos Mutual Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 888 well records for the Los Molinos Mutual Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Los Molinos Mutual Sub-Inventory Unit are presented in Figures ## and ##. A cumulative frequency distribution curve was not developed for municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells in the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Los Molinos Mutual Sub-Inventory Unit are for domestic use. The average domestic well depth is about 89 feet. The average irrigation well depth is 160 feet. The eight municipal wells range in depth from 100 to 556 feet and average 240 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Los Molinos Mutual Sub-Inventory Unit. A total of 754 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 19 to 315 feet.

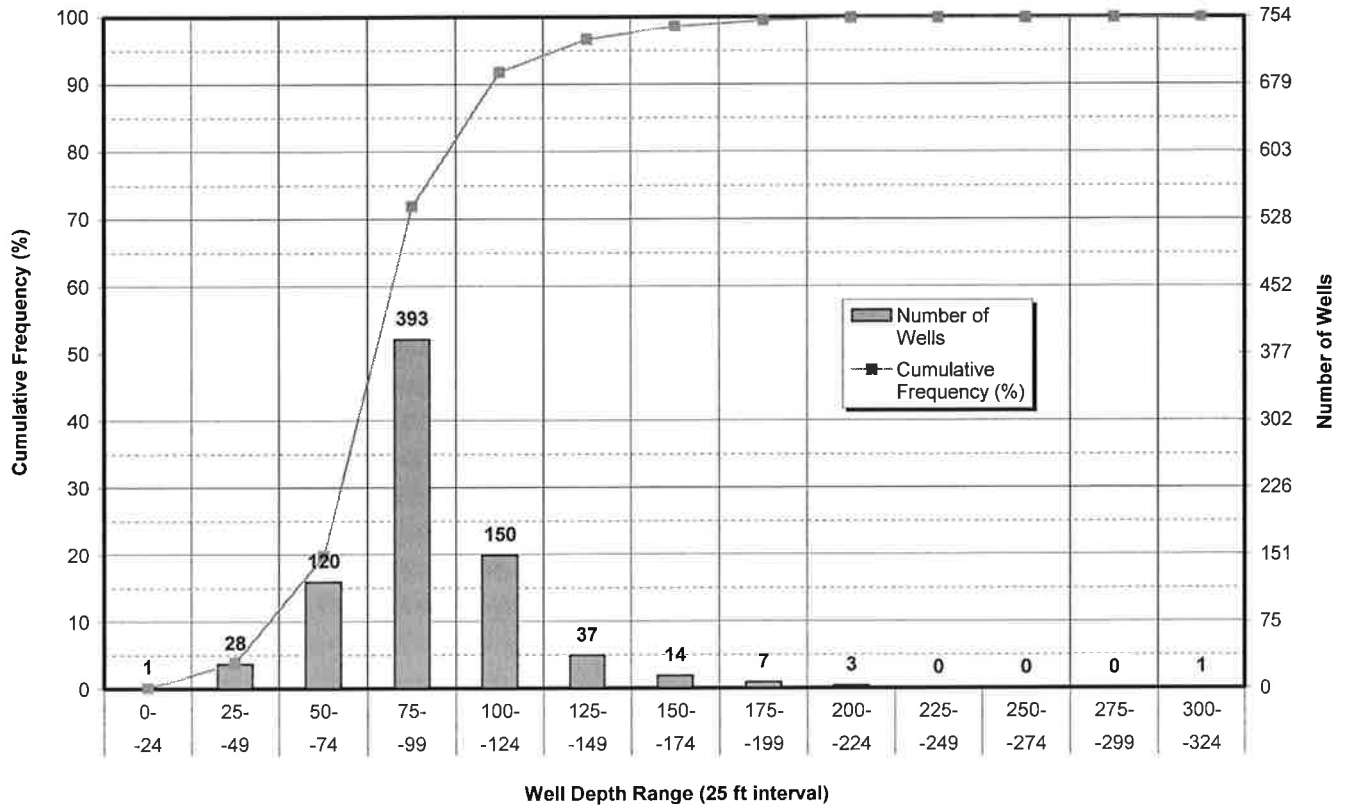


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Los Molinos Mutual Water Company Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is a symmetrical distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability with respect to well depths.

The frequency distribution of domestic well depth data for the Los Molinos Mutual Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 83 feet or less,
- 20% of the wells are installed to a depth of 75 feet or less, and
- 10% of the wells are installed to a depth of 60 feet or less.

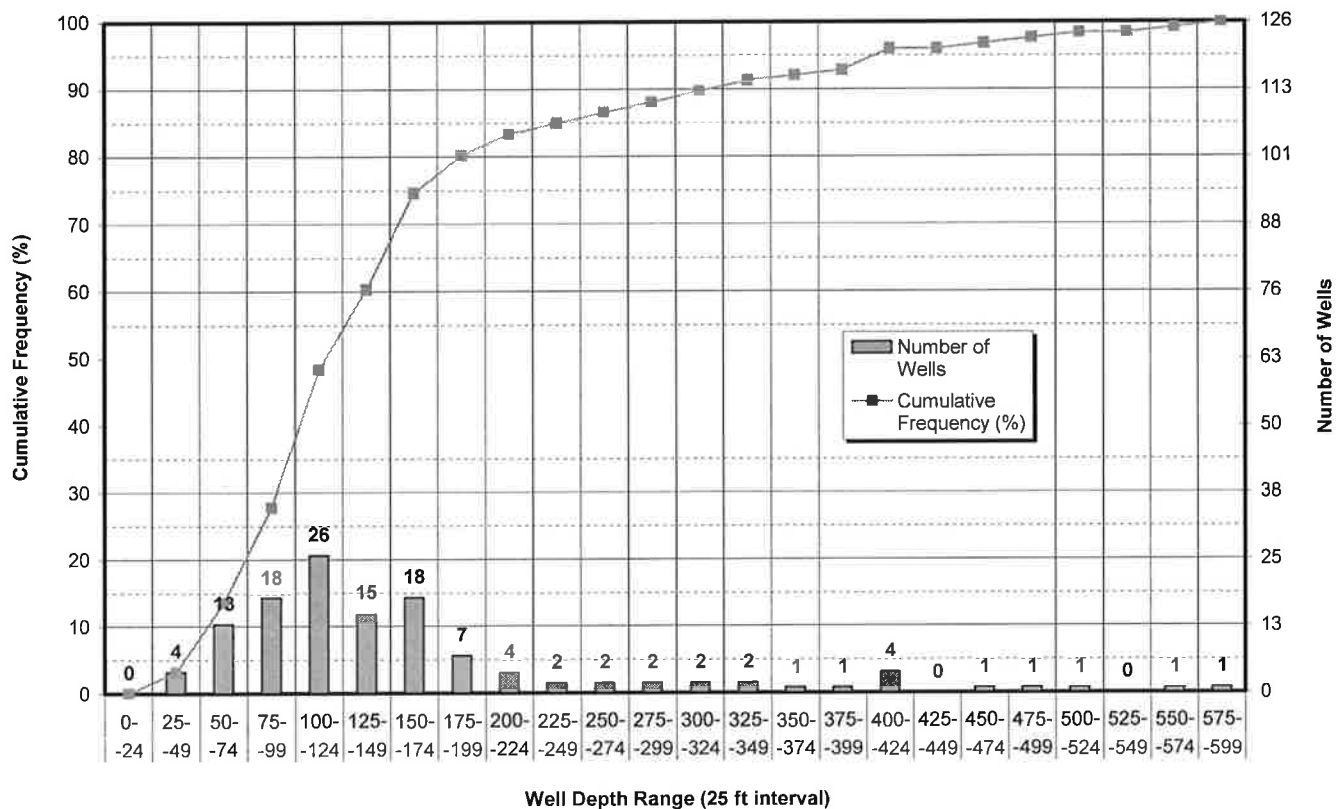


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Los Molinos Mutual Water Company Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low to moderate variability with respect to well depths.

The frequency distribution of irrigation well depth data for the Los Molinos Mutual Sub-Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 126 feet or less,
- 20% of the wells are installed to a depth of 82 feet or less, and
- 10% of the wells are installed to a depth of 68 feet or less.

Dye Creek Independent Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Dye Creek Independent Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 8 well records for the Dye Creek Independent Sub-Inventory Unit were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. Cumulative frequency distribution analyses were not developed due to the low number of wells.

Table #, Appendix #, shows that the majority of wells in the Dye Creek Sub-Inventory Unit are for domestic use. Six domestic wells range in depth from 100 to 220 feet and average about 127 feet. Two irrigation wells were identified ranging in depth from 145 to 597 feet, averaging about 371 feet.

LOS MOLINOS INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Los Molinos Inventory Unit were collected from well completion reports filed with DWR. A total of 347 well records for the Los Molinos Inventory Unit were evaluated and classified into three well types: domestic, irrigation and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Los Molinos Inventory Unit are presented in Figures ## and ##. A cumulative frequency curve for municipal wells was not developed due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the wells for domestic and irrigation wells in the inventory unit.

Table #, Appendix #, shows that the majority of wells in the Los Molinos Inventory Unit are for domestic use. The average domestic well depth is about 89 feet. Table # also shows that wells drilled for irrigation and municipal uses are deeper than those for domestic use. The average irrigation well depth for the Los Molinos Inventory Unit is 230 feet. The six municipal wells range from 40 to 556 feet and average 262 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Los Molinos Inventory Unit. A total of 303 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 37 to 220 feet.

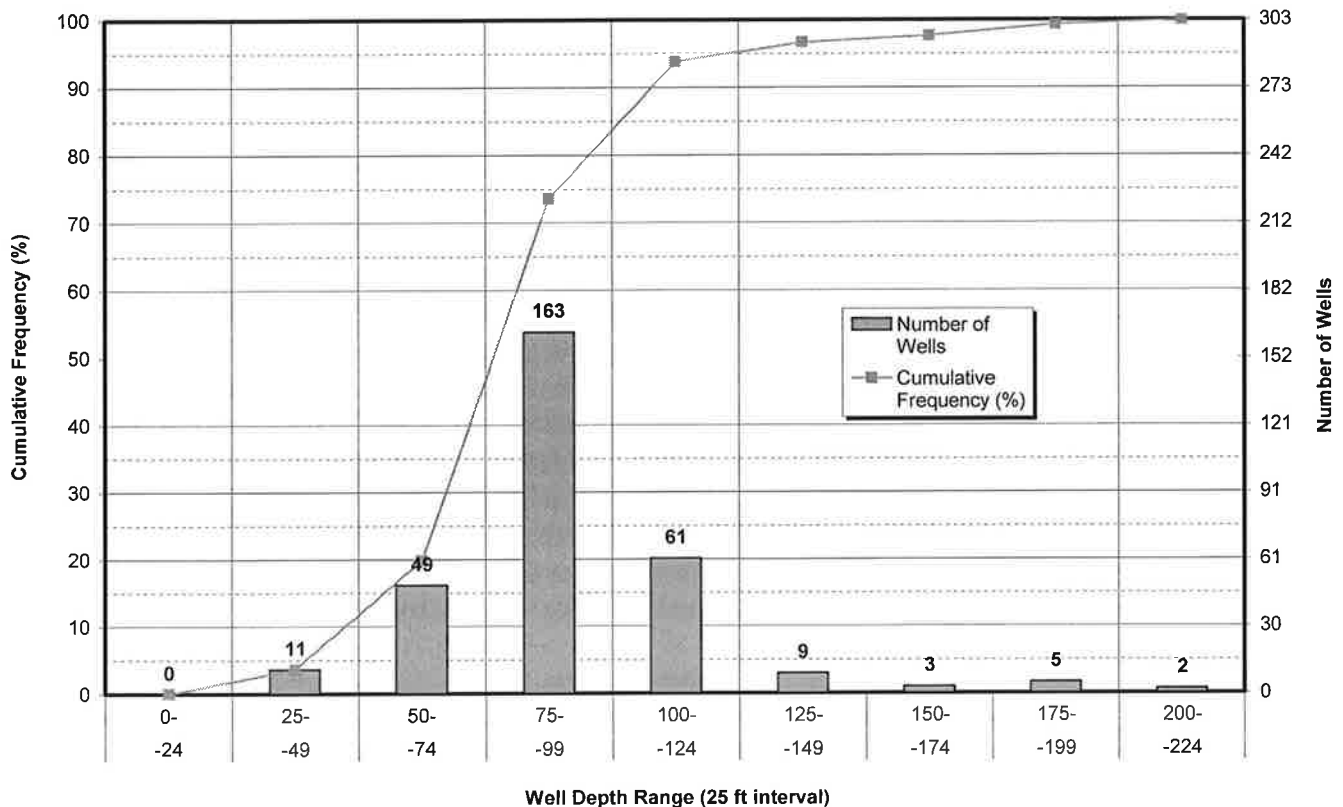


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Los Molinos Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is more of a symmetrical distribution with positive skewness. Note that over 50 percent of the wells are constructed to well depths ranging from 75 to 100 feet. The histogram also shows low variability with respect to well depths.

The frequency distribution of domestic well depth data for the Los Molinos Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 85 feet or less,
- 20% of the wells are installed to a depth of 75 feet or less, and
- 10% of the wells are installed to a depth of 60 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Los Molinos Inventory Unit. A total of 38 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depths from 35 to 560 feet.

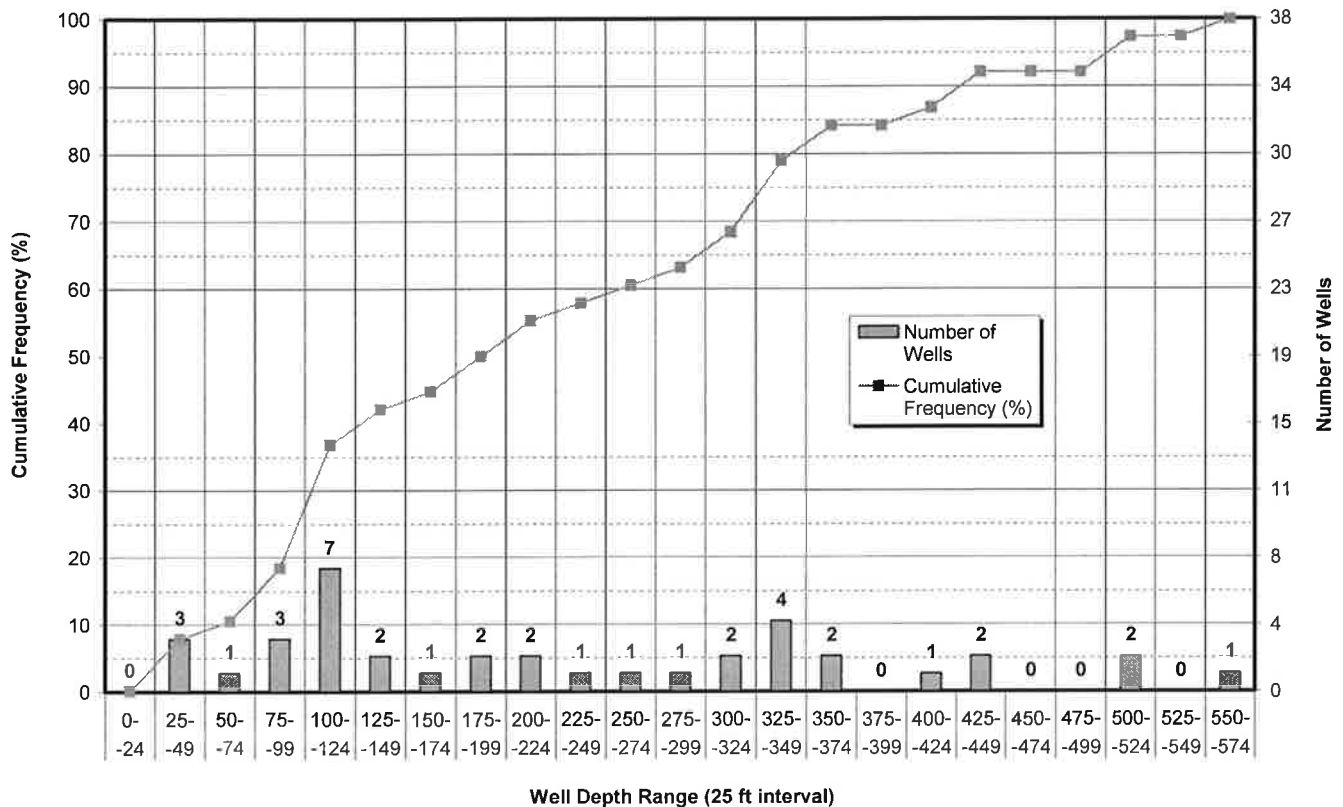


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Los Molinos Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows high variability with respect to well depths.

The frequency distribution of irrigation well depth data for the Los Molinos Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 290 feet or less,
- 20% of the wells are installed to a depth of 100 feet or less, and
- 10% of the wells are installed to a depth of 55 feet or less.

Los Molinos Independent Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Los Molinos Independent Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 32 well records for the Los Molinos Independent Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. Cumulative frequency distribution analyses were not developed due to the low number of wells.

Table #, Appendix #, shows that the majority of wells in the Los Molinos Independent Sub-Inventory Unit are for domestic use. A total of 21 domestic wells were identified ranging in depth from 70 to 200 feet. The average domestic well depth is about 131 feet. Nine irrigation wells were identified ranging in depth from 95 to 560 feet. The average irrigation well depth is about 239 feet. Two municipal wells were identified ranging in depth from 40 to 155 feet, averaging about 98 feet.

VINA INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Vina Inventory Unit were collected from well completion reports filed with DWR. A total of 185 well records for the Vina Inventory Unit were evaluated and classified into three well types: domestic, irrigation and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Vina Inventory Unit are presented in Figures ## and ##. A cumulative frequency curve for municipal wells was not developed due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells within the inventory unit.

Table #, Appendix #, shows that the majority of wells in the Vina Inventory Unit are for domestic use. The average domestic well depth is about 127 feet. Table # also shows that wells drilled for irrigation and municipal uses are deeper than those for domestic use. The average irrigation well depth for the Vina Inventory Unit is 395 feet. The seven municipal wells range in depth from 147 to 500 feet and average 185 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Vina Inventory Unit. A total of 115 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 31 to 500 feet.

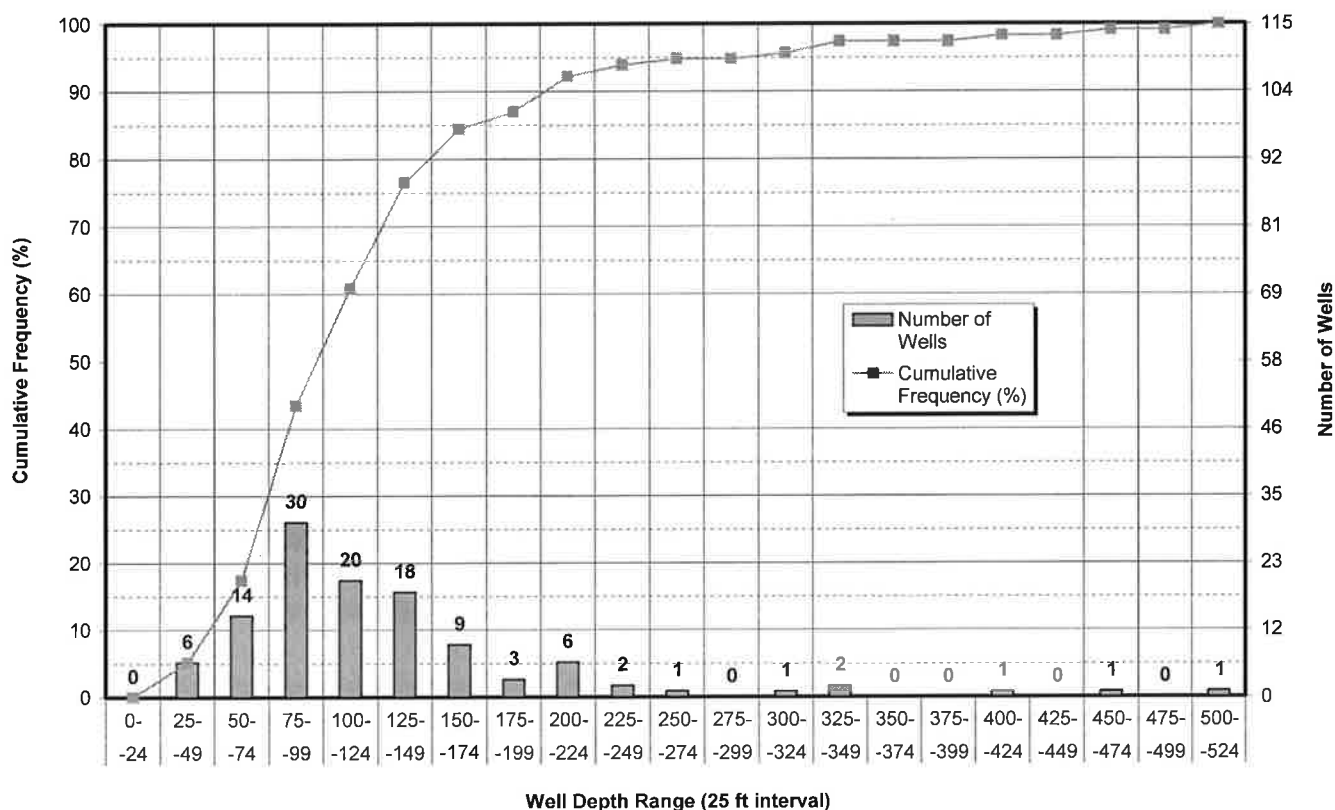


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Vina Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth interval with the greatest number of wells. The histogram also shows low variability with respect to well depths.

The frequency distribution of domestic well depth data for the Vina Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 105 feet or less,
- 20% of the wells are installed to a depth of 79 feet or less, and
- 10% of the wells are installed to a depth of 55 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data for the Vina Inventory Unit. A total of 66 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The irrigation wells range in depths from 27 to 764 feet.

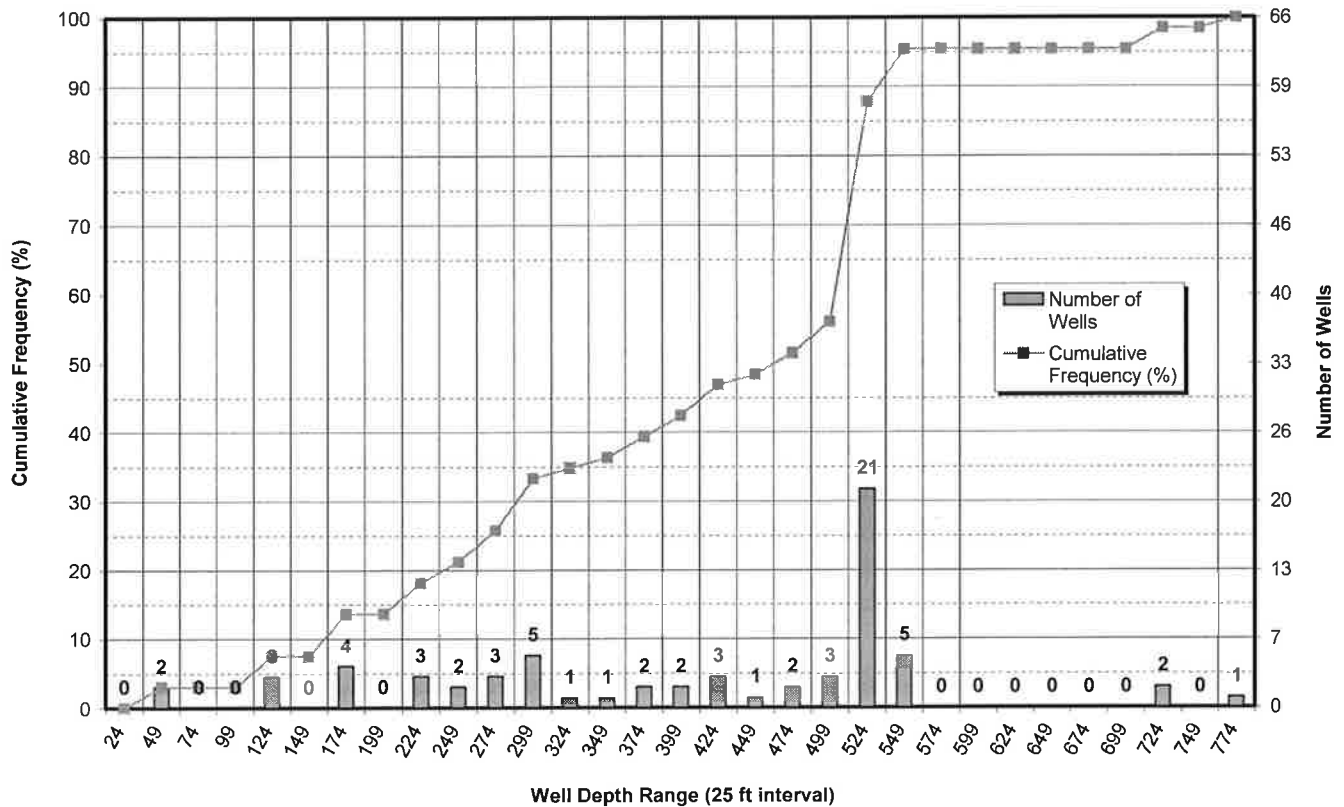


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Vina Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram distribution is asymmetrical indicating a wide range of well depths within the inventory unit. Note that almost 30 percent of the wells are constructed to depths ranging from 525 to 550 feet.

The frequency distribution of irrigation well depth data for the Vina Inventory Unit shows is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 453 feet or less,
- 20% of the wells are installed to a depth of 245 feet or less, and
- 10% of the wells are installed to a depth of 153 feet or less.

Stanford Vina Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Stanford Vina Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 112 well records for the Stanford Vina Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. A statistical distribution of the well depth data was also evaluated through cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Stanford Vina Sub-Inventory Unit are presented in Figures ## and ##. Cumulative frequency distribution curves were not developed for municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells within the sub-inventory unit.

Table #, Appendix #, shows that the majority of wells in the Stanford Vina Sub-Inventory Unit are for domestic use. The average domestic well depth is about 101 feet. The average irrigation well depth is 357 feet. The three municipal wells range in depth from 164 to 215 feet and average 193 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Stanford Vina Sub-Inventory Unit. A total of 72 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 45 to 256 feet.

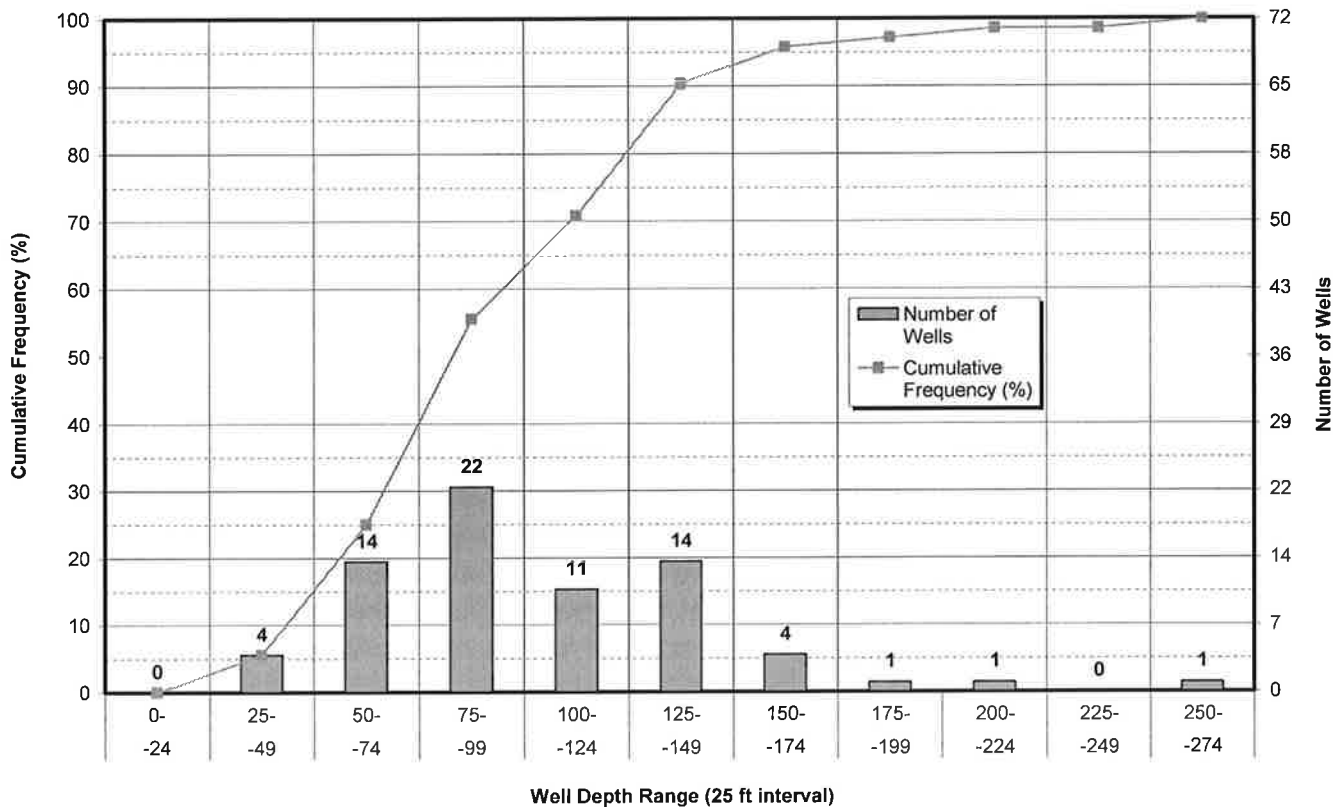


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Stanford Vina Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is a normal distribution with slight positive skewness. The histogram also shows low variability in well depths.

The frequency distribution of domestic well depth data for the Stanford Vina Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 91 feet or less, and
- 20% of the wells are installed to a depth of 63 feet or less, and
- 10% of the wells are installed to a depth of 52 feet or less.

Figure ## shows the cumulative frequency distribution of well depths for irrigation wells in the Stanford Vina Sub-Inventory Unit. A total of 37 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of irrigation wells range from 48 to 530 feet.

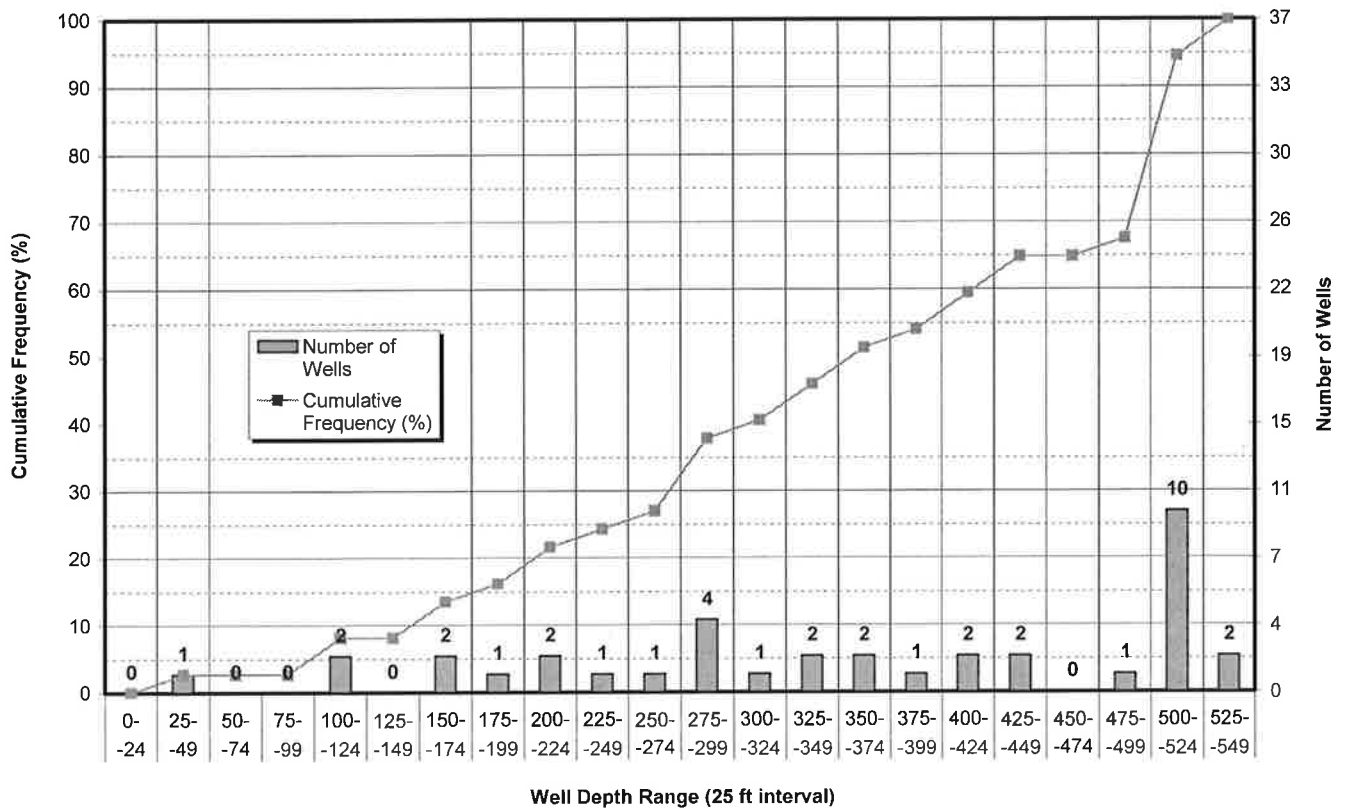


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Stanford Vina Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is asymmetrical in distribution indicating a wide ranged of well depths. Note that over 25 percent of the wells are constructed within the depth interval of 500 to 525 feet.

The frequency distribution of irrigation well depth data for the Stanford Vina Sub-Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 368 feet or less,
- 20% of the wells are installed to a depth of 220 feet or less, and
- 10% of the wells are installed to a depth of 150 feet or less.

Deer Creek Irrigation District Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Deer Creek Irrigation District Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 31 well records for the Deer Creek Irrigation District Sub-Inventory Unit were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. Cumulative frequency distribution analyses were not developed due to the low number of wells.

Table #, Appendix #, shows that the majority of wells in the Deer Creek Irrigation District Sub-Inventory Unit are for domestic use. A total of 23 domestic wells were identified ranging in depth from 31 to 460 feet. The average domestic well depth is about 144 feet. Eight irrigation wells were identified ranging in depth from 27 to 700 feet. The average irrigation well depth is about 384 feet.

Vina Independent Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Vina Independent Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 56 well records for the Vina Independent Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. Cumulative frequency distribution analyses were not developed due to the low number of wells.

Table #, Appendix #, shows that the majority of wells in the Vina Independent Sub-Inventory Unit are for domestic use. A total of 28 domestic wells were identified ranging in depth from 72 to 500 feet. The average domestic well depth is about 172 feet. A total of 27 irrigation wells were identified ranging in depth from 100 to 764 feet. The average irrigation well depth is about 438 feet. The single municipal well is constructed to a depth of 145 feet.

REDDING GROUNDWATER BASIN

WELL DEPTH

Well depth and well use data for the Redding Groundwater Basin Region were collected from well completion reports filed with DWR. A total of 1,329 well records with depth data were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Redding Groundwater Basin Region are presented in Figures ## and ##. A cumulative frequency curve was not developed for municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells within the region.

Table #, Appendix #, shows that the average depth of domestic wells in the Redding Basin portion of Tehama County is about 224 feet. Table ## also shows that wells drilled for irrigation and municipal uses have a greater average depth than domestic wells with average depths of 310 and 440 feet respectively.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Redding Basin Region. A total of 1,259 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 48 to 710 feet.

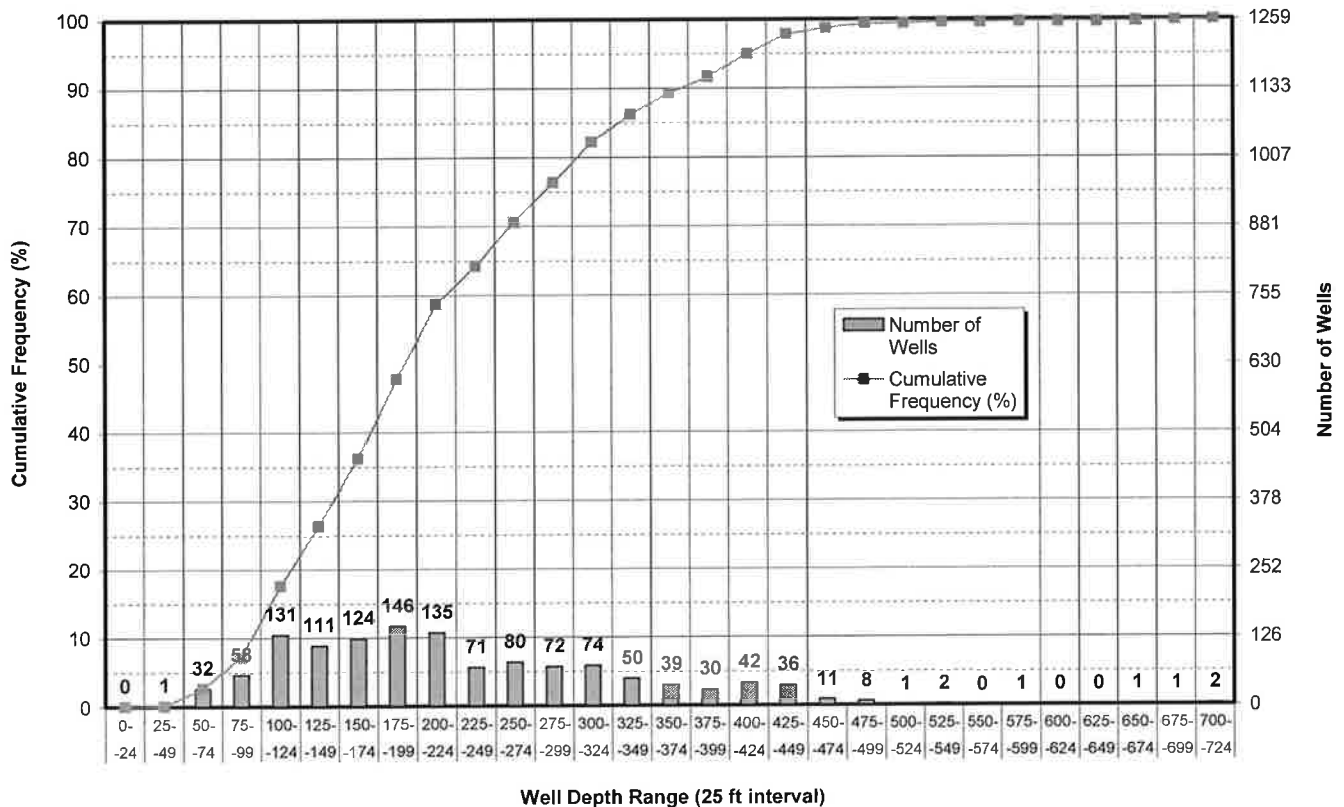


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Redding Basin Portion of Tehama County.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth class interval with the greatest number of wells. The histogram also shows high variability in well depths.

The frequency distribution of domestic well depth data for the Redding Basin Region is summarized as follows:

- 50% of the domestic wells are installed to a depth of 200 feet or less,
- 20% of the wells are installed to a depth of 135 feet or less, and
- 10% of the wells are installed to a depth of 101 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data in the Redding Basin Region. A total of 55 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of irrigation wells range from 60 to 600 feet.

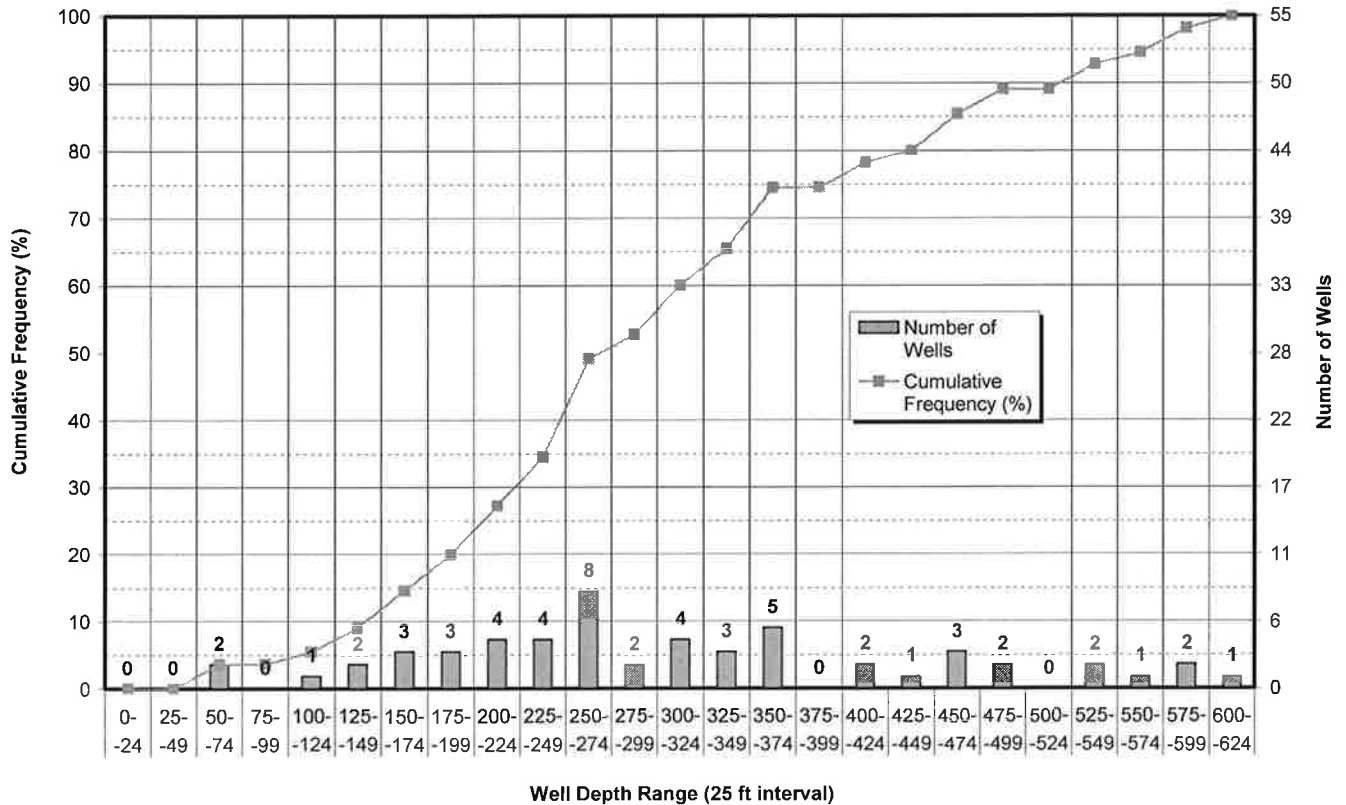


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Redding Basin Portion of Tehama County.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution and shows high variability for well depths.

The frequency distribution of irrigation well depth data for the Redding Basin Region is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 275 feet or less,
- 20% of the wells are installed to a depth of 190 feet or less, and
- 10% of the wells are installed to a depth of 150 feet or less.

BOWMAN INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Bowman Inventory Unit were collected from well completion reports filed with DWR. A total of 1,102 well records with depth data were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a series of cumulative frequency distribution curves for domestic and irrigation wells showing the number of wells constructed for each 25 foot interval. Cumulative frequency curves associated with the Bowman Inventory Unit are presented in Figures ## and ##. A cumulative frequency curve was not developed for municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic and irrigation wells in the inventory unit.

Table #, Appendix #, shows that the average depth of domestic wells in the Bowman Inventory Unit is about 228 feet. Table ## also shows that wells drilled for irrigation and municipal uses have a greater average depth than domestic wells. The average depth for irrigation wells is 356 feet. The 14 municipal wells range in depth from 88 to 840 feet and average 460 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Bowman Inventory Unit. A total of 1,051 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 48 to 710 feet.

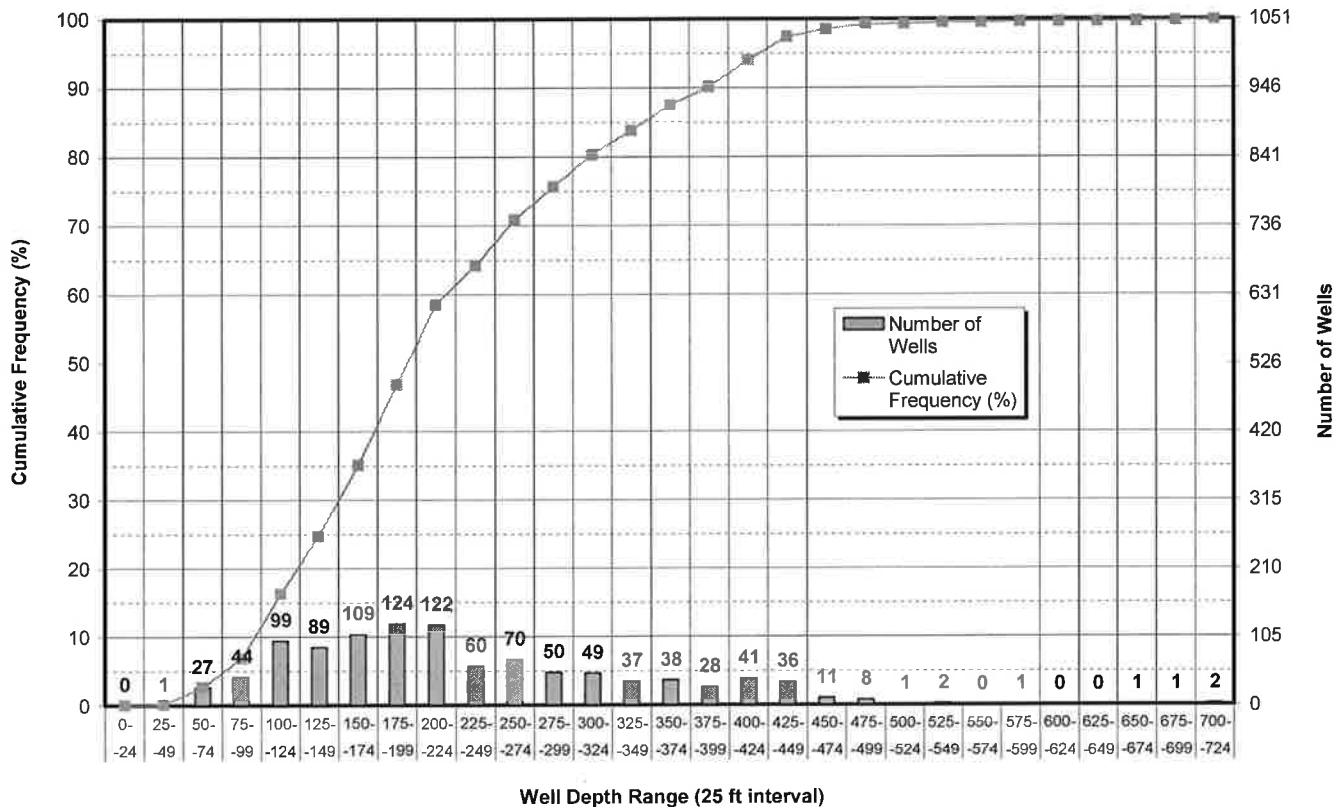


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Bowman Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram has a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth class interval with the greatest number of wells. The histogram also shows high variability for well depths.

The frequency distribution of domestic well depth data for the Redding Basin Region is summarized as follows:

- 50% of the domestic wells are installed to a depth of 201 feet or less,
- 20% of the wells are installed to a depth of 140 feet or less, and
- 10% of the wells are installed to a depth of 103 feet or less.

Figure ## illustrates the cumulative frequency distribution of irrigation well depth data in the Bowman Inventory Unit. A total of 37 irrigation wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of irrigation wells range from 60 to 600 feet.

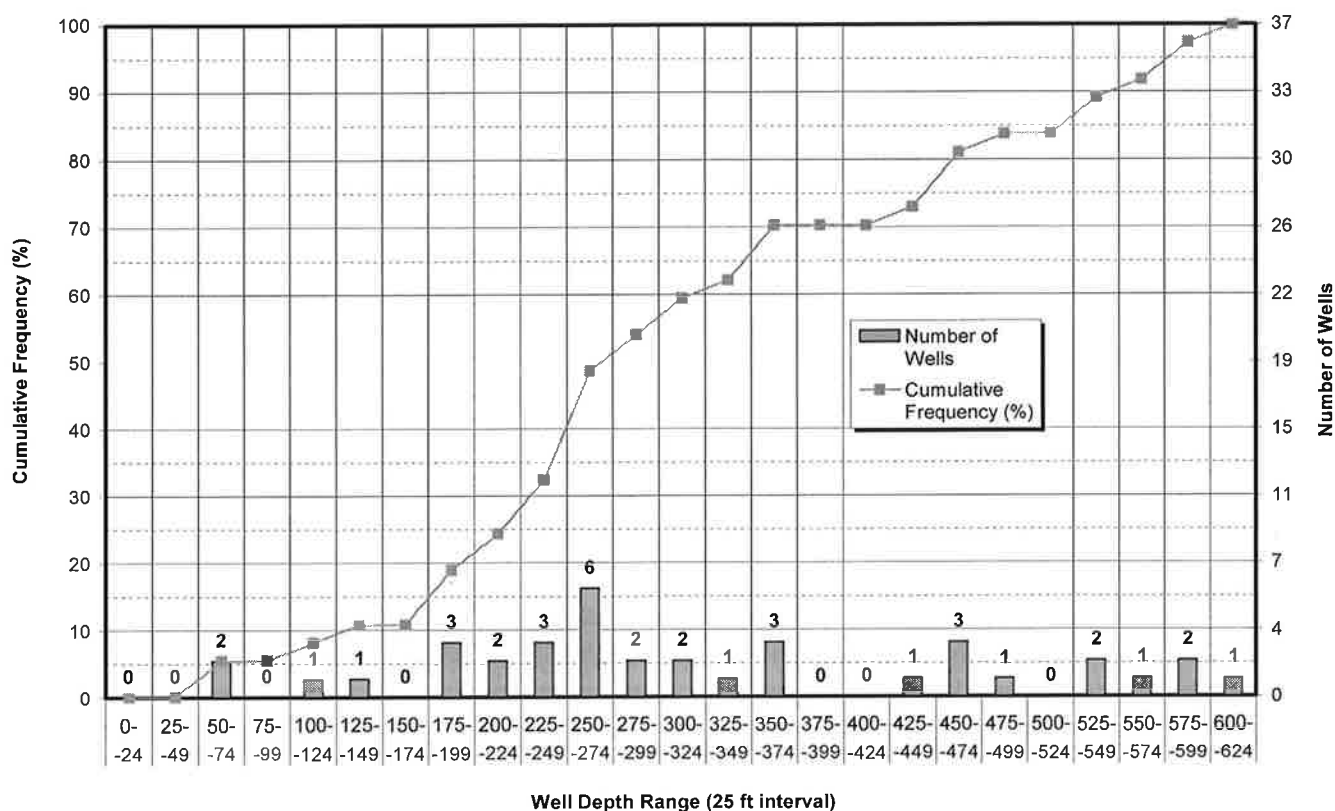


Figure ##. Cumulative Frequency Distribution of Irrigation Wells, Bowman Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with positive skewness and shows high variability in well depths.

The frequency distribution of irrigation well depth data for the Bowman Inventory Unit is summarized as follows:

- 50% of the irrigation wells are installed to a depth of 275 feet or less,
- 20% of the wells are installed to a depth of 200 feet or less, and
- 10% of the wells are installed to a depth of 132 feet or less.

Anderson-Cottonwood Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Anderson-Cottonwood Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 239 well records with depth data were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval. The cumulative frequency curve associated with the Anderson-Cottonwood Sub-Inventory Unit is presented in Figure ##. A cumulative frequency curve was not developed for irrigation and municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the depths for 50%, 20%, and 10% of the domestic wells within the sub-inventory unit.

Table #, Appendix #, shows that the average depth of domestic wells in the Anderson-Cottonwood Sub-Inventory Unit is about 140 feet. Table ## also shows that wells drilled for irrigation use have a greater average depth than domestic wells with a depth of 265 feet. The two municipal wells are constructed to 170 and 401 feet, averaging 286 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Anderson-Cottonwood Sub-Inventory Unit. A total of 221 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 56 to 320 feet.

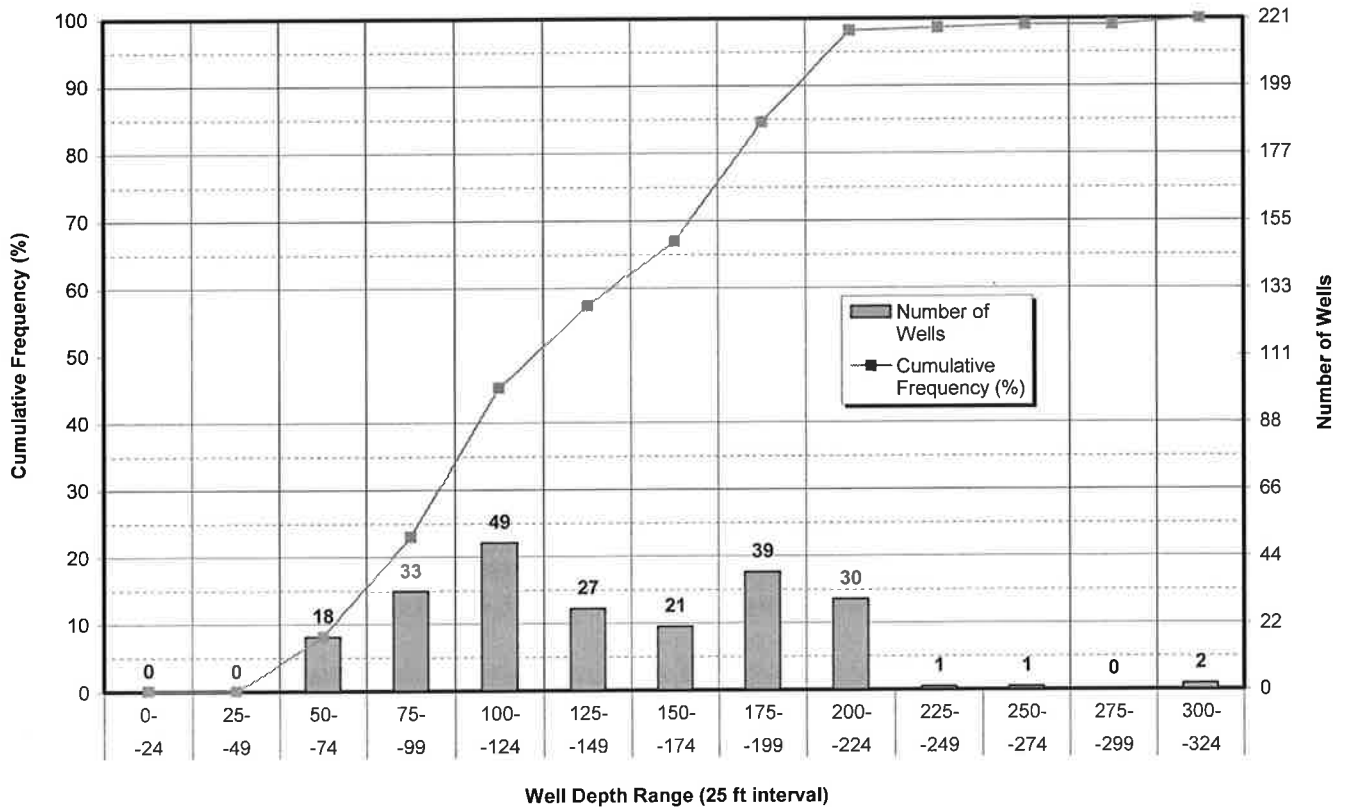


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Anderson-Cottonwood Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approximates a normal distribution with slight negative skewness. The negative skewness is due to the number of wells constructed to deeper well depths. The histogram also shows low variability for well depths.

The frequency distribution of domestic well depth data for the Anderson-Cottonwood Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 135 feet or less,
- 20% of the wells are installed to a depth of 96 feet or less, and
- 10% of the wells are installed to a depth of 78 feet or less.

Bowman Independent Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Bowman Independent Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 894 well records with depth data were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as shown in Figure ##. Cumulative frequency curves were not developed for irrigation and municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the sub-inventory unit.

Table #, Appendix #, shows that the average depth of domestic wells in the Bowman Independent Sub-Inventory Unit is about 248 feet. Table ## also shows that wells drilled for irrigation and municipal uses have a greater average depth than domestic wells. The 25 irrigation wells range in depth from 132 to 600 feet and average 351 feet. The 11 municipal wells range in depth from 88 to 790 feet and average 429 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Bowman Independent Sub-Inventory Unit. A total of 858 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 48 to 710 feet.

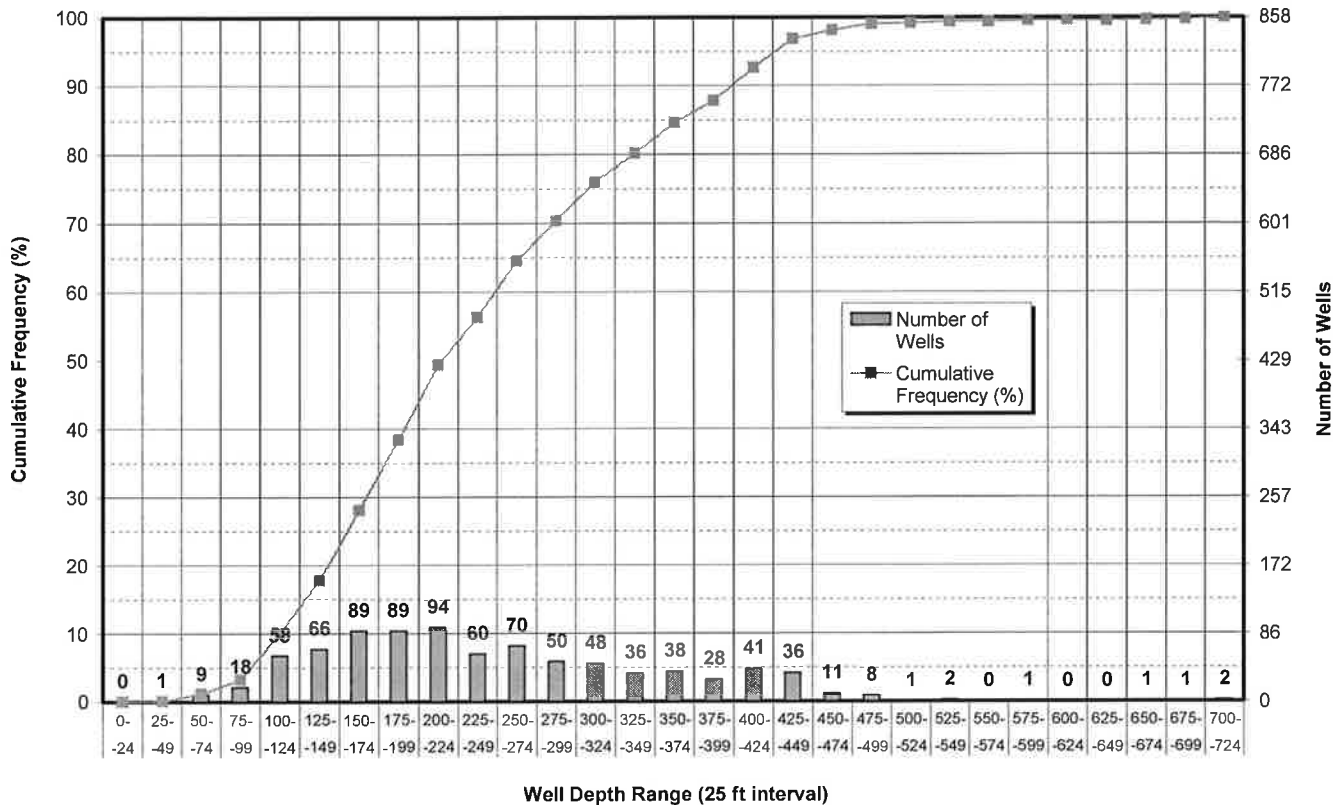


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Bowman Independent Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is a normal distribution with negative skewness due to the number of wells constructed to deeper well depths. The histogram also shows high variability for well depths.

The frequency distribution of domestic well depth data for the Bowman Independent Sub-Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 225 feet or less,
- 20% of the wells are installed to a depth of 155 feet or less, and
- 10% of the wells are installed to a depth of 124 feet or less.

ROSEWOOD INVENTORY UNIT

WELL DEPTH

Well depth and well use data for the Rosewood Inventory Unit were collected from well completion reports filed with DWR. A total of 210 well records with depth data were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as shown in Figure ##. A cumulative frequency curve was not developed for irrigation and municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the inventory unit.

Table #, Appendix #, shows that the average depth of domestic wells in the Rosewood Inventory Unit is about 209 feet. Table ## also shows that wells drilled for irrigation use have a greater average depth than domestic wells with an average depth of 305 feet. The single municipal well is constructed to a depth of 170 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Rosewood Inventory Unit. A total of 196 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 63 to 409 feet.

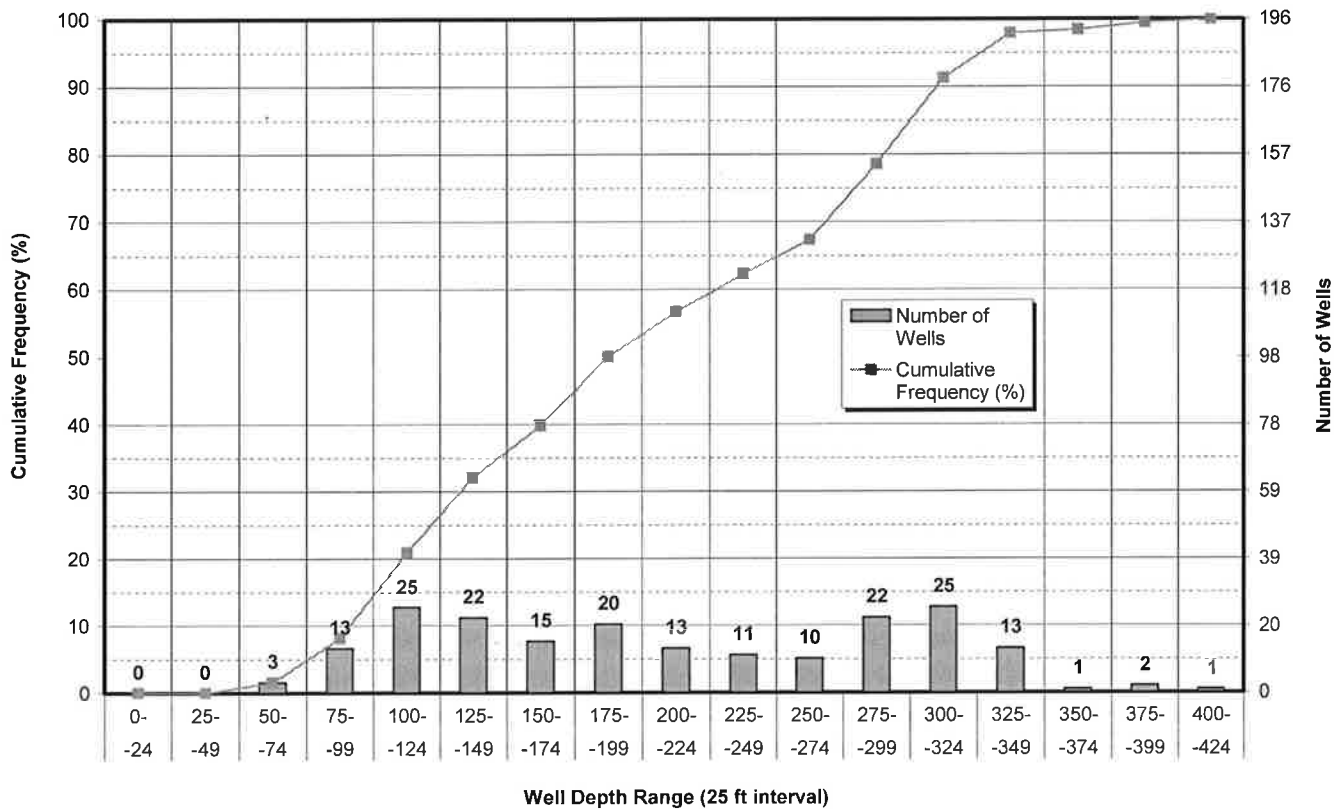


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Rosewood Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is a normal distribution with negative skewness due to the number of wells constructed to deeper well depths. The histogram also shows that there is high variability for well depths.

The frequency distribution of domestic well depth data for the Rosewood Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 198 feet or less,
- 20% of the wells are installed to a depth of 124 feet or less, and
- 10% of the wells are installed to a depth of 100 feet or less.

Rio Alto Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Rio Alto Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 9 well records for the Rio Alto Sub-Inventory Unit were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. Cumulative frequency distribution analyses were not developed due to the low number of wells.

Table #, Appendix #, shows that there are 3 domestic wells ranging in depth from 60 to 340 feet. The average domestic well depth is 153 feet. Four irrigation wells range in depth from 112 to 426 feet with an average of 267 feet. Two municipal wells were constructed to depths of 475 and 840 feet.

Rosewood Independent Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Rosewood Independent Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 170 well records with depth data were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as presented in Figure ##. A cumulative frequency curve was not developed for irrigation wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the sub-inventory unit.

Table #, Appendix #, shows that the average depth of domestic wells in the Rosewood Independent Sub-Inventory Unit is about 223 feet. Table ## also shows that wells drilled for irrigation use have a greater average depth than domestic wells with an average depth of 366 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Rosewood Independent Sub-Inventory Unit. A total of 165 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 63 to 409 feet.

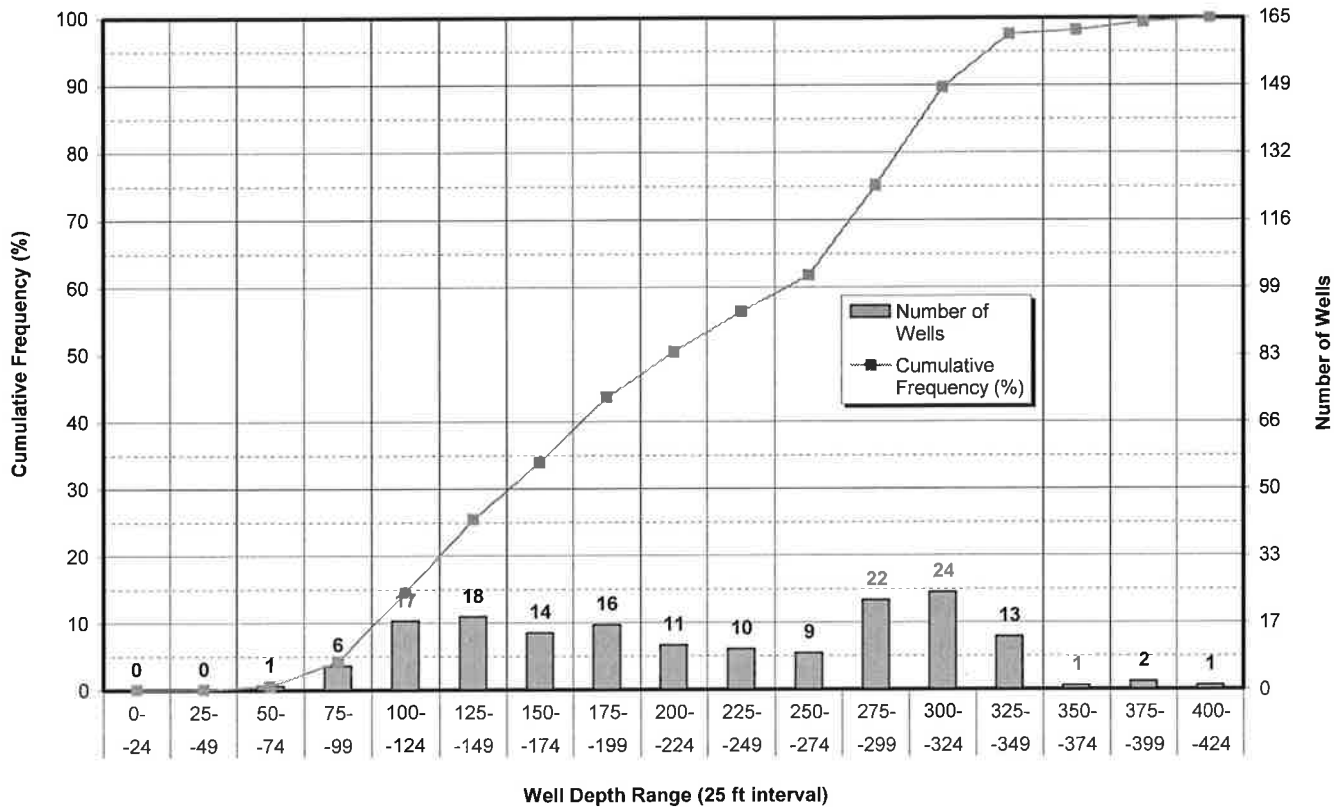


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Rosewood Independent Sub-Inventory Unit.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is a normal distribution with negative skewness due to the number of wells constructed to deeper well depths. The histogram also shows moderate variability for well depths.

The frequency distribution of domestic well depth data for the Rosewood Independent Inventory Unit is summarized as follows:

- 50% of the domestic wells are installed to a depth of 223 feet or less,
- 20% of the wells are installed to a depth of 134 feet or less, and
- 10% of the wells are installed to a depth of 112 feet or less.

South Battle Creek Inventory Unit

WELL DEPTH

Well depth and well use data for the South Battle Creek Inventory Unit were collected from well completion reports filed with DWR. A total of 17 well records for the South Battle Creek Inventory Unit were evaluated and classified into two well types: domestic and irrigation. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. Cumulative frequency distribution analyses were not developed due to the low number of wells.

Table #, Appendix #, shows that there are 12 domestic wells ranging in depth from 67 to 190 feet. The average domestic well depth is 114 feet. There are 5 irrigation wells ranging in depth from 150 to 315 feet. The average irrigation well depth is about 230 feet.

MOUNTAIN WEST REGION

WELL DEPTH

Well depth and well use data for the Mountain West Region were collected from well completion reports filed with DWR. A total of 94 well records with depth data were evaluated and classified into three well types: domestic, irrigation, and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as presented in Figure ##. Cumulative frequency curves were not developed for irrigation and municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of domestic wells within the region.

Table #, Appendix #, shows that the average depth of domestic wells in the Mountain West Region is about 176 feet. The two irrigation wells are constructed to depths of 84 and 157 feet, averaging 121 feet. The seven municipal wells ranged in depth from 147 to 500 feet, averaging 267 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Mountain West Region. A total of 85 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 30 to 610 feet.

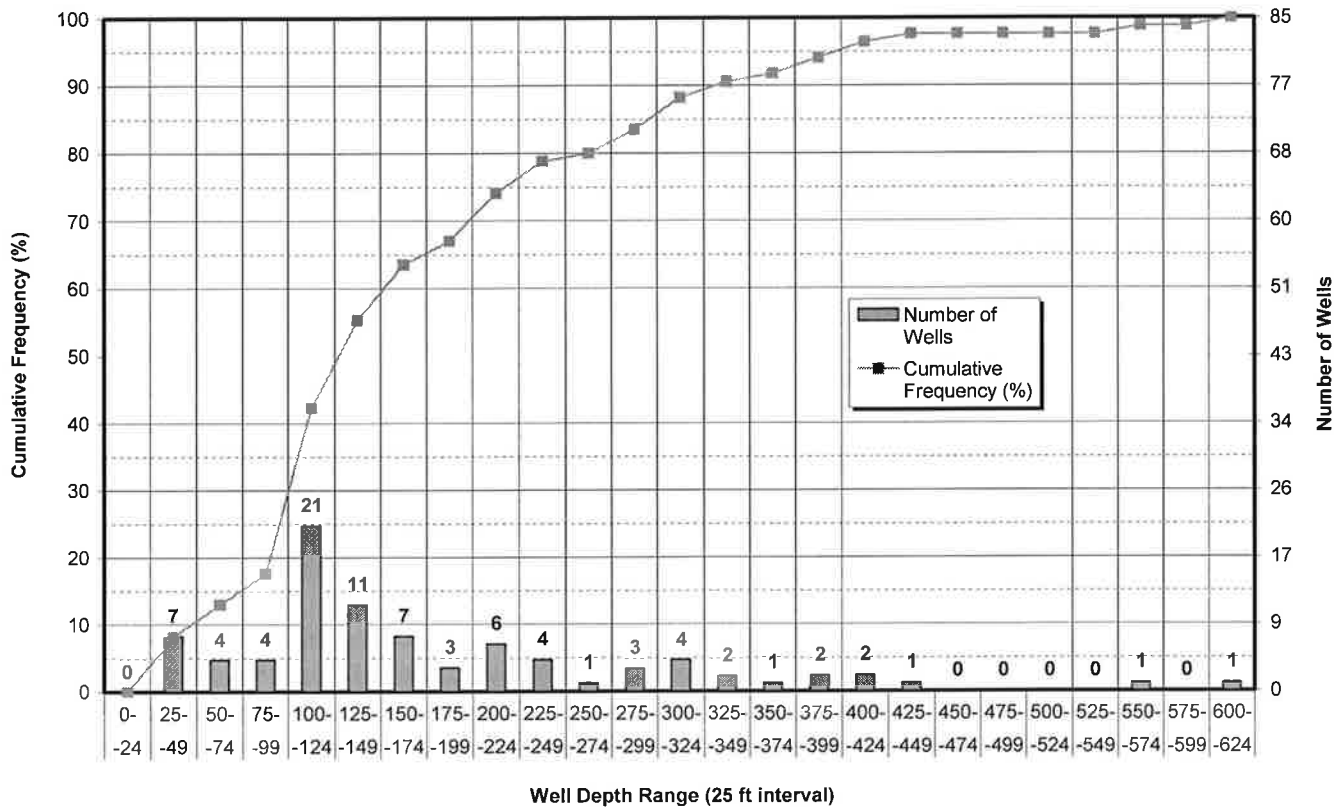


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Mountain West Region.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram approaches a normal distribution with positive skewness. Positively-skewed distribution of domestic well data indicates that average well depth is deeper than the most frequently occurring well depth or the depth class interval with the greatest number of wells. The histogram also shows moderate to high variability with respect to well depths.

The frequency distribution of domestic well depth data for the Mountain West Region is summarized as follows:

- 50% of the domestic wells are installed to a depth of 140 feet or less,
- 20% of the wells are installed to a depth of 100 feet or less, and
- 10% of the wells are installed to a depth of 60 feet or less.

MOUNTAIN EAST REGION

WELL DEPTH

Well depth and well use data for the Mountain East Region were collected from well completion reports filed with DWR. A total of 139 well records with depth data were evaluated and classified into three well types: domestic, irrigation and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval. The cumulative frequency curve associated with the Mountain East Region is presented in Figure ##. Cumulative frequency curves were not developed for irrigation and municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells within the region.

Table #, Appendix #, shows that the average depth of domestic wells in the Mountain East Region is about 253 feet. Five irrigation wells are constructed to depths ranging from 110 to 722 feet, averaging 349 feet. The 16 municipal wells range in depth from 67 to 610 feet and have an average depth of 263 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Mountain East Region. A total of 118 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 25 to 848 feet.

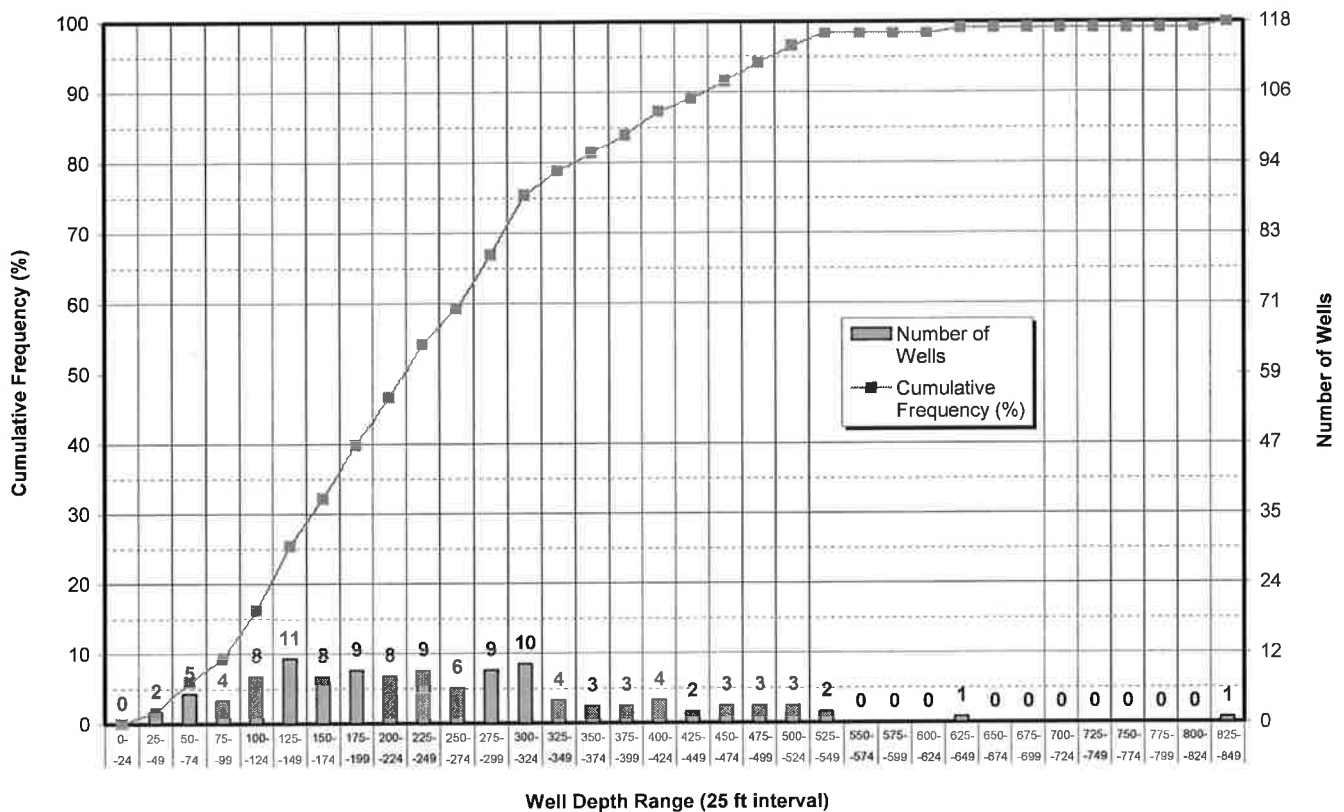


Figure ##. Cumulative Frequency Distribution of Domestic Wells, Mountain East Region.

The histogram bars in Figure ## show the total number of wells associated with each 25-foot class interval. The histogram is a normal distribution with negative skewness due to the number of wells constructed to deeper well depths. The histogram also shows high variability for well depths.

The frequency distribution of domestic well depth data for the Mountain East Region is summarized as follows:

- 50% of the domestic wells are installed to a depth of 234 feet or less,
- 20% of the wells are installed to a depth of 130 feet or less, and
- 10% of the wells are installed to a depth of 100 feet or less.

Mineral Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Mineral Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 7 well records for the Mineral Sub-Inventory Unit were evaluated and classified into two well types: domestic and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. Cumulative frequency distribution analyses were not developed due to the low number of wells.

Table #, Appendix #, shows that there is one domestic well constructed to a depth of 180 feet. There are six municipal wells ranging in depth from 67 to 347 feet. The average municipal well depth is about 177 feet.

Mountain East Independent Sub-Inventory Unit

WELL DEPTH

Well depth and well use data for the Mountain East Independent Sub-Inventory Unit were collected from well completion reports filed with DWR. A total of 132 well records with depth data were evaluated and classified into three well types: domestic, irrigation and municipal. A summary of the minimum, maximum, and average well depths, listed by well type, is presented in Table ##, Appendix ##. The statistical distribution of the well depth data was also evaluated through a cumulative frequency distribution curve for domestic wells showing the number of wells constructed for each 25 foot interval as presented in Figure ##. Cumulative frequency curves were not developed for irrigation and municipal wells due to the limited number of wells. The frequency distribution by well depth was also summarized showing the well depths for 50%, 20%, and 10% of the domestic wells in the sub-inventory unit.

Table #, Appendix #, shows that the average depth of domestic wells in the Mountain East Region is about 254 feet. Five irrigation wells range in depth from 110 to 722 feet and average 349 feet. The 10 municipal wells range in depth from 80 to 610 feet, averaging 315 feet.

Figure ## shows the cumulative frequency distribution of well depths for domestic wells in the Mountain East Independent Sub-Inventory Unit. A total of 117 domestic wells were evaluated in terms of cumulative frequency distribution with respect to well depths. The depths of domestic wells range from 25 to 848 feet.