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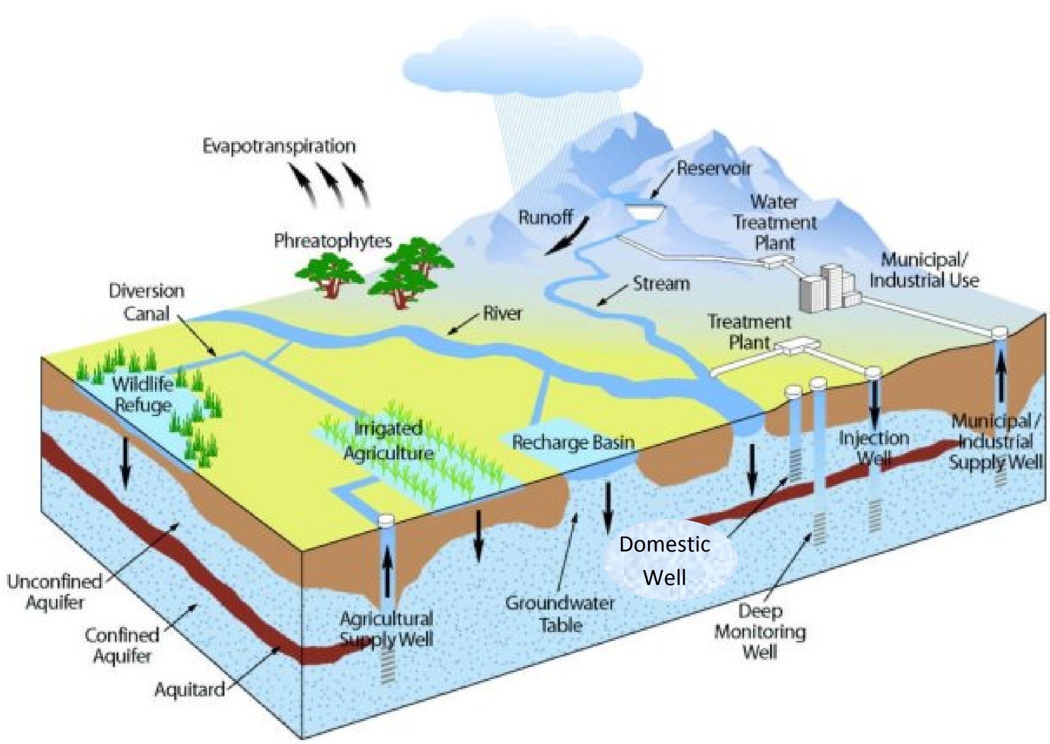
Where Does My Domestic Water Come From and Who Else Uses Groundwater?

What does the groundwater basin where I pump groundwater look like?

Below is a generalized block diagram showing features of a typical alluvial valley such as the Sacramento Valley. On the ground surface, the block diagram shows runoff from storms or snow melt in the mountains, rivers and streams flowing through the valley, and native vegetation. It also shows man-made infrastructure such as reservoirs, water treatment plants, diversion canals, recharge basins, and well heads.

Looking at the vertical cut-away of the 3-dimensional diagram, one can see how wells look below the surface. This diagram shows that typically agricultural supply wells and municipal/industrial wells are constructed deeper than domestic wells.

Figure 1. Generalized 3-Dimensional Block Diagram of a Typical Alluvial Valley such as the Sacramento Valley (DWR).



Also shown in Figure 1 are generalized depictions of an unconfined aquifer, a confined aquifer, and an aquitard.

- An **unconfined aquifer** is an underground layer of water-bearing, permeable sediments such as gravel or sand, that water wells typically extract water from. Unconfined aquifers are recharged from water that percolates through overlying unsaturated sediments down into the aquifer. The source of recharge water is generally from precipitation or from rivers, streams, or lakes. Many domestic and some irrigation wells are constructed in this shallow aquifer zone.
- A **confined aquifer** is also an underground layer of water-bearing, permeable sediments such as gravel or sand, however it is separated from an unconfined layer by an aquitard. Recharge to a confined aquifer is from precipitation or from rivers, streams, or lakes at a substantial distance from the confined aquifer, such as the edges of the valley, or in the foothills or mountains. Many irrigation wells, and municipal and industrial wells are constructed in this deeper aquifer zone.
- An **aquitard** is an underground layer of very fine sediments such as silt and clay that has very low permeability, and separates the unconfined aquifer above from the confined aquifer below. It is considered a barrier to the downward flow of groundwater.

How is the groundwater recharged or refilled in the groundwater basin?

Groundwater is recharged by surface water that percolates in the groundwater basins. More recharge occurs in wet years than dry years because surface water is more abundant. Natural recharge (sometimes described as passive recharge) is the simplest method of replenishing groundwater. Water percolates into the aquifer from a combination of surface water sources such as streams, rivers, lakes, surface water conveyance facilities, precipitation, and applied irrigation water. Natural recharge may also occur from subsurface inflow from other parts of the groundwater basin. Natural recharge requires no infrastructure, surface water supply, or extra effort other than what already exists or occurs. It is typically the slowest method of replenishing aquifers and it is relatively unmanaged.

Interest is increasing in "active" or "managed" groundwater recharge. The goal is to enhance recharge above what is accomplished naturally. With active recharge, people interject more thought into groundwater recharge, and implement plans and different methods to accomplish groundwater recharge.

Factors such as groundwater demand, soil, and geologic conditions in the groundwater basin are all considered when planning and implementing active groundwater recharge. These factors affect recharge rates and volume, availability of surface water, and ability to distribute surface water over the basin to accomplish recharge

Examples of active or managed groundwater recharge efforts include: identifying sources of surface water that may be available in normal to wet years for active recharge programs; constructing percolation basins in settings with high groundwater demand and permeable soils and geologic conditions; incentive programs to irrigate crops with surface water instead of groundwater when a choice is available; programs to encourage winter irrigation of select farmlands for the primary purpose of groundwater recharge; and aquifer injection.

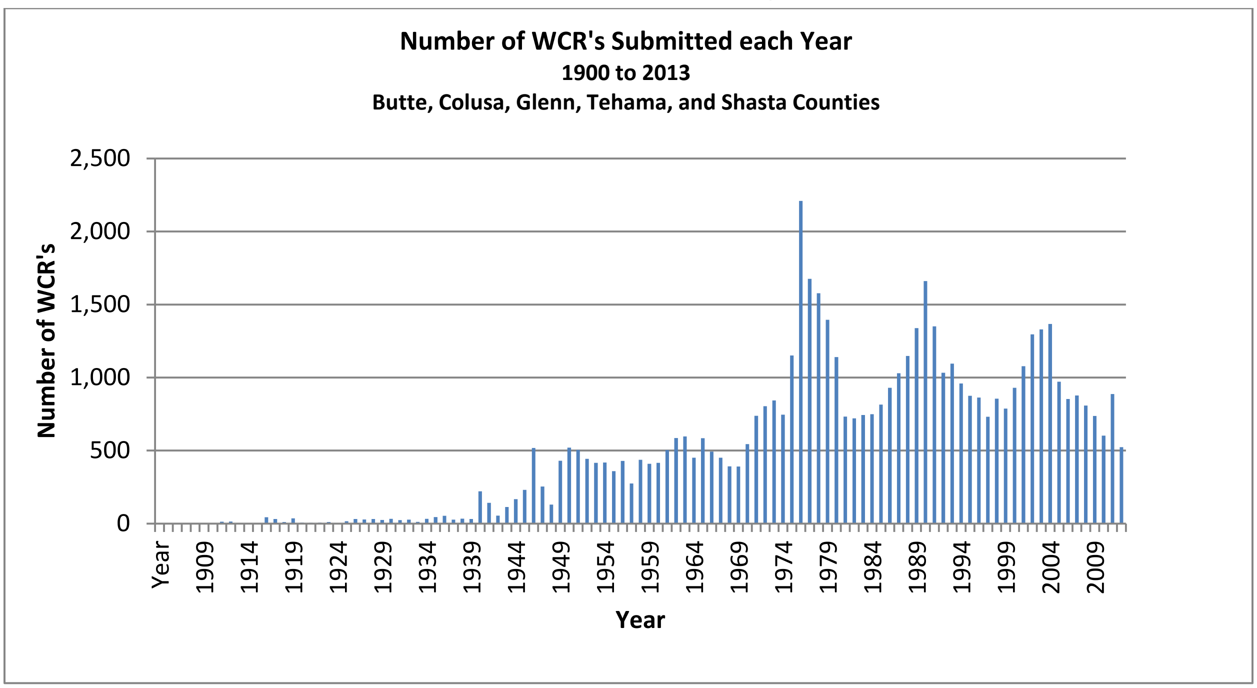
How many groundwater wells are there and where are we pumping our water from?

The information available to answer this question comes from owner-confidential Well Completion Reports (WCRs) that water well drillers submit to DWR after drilling and installing a well. Using WCR data, assessments can be made as to how deep a well has been drilled, what the well construction is, what the underlying sediments are, the number of wells that have been drilled in a certain area, etc.

The number of WCRs submitted usually corresponds with the number of wells that have been drilled (with the exception of instances such as well destruction, which also requires a WCR to be submitted).

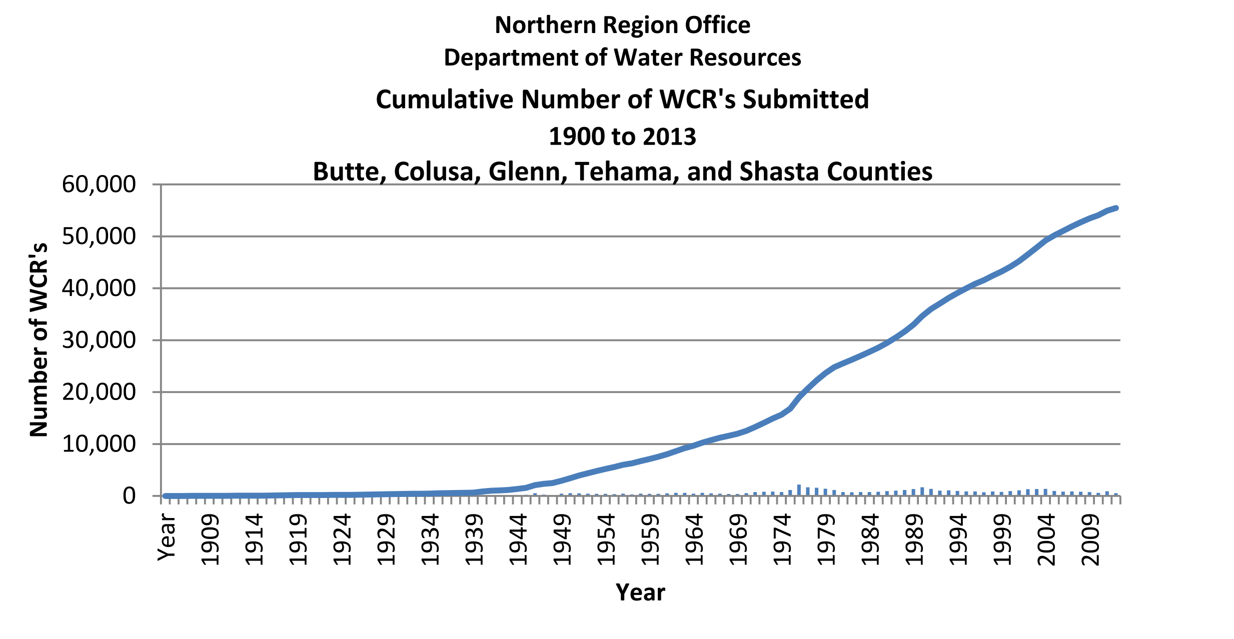
Therefore, the number of water wells that have been drilled in an area over time can be an indicator of groundwater development. Figure 2 shows the number of wells that have been drilled in Butte, Colusa, Glenn, Tehama, and Shasta counties from 1900 to 2013. Well completion reports were not required to be submitted in the early part of the 20th century, hence the low numbers from 1900 to about 1947. The years with the highest number of wells drilled generally correspond with below normal, dry, or critically dry precipitation years.

Figure 2. Number of Wells drilled in the northern Sacramento Valley Counties, 1900 through 2013 (Source: DWR, Northern Region)



Another way to look at these data is to graph the cumulative number of wells that have been drilled in the Sacramento Valley over the years. Figure 3 shows the cumulative number of wells that have been drilled in the valley from 1900 to 2013. Although some wells may not be active anymore, this graph shows that groundwater use has been increasing dramatically since about the early 1970's.

Figure 3. Cumulative Number of Wells drilled in the northern Sacramento Valley Counties, 1900 through 2013 (Source: DWR, Northern Region)



The WCR data can also be sorted by county and well use. Table 1 summarizes the number of WCRs submitted to DWR for the five northern Sacramento Valley Counties. The records show that 56,833 wells have been constructed predominantly on the valley floor of Butte, Colusa, Glenn, Tehama, and Shasta Counties. As a regional average, about 67 percent of the wells are smaller capacity domestic wells, the majority of which are constructed in the shallower aquifer, generally about 150 to 200 feet below ground surface. On average, about 12 percent of the wells are irrigation wells and only about 2 percent are municipal and industrial (M & I) wells. Both irrigation and M&I wells are larger capacity wells and are generally constructed in the deeper aquifer, generally about 300 to 400 feet below ground surface.

Table 1. Well Completion Report Data for the Northern Sacramento Valley Counties through 2013 (Source: DWR, Northern Region)

Number of Wells Drilled 1900 through 2013*

Well Use	Butte Co.	Colusa Co.	Glenn Co.	Tehama Co.	Shasta Co.	Total	Percentage

Domestic	12,553	1,311	2,869	10,273	11,175	38,181	67
Irrigation	2,562	932	1,689	1,530	364	7,077	12
****M & I**	325	93	82	155	283	938	2
Other	3,874	1,058	1,377	1,871	2,457	10,637	19
Total	19,314	3,394	6,017	13,829	14,279	56,833	100

*Unknown wells that were drilled without the submission of a Well Completion Report are not included in these data.

**M & I: Municipal and Industrial.

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