FEBRUARY 2015

University of California
Agriculture and Natural Resources
UC Cooperative Extension

TEHAMA, GLENN, COLUSA, AND SHASTA COUNTIES
1754 WALNUT ST, RED BLUFF, CA 96080
(530)-527-3101
Email: aefulton@ucdavis.edu

Water & Land Management Newsletter

Allan

Allan E. Fulton
UC Irrigation and Water Resources Farm Advisor
Tehama, Glenn, Colusa, and Shasta Counties

- ◊ **SAVE THESE MEETING DATES!**
- ◊ **WHERE DOES MY DOMESTIC WATER COME FROM AND WHO ELSE USES GROUNDWATER?**
- ◊ **BEING A PROACTIVE OWNER OF A DOMESTIC WELL**

Much has happened on the water front since September 2014. The "Groundwater Sustainability Act" was passed into California Law mandating local groundwater management. A state water bond was passed by California voters seeking to bolster and secure water supplies in the future. The fall and winter of 2014 were initially encouraging by bringing much needed rainfall to our valley area and the beginning of some snowpack in our upper watersheds. However, so far, the rainfall and snowpack in the New Year has been very low causing all of us to consider the prospects of managing another year of drought. This newsletter highlights some upcoming meetings and opportunities to participate in discussions concerning local efforts to sustain water supplies. Two articles are also included. One looks at the complexities and challenges of securing water supplies and the importance of working together towards this goal. The second outlines some steps domestic well owners should be considering, if not already, in light of the drought to anticipate problems and prepare for them.

Acknowledgements: A special thanks is extended to individuals who contributed to the articles in this newsletter: Kelly Staton, Roy Hull, and Bill Ehorn who are staff in the Groundwater section of DWR, Northern Region; to Lisa Hunter, Water Resources Coordinator, Glenn County Department of Agriculture; and Mary Fahey, Water Resources Coordinator, Colusa County Agriculture Department.

SAVE THESE MEETING DATES

Jointly, the Glenn County Water Advisory Committee, the Glenn County Farm Bureau, and the University of California Cooperative Extension will be hosting three local meetings in February and March 2015 in Glenn County. The meeting content and objectives will be the same at each meeting so it is not necessary to attend all three meetings. Each meeting will provide an overview of the local water resources setting in the county, review past and future efforts to implement local water resource management in Glenn County, and give a summary of the recent "Groundwater Sustainability Act". This is an opportunity to converse about the challenges that lie ahead to sustain reliable and affordable water supplies in the future.

Meeting #1: WILLOWS

WHERE: WILLOWS CITY COUNCIL CHAMBERS
201 North Lassen Street, Willows, CA, 95988

WHEN: THURSDAY, FEBRUARY 19, 2015

TIME: 6:30 to 8:00 p.m.

Meeting #2: ORLAND

WHERE: GLENN COUNTY FAIRGROUNDS, ARTS AND CRAFTS BUILDING
221 E. Yolo Street, Orland, CA, 95963

WHEN: THURSDAY, FEBRUARY 26, 2015

TIME: 6:30 to 8:00 p.m.

Meeting #3: ORD BEND

WHERE: Ord Bend Community Hall
3241 California 45, Glenn, CA 95943

WHEN: THURSDAY, MARCH 5, 2015

TIME: 6:30 to 8:00 p.m.

A fourth informational meeting is planned for Thursday, April 30, 2015 in Corning, CA. This meeting will be sponsored jointly and will provide a venue to discuss water resource management from a Northern Sacramento Valley regional scale. Current groundwater conditions will be discussed, dialogue about the building of new partnerships to manage drought and sustain water supplies in the long run will be the focus of this meeting. More information will be available as the meeting date approaches.

Meeting #4: CORNING

WHERE: Rolling Hills Casino, 2655 Everett Freeman Way, Corning, CA 96021

WHEN: April 30, 2015

TIME: This meeting will held mid morning through lunch. More details to come.

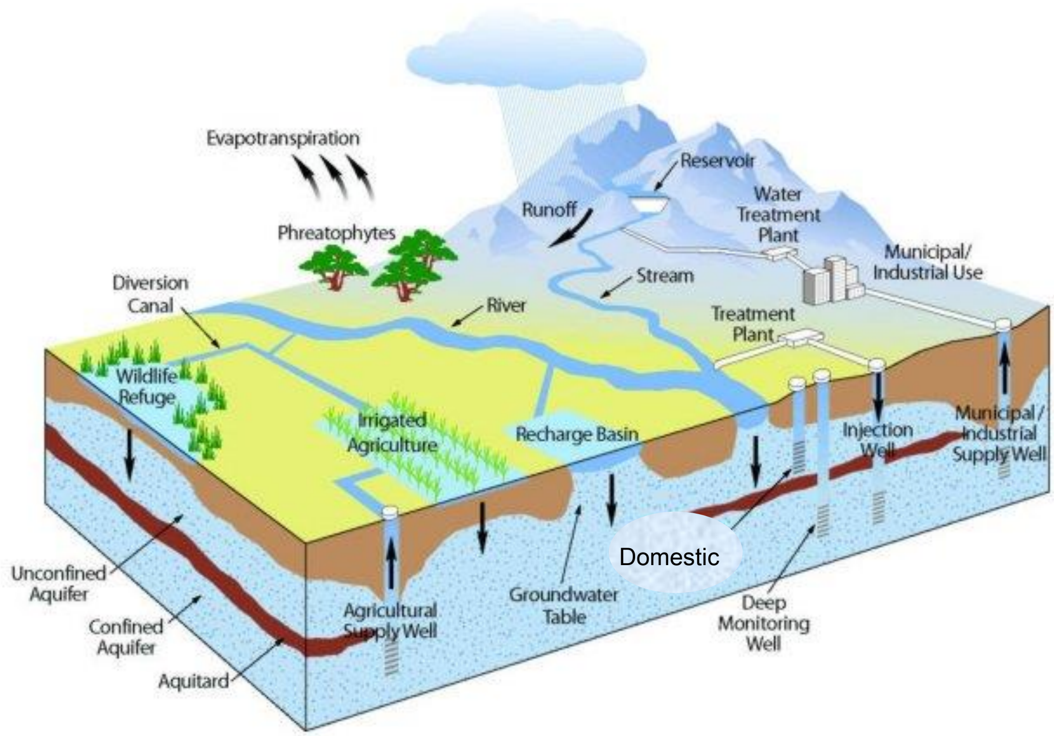
Where Does My Domestic Water Come From and Who Else Uses Groundwater?

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

Below is a generalized diagram showing features of a typical alluvial valley such as the Sacramento Valley. On the ground surface, the 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. Water wells typically extract water from unconfined aquifers. They 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. Sometimes the aquitard does not completely confine the water-bearing layer and is described as **semi-confined.**

Recharge to a confined or semi-confined aquifer is from precipitation or from rivers, streams, or lakes at a substantial distance from the confined aquifer, such as the alluvial fans at 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. This less permeable layer 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, canals and ditches, precipitation, and irrigation water applied to farm fields. 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.

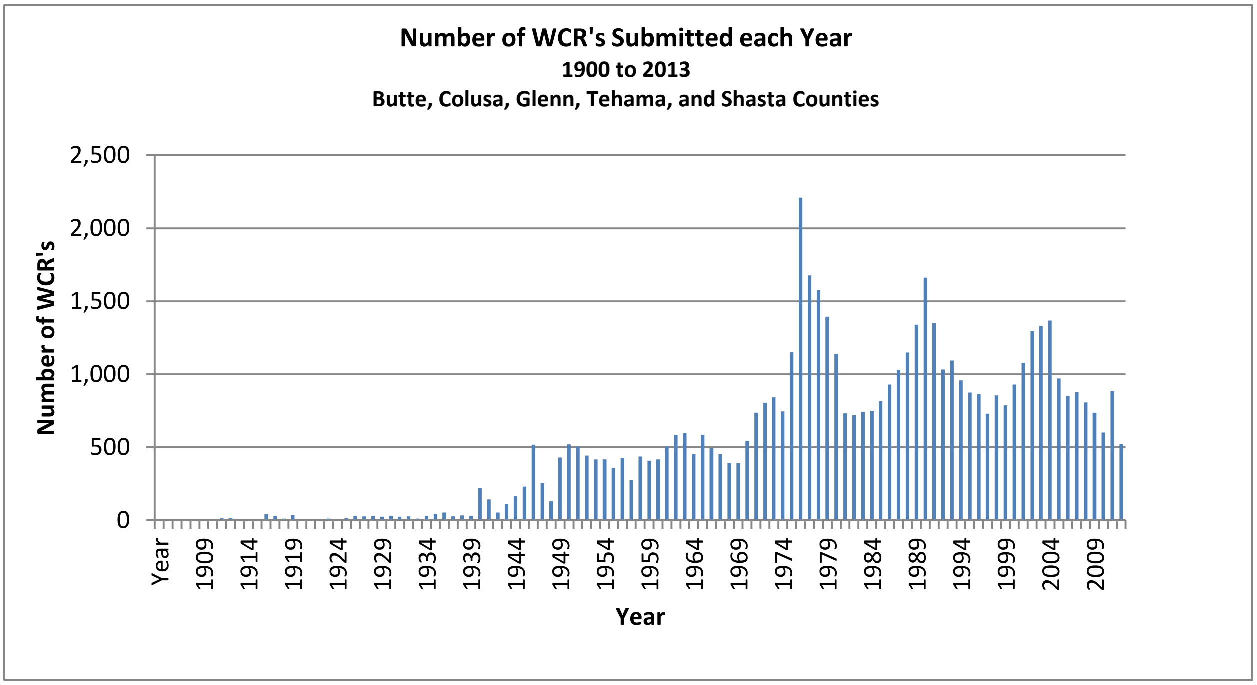
How many groundwater wells are there and where are we pumping our water from?

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)

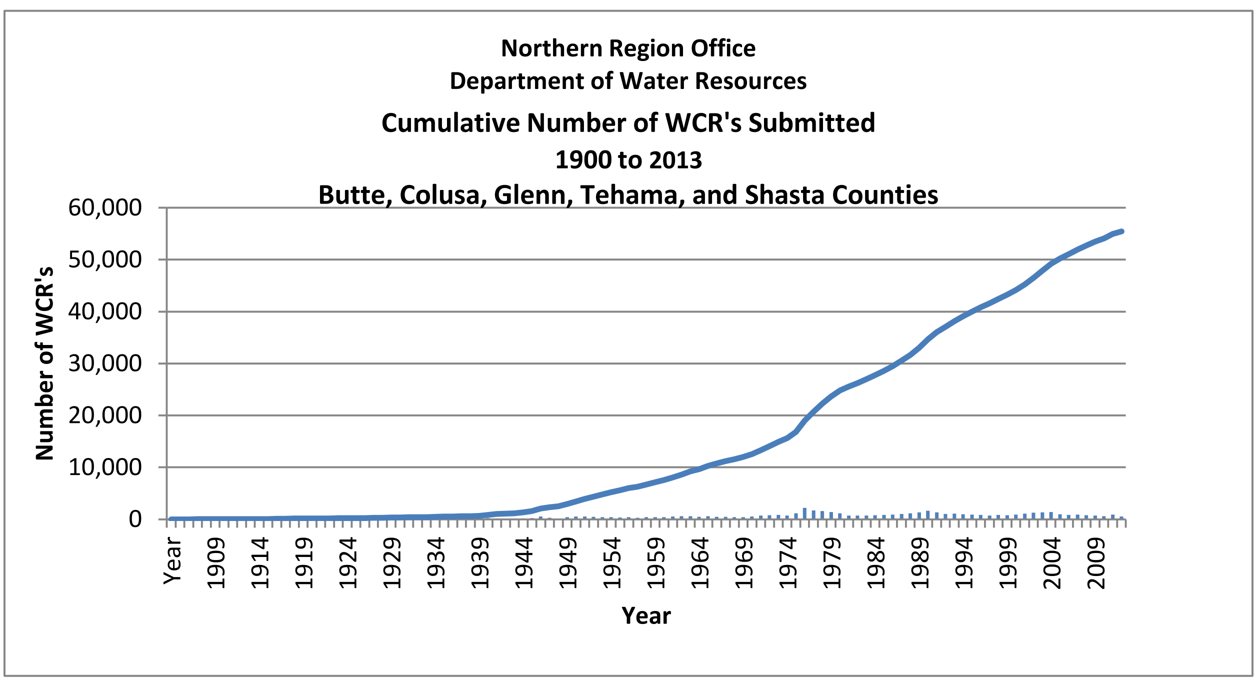


Table 1. Well Completion Report Data for the Northern Sacramento Valley Counties through 2013 (Source: DWR, Northern Region)

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.
*** Other uses represent wells where well use was not specified on the WCR. Many of these wells are most likely additional domestic and irrigation wells. An example of another well use that is different from domestic, irrigation, and M & I would be small, shallow wells used to for livestock water.

BEING A PROACTIVE OWNER OF A DOMESTIC WELL

What does it mean to be a proactive owner of a domestic well?

- A domestic well owner recognizes that securing a reliable good quality supply of drinking water from groundwater has a large degree of personal responsibility and can potentially be costly.
- A domestic well owner should approach well ownership just as they would other aspects of home upkeep and improvement such as with a septic system, roof, heating and air conditioning unit, or other personal living costs. This includes having a financial strategy to address potential problems should they occur.
- A domestic well owner is sufficiently informed to foresee a potential problem with their domestic well and address it before their water supply is jeopardized or interrupted.

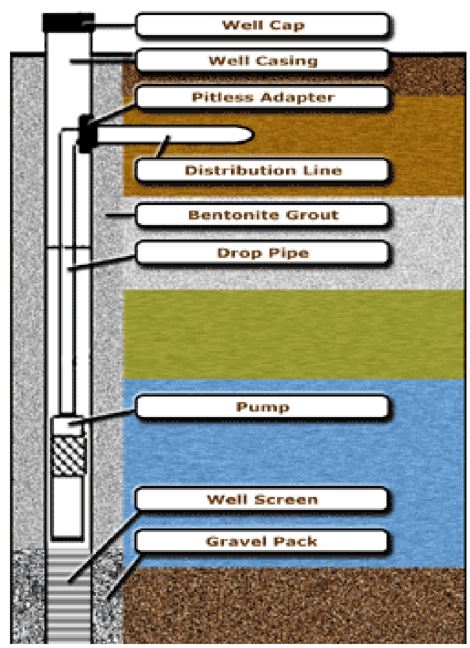


Figure 1. Basic well system components. Courtesy of wellowner.org.

What are the basic components of a domestic well water system and how does it all work?

Figure 1 illustrates the basic domestic well system components for a modern well. It consists of a **casing** that is placed in the drilled bore hole to maintain the well opening. The casing is usually carbon steel or can be plastic. **Bentonite or clay grout** is placed in the bore hole on the outside of the casing to confine the groundwater to the zone underground where it originates, and to prevent contaminants from other zones from mixing with the water. The top of the casing is capped with an approved **well cap** so that it snugly fits and prevents debris, insects, and small animals from finding their way into the well.

Well screens are located in portions of the well casing adjacent to gravel and sand layers that were observed as the well was drilled. Usually these soil layers will provide the most water into the well. The well screens allow water to enter the well so it can be pumped and also act as a filter preventing or limiting sediment from entering the well and still maintain the well opening. There are different types of well screens available for domestic wells such as mill slot, louver screen, and wire wrap (Fig. 2). Mill slot and wire wrap are more common. A **gravel pack filter** (Fig. 3) may also be constructed adjacent to the well screens on the outside of the well casing to increase the effective radius of the well in the main water bearing strata and to provide additional filtering of the water.

Figure 2. Mill slot, louver, and wire wrap screen (left to right).

Historically, hundreds of open bottom wells have be constructed in the northern Sacramento Valley. The only entry point for water into the well is through an open cavity at the bottom of the well casing. These wells are the least expensive because they do not require well screens or gravel packs. However, they can lead to more wear on pumps due to sand and other abrasives and they may require more well development (pumping) to secure domestic water that is not turbid. While it is not known to occur often, it is also possible for the open cavity to collapse and reduce water entry and access for pumping.

Figure 3. Wire wrap screen with gravel pack filter.

After the well has been constructed a **submersible electric motor and pump** are lowered into the well below the surface of the groundwater to lift the water. The motor and pump are attached to a **drop pipe** inside the well casing so that the pump and motor can be retrieved for maintenance and repairs. The pump consists of a screened intake for the water to enter the pump, and then pump bowls or impellers spin and provide centrifugal force to lift the water to the surface (Fig. 4). The pump discharge is connected to a **distribution line** which conveys the water to ground surface. A **pitless adapter** provides a sanitary and frost proof seal between the well casing and the water line running to the well owner's house.

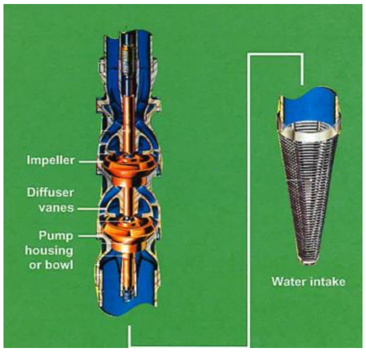


Figure 4. Example pump bowls and water intake screen. Submersible motor not shown.

A **bladder pressure tank** (Fig. 5) is installed into the water distribution line to the home. It provides a source of water and pressure to various household devices that are used intermittently so that the pump in the well does not have to turn on and off every time there is a need for water. This increases the life of the motor and the pump in the well.

The most common bladder pressure tanks consist of a balloon that partially occupies the space inside an air tight tank. The balloon fills with water when the pump in the well runs. The rest of the tank that is not occupied by the balloon when it is filled with water is filled with compressed air that is pre-charged to usually 40 to 50 psi. The pressure is regulated with a cutoff pressure switch. When water is demanded in the home, the pre-charged air pressure inside the tank forces water from the balloon into the home piping system and delivers it to a faucet, toilet, or shower head. When the water in the bladder nears empty, the air pressure inside the tank decreases because air space is freed up as the bladder empties. The air pressure inside the tank drops to the pressure level set at the pressure switch, and the switch triggers power to the pump in the well to turn on and re-fill the bladder in the tank. This cycle is repeated to deliver water throughout a home over the course of a day.

Figure 5. Example bladder pressure (blue) tank.

Besides understanding the components of a domestic well system, what information do I need to foresee a potential water supply problem?

- **Age of well**. The age of a well is often indicative of the likelihood that a well owner could encounter a problem with the water system, although this is not always the case as groundwater conditions may affect well production. Older wells are likely to be more shallow and not as well suited for the added competition of groundwater resulting from growth and change over time. They may be constructed with inferior drilling methods and design features. The mechanical parts associated with the pump are likely to have more wear and tear, and there is greater chance of well failure due to corrosion and well collapse.
- **Well depth and depth of well screens**. Knowing the depth of a domestic well and how it is constructed or where the well screens are located is critical. Having this information allows the owner to determine how the well is designed to intercept water and anticipate how close groundwater levels are from dropping to levels where it can no longer enter the well.
- **Depth of submersible pump in the well.** The depth that the pump is set in the well can be compared to the depth of the well screens or well. By comparing them, a well owner will have a sense of how much flexibility there may be to lower the depth that the pump is set in a well as a means of addressing declining groundwater levels.
- **Groundwater level measurements.** Knowing the depth to groundwater in a domestic well or in the vicinity of the well can be compared to the depth of the well screens, the total well depth, and to the depth that the pump is set. A comparison of these pieces of information will give a domestic well owner a sense of whether groundwater levels are approaching levels that may require setting the pump deeper or whether a more substantial cost to deepen or replace the well may lie ahead. Routine measurements (approximately every three months) of groundwater levels can give an indication of how much the groundwater conditions are changing and how quickly a problem might be approaching. Seasonal fluctuations usually occur. Groundwater levels will typically be shallower in the spring after winter and spring groundwater recharge. They will usually be deepest in the summer when water demand is highest, especially if measured while a pump is operating. Groundwater levels usually begin to recover in the Fall and winter. The extent of recovery depends on the amount of rainfall and snowpack received.

How do I acquire well construction, groundwater level, and pump setting information?

- A confidential well completion report for an existing well can be acquired by contacting the Department of Water Resources Northern Region at (530)-529-7300 or access the request form at: http://www.water.ca.gov/pubs/groundwater/well_completion_report_request-owner/wcr_request_owner_20110518.pdf. A well completion report lists the location of the well, when it was drilled, and the texture and structure of the soil formations that were observed while drilling. The soil descriptions help identify the soil layers that will yield more water and where to locate the well screens. It also lists the well construction, such as how deep the casing is, where the perforated interval is to intercept groundwater, if the well is open hole at the bottom, what the wellhead protection is, etc. It will also indicate the depth to groundwater at the time the well was constructed so it is possible to tell how much the groundwater conditions may have changed since its construction, and it may give the maximum flow rate pumped from the well soon after it was constructed.
- Information about groundwater levels at or near your domestic well will help answer questions about how deep a well should be to provide water reliably and how deep to position the pump inside the well so it will lift water reliably for many years ahead. To access groundwater level information for your area refer to the California Statewide Groundwater Elevation Monitoring (CASGEM) program at: http://www.water.ca.gov/groundwater/casgem/online_system.cfm or the

California Water Data Library at http://www.water.ca.gov/waterdatalibrary/index.cfm. Alternatively, it is possible to learn how to measure groundwater levels in your own domestic well. This will be a topic of another newsletter.

- A well owner will have to rely upon their own recordkeeping to know the depth that a pump is set in a well. It is usually provided at the time a pump has been installed or repaired. If no record of the depth that the pump is set in the well exists, it will require pulling the pump and resetting the depth to acquire this information.

University of California
Cooperative Extension
Glenn County
P. O. Box 697
Orland, CA 95963