

INSTALLING A WATER SUPPLY WELL IN THE CENTRAL AND WEST COAST BASINS - USING AVAILABLE GEOLOGIC INFORMATION TO PREDICT HOW DEEP TO DRILL

By: Tony Kirk, Senior Hydrogeologist
email: tkirk@wrdd.org

Many of the issues and costs of installing a Water Supply Well were presented in Technical Bulletin, Volume 5. The purpose of this Technical Bulletin is to provide the types and sources of hydrogeologic information available on the Central and West Coast Basins (CWCB) before beginning a drilling program.

The decision on how deep to drill and construct a well involves many considerations and it is important to review and analyze available information during the planning stages. There are many advantages to drilling deeper, but increasing depth also increases costs. Water quality considerations, which also influences drilling depth, will be presented in a future Technical Bulletin.

By researching available information first, preparations can be made in advance to improve the likelihood of constructing a successful new water supply well. Information can be obtained from many sources including WRD, the State of California Department of Water Resources, University and public libraries, and the pumping community. WRD staff has worked extensively to research, archive and interpret various geologic and other data and can serve as a resource.

Geologic Considerations

As discussed in Technical Bulletin, Volume 1, the CWCB are comprised of unconsolidated sediments underlain by older consolidated sediments and bedrock. The sediments are geologic materials ranging from coarse gravels and sands to fine grained silts and clays. The gravels and sands can be massive, thick, and extend to the ground surface; or they can be inter-layered with the finer silts and clays as in the pressure areas. Significantly thick water yielding sands and gravels are designated aquifers. Finding and tapping the aquifers in order to construct a successful well at a specific location can be reasonably predicted using a variety of geologic information.

The various types of information which summarize useful lithologic information include boring/drilling logs, geophysical logs, cross-sections, and structural contour maps. WRD has drilled over 40 deep monitoring wells in the CWCB and detailed borehole log and geophysical log information from these wells are available. In California, well completion reports from water supply wells are confidential and permission to use them must be obtained from the well owner.

Hydrogeologic cross-sections and structural contour maps of CWCB aquifers are presented in various publications. Especially useful is the State of California Department of Water Resources *Bulletin No. 104: Planned Utilization of the Groundwater Basins of the Coastal Plain of Los Angeles County-Appendix A Groundwater Geology*, published in 1961.

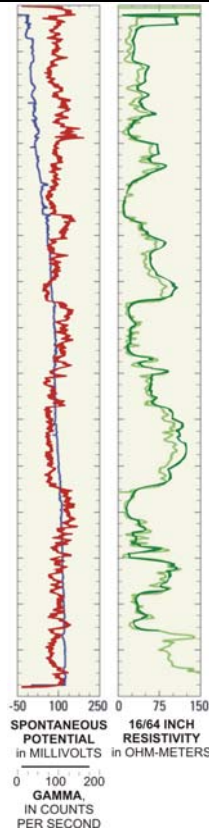
Borehole logs are depth specific descriptions of the geologic materials encountered at a drilling location. Borehole logs may stand alone but are often included as part of a Well Completion Report like the one shown below. During the drilling of a borehole for a soil boring, monitoring well, or water supply well, geologic materials are collected at intervals from the ground surface to the total depth of the bore-

ORIGINAL File with DWR 449 00064		STATE OF CALIFORNIA WELL COMPLETION REPORT		DATE USE ONLY - DO NOT FILL IN					
Page 1 of 6		Owner's Well No. Rio Hondo #1		No. 767115					
Date Work Began 12/9/97		Local Permit Agency		Permit Date					
Orientation (Z): <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> HORIZONTAL <input type="checkbox"/> ANGLE (DEGREE) <input type="checkbox"/> (SPECIFY)		Name WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA		Mailing Address 12621 E. 166th St. CA 90703					
Method Hydraulic Mud Rotary		City Cerritos		State CA					
Description		Address		WELL LOCATION					
FL. SURF. TO FL. SURF. Describe material, grain size, color, etc.		City Los Angeles		APN Book Page Parcel					
0 - 40 Sandy clay, v. fine to v. coarse sand w/ some clay.		Township		Section					
40 - 100 Sand, medium sand to granular pea gravels, some clay		Latitude 33 58 29 north		Longitude 118 08 52 west					
100 - 140 Sandy clay, fine to v. coarse sand		Longitude		ACTIVITY (Z):					
140 - 200 Sand, fine to v. coarse sand, pick up lots of gravels		EAST		<input checked="" type="checkbox"/> NEW WELL					
200 - 240 Clayey silt, fine to med. sandy clayey silt		WEST		<input type="checkbox"/> MODIFICATION/REPAIR					
240 - 290 Silty sand, fine to v. coarse sand w/ silt, poorly sorted		SOUTH		<input type="checkbox"/> DRIPPER					
290 - 320 Sand, med. to v. coarse sand, some gravelly sand		Illustrate or Describe Diameter of Well from Borehole, Borehole, Screen, Riprap, etc. (Attach Log if available)		<input type="checkbox"/> OTHER (SPECIFY)					
320 - 520 Gravelly sand, granules to cobbles, silt and clays, angular fragments		WATER LEVEL & YIELD OF COMPLETED WELL		DEPTH TO FIRST WATER (FT) BELOW SURFACE					
520 - 540 Gravelly clay and sand, well sorted sand		DEPTH OF STATIC WATER LEVEL (FT) & DATE MEASURED		DEPTH OF STATIC WATER LEVEL (FT) & DATE MEASURED					
540 - 560 Gravelly silty sand, med. to poorly sorted		ESTIMATED YIELD * (GPM) & TEST TYPE		TEST LENGTH (MIN) (GPM) TOTAL DRAWDOWN (FT)					
560 - 640 Gravelly sand, silt to v. coarse sand, poorly sorted		* May not be representative of a well's long-term yield.							
640 - 660 Silty sand w/ gravel, fine to coarse sand, poorly sorted									
660 - 840 Gravelly sand, fine to coarse sand, subangular to subrounded									
840 - 1000 Slightly gravelly sand, v. fine to med. sand, some silt									
1000 - 1060 Silty silt, v. fine to fine sand w/ clay									
1060 - 1100 Silty sand, v. fine to coarse sand w/ clay, poorly sorted									
1100 - 1160 Gravelly sand, fine to v. coarse sand, some shells and wood									
TOTAL DEPTH OF BORING 1160 (Feet)									
TOTAL DEPTH OF COMPLETED WELL 1130 (Feet)									
DEPTH FROM SURFACE		CASING (S)				DEPTH FROM SURFACE		ANNULAR MATERIAL	
FL. TO FL.	BORE HOLE DIA. (INCH)	TYPE (I.C.I.)	MATERIAL / GRADE	INTERNAL DIAMETER (INCH)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (INCH)	FL. TO FL.	CE. MENT (FOUR) (I.C.)	TYPE (FOUR) (I.C.)
0 - 198	12.25								
198 - 759	9.875								
759 - 1160	8.5								
0 - 1160		X	PVC	2		schd 80			
1160 - 1130		X	PVC	2		schd 80	0.020 x 1.2		
ATTACHMENTS (Z):		CERTIFICATION STATEMENT							
<input checked="" type="checkbox"/> Geologic Log		I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.							
<input checked="" type="checkbox"/> Well Construction Diagram		NAME United States Geological Survey (858) 637-9005		ADDRESS 6735 Keamy Villa Rd, Suite 0		CITY San Diego		STATE CA	
<input checked="" type="checkbox"/> Geophysical Log(s)		PHONE (619) 594-1111		ADDRESS 6735 Keamy Villa Rd, Suite 0		CITY San Diego		STATE CA	
<input checked="" type="checkbox"/> Software Chemical Analysis		ADDRESS 6735 Keamy Villa Rd, Suite 0		CITY San Diego		STATE CA		ZIP 92123	
<input checked="" type="checkbox"/> Other On File @ USGS San Diego		ADDRESS 6735 Keamy Villa Rd, Suite 0		CITY San Diego		STATE CA		ZIP 92123	
ATTACH ADDITIONAL INFORMATION IF IT EXISTS		SIGNATURE <i>Joseph Montville</i>		DATE SIGNED		CST. GENE NUMBER			
		5/18/11 10:54:07		IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM					

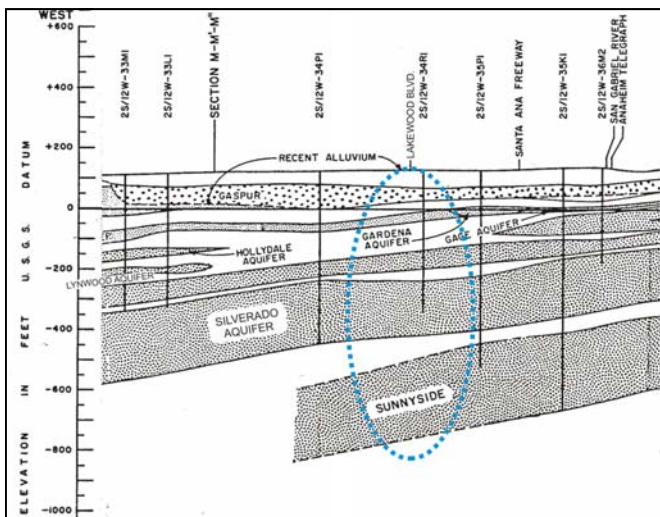
hole and described by a geologist, engineer or well driller. Sampling methods and the quality of descriptions vary widely based on the level of effort and qualifications of the person logging the data. Descriptions can range from as

simple as “from 275 to 300 feet: Sand” to highly detailed descriptions of grain-size, color, sedimentary structure, and fossil assemblage. Most water supply wells, monitoring wells, and oil wells have a borehole log which was prepared during drilling.

Geophysical logs are often produced along with borehole logs. These logs are plots of various types of measurements of the physical properties of the geologic materials and groundwater in the borehole. The measurements are made by lowering instruments down the borehole and are plotted by depth starting from the top and continuing downwards. The sample at the right shows the most common geophysical logs including gamma ray, spontaneous potential and electrical resistivity. Generally, higher resistivity indicates coarser geologic materials and higher gamma and spontaneous potential indicate finer materials. There are other types of geophysical logs, many developed for oil exploration. Although geophysical logs are complicated and requires interpretation by a geologist or engineer, they can provide invaluable information in planning and constructing a well.



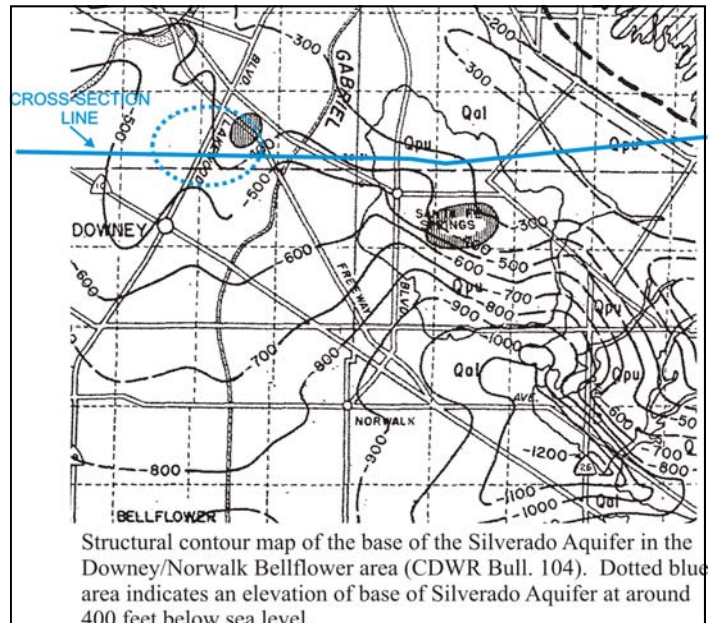
Cross-sections may be the easiest tool to help visualize the geologic subsurface. The depths to tops and bottoms of aquifers and aquitards are easily seen. Scales indicating depths and/or elevations are provided along with some surface features.



Hydrogeologic cross-section running west to east though the Downey/Santa Fe Springs area. Sand and Gravel Aquifer (stippled) Are Shown Separated by silt and clay Aquitards (white)

Cross-sections are built from nearby borehole and geophysical logs along straight or sometimes segmented lines on a map. The example above shows a portion of a geologic cross-section through the Downey/Santa Fe Springs area. Local aquifers are shown and provide an indication of the depths where water might be encountered.

Structural contour maps in CDWR Bulletin 104 include thicknesses and base elevations of the main aquifers in the CWCB. The maps can be used to determine the approximate depths to the tops and bottom of aquifers at a location, especially when there is no cross-section nearby. The structural contour map below illustrates a portion of the elevation contours of the base of the Silverado Aquifer in the Downey/Norwalk/Bellflower area. A location is indicated at



the intersection of Lakewood Boulevard and Interstate 5 which is very near a contour line with a value of 400 feet below mean sea level (an approximate depth of 525 feet).

Summary

By locating and utilizing existing geologic information available on the CWCB, significant predictions can be made regarding planning the depth of drilling and the construction design of a new water supply well. This information may also help with determining a location, developing bid specifications, and selecting a drilling method for a well. WRD hydrogeologists and engineers can assist in identifying and interpreting relevant information discussed in this Bulletin.

Well logging and zone testing techniques have advanced over recent years. Additionally, oil field technologies have been transferred and applied to the groundwater supply industry and can be used to supplement the traditional information.



12621 E. 166th Street, Cerritos, California 90703
 Phone : (562) 921-5521
 Fax: (562) 921-6101