California Department of Parks and Recreation
Natural Resources Division

Groundwater Monitoring at Wilder Ranch State Park

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by
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I. Introduction

The effect of fluctuating groundwater levels on stream watercourses in Wilder Ranch State Park is the main investigative concern of this study. Wilder Ranch State Park is notable because it encloses two other properties: the Santa Cruz City Landfill and Granite Rock Sand Quarry. Both properties affect groundwater in the park. For example, the city landfill has potential to pollute aquifers through leachate infiltration. In 1989 Brown & Caldwell Consulting Engineers had groundwater samples from the city landfill area analyzed (Maroney 1989). Concentrations of benzene and toluene exceeded the state action level of 1.0 ug /L in some wells. The sand quarry pumps large quantities of groundwater from a single well for its operation. Agriculture is also practiced year round on most of the parkland between Highway 1 and the Pacific Ocean. Along this coastal terrace many groundwater wells have been drilled at various sites, and groundwater pumping for agricultural irrigation has been practiced for years.

As water is pumped from an aquifer, a cone shaped depression in the water table is created (Keller 2000). If the rate of aquifer recharge is slower than the rate of extraction, a long term depletion of the water table will result, which may affect the level of associated surface water. In the case of wells situated close to marine waters, the long term effects of a depleted water table may lead to saltwater intrusion in both ground and surface waters. Long term groundwater depletion is occurring at Wilder Ranch State Park, amounting to about "a few hundred acre feet per year" (Landino, interview). This has created a “pumping trough” that extends an average of about 100ft. below sea level. The level of this "trough" fluctuates each year, as water is extracted in the growing season and recharged in the winter. It is assumed that a mudstone layer, has protected the aquifer from saltwater intrusion, but lack of a full knowledge of the subsurface geology precludes an assumption that this won’t happen in the future.

The lower reaches of the perennial streams in Wilder Ranch State Park form small estuaries near the ocean. These small ecosystems have their own unique flora and fauna, including the potential role of nursery for fish species. To assure that these waters are not adversely affected by the overdraft of local groundwater, a program for monitoring groundwater is being implemented.

The objectives of this study are to:

1.) Locate each operational well on Wilder Ranch State Park.
2.) Record who operates each well and what the water is used for.
3.) Determine trends in water pumping for each well and amount of water being drawn over time.
4.) Record what geologic layers are present and which aquifer is being drawn by each well.
5.) If possible, keep track of aquifer levels for each well.

Because of prohibitive costs, this study was not completed. However, data was acquired and information gathered to assist in planning for possible future monitoring. This paper chronicles the actions taken and the results found.

II. Actions

The following is a list of the actions taken from April 2001 to May 2002:

- Reviewed information gathered by Tamara Sasaki, IMAP Associate Ecologist that included well driller records, various reports and letters concerning groundwater concerns in the Santa Cruz area, notes of an interview with well driller Dave Landino, and a primer on groundwater hydrology.
- Communicated with three hydrologists concerning the development of a monitoring program at Wilder Ranch State Park.
- Contacted Vic Roth at the Santa Cruz district office and got a list of agricultural leasees in Wilder Ranch State Park.
- Contacted some of the farmers on Wilder Ranch State Park, including Jon Steinberg, Bill Rodoni, Mario Rodoni, and Mac Morelli. Gathered some general information on well locations, depths, pumping rates, etc.
- Located the eleven groundwater wells being used on leased land in the park.
- Used the Trimble GPS unit to get locations of each well recorded for later downloading into a GIS-based map. Also took photographs of the four cardinal directions around each well to aid in locating later.

III. Findings

A.) General information on groundwater aquifer and groundwater usage.

From some of the reports, talks with Mario & Bill Rodoni, and notes from an interview with Dave Landino, the following information was gathered:

1.) There are two water-bearing strata in Wilder Ranch State Park, Santa Margarita Sandstone and an area of marble karst in the Wilder Creek area. Santa Margarita Sandstone is up to 250 ft. thick. The aquifer recharge area is between Dimeo Rd. & Wilder Creek, and includes the sand quarry.
2.) Groundwater movement averages about 3.7 miles /day. The angle of underground water movement is about 12 degrees from the recharge area (between Dimeo Rd. and Wilder Creek) toward the ocean. Permeability of the strata is considered good, with the sandstone being coarser beneath the area of Wilder Ranch State Park (Weber & Hayes 1989).
3.) Over many years of groundwater pumping, the aquifer level has dropped, creating a “trough” that extends about 100 ft. below sea level, within a couple thousand feet of the ocean. The center of this trough is located approximately under Sandy Flat Gulch. Since the area farmers grow non-salt tolerant crops, there are concerns of possible saltwater intrusion. However, a problem hasn’t occurred up to now. The presence of a mudstone layer is thought to block off intruding seawater. Because there has been no aggressive monitoring program

to study this, it is unclear whether or not this may become a problem in the future (Weber & Hayes 1989).

4.) Although the long-term depletion of groundwater is "a few hundred acre feet/ year," Dave Landino thinks the aquifer is close to balance. However, he is concerned with the threat of further depletion caused by the use of Granite sand quarry's new well, drilled on the terrace above Wilder Creek estuary. Those concerns involve the possible effects on the estuary's water table.
5.) Past surveys (Harvey & Stanley Associates 1982) have indicated the potential for steelhead spawning in Majors and Baldwin Creeks. A recent survey indicated the presence of steelhead in Wilder Creek (Kanamoto 2002).
6.) In order to determine whether the pumping of the aquifer beneath Wilder Ranch State Park is affecting the water tables of the permanent streams, a monitoring program would be necessary.
7.) According to Mario Rodoni, the high period of groundwater pumping is July – September. All wells but one have casing, and all are sealed on the top 25 – 50 feet.

B.) Developing a groundwater monitoring program.

The following information is based on personal communication with three hydrologists: Brannon Ketchum (National Park Service), Dr. Timothy Horner (California State U., Sacramento), and Dr. Thomas Harter (U.C. Davis). Since the main concern of groundwater monitoring is the potential effects of groundwater depletion on the water tables of streams, the following information is a basic plan for developing a means to monitor both the groundwater wells in the park, and the three permanent streams in the park.

1.) Map the locations of all operating wells in relation to stream courses.
2.) Develop a cross-section of each well and know permeablility of layers. Are there any closed aquifers? Look at drilling records to see if there are any impermeable layers in wells close to streams. These wells may influence stream water tables.
3.) Know at what depth each wells are screened. This will also help to tell whether wells near a stream could potentially draw water from the stream's water table. An example would be Granite sand quarry's well near the estuary of Wilder Creek.
4.) Contract a professional hydrologist to oversee the placement of monitoring wells and a monitoring program for Wilder Ranch State Park.
5.) Drill a series of monitoring wells positioned between the stream and the closest groundwater well. Five to ten monitoring wells for each stream. That makes a total of 15- 30 wells for Wilder Ranch State Park, to cover the three permanent streams: Majors, Baldwin, and Wilder.
6.) The monitoring wells should be drilled to a depth of 20 – 30 feet. Cost for drilling is about $40 - $70/ foot. Total cost per well can range from $2000 - $10,000. That makes a total cost range of $30,000 - $300,000 for establishing monitoring wells.

7.) Once the wells are in place, a monitoring routine should be established. It is important to monitor the total volume of groundwater pumped per year, along with water level measurements for both the groundwater aquifer and the stream water tables. A correlation will be looked for, to see if groundwater pumping is affecting the water table levels.
8.) It is possible to connect a totalizing flowmeter to each of the groundwater wells in the park, to quantify water volume pumped each year. Cooperation from the farmers would be necessary, of course.
9.) A water level meter can be used to measure water levels every 6 months (spring and late fall). These can be purchased for $300 - $800. Also monitor water levels after times of heavy pumping during the growing season to look for short-term effects of pumping on the streams. Again, cooperation from the farmers would be necessary, as one would need to know their irrigation schedules.

C.) Data summary of groundwater wells at Wilder Ranch State Park

1.) Features of each groundwater well are found in Appendix A of this report. Most of this data was taken from well driller reports or word-of-mouth from farmers.

2.) Cross-sections were available for a few groundwater wells. These are from available well drillers reports. Data from these reports is sketchy.

Well # 11S/2W- 18L1 (HWY 3)

0 – 3 ft.	Top soil
3 – 250 ft.	Fractured brown shale
250 – 275 ft.	Gray sand, fine
275 – 350 ft.	Gray sand & white clay
350 – 380 ft.	Gray sand, fine
380 – 405 ft.	Gray clay & brown shale

Well # 11S/2W- 21C1 (HWY 1)

0 – 4 ft.	Black top soil
4 – 15 ft.	Yellow shale
15 – 40 ft.	Green shale
40 – 58 ft.	Yellow sand
58 – 115 ft.	Green-black shale
115 – 190 ft.	Gray sandstone
190 – 200 ft.	Free gray sandstone 1/8”
200 – 274 ft.	Gray sandstone

Well # 11S/2W- 21G2 (GSQ1)

0 – 2 ft.	Topsoil
2 – 16 ft.	Brown shale
16 – 140 ft.	Black shale
140 – 182 ft.	Shale & clay
182 – 206 ft.	Shale
206 – 290 ft.	Blue sand
290 – 314 ft.	Limestone

Well # 11S/2W-21F2 (SGE1)

0-3 ft.	Topsoil
3-33 ft.	Shale
33-55 ft.	Sandstone/ Mixed shale
55-225 ft.	Shale
225-275 ft.	Sandstone/ Mixed shale
275-325 ft.	Soft sandstone
325-335 ft.	Shale
335-355 ft.	Free sand
355-380 ft.	Mixed sandstone & shale

Well 11S/2W-21F3 (SGE2)

0-162 ft.	Brown-green shale
162-195 ft.	Fine grey sand
195-228 ft.	Brown-green shale
228-395 ft.	Grey sand & sandstone (very fine to fine)

IV.) Data Management

Accompanying this report is a CD containing

- A copy of the report Groundwater Monitoring
- A copy of the Excel file containing data on the groundwater wells.
- Copies of all photographs (four cardinal directions) surrounding each well location.
- An Arcview project which includes a GIS map of Wilder Ranch State Park and all well locations. This project is hot linked to photographs of the area surrounding each well.

V.) Recommendations

1.) All possible ideas for monitoring groundwater require cooperation from the leasees that farm on Wilder Ranch State Park. Installing flowmeters on the wells is the most accurate way to monitor water usage, but for some wells

may not be possible. Because some of the irrigation water comes from reservoirs as well, and because booster pumps are used, it may not be possible to get a reliable estimate of groundwater usage.

2.) If the concern over stream water tables is serious enough, it might be necessary to hire a hydrologist to assess the problem. Professional advise would be best, and may save money over the long term. However, the lack of complete data from well drillers reports will be a problem in helping them to make an assessment.

3.) The closest wells to any permanent stream are GSQ1, located by Wilder Creek, and LGW, located in Lomabardi Gulch. These wells pose the most potential for affecting stream water tables.

VI.) References

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Maroney, Patrick. Letter to Larry Erwin. 15 October 1989. Inventory, Monitoring & Assessment files. Natural Resources Division. California Department of Parks & Recreation, Sacramento, CA.

Weber and Associates. 1989. North coast groundwater exploration program: phase I. Prepared for City of Santa Cruz Water Department.

Internet Links

UC Davis Groundwater Web Page
http://groundwater.ucdavis.edu/gwindex.htm
The Groundwater Foundation
http://www.groundwater.org/
EPA Groundwater Primer
http://www.epa.gov/seahome/groundwater/src/ground.htm

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Appendix A

Groundwater Well Data