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GEOLOGIC, HYDROLOGIC, AND HISTORIC GROUNDWATER USE STUDY OF THE SAN MATEO PLAIN, SAN MATEO COUNTY, CA

FOR:

The Regional Water Quality Control Board - San Francisco Bay Region
&
The Groundwater Protection Program - San Mateo County Environmental Health Services

BY:

James R. Peeler

PUBLIC HEALTH AND ENVIRONMENTAL PROTECTION DIVISION

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1.0 Introduction

This report is a synopsis of the work I did for both the San Mateo County Environmental Health Dept. in Redwood City, CA and the San Francisco Regional Water Quality Control Board in Oakland, CA. I worked as an intern for approximately three months gathering geologic, hydrologic, and historical water use data on the San Mateo Plain groundwater basin. This data was researched, collected, and copied and the reports now reside in Erdmann Rogge's cubicle at the San Mateo County Environmental Health Dept. In addition to the research, I also completed rough drafts of a cross section of the basin along El Camino Real between Broadway Ave. in Burlingame and San Francisquito Creek. In doing my research, I found that San Mateo County has been sort of the ugly stepchild of the Bay area counties as far as being geologically studied. Recent contamination site studies, environmental impact reports, and a couple USGS reports comprise most of the data that is available. There is very little data on the whereabouts of historic wells. This information will probably have to be gathered using a door to door survey. It is the only way I know to find most of the wells that have been drilled for domestic, industrial, and agricultural wells during the historical development of eastern San Mateo County, which dates back to the 1850's.

This internship has been very enjoyable and a great learning experience. I can't thank Gail Lee, Greg Bartow, or Erdmann Rogge enough for their help and guidance. I feel that I collected a great deal of useful material but in order for this internship to be truly successful, I hope that the 50+ reports and cross section will be utilized fully in the coming months rather than becoming dust collectors as can so easily happen.

1.1 Project Scope

The objective, as given to me, for my summer internship was to "perform research for historic and current data regarding groundwater usage, conduits, geology, hydrogeology and land use of the San Mateo Plain". In order to find this information I was instructed to contact and/or visit cities within the basin, city and county libraries, historical societies, the U.C. Berkeley Water Archives, local universities, the USGS, and the Department of Water Resources. In addition, aerial photos, historic maps, and Sanborn fire insurance maps were to be examined in the hopes of finding historic and/or abandoned wells.

I was required by San Mateo County to fill out daily activity forms as well as checking in with Greg Bartow at the RWQCB and Gail Lee at San Mateo County Environmental Health on a regular basis.

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1.2 Project Background

The overall mission of the project is to better protect the groundwater in the South Bay Basins. These basins include the Niles Cone, Santa Clara Valley and the San Mateo Plain. Well water is used extensively in all three basins as a drinking water source, for agricultural purposes, and for municipal needs. Because of this, contamination plumes and their hydrologic relation to the groundwater must be constantly monitored. In order to better understand these relations, a geographic information system is needed that presents the contamination plumes, the existing wells, and any potential conduits in an easily understood and accessible format.

The project is a joint venture between the San Francisco Bay Regional Water Quality Control Board, Alameda County Water District, Santa Clara Valley Water District, and the San Mateo County Department of Environmental Health. The Groundwater Committee is composed of individuals from each of these agencies and is primarily responsible for the project's undertaking.

1.3 Methodology

The geologic, hydrologic, and historic groundwater information was gathered from a variety of sources. These included: the Water Resource Archives at U.C. Berkeley, the geologic and map library at U.C. Berkeley, the Drinking Water Division of the California Environmental Health Department, the Department of Water Resources - Sacramento, the USGS library - Menlo Park, the Caltrans map and archive library, the San Mateo County Historical Association, the Redwood City Public Library, the San Mateo County Planning Department, the RWQCB's library and SLIC site cases repository, and the Stanford Earth Sciences library. Other locations that were investigated include: the San Mateo County Public Works Department, the San Mateo city library, the San Francisco Public Library, the Stanford main library, and the Burlingame and Millbrae city libraries. None of these locations turned up any new information.

In addition to personal visits, both phone and e-mail surveys were conducted. Some of the people contacted were: Henry Miyaschata, Loren Metzger, John Fio, Chris Farrar, and Randy Hanson - all from the USGS; Senna Hoose, Tom Mohr, and Roger Pierno of the Santa Clara Valley Water District; Lester Feldman and Tom Gavigan at Geomatrix, Lincoln King of the California Drinking Water Division, Ricardo Romagnoli at PG&E, Jason Weinstein, Bob Banks and Richard Higgins at Caltrans, and Earl James of Erler & Kalinowski. Information was also obtained from various employees at both the RWQCB- SF Bay Region and San Mateo County Environmental Health. (Table 1)

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Well data collected by myself and other San Mateo County Environmental Health employees was entered into Arcview and is available from Erdmann Rogge (S.M.County). In addition, all the wells in San Mateo County are being entered into a GPS (Global Positioning System).

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Table 1

Agency/Company	Location/Phone	Contact
Atherton Public Library	2 Dinkelspiel Station Lane Atherton, CA	
Burlingame Public Library	480 Primrose Rd. Burlingame, CA	
California Dept. of Mines & Geology	San Francisco, CA 415-904-7707	
California Dept. of Health Services Drinking Water Division	2151 Berkeley Way, Room 458 Berkeley, CA 510-540-3009	Lincoln King
California Dept. of Water Resources	1416 9 th St. Sacramento, CA 916-227-7590	
California Water Service Co.	1720 N. 1 st St. San Jose, CA 408-367-8242	Jim Simunovich jsimunovich@calwater.com
Caltrans	111 Grand Ave. Oakland, CA	Richard Higgins 510-286-5043 Bob Banks 510-286-4818 Jason Weinstein 510-780-1526
Erler & Kalinowski	1730 Amphlett Blvd. Suite 320 San Mateo, CA 650-578-1172	Earl D. James 650-655-4942
Geomatrix	2101 Webster Oakland, CA 510-663-4100	Lester Feldman 510-663-4240 Tom Gavigan 510-663-4100
Millbrae Public Library	1 Library Ave. Millbrae, CA	
PG&E	650-598-7204	Ricardo Romagnoli 650-598-7214
Raychem	307 Constitution Dr. Menlo Park, CA 650-361-5519	Jerry Jones jjones@tycoelectronics.com Tom Rooze 650-361-3714
Redwood City Public Library	1044 Middlefield Rd. Redwood City, CA 650-780-7026	
RWQCB - SF Bay Region	1515 Clay St. Suite 1400 Oakland, CA 510-622-2300	Greg Bartow 510-622-2315 Jeff Kapellas 510-622-2370
S.M. County Environmental Health	455 County Center 4 th Floor Redwood City, CA	Gail Lee 650-363-4972 Erdmann Rogge 650-363-4355

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Agency/Company	Location/Phone	Contact
S.M. County Historical Assoc.	Hamilton Ave. 650-299-0104 Redwood City, CA	
S.M. County Planning Dept.	455 County Center 2 nd Floor Redwood City, CA	Pete Bentley Sam Herzberg
S.M. County Public Works Dept.	County Center Redwood City, CA	Daniel Wang Walt Callahan
Santa Clara Valley Water District	1020 Blossom Hill Rd. San Jose, CA 408-265-2600	Tom Mohr 408-265-2607 x2626 Senna Hoose Roger Pierno
Stanford Univ. Earth Sciences Library	Mitchell Building 2 nd Floor Palo Alto, CA 650-723-2746	
U.C. Berkeley - Map and Geology Library	McCone Hall 1 st Floor Berkeley, CA 510-642-4940	
U.C. Berkeley - Water Resources Center Archives Library	O'Brien Hall 4 th Floor Berkeley, CA 510-642-2666	
U.S.G.S.	Survey Lane Menlo Park, CA 650-329-4390	Chris Farrar cdfarrar@usgs.gov John Fio h2ofocus@mother.com Randy Hanson rhanson@usgs.gov Peter Martin pmmartin@usgs.gov Loren Metzger lmetzger@usgs.gov Henry Miyaschata hideki@usgs.gov

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2.0 San Mateo Plain Groundwater Basin

2.1 Location

The San Mateo Plain is located in eastern San Mateo County, California, along the western shore of San Francisco Bay. The groundwater basin covers approximately 40 square miles with depths ranging from 20 to more than 600 feet. Cities included in the basin are: San Mateo, Foster City, Redwood City, Belmont, San Carlos, Atherton, Menlo Park, East Palo Alto, and parts of Burlingame and Hillsborough. The Westside Basin lies to the north of the San Mateo Plain and the Santa Clara Valley basin to the south. San Francisquito Creek forms most of the boundary between San Mateo and Santa Clara counties and is also the political divider between the basins. The Coast Range, west of Crystal Springs Reservoir, along with the hills west of Alameda de Las Pulgas are the major catchment area for the groundwater basin as well as being its' western boundary.

2.2 Geology

The geology of the basin is predominantly comprised of three formations and three different types of deposits. First is the Jurassic aged Franciscan Formation which forms the northern boundary of the basin. **The Franciscan appears along a NE-SW line west of Poplar Avenue in San Mateo. Greenstone, chert, and sandstone are all found here and this arm of the Franciscan divides the San Mateo Plain basin from the Westside basin to the northwest.** The Franciscan also forms the northern and central portions of the western boundary of the basin. This boundary lies roughly along Alameda de Las Pulgas except near Ralston Avenue in Belmont, where the boundary is further east along El Camino Real. The Franciscan Formation also underlies most of the basin, although more deep well data is needed in certain areas to confirm this.

The second formation found in the basin is the Santa Clara Formation – a lower Pleistocene and upper Pliocene formation comprised of conglomerate, sandstone, and mudstone in irregular and lenticular beds. (Brabb & Pampeyan, 1983) The Santa Clara Formation is only found in the northwestern and southwestern corners of the basin.

The third formation, which forms the southern portion of the western boundary of the basin, is the Butano Sandstone – a middle and lower Eocene arkosic sandstone. The Butano Sandstone contains conglomerate, mudstone and shale in addition to the dominant sand.

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The great majority of the San Mateo Plain basin is comprised of Holocene unconsolidated deposits. These deposits fall into three categories. First is Bay Mud, which is blue-grey to dark grey in color and comprised mainly of clay or silty clay with lenses of sand, gravel, and shell fragments. (Brabb & Pampeyan, 1983) Bay Mud thickens towards the Bay and reaches thicknesses of more than 100 feet along the Bay. The Bay Mud forms a major aquiclude in the basin.

The dominant water bearing deposits are the Alluvial Fan deposits. The Alluvial Fan deposits are Holocene in age and are found adjacent to the many creeks flowing west to east across the basin. These creeks include: San Mateo Creek, Laurel Creek, Belmont Creek, Pulgas Creek, Arroyo Ojo de Agua, Cordilleras Creek, San Francisquito Creek and several smaller unnamed creeks. The deposits contain unconsolidated fine-coarse grained sand, silt, gravel and clay in all combinations. Generally, the gravel is found closer to the creeks and the clay furthest from the creeks. Water is found in lenses containing sand or gravel while the silt and clay form aquicludes above and below the larger grained material. The lenses come in all sizes and are hard to follow even over short distances.

The third type of deposit is the Basin deposit. The Basin deposits are also Holocene in age and they are comprised of unconsolidated fine sand, silt and clayey silt. (Brabb & Pampeyan, 1983) The Basin deposits are generally found adjacent to the Bay Mud, east of the Alluvial Fan deposits. Some of these deposits are water bearing.

There are two named faults in the San Mateo Plain basin. The Belmont Hill Fault which starts in Belmont and runs southeast through San Carlos and Redwood City to Highway 84 and the Pulgas Fault which starts in Redwood City and runs adjacent to Alameda de Las Pulgas past the county line. The Pulgas Fault is very likely a major determiner of the western boundary of the basin. Both faults are part of the San Andreas Fault System but neither are considered active.

3.0 Findings

3.1 Historic Findings

In researching the San Mateo Plain basin, I unfortunately found that very little historic well information has been published or is available from traditional sources. While several hydrologic studies have been conducted for both Alameda and Santa Clara counties, no historic studies were done for eastern San Mateo County. W.O. Clark's *Ground Water in Santa Clara Valley, California* is an excellent resource for Santa Clara County but his research barely crosses San Francisquito Creek. Both Daniel Sokol and the U.S. Dept. of Agriculture did studies of San Francisquito Creek but this data is only good for the southernmost region of the basin. Historical books written on the region don't include geologic

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or well data. Since the late 1960's, when the California Dept. of Water Resources published *Bulletin No. 118-1*; additional research has been done on individual cities in the basin such as Atherton or individual sites like Redwood City Harbor. The majority of studies are either done as part of Environmental Impact Report's or as site cleanup studies or recent USGS studies. All of these are post 1965 as well. Cumulatively, these reports give a good picture of the geology and hydrology of the basin but the data must be pieced together from the 50+ reports collected in order to see the basin as a whole. These reports are listed in the References section of this paper and the majority of them can be found in Erdmann Rogge's cubicle at San Mateo County Environmental Health.

The most important information locations are the Water Resource Archives at UC Berkeley, the Maps and Geologic library at UC Berkeley, the USGS library in Menlo Park, the Dept. of Water Resources in Sacramento, the Earth Sciences Library at Stanford, the San Mateo County Historical Association in Redwood City, and the San Mateo County Planning Dept. The Water Resource Archives contains just about every book written on water issues as well as all government reports related to water and a large assortment of maps. The Berkeley Maps and Geologic library has all the Sanborn maps for California on microfiche. These maps are most helpful if a specific well is being sought. To go through all the Sanborn maps generally looking for wells is very tedious and for the most part unproductive. I only saw a couple artesian wells on the lot parcel plans while looking through at least a hundred pages of lot plan views. The Sanborn maps were divided into lots for fire insurance purposes. The Berkeley Maps library also contains the most extensive set of geologic, road, and historical maps of any location I have ever visited. In addition, there are 10-20 sets of aerial photos covering all of California. Unfortunately, San Mateo County was one of the few areas not covered as extensively and when it was covered, it was from such a high altitude that wells cannot be located or the photos were so large as to be unmanageable. The USGS library contains all the Open File Reports and Water Resource Initiatives that have been conducted by the USGS as well as geologic maps, government water reports, and much more. It is a great resource. Although I never visited the Dept. of Water Resources, Erdmann Rogge from San Mateo County Environmental Health did, and he copied all the well records for the county. These, too, are an invaluable resource. The Stanford Earth Sciences Library contains much of the same information as the Berkeley Maps and Geologic library. It also houses all the theses ever written for the Stanford Earth Sciences Dept. Another bonus of this library is it contains a copy machine capable of copying full size maps. It was the only such copier I came across. The San Mateo County Historical Association contains an extensive collection of historical maps and books on the county. Water towers can be seen on a couple maps and there may be other well indicators on the maps. The archives is only open Tuesday – Thursday, 10:00 – 4:00. This location deserves another visit. The San Mateo County Planning Dept. is located on the 2nd Floor of the same building housing Environmental Health. It contains at least one set of aerial photos for the county as well as having a good library containing EIR's

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and other studies done in the county. There are also several studies pertaining to different parts of the San Mateo coast which may be valuable to Charlotte Hedlund in her current investigation.

3.2 Geologic Findings

After doing my research and collecting the various studies that had been done on different parts of the San Mateo Plain, I was asked to do a cross section of the basin. I collected the soil borings done by Caltrans for highways 101, 84, 92, and 82 – El Camino Real. These along with domestic and monitoring well logs from near these same highways were used for the cross section I did and will be used for future ones as well.

The well logs and cross section along El Camino Real made several geologic aspects more clear. First is the division between the San Mateo Plain basin and the Westside basin to the northwest. **There are two bedrock highs and one narrow basin dividing the two larger basins. The more northerly bedrock high is located beneath Burlingame Ave. in Burlingame. The bedrock here reaches an elevation of -40 ft. before dropping off to -150 ft. beneath Peninsula Ave., just to the southeast. Southeast of here is the bedrock high associated with Coyote Point which runs west of Poplar Ave. in San Mateo. This should be considered the divide between the two groundwater basins. Southeast of Coyote Point begins the San Mateo Plain basin. The bedrock drops off sharply in this region beneath El Camino Real. It reaches a depth of approximately -330 ft. beneath the Highway 92 interchange.** South of here, the Franciscan bedrock of the Belmont and San Carlos hills narrows the basin significantly. Below Ralston Ave., in Belmont, the bedrock comes to within 40 feet of the surface. Along El Camino Real, the bedrock then gradually dips down as you move toward San Francisquito Creek, which is the county line. Beneath the creek, the Butano Sandstone bedrock is found at a depth of greater than -600 ft. in this region.

San Francisquito Creek forms both the county boundary and the political basin boundary between the San Mateo Plain basin and the Santa Clara Valley basin. From our data, this boundary has nothing to do with the geology. The two political basins are one geologic basin underneath the creek. The bedrock continues to be found at lower elevations as you continue into Santa Clara County. San Francisquito Creek also appears to have been the major drainage for this region during the last couple of glacial periods when this region was a lot wetter than it is now. Beneath the creek in East Palo Alto, there are more than 1200 feet of sediments that have been deposited in the last million years.

As far as sediments in the basin beneath El Camino Real, gravel and gravelly clay lenses dominate the lower half of the basin while sand, silt, and clay lenses are more plentiful in the upper half. This probably corresponds to the drying of the climate since the last glacial period and the accompanying lessening of total runoff and the velocity of the runoff. As the cross sections for Highways 101, 84, 92 and

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Alameda de Las Pulgas are completed in the upcoming months, a better picture of the basin as a whole will come into view.

3.3 Well Findings

The Groundwater Protection Program employees of San Mateo County Environmental Health have done a mammoth job in locating thousands of wells in the county. At least 3093 wells have been identified so far. The wells break down as follows: 396 agricultural wells, 25 cathodic protection wells, 497 domestic wells, 52 industrial wells, 49 improperly abandoned wells, 294 properly abandoned wells, 1 dry well, 1704 monitoring wells, and 75 wells that fit into the "other" category. The wells are currently being GPS'd so that the information can be better utilized. After attending the Groundwater Committee public input hearings in June, and talking to various county citizens, it has become obvious that there are many more wells yet to be found. San Mateo County was a predominantly agricultural region until the 1960's and agriculture requires a lot of water and therefore wells.

4.0 Future Work

Because the Dept. of Water Resources didn't require well logs until the 1970's there are probably tens to hundreds of undocumented domestic and agricultural wells in the San Mateo Plain basin. A door to door survey is the only way I know to locate these wells. Using volunteers from the AARP, like the City of Menlo Park did, seems like the least intrusive and therefore most likely successful way to collect this data. Most of these unidentified wells were probably not destroyed properly if they were destroyed at all. Because of the conduit potential of these wells, this survey should be done as soon as it is possible, keeping in mind budget restraints.

Other work that needs to be done is completing the cross sections for Highways 92, 84, 101, and Alameda de las Pulgas. These along with the San Mateo – Hayward and Dumbarton Bridge cross sections will give a good view of the overall depth of the basin as well as helping identify the multitudes of sediment lenses which make up the basin. Water bearing zones should be able to be identified and then by overlaying a contaminant site map, a priority cleanup list may be able to be generated. Gail Lee, from San Mateo County Environmental Health, suggested that the cross sections also be published. This is a great idea. The Caltrans bridge borings should be used to help identify the eastern margin of the groundwater basin, for which there is very little data at this time.

Activities that I did not have a chance to get to include: going over the aerial photos of the county that the San Mateo County Planning Dept. possesses, doing additional research for valuable historical

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documents and maps at the San Mateo County Historical Association, copying the useful parts of many of the SLIC site files located at the Regional Board – Oakland and in the San Mateo County Environmental Health's archives, further pursuing the locations of PG&E's cathodic protection wells, and visiting the city of Atherton's government office which houses their well records. Both the USGS library and UC Berkeley's Water Resource Archives are locations that can be visited over and over to obtain more data depending on how one words his/her computer search.

Overall, I feel I did an admirable job in collecting as much information as I did in three months. With more time, more data on the San Mateo Plain basin may be collected and there are currently geologic investigations going on in the region. Loren Metzger at the USGS is a good person to keep in touch with as far as keeping up with these investigations.

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5.0 References

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PUBLIC HEALTH AND ENVIRONMENTAL PROTECTION DIVISION

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