CITY OF BEVERLY HILLS

PUBLIC WORKS SERVICES DEPARTMENT

MEMORANDUM

TO: PUBLIC WORKS COMMISSION

FROM: Michelle Tse, Senior Management Analyst MT

DATE: November 13, 2014

SUBJECT: 2009 Shallow Groundwater Study

ATTACHMENT: 2009 Shallow Groundwater Study

Mr. Slade will be in attendance to provide historical information relating to a shallow groundwater study he completed in 2009 for the City. Attached is a copy of the report. This background information may be helpful as the Public Works Commission and staff review and develop the City's Water Enterprise Plan document.

RICHARD C. SLADE & ASSOCIATES LLC
CONSULTING GROUNDWATER GEOLOGISTS

HYDROGEOLOGIC FEASIBILITY STUDY AND PRELIMINARY DESIGN REPORT FOR DEVELOPMENT OF SHALLOW GROUNDWATER NEAR WATER TREATMENT PLANT BEVERLY HILLS, CALIFORNIA

PREPARED FOR
PUBLIC WORKS DEPARTMENT
CITY OF BEVERLY HILLS

PREPARED BY
RICHARD C. SLADE AND ASSOCIATES LLC
CONSULTING GROUNDWATER GEOLOGISTS
STUDIO CITY, CALIFORNIA

JOB NO. 162-LAS05

JANUARY 2009

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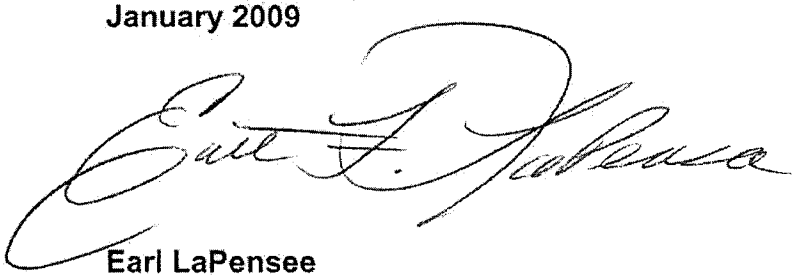

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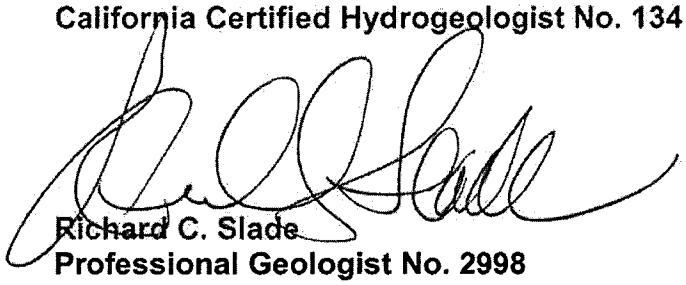

Richard C. Slade
Professional Geologist No. 2998

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INTRODUCTION

GENERAL STATEMENT

Provided in this document are the results of our Phase 1 hydrogeologic assessment of the feasibility for the City of Beverly Hills (City) to develop shallow groundwater in the vicinity of the City's Water Treatment Plant (WTP) and the preliminary design of the initial shallow water wells that may be constructed as part of the overall project. These new shallow wells, if feasible, would be designed and constructed as municipal-supply water wells, and would be used to augment the City's current groundwater supplies available from its existing 4 deep water-supply wells that were sited, designed and constructed by others in the 1990s. The groundwater pumped by the possible new shallow water wells is to be conveyed by a new pipeline to the City's existing Water Treatment Plant (WTP) located along the west side of Foothill Rd, just south of Santa Monica Blvd. Figure 1, "Location Map," provides the general study area for the possible siting of the new shallow water wells, along with the locations of the following:

- The City's existing deep water-supply wells.
- Several now-destroyed nearby wells that were formerly owned by the City.
- The City's WTP where the locally-pumped groundwater is currently treated.
- A few of the main streets in the area.

PURPOSE AND SCOPE OF HYDROGEOLOGIC SERVICES

The basic purposes of this hydrogeologic assessment were to: determine the feasibility, from a hydrogeologic perspective, of developing additional groundwater supplies for the City from shallow aquifer systems near No. Maple Drive in the City; select sites for possible new, shallow municipal-supply water wells for the City; and provide the preliminary design for those new wells.

As described in our proposal dated May 19, 2008 to Ms. Shana Epstein, Environmental Utilities Manager, of the Public Works Department of the City, our basic Scope of Services for this Phase 1 hydrogeologic assessment included the following tasks:

- Task 1 – Collect and Review Basic Data
- Task 2 – Field Reconnaissance
- Task 3 – Meetings and Liaison with Facility Owners

- Task 4 – Hydrogeologic Analyses
- Task 5 – Preliminary Design Report (PDR)
- Task 6 – Engineering Input
- Task 7 – Meetings and Liaison with City

FINDINGS

GENERAL STATEMENT

Presented in this hydrogeologic feasibility study are our analyses of available groundwater data and subsurface data, and our preliminary design of one or more possible new water wells that may be constructed by the City to extract shallow groundwater in the project area. All groundwater pumped by these new wells would be directed via a new pipeline to the City's nearby WTP (see Figure 1), where it would be treated, as needed; this water would then be used by the City to augment its current groundwater supplies available from the series of deep wells constructed in the mid-1990s.

Technical Specifications for the eventual drilling, construction and testing of these possible new shallow water wells will be prepared by RCS under separate cover, and will be based on the data and recommendations provided in this report. From our prior discussions and meetings with the City, RCS understands that a combined total production rate of perhaps a few hundred gallons per minute (gpm) would be desired by the City from a series of these new shallow water wells.

RAINFALL CONDITIONS

Because rainfall has a very important impact on water levels and hence on the availability of groundwater in the shallow aquifer system in the study area, RCS acquired rainfall data available from the Los Angeles Civic Center raingage and determined annual totals (on a calendar year basis) for a period of record dating between 1914 and 2006. These data, which are shown as a bar graph for each year of annual rainfall on Figure 2A, "Annual Rainfall Totals," display a long-term average annual rainfall of 14.90 inches at this Civic Center gage. To help identify possible trends in annual rainfall over the years, RCS further created the graph shown on Figure 23, "Accumulated Rainfall Departure Curve," using the data from the Civic Center

raingage. This graph illustrates the accumulated departure of each year of annual rainfall from the long-term average annual rainfall (14.90 inches from Figure 2A) at this gage.

Review of Figures 2A and 2B reveals the following:

a. annual rainfall totals have fluctuated greatly over the period of record, ranging from a low of 4.08 inches in 1953, to a high of 34.04 inches in 1983. The long-term average annual rainfall has been 14.90 inches.

b. The accumulated rainfall departure values are plotted for each year relative to that long-term average annual rainfall for the subject raingage. The zero line on the accumulated departure curve represents the long-term average rainfall points; data points above this zero line represent years of excess precipitation whereas points below that line represent years of deficient precipitation, relative to the long-term average. The purpose of the accumulated departure curve is to illustrate temporal trends in the rainfall data. For example, the slopes of the curve declining to the right-hand side of the graph (negative slopes) indicate those years where accumulated rainfall departure totals are declining, relative to the long-term average; these declining trends represent general periods of deficient rainfall or a "typical dry period." Conversely, those portions of the curve ascending towards the right-hand side of the graph (positive slopes) indicate years where accumulated rainfall departure totals are increasing, relative to the long-term average; in essence, these rising trends represent general periods of excess rainfall, or a "typical wet period."

   The Figure 2B graph shows a series of years during which precipitation was declining relative to the long-term average: for example, from 1944 through 1964 and also from 1983 through 1992. These years are considered relatively "dry" hydrologic periods, and indicate that drought conditions prevailed during those time periods. However, the curve generally ascends to the right from 1964 through 1983, and from 1992 through 2006, indicating relatively "wet" hydrologic periods.

LOCAL HYDROGEOLOGIC CONDITIONS

The local shallow aquifer system consists of complexly interlayered and interfingered layers and lenses of gravel, sand, silt and clay. For the most part, these earth materials are considered to be unconsolidated to poorly consolidated; permeability ranges from moderate in the coarser-grained sands units to very low in the clay layers and/or in the layers that have abundant clay in the void spaces between the individual sand/gravel grains.

In essence, this shallow aquifer system is considered to represent geologically young alluvial sediments. Groundwater in these shallow sediments is considered to occur under water table conditions and strictly within the void spaces between the sand and gravel grains. The cause of groundwater occurring at shallow depths in this area may relate to the existence and alignment of a branch of the Hollywood-Santa Monica fault zone. Basically, groundwater moving

south/southwest from the mountain front of the Santa Monica Mountains (roughly along Sunset Blvd) would tend to encounter this fault; because faults tend to be infilled with clay-rich fault debris (known as gouge), the continued southerly movement of groundwater would be impeded by this gouge and the groundwater would tend to rise up into the more shallow alluvial-type sediments; that is, the groundwater tends to "back-up" on the northern side of this fault. Thus, this fault acts like, at least, a partial barrier to the normal north to south groundwater flow across the region.

Review of geotechnical studies (foundation investigations) conducted at several nearby properties for the eventual construction of new buildings, as provided to RCS by the City, reveals the following regarding the shallow earth materials and shallow groundwater conditions in the study area:

REVIEW OF LOCAL SUBSURFACE DATA

Based on review of available records and data, RCS has encountered four different but important sources of information on local subsurface geologic conditions. Specifically, these sources include: driller's logs from nearby, now-destroyed City-owned water wells (the four Foothill wells) and from nearby privately-owned wells; data from currently existing City wells in the area; foundation investigation reports (i.e., geotechnical studies) for the design of new buildings in the area (these reports were requested from and provided by the City of Beverly Hills Public Works Department); and data in RCS files from a test hole drilling project at a nearby hospital. Details of the RCS review of these four data sources are provided below.

Driller's Logs for Nearby Destroyed Wells

At least four municipal-supply water wells were historically constructed for the City at/near the City's former water treatment plant located at 342 Foothill Rd (basically, this former plant site was across the street from the existing WTP). These four wells were known as Foothill Well Nos. 1, 2, 3 and 4. Table 1, "Summary of Driller's Log Data, Nearby Destroyed Wells," provides a brief summary of key information for former City-owned and privately-owned wells near Foothill Rd, the Los Angeles County Flood Control District (LACFCD) well number, the owner's name, the owner's reported well name/number, the date of well construction, the well depth and depth to the uppermost perforations, and a summary of the driller's log information for the earth materials logged by the driller at the date of borehole drilling between the approximate depths of

50 ft and 190 ft. This depth zone was considered by RCS to represent the maximum possible depth zone for potential casing perforations in the proposed shallow water wells for the City. Along with information for the nearby City wells, Table 1 also provided similar information, as available, for proximal but now-destroyed wells owned by private parties. Noteworthy is that there are no records available to document if and/or how any of these proximal wells owned by the City and/or by the private parties were permanently and properly destroyed. Figure 1, illustrates the approximate locations of these older, now-destroyed wells, City-owned Foothill wells.

From Table 1, Foothill Well Nos. 1 and 2 were both constructed in 1931, whereas Foothill Well Nos. 3 and 4 were constructed in 1953. Although the available log data are somewhat contradictory, these four wells appear to have ranged in total depth from 616 ft (Foothill No. 3) to 692 ft (Foothill No. 4); the uppermost perforations in these wells ranged from 198 ft in Foothill No. 3 to 237 ft in Foothill No. 2 (no data are available to document the depth to the uppermost perforations in Well No. 1.). None of these Foothill wells were perforated in the shallow depth zones that are of interest to this current hydrogeologic feasibility study; no reasons for this lack of shallow perforation in these wells are available on the original logs or in the historic database.

The summary of the driller's log for three of the four destroyed City wells on Table 1 (no driller's log is available for Foothill No. 2) reveals that potential aquifer zones (sand and/or gravel layers) appear to occur in the RCS-selected depth zones of interest for this project (±50 ft to ±175 ft). In some cases, the driller-reported sand and gravel zones contain clay (driller's terms like "sandy clay" or "gravel streaks in clay"). Other earth materials reported by the respective drillers in the depth zones of interest for this project.

Driller's Logs for Current City Wells

In the mid-1990s, the City retained a consultant to locate, drill, and construct new municipal-supply wells in the City; the locations of these newer wells are shown on Figure 1. As seen thereon, the nearest existing City-owned water wells that actively pump to the WTP are No. 4 to the northeast, No. 6 to the south, and No. 5 to the west. Because Well No. 2 lies more distant to the northeast along Santa Monica Blvd, RCS is not including a discussion herein of the shallower sediments logged by the geologist during drilling of its pilot borehole.

Review of the geologic logs of the pilot boreholes for the three closest City wells reveals the following for the earth materials in our ±50-foot to ±175-foot depth zone of interest for this hydrogeologic feasibility study (the wells are described below, based in their proximity to the WTP, see Figure 2):

Well No. 4 – Sediments from 55 ft to ±115 ft are mainly fine-to-course-grained sands with occasional thin interbeds of silty or clayey sands and/or clayey silt. Additional sand layers were logged from 140 ft to 190 ft; occasional layers having silt and/or clay in the matrices of these sand layers were present in this depth range. None of these strata were noted to have blue or gray blue colors; only yellow brown to dark brown colors were observed by the geologist. Three potential aquifer zones were selected for isolated aquifer zone testing of water quality and possible pumping rates but these three tested zones were all below a depth of 392 ft.

Well No. 6 – The geologic log shows: clay and sandy clay from 35 ft to 90 ft; sand and gravel from 90 ft to 108 ft; clay with some sand and gravel from 108 ft to 127 ft; then predominantly clay but with some sand and/or gravel from 127 ft to 200 ft. Sediments were observed to be yellow brown in color to a depth of 220 ft, and then olive gray below. Isolated aquifer zone tests were performed in four depth zones, all of which were below a depth of 250 ft; once again, these test results are not applicable to this current project.

Well No. 5 – Sediments logged by the geologist included: sandy and clayey silt from 50 ft to 90 ft; gravelly sand from 90 ft to 100 ft; a thick unit of clayey silt from 100 ft to 140 ft; and then clayey sand and sand from 140 ft to 180 ft. These sediments were mainly brown in color, although some were noted to be dark gray. As with Well Nos. 4 and 6, isolated aquifer zones tests were conducted in Well No. 5 but none of these tests were above a depth of 410 ft in this well.

Review of Nearby Foundation Studies

Several reports for foundation studies (geotechnical investigations) of nearby structures were obtained from the City Department of Public Works and reviewed for this project. These geotechnical studies included logs of exploratory foundation boreholes drilled to depths in the range of 20 ft to 70 ft, depending on such factors as the size of the property, the height of the proposed building, and the proposed depth of its subterranean parking garage, if any. These reports for nearby structures and our review of their exploratory borehole data are as follows:

1. "Report of Geotechnical Investigation, Proposed Operations Service Center"; prepared for Earth Tech Inc by MACTEC Engineering and Consulting, Inc; report dated October 22, 2004.
    a. Proposed structure located at northwest corner of Foothill Rd and 3rd St in City.
    b. Four borings drilled to depths of 20 ft to 50 ft.
    c. Groundwater encountered at depth of 36 ft.

d. Report states (p. 17) that property lies within "the limits of the San Vicente Oil Field, [and] there is a potential for methane and other volatile gases to occur at the site."

e. Report states that the Santa Monica fault is "located approximately 0.15 km [about 500 ft] to the south" [of the site]... "The Santa Monica fault is the western segment of the Santa Monica-Hollywood fault zone" (p.6).

f. Sediments in the exploratory boreholes consisted of stiff to hard silty clay and clayey silt, and medium dense to dense silty sand and well-graded sand with gravel. The report estimated these sediments to be about 30 ft thick beneath the site; they were reported to be directly underlain by ±225 ft of continental to marine sediments of the Lakewood Formation. This latter formation was considered to be underlain, in turn, by ±350 ft of the San Pedro Formation.

2. "Report of Geotechnical Investigation Proposed Parking Structure Public Works Campus"; prepared for City of Beverly Hills by MACTEC Engineering and Consulting Inc; report dated August 8, 2007.

   a. Proposed structure located at northwest corner of Foothill Rd and 3rd St in City.

   b. Five borings drilled to depths of 70 ft.

   c. Groundwater encountered at depths of 38 to 42 ft; on pgs 6-7, the report states that the historic high groundwater level in this area was at a depth of about 25 ft.

   d. Report made same statements (p.16) as were made in item "d" of Reference No. 1 (listed above).

   e. Report states that "the Santa Monica fault is located 2.0 miles southwest of the site" (p. 8) and that the Hollywood fault is located about "0.6 miles north of the site" (p. 7).

   f. Sediments encountered in the boreholes included clay, silty and/or sandy clay, and sandy silt from ±50 to ±60 ft, and then sands and sands with some gravel at depths of 60 to 70 ft.

3. "Report of Geotechnical Investigation Proposed Office Building Public Works Campus"; prepared for City of Beverly Hills by MACTEC Engineering and Consulting Inc; report dated August 8, 2007.

   a. Proposed structure located at northwest corner of Foothill Rd and 3rd St. In City.

   b. Five borings drilled to depths of 25 to 70 ft.

   c. Groundwater encountered at depths of 38 to 39 ft.

   d. P. 16 of report made same statements as were made in item "d" of Reference Nos. 1 and 2 (listed above).

   e. The Santa Monica and Hollywood faults (p. 8 and P. 17) were reported to be at some distances from this structure as were mentioned in item (e) of Reference No. 2 above.

f. Sediments encountered in the borings were clayey and/or silty sands and well graded sands from ±58 ft to 70 ft. Silty and/or sandy clays and clayey silts were prevalent at shallow depths.

4. "Supplemented Geotechnical Field Explorations Proposed Office Building Public Works Campus"; prepared for City of Beverly Hills by MACTEC Engineering and Consulting Inc; report dated October 31, 2007.
    a. This report is for the same site, and represented a supplemental investigation, to the one described in Reference No. 3 above.
    b. Four additional boreholes were drilled, but all were ≤26 ft deep.
    c. No groundwater was encountered.
    d. These boreholes provided no useful information to RCS in the depth zones of interest for this hydrogeologic assessment.
5. "Report of Foundation Investigation Proposed Mercedes Benz Dealership Building"; report prepared for R.G.M.B. Corporation by LeRoy Crandall and Associates; report dated February 27, 1987.
    a. Proposed structure located at northwest corner of Beverly Blvd and Maple Dr.
    b. Eight boreholes were drilled to depths of 32 ft to 66 ft.
    c. Groundwater encountered at depths of 22 to 32½ ft.
    d. The report noted that a Chevron service station was formerly located at the northeast corner of the site (p. 2); a gasoline odor was detected below a depth of 23 ft in one boring (p. 3), but no further assessment of possible groundwater contamination was conducted.
    e. From the borehole logs, the encountered earth materials were silty/sandy clays in the upper portions of the boreholes and silty/clayey sands, with occasional gravel and silt/clay interbeds from ±51 ft to 66 ft.
6. "Report of Geotechnical Foundation Investigation Reverse Osmosis Treatment Facility and Administration Building"; report prepared for RBF & Associates, by Goffman, McCormich and Urban, Inc; report dated December 3, 1998.
    a. Proposed structured located at 345 Foothill Blvd; this is the City's existing Water Treatment Plant.
    b. Four exploratory borings were drilled to depths of 36 to 62 ft.
    c. Groundwater was encountered at depths of 36 to 38 ft.
    d. Pgs 5 and 6 state that the Santa Monica-Hollywood fault is the closest fault to the site, "approximately 0.1 mile away."
    e. The two deeper borings encountered sandy clay, clay and/or fine- to coarse-grained sand between ±48 ft and 62 ft.
    f. No figures showing fault locations and no mention of gas and/or proximal oilfields were provided in this report.

Data from Test Hole at Cedars Hospital

In December 1991, RCS was involved with the drilling exploration for a possible new water-supply well for Cedars Hospital. The project included the drilling, geologic logging and down-hole testing of a borehole to a depth of 350 ft; this borehole was located at the west corner of the intersection of San Vicente Blvd and 3rd Street (this site is approximately 1 mile east of the City's WTP). Key findings of this exploration regarding the subsurface earth materials are as follows: the drill cuttings in the depth zone of interest for this current project were thinly interbedded sands and silts/clays to 85 ft, then a 20-foot thick layer of fine- to coarse-grained sand from 85 ft to 105 ft, followed by additional thinly interbedded sands/silts/clays, and then a 30-foot thick sand and gravel layer from 155 ft to 185 ft. The color of these sediments was principally blue gray below about ±70 ft, indicating the presence of a reducing environment.

WATER LEVEL DATA AND FLOW RATES FROM NEARBY SUMPS

Data for the two nearby, active dewatering sumps along North Maple Drive were summarized and described in separate RCS-prepared documents, dated January 31, 2008, which were provided to the City and titled, "Updated Technical Memorandum"; the reader to referred to these two memoranda for details regarding each of these existing dewatering facilities. Figure 1 shows the locations of these two sumps. Since the date of their construction, each building has been conducting permanent dewatering at/just below the lowest level of their subterranean parking garages. At these properties, the dewatering methods, facilities and ongoing operations were/are wholly designed, constructed, operated and maintained by others. RCS generally understands that each dewatering system consists basically of a series of horizontal collector pipes placed within a thick gravel blanket beneath the lowestmost concrete floor of each subterranean garage structure; the collector pipes intercept and divert rising groundwater levels toward a large concrete sump beneath the garage floor. All groundwater collecting inside the sump is pumped, via a set of float-activated pump switches, up to ground surface and then to a nearby stormdrain. Each site has a National Pollutant Discharge Elimination System (NPDES) permit to discharge the pumped groundwater to the stormdrain. Quarterly reports have been, and will continue to be, prepared by a site consultant who then submits each report to the RWQCB on a quarterly basis. Based on the four-story depth of the lowest level of each subterranean parking garage, the groundwater collected from each pipeline collection system is estimated to locally be at a depth of ±45 ft. There has been no monitoring of water level depths

by anyone in the sumps or in the local shallow aquifer system in the area. Hence, there are no data regarding the actual water levels or the changes in these water levels in this aquifer system over time; thus, hydrographs can not be prepared.

Based on the referenced RCS Updated Technical Memorandum for each site, dated January 31, 2008, the following summarizes water level and flow rate data available through the date of those memoranda (water quality data for each sump are discussed later in this report):

a. 331 No. Maple Drive. At this site, discharge rates have been monitored and reported to the RWQCB in quarterly monitoring reports prepared by others since January 2000. From RCS-prepared graphs of available flow data (see Figure 3 in the Updated Technical Memorandum for this site), flow volumes discharged to the storm drain have ranged between 210,000 gallons per day (gpd) to 290,000 gpd (mid-2002 through December 2007; no more current data have been reviewed for this project). These daily rates calculate to average flow rates of 135 to 197 gpm over the period of available record. Based on a comparison of these flow rates to variations in rainfall over the same period (as recorded at the Los Angeles Civic Center raingage), the referenced memorandum by RCS for this site noted that discharges from the sump increased during periods of high rainfall (e.g., above average rainfall years or in a wet period of a few years), and conversely those flow rates decreased during periods of either low annual rainfall and/or during a series of dry years (i.e., during droughts).

b. 407 No. Maple Drive. Quarterly monitoring reports on file at the RWQCB through the end of 2006 reveal that no flow rate data for the sump discharge were ever reported by the site consultant. However, the referenced January 31, 2008 Updated Technical Memorandum by RCS for this site noted that a flow dial was finally installed by others in May 2007. In mid-May 2007, Mr. Josette Descalzo of the City provided the initial monitoring data to RCS; those data revealed average daily volumes of 431,000 gpd and 443,000 gpd for two successive days, one week apart in mid-May of 2007. Thus, at that time, this sump was diverting about 300 gpm of groundwater to the sump on a daily basis. These are clearly only short-term data but they represent the only available daily flow rate data for this site.

GROUNDWATER QUALITY

Local water quality data are available from three different sources: the older or original City-owned, deep water wells in the area, all of which were destroyed by the mid-1970s or earlier; the currently existing City-owned, deep water wells in the area, and; dewatering sumps that lie beneath the lowestmost subterranean garage levels in two buildings along No. Maple Drive in which permanent dewatering of shallow groundwater has been occurring for a few years. The basic water quality from each of these sources is discussed separately below. In addition, Figure 3, "Map of Stiff Water Quality Pattern Diagrams," has been prepared to help illustrate the

differences in the character of the groundwater from each of these different sources using a method developed by H. Stiff in 1951. It is important to note that the Stiff diagram created for each water source dates from the sample collection date from each source and hence varies from source to source. In general, however, the Stiff diagrams for the older, destroyed wells date from the early- to mid-1970s, whereas the Stiff diagrams for the existing City wells and the two dewatering sumps along No. Maple Dr date from the mid- to late-2000s.

Data From Destroyed City Water Wells

This group of former, now-destroyed, City-owned wells was located northeast of the City's WTP and included, from closest to farthest, Melrose C, Melrose A, Melrose M, Sherman 6A, Sherman 5B, and Westknoll 1A. As shown on Figure 3, the size and shape of the Stiff water quality diagram for each of these five wells are very similar and display a common sodium bicarbonate ($NaHCO_3$) groundwater character. Concentrations of total dissolved solids (TDS) are also relatively similar, ranging from 460 milligrams per liter (mg/L) in Melrose M, to 664 mg/L in Melrose C. The concentrations of total hardness (TH) in these wells are variable also, and range from 105 mg/L in Melrose A, to 204 mg/L in Melrose C. In slight contrast to the above, the Westknoll 1A well displays a sodium-calcium-bicarbonate (Na-Ca-HCO3), a TDS value of 503 mg/L, and a TH concentration of 312 mg/L.

The two nearest City-owned, now-destroyed wells for which limited water quality data exist are Foothill Well Nos. 3 and 4. As seen on Figure 3, Foothill No. 3 had a $NaHCO_3$ character, a TDS of 573 mg/L and a TH of 296 mg/L (sample collection date July 1966). Foothill No. 3, in a sample collected in July 1966, displayed a $CaHCO_3$ character; TDS and TH values were 705 mg/L and 440 mg/L, respectively.

Data From Active City Wells

RCS has tabulated the results of laboratory testing of groundwater samples collected from the four nearby, existing City wells (Nos. 2, 4, 5, and 6); refer to Table 2, "Summary of Water Quality Data, Existing City Wells and Nearby Sumps." Also shown on Table 2 are the analytical water quality data from testing of shallow groundwater at the two nearby dewatering sumps along No. Maple Drive (samples collected 5/11/06 from both sites). Figure 1 provides the locations of the four active City wells relative to the locations of the City's WTP and the two

privately-owned dewatering sumps (the bottoms of these groundwater collection sumps are estimated to lie at approximate depths of 45 ft at each site).

Table 2 and Figure 3 data reveal the following for the four active City wells:

a. Well Nos. 2 and 4 display a sodium bicarbonate water character, whereas Well Nos. 5 and 6 tend to display a mixed sodium-calcium bicarbonate character.
b. TDS values range from 496 mg/L in Well No. 6 to 822 mg/L in Well No. 2.
c. TH values are noted to range from a low of 156 mg/L in Well No. 2 to a high of 274 mg/L in Well No. 4.
d. Chloride is relatively high in Well No. 2 (203 mg/L), but is less than 75 mg/L in Well Nos. 4, 5 and 6. Fluoride is relatively high in Well Nos. 2 (1.09 mg/L) but is at or less than 0.62 mg/L in the other three wells.
e. Nitrate as nitrogen (N) was not detected (ND) in all four City wells.
f. Iron was detected at excessive concentrations of 375 micrograms per Liter (µg/L) and 617 µg/L in Well Nos. 2 and 6, respectively, compared to its State Secondary Maximum Contaminant Level (MCL) of 300 µg/L. Iron in Well Nos. 4 and 5 was ND and 102 µg/L, respectively.
g. No VOCs or perchlorate were detected in any of these wells.
h. H_2S odors were detected in Well Nos. 5 and 6, but relatively smaller amounts are reportedly present in Well Nos. 2 and 4. Methane gas (CH_4) has also been detected, at least, in Well No. 2 to date.

Data From Cedars Test Hole

RCS geologists conducted isolated aquifer zone testing in December 1991 within the open borehole for the possible new water well at Cedars Hospital. These tests, which were performed to assess the water quality and potential flow rates of aquifer zones detected by the electric log of the borehole, were performed at depths of approximately 165 to 175 ft and also at 241 to 251 ft. Shallower zones could not be tested because the small drill site was located near a sewer line and the County Department of Health Services insisted on having a 100-foot deep sanitary seal in a well at this site.

Groundwater sampling in both tested depth zones revealed a hydrogen sulfide (H_2S) odor and a slight hydrocarbon odor. The groundwater character of both tested zones was sodium bicarbonate; the TDS values of the zones were 470 and 504 mg/L, respectively, whereas the TH values were 204 and 148 mg/L, respectively. Arsenic ranged from 10 to 13 µg/L,

respectively. A few natural hydrocarbons were also detected in the groundwater. Further, each zone was airlifted and pumped at rates of less than 10 gpm.

Thus, it was concluded that the tested earth materials: were of marine origin, displayed an overall relatively low permeability, and had odor and water quality problems. As a result, the borehole was destroyed; no well was constructed.

Data From Nearby Dewatering Sumps

As part of a separate project for the City, RCS geologists previously sampled the groundwater being collected in sumps beneath the lowestmost subterranean parking garage level for two properties along the west side of No. Maple Dr and due east of the WTP (see sump locations on Figure 3); the bottom of the sumps in which groundwater is collected, as part of the permanent dewatering system for each building, are estimated to lie at depths of ±45 ft below ground surface at each facility.

The groundwater samples were collected from each sump on May 11, 2006 and were tested immediately thereafter. Laboratory results (see Table 2) reveal TDS concentrations of 980 mg/L to 1100 mg/L, and both TH values were 780 mg/L. Iron concentrations were 310 to 380 µg/L, relative to a State Secondary MCL for this constituent of 300 µg/L. Concentrations of perchlorate were 2.5 and 2.6 µg/L, chloroform was detected at 1.2 and <0.5 µg/L, and tetrachloroethylene (PCE, a VOC) was detected at 1.4 µg/L and <0.5 µg/L, respectively, in the two sumps. The basic character of the groundwater in each sump is calcium bicarbonate. No. H_2S or hydrocarbon odors were detected in the shallow groundwater in either sump.

REVIEW OF LOCAL ENVIRONMENTAL CONDITIONS

A review of local environmental conditions was performed by obtaining records via Environmental Data Resources (EDR), of Milford, CT. EDR is a company that provides summary information and data on the surrounding environment in a project area, and this outside services company was used by RCS to obtain and provide information on potentially contaminating activities (PCAs), within a one-mile radius of the WTP.

Facility Review

Within one mile of the City's WTP on No. Foothill Rd (the property used as the "center" around which PCAs would be determined by EDR), several individual generators of waste or PCAs

(some at the same address) were reported by EDR. Generally, the PCAs consist of the environmental data on these facilities; a copy of the EDR GeoCheck report is included in Appendix 1 of this report.

Historic Topographic Map and Aerial Photograph Review

EDR provided a number of historic topographic maps and aerial photographs which revealed the progression of development within the region. The historic maps ranged in date from 1900, through 2005. These items, a copy of which is also provided in Appendix 1, reveal the following:

- 1900 to 1902: These data consist of topographic maps showing relatively little development in the region. Train tracks are shown (the Pasadena and Pacific Railroad), the former railroad siding known as "Sherman," and an area listed as "Rodeo de Las Aguas"; clearly, the Beverly Hills area has historically witnessed high (shallow) groundwater conditions. Along what is now Robertson Blvd, and just southeast of the railroad tracks (present day Santa Monica Blvd) in the former area of Sherman (now basically West Hollywood), these three topographic maps have wavey blue-colored lines on the map; these lines represent swampy or marsh-like conditions. Blue-colored drainage channels reveal south-flowing creeks were common from Beverly Hills on the west to Hollywood on the east.
- 1928 and 1938: There are the two earliest air photos of the Foothill Rd area; most properties are developed and the areas to the north and south appear fully developed by single family homes. The Foothill Rd area itself, where developed, appears to be comprised by warehouses, building and offices.
- 1956 and later: Some changes in the buildings along Foothill Rd are observed, and local development reveals full buildout in recent years.
- 1956 through 2005: A series of six aerial photographs showing increasing industrial development of the region; little change between 1989 and 2005.

Federal, State and Local Database Searches

From their search of Federal EPA databases, which provide access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous Waste and Solid Waste Amendments (HSWA) of 1984, EDR attempted to identify sites within less than one mile of the City's WTP which may have generated, transported, stored, treated and/or disposed of hazardous wastes per RCRA. Four such RCRA sites, known as Small Quantity Generators (SQGs), were encountered within ¼-mile of the City's WTP by the EDR database search; a SQG was defined as a site that generates 100 kg to 1000 kg of hazardous waste per month. These four near RCRA-SQG sites include: a telephone company at 490 No. Foothill Dr; a gas

company building at 400 No. Foothill; an office building at 345 No. Maple Dr, and a car dealership/service building at 9250 Beverly Blvd.

EDR also searched for possible nearby sites on the "Cortese list" that have been designated by the State Water Resources Control Board, the State Integrated Waste Board, and/or the State Department of Toxic Substances Control (DTSC); any defined sites would include LUST sites (leaky underground storage tanks), SWF/L&S sites, and Cal-sites, respectively. Nine Cortese list sites were identified within 0.5 miles of the City's WTP. These included: four City facilities (the fire department, the public library, and buildings at 331 No. Foothill Rd and 9357 & 9268 W. 3rd St); a gas station at 427 No. Crescent Dr; a former market at 409 No. Beverly Dr; a gas company facility at 400 No. Foothill Rd; a studio at 331 No. Maple Dr; and a former gas station at 9039 Beverly Blvd.

Of the above-listed eleven LUST sites, for which there are reported leak incidents, 10 have been denoted as being "case is closed." Only one site, the service station at 427 No. Crescent Dr, is reported to be currently undergoing "remediation."

From other databases, the EDR report showed that in addition to the above listed sites there are 6 other listed sites within 0.25 miles of the City's WTP that have had historically registered underground storage tanks on their property that were regulated under RCRA. These 5 other listed sites are at the Los Angeles County Courthouse at 9355 Burton Way, another City property at 464 N. Rexford Drive, a tank at City Hall, the City's Central Fueling Facility at 9335 W. 3rd St, the Beverly Hills Ice House at 9348 W. Santa Monica Blvd, and a LA Facility Service Office at 325 N. Maple Drive.

In addition to these sites, an EDR proprietary database for historical service stations revealed four facilities, namely, Kellogg's Foothill Service at 500 N. Foothill Rd and stations owned (or formerly owned) by: T.E. Burton at 450 N. Foothill Rd.; Mathias Nielsen at 458 N. Foothill Rd; and W.E. Carter, at 41 N. Foothill Rd.

Further, there are 7 historical cleaners listed within 0.25 miles of the WTP as follows:

- Hy-Tone Cleaners at 9320 Santa Monica Blvd.
- Beverly Hills Laundromatic at 9274 Santa Monica Blvd.
- 2 cleaners owned by Alsonso Culveaux and Ralph Pina at 531 and 533 Alpine Way, respectively.

- Charrisson Rug Cleaning Company at 312 N. Foothill Blvd.
- Hollywood Dry Cleaning & Laundry at 325 N. Maple Dr.
- Beverly Hills Laundry at 321 N. Maple Dr,

Lastly, a parking lot property at 9315 Civic Center Drive, lots 12 and 13, is listed as "low threat-level properties with either confirmed or unconfirmed releases" and/or that "have known contamination" or that "there may be reasons to investigate further" as identified by the State DTSC's Site Mitigation and Brownfields Resuse Programs (SMBRPs) EnviroStor database.

Site Specific Maps

EDR also supplied a few site specific maps which show a somewhat greater amount of detail on historical developments within one mile of the City's WTP. A copy of these maps, as adapted by EDR from the Sanford Library collection, is also provided in Appendix 1. Three "land use" – type maps were provided: 1926, 1950 and 1969. The earliest local developments included a "lime and cement" storage facility where the existing WTP is located and a "putty plant" immediately to the west. Directly east, on the other side of Foothill Rd, was the "Payne Furnace and Supply Co (furnace factory)." A door manufacturer, a lumber company and a telephone company were present along Foothill Rd to the north. Several nearby properties were not developed at all.

The 1950-dated map shows City of Beverly Hills facilities on both sides of Foothill Rd in the area; virtually all surrounding properties are fully developed. Nearby facilities included a cat hospital, a cosmetics manufacturer, a welding and wood working shop, a telephone company building, and a Southern California Gas Company office. Incinerators, shop buildings, an auto service area, offices, etc, are shown on City-owned properties.

The final Sanborn Library map is dated 1969 and it shows similar City-owned facilities, as above, along both sides of Foothill Rd. To the north are one or two gas and oil tanks, a silver plating company, and a machine shop.

KEY CONCLUSIONS

BASIC FEASIBILITY

It is considered hydrogeologically feasible, though somewhat risky, for the City to attempt to drill and construct new, shallow municipal-supply water wells in the study area. There are both potential benefits and problems associated with the project, as described below.

Principal benefits to the City if this groundwater development were to be successful could include:

a. the shallow aquifer system does contain groundwater and this source is not being put to beneficial use by anyone in the area.
b. This shallow aquifer system in this area could become a new and independent or separate source of groundwater for the City; the existing City-owned water wells extract groundwater from an underlying and geologically older group of sedimentary earth materials.
c. The shallow aquifer system might be capable of providing on the order of a few hundred gallons per minute of groundwater to the City supply, on a long-term average annual basis, depending on the number of new shallow wells and on the inflow rate to each such well.
d. The properties on which the initial wells could be constructed are owned by the City, thereby precluding the great expense of purchasing property from private owners.
e. Each new shallow aquifer water well will be relatively shallow (±175 ft or less) and hence the drilling and construction should involve a relatively small drill rig. Thus, the costs for drilling, construction and testing should be much less than those for a more typical 700-foot deep or greater, municipal-supply well.
f. The anticipated water quality from the local shallow aquifer system is not expected to have an elevated temperature or methane gas or hydrogen sulfide odors.
g. The proposed wells will be located relatively close to the City's WTP; hence pipeline costs to transmit the pumped groundwater to this WTP for treatment should not be too large.
h. Groundwater extractions from new shallow wells should not adversely impact production from the City's existing deep water wells.

Principal problems for the City that are associated with this shallow groundwater development project could include:

a. The pumping rates and annual volumes of groundwater expected from each new well are not large, perhaps, on the order of 100 gpm and ±130 to 150 AF, respectively.
b. These rates and volumes will tend to vary not only by season each year (a bit higher in the spring months and a bit lower in the fall months) but also from year to year

(somewhat higher following a series of wet years when water levels rise, and somewhat lower following a series of drought years when water levels decline).

c. The water quality of the shallow groundwater has the potential to be impacted by groundwater contaminants from existing and/or prior commercial and/or industrial facilities in the region. All pumped groundwater is to be discharged directly to the City's nearby WTP for treatment.

d. There are no data available to help determine realistic long-term pumping rates, specific capacities, static water level trends, or resulting pumping levels in the proposed wells in the local shallow aquifer system.

PRELIMINARY DESIGN CRITERIA

Locations for New Shallow Wells. Figure 4, "Proposed Locations for Initial Shallow Wells," provides our recommendations for the locations for the initial two new shallow aquifer water wells for the City. As indicated, both sites are relatively close together and are located at the east side of existing, City-owned property.

Drilling Method. The proposed wells should be drilled by the direct (mud) rotary drilling method. Due to the anticipated drilling depths and casing sizes, RCS expected that a relatively small rotary drill rig can be used for the project (e.g., a Failing 1500-type of drill rig). Such rigs are truck mounted and quite mobile and relatively inexpensive to mobilize and use compared to the typical drill rig needed for drilling by the reverse circulation method.

Just prior to initially starting pilot hole drilling, the Contractor will drill a 30-inch diameter borehole to a depth of 50 ft. Into this borehole, he will then install a 26-inch diameter by ¼-inch wall thickness mild steel conductor casing. The annular space between the borehole walls and the outside of the casing will be cemented-in to a depth of 50 ft to create a sanitary seal for each new well. Such a seal depth is required to allow the groundwater extraction by each well to be used for domestic purposes.

Drilling Depths and Diameters. The pilot borehole for each well should be drilled to a maximum depth of 200 ft and to a diameter between 6 and 9 inches. As soon as pilot hole drilling is completed, a suite of geophysical electric logs will be performed in the open borehole. In an effort to keep costs limited and because the groundwater pumped by each of the new wells is to be treated at the City's nearby WTP, RCS is suggesting that no isolated aquifer zone testing be conducted in the open borehole for any of these new wells.

Isolated Aquifer Zone Testing. After drilling of the pilot hole has been completed, and because of the proximity of many LUST sites in the region, it is recommended that one isolated aquifer zone be performed in the open pilot hole to test for possible groundwater contaminants. A groundwater collected from the isolated aquifer zone should be tested for a suite of general mineral, inorganic and volatile organic compounds (VOCs) and other inorganics such as perchlorate.

Well Casing and Gravel Pack. RCS recommends that maximum 12-inch diameter well casing be used in light of the maximum pumping rate expected from any of the new wells. Each pilot hole will need to be reamed to a final diameter of 24 inches and to a maximum depth of 175 ft. Two casing options are possible for the two proposed wells: high strength-low alloy steel (HSLA steel) or Type 304L stainless steel. The former type of steel will provide longevity and a moderate degree of protection against corrosion without incurring a greatly increased cost; the latter steel option will provide a much longer period of longevity and provide a higher degree of corrosion protection. However, the cost for Type 304L stainless steel is significantly greater when compared to the cost of HSLA, which may be adequate for the two proposed wells.

Casing perforations are to be Super-Flo louvers as manufactured by the Roscoe Moss Co of Los Angeles. The preliminary estimate for the slot size opening for the perforations is 0.060 inches. The preliminary gravel pack for the louvered casing can have a 6 x 12 gradation, as produced by TACNA Sand and Gravel.

It is understood that the City's existing deep water-supply wells might currently produce sand. However, in the new shallow water-supply wells, the gravel pack will be designed and chosen such that groundwater flow through the perforated sections of the wells is enhanced without producing significant quantities of sand.

Well Development. Because bentonite drilling fluids have been used to drill and ream the borehole for each new well, it will be necessary to conduct chemical well development and then mechanical development in each well. These well development operations are needed to help remove the bentonitic clays and associated turbidity from the adjoining formation, the borehole walls, the new gravel pack and the well casing.

Pumping Tests. After a test pump has been installed and after pumping development has been performed, two types of pumping tests are recommended: an initial step drawdown test and a

final constant rate pumping test. Test durations are anticipated to be 9 hours for the step test and a minimum of 24 hours for the constant rate test in each well.

Other Drilling and Well Construction Issues

A source of potable water is needed to drill the proposed wells. Based on our field visit, and because the initial proposed wells are on City-owned property, an nearby onsite water-supply is available for the drilling contractor. Further, each drill site will need to be on the order of 100 ft by 150 ft in extent during the drilling, construction and testing of each new well. One benefit of having each well drilled to a shallow depth is that the required drill rig is smaller than the normal reverse circulation rig that is used to drill and construct most municipal-supply wells in Southern California.

Proximal to the drill rig, the driller must be able to place at least one Baker tank to allow for the temporary storage of all fluids and groundwater extracted from the well during its drilling, development and testing. Based on NPDES permit requirements, the driller (and owner) must not allow any such fluids and/or groundwater to flow onto any adjoining properties or directly into any stormdrains (without treatment). The nearest stormdrain to the initial drill site is likely the one located on the west side of the driveway to the parking garage entrance along the west side of 331 No. Maple Dr.

ENGINEERING ELEMENTS

Pipeline Hydraulics

Based on the proposed alignment, Tetra Tech (the engineering subcontractor to RCS for this project) has prepared Table 3, "Summary of Pipeline Hydraulics," to provide recommended pipe sizes, friction losses and velocities. Two design points were reviewed for the combined force main: 100 gpm and 400 gpm. It appears that either a 6-inch or 8-inch diameter pipe would be sufficient to accommodate up to 400 gpm. Typically the force main velocities should be between 2 to 5 ft/sec. We recommend that an 8-inch PVC or steel pipe be used in case additional wells are added in the future. The proposed alignment of the piping will run through the City's yard over to Foothill Rd and tie into the existing influent line at the WTP.

Table 3
Summary of Pipeline Hydraulics

Pipe diameter	6 inch force main		8 inch force main	
Combined flow from wells (gpm)	200	400	200	400
Length (ft)	630	630	630	630
Friction loss (ft)	1.8	6.6	0.4	1.6
Velocity (ft/sec)	2.2	4.5	1.2	2.5

Treatment Plant Capacity

The current capacity of the City's WTP ranges from approximately 1.2 to 1.5 million gallons per day (mgd). Since the plant was designed by others for 3.0 mgd, there is sufficient capacity to provide for supplemental water supply sources. The flow from the two initially proposed is currently wells could add an estimated additional 0.6 mgd.

Water Quality

It is assumed that the water quality from the proposed shallow wells may be similar to the quality of the groundwater discharged from the dewatering sumps at 331 North Maple and 407 North Maple Drive (see sump locations on Figures 1 and 3). The City has not yet added any iron and manganese treatment to the existing treatment plant. However, iron levels for the new shallow wells are expected to be similar in concentration to both the sump water and the City's existing potable wells. The City is currently using antiscalant chemicals in the pretreatment system prior to reverse osmosis which should help with low to moderate levels of iron. From the limited water quality data, there did not appear to be any constituents in the sump water that would preclude use of reverse osmosis treatment to provide potable water.

Also of concern to the City is the potential production of sand from the proposed shallow wells; sand, if present, might impact the water treatment process at the WTP. As noted earlier (under the preliminary well design), the proposed wells will be designed to preclude sand production. However, it is possible that the wells might still produce some sand and this can be mitigated through the future use of sand separators installed in the discharge line of each well.

Regulatory Concerns

The California Department of Public Health (CDPH) reviewed the proposed project alternatives originally submitted to the City by RCS and Tetra Tech, as part of the prior work by RCS on the

two building dewatering sumps along No. Maple Dr and provided comments in a letter to the City dated June 20, 2008. CDPH indicated they would require the City to conduct water quality monitoring and submit the results for review as part of the water supply permit amendment application package. The parameters, frequency and duration of monitoring would be determined by CDPH's review of the design and construction of the proposed shallow wells and the source water assessment results. Following their review of the data CDPH would then determine whether the new wells were suitable as sources of drinking water supply and identify any additional treatment that might be required. At this time, we do not anticipate that additional pretreatment would be required, however, the final determination will be made by CDPH. If the groundwater is pumped by he new wells from an unconfined aquifer, a 4-log virus reduction treatment with disinfection will be required by CDPH based on the Groundwater Rule. This level would need to be achieved through chlorination and providing the appropriate contact time.

Projected Construction Costs

Unit piping costs are approximately $220 per lineal foot which included pipe materials, trenching, excavation, backfill and pavement replacement, for a total of $138,600. The total project cost estimate would include costs for drilling and wells, pumps, motors, electrical panels and connection to the City's SCADA. A 20% contingency is recommended for the planning level stage. Preliminary construction costs are presented on Table 4, "Preliminary Estimate of Capital Costs."

Table 4
Preliminary Estimate of Capital Costs

Item	Units	Quantity	Unit Cost	Total Cost
Construct two new shallow wells	Ea	2	$195,000	$390,000
New Vertical Turbine Pumps and motors	Ea	2	$75,000	$150,000
Desanding Unit (if deemed necessary)	Ea	2	$25,000	$50,000
Civil/Sitework – fencing, paving	LS	1	$10,000	$10,000
Electrical and Instrumentation	LS	1	$100,000	$100,000
Piping from wells to RO Plant	LF	630	$220	$139,000
Modifications to existing RO Plant (piping, SCADA, etc)	LS	1	$80,000	$80,000
Mobilization/Demobilization	LS	1	$25,000	$25,000
Subtotal				$944,000
Contingencies @ 20%				$188,800
Estimated Construction Cost				$1,132,800
Technical, Legal, Administrative @ 30%				$340,000
Total Capital Cost				$1,472,800

Job No. 162-LAS05

TABLE 1 - SUMMARY OF DRILLER'S LOG DATA, NEARBY DESTROYED WELLS

January 2009

LACFCD Well No.	Well Owner	Reported Well Name	Date Drilled	Total Well Depth (ft)	Depth to Uppermost Perforations (ft)	Summary of Driller's Log Information	
						Depth Interval (ft)	Logged Materials
2602A	Beverly Globe Div	---	1929	647	462	22-65 65-68 68-79 79-85 85-166 166-182	red clay gravel, clay clay-streaked sand & gravel clay & gravel clay & gravel clay & gravel
2602B	City of Beverly Hills	Foothill No. 1	1931	664	No Data	34-66 66-94 94-147 147-153 153-169 169-187	clay & gravel gravel clay gravel clay gravel
2602C (located at 339 No. Maple Dr.)	Beverly Hills Ice Co.	---	1931	576	163	50-68 68-72 72-84 84-88 88-94 94-118 118-148 148-162 162-180	clay & gravel gravel & slate sandy clay clay and small gravel blue clay clay and small gravel hard clay clay & gravel sand & gravel, minor clay
2602D	No Data-private owner	---	1902	153	No data	56-64 100-110 138-153	gravel and water gravel and water gravel and water
2602E (located 150 ft east of 2602B)	City of Beverly Hills	Foothill No. 2	1931 (?)	616	237	No log	No log
2602F	City of Beverly Hills	Foothill No. 3	1953	660	198	75-85 85-100 100-127 127-160 160-187	sand & gravel gravel streaks in clay coarse sandy clay & streaks of gravel coarse sandy clay coarse sand & gravel with clay
2602G	City of Beverly Hills	Foothill No. 4	1953	692	204	34-83 83-143 143-185	clay & gravel sandy clay sand & gravel

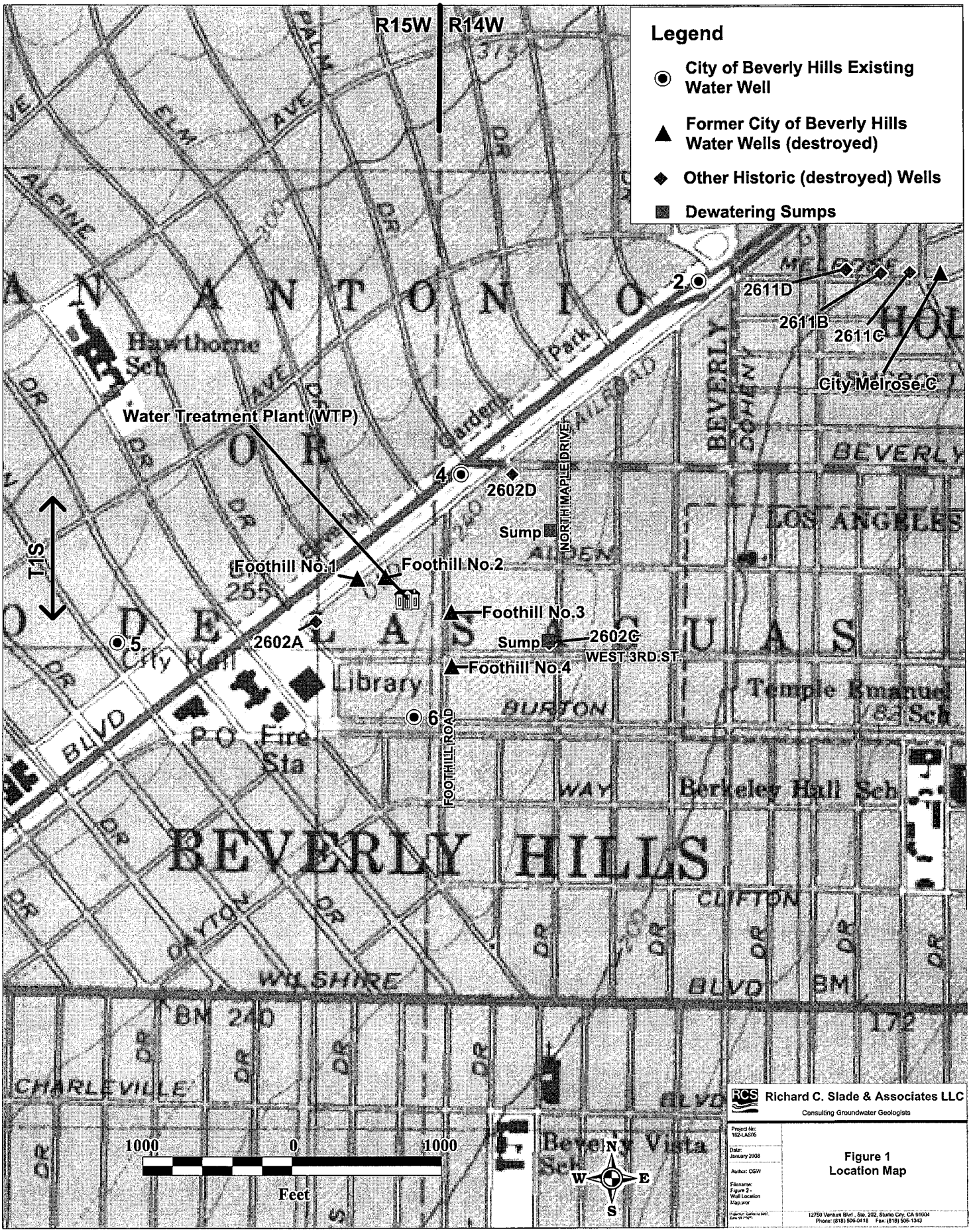
Notes: 1) See Figure 2 for approximate location of these wells.
2) All listed wells have been adandoned or destroyed.

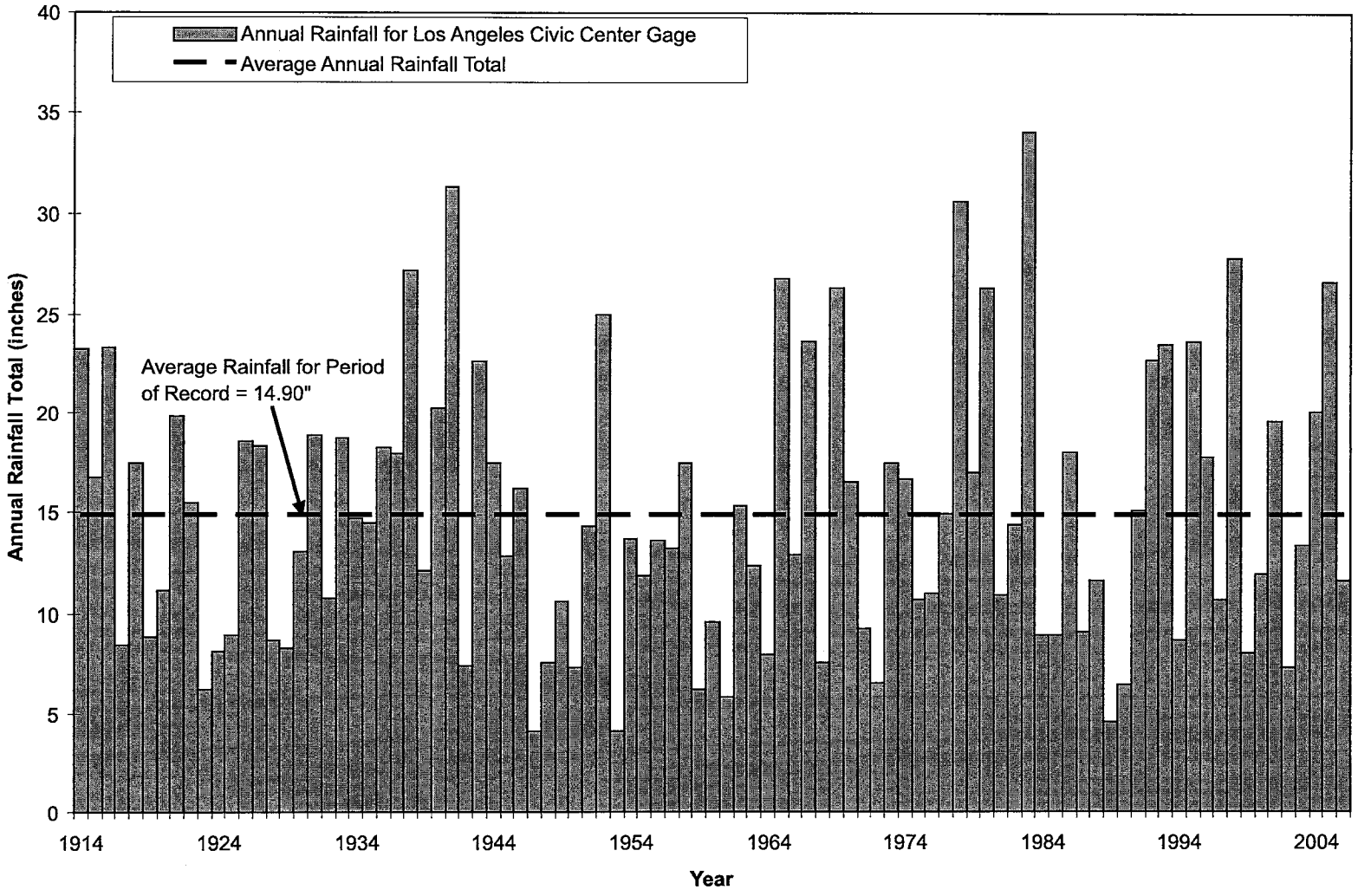
TABLE 2 - SUMMARY OF WATER QUALITY DATA, EXISTING CITY WELLS AND NEARBY SUMPS
CITY OF BEVERLY HILLS SHALLOW GROUNDWATER EVALUATION PROJECT

Constituent Analyzed	Units	State Regulatory Levels	RESULTS FOR CITY WELLS				RESULTS FOR SUMPS	
			City Well No. 2	City Well No. 4	City Well No. 5	City Well No. 6	Dewatering Sump 331 Maple Drive	Dewatering Sump 407 Maple Drive
General Physical Constituents								
Electrical Conductance	µmhos/cm	900, 1600, 2200*	1320	900	780	750	1500	1500
Turbidity	NTU	5	0.22	0.1	0.46	1.73	<1.0	<1.0
Odor	TON	3	<1.0	<1.0	<1.0	<1.0	1	<1.0
Color	CU	15	9	3	4	15	<1.0	2
pH	units	6.5 to 8.5	7.91	7.90	7.52	7.63	7.70	7.60
General Mineral Constituents								
Total Dissolved Solids (TDS)	mg/L	500, 1000, 1500*	822	571	509	496	980	1100
Total Hardness (TH)		None	156	236	274	204	780	780
Calcium		None	30.1	58.5	77.3	63.6	150	150
Magnesium		None	24.8	32.5	24.7	21	65	67
Sodium		None	218	121	77.9	104	84	86
Potassium		None	8.64	4.55	5.07	4.12	2.4	2.3
Total Alkalinity as $CaCO_3$		None	429	361	298	268	380	370
Bicarbonate (HCO_3)(Calculated)		None	523	440	364	327	464	451
Sulfate		250, 500, 600*	5.22	35.7	109	104	230	230
Chloride		250, 500, 600*	203	74.2	33.7	39.6	130	140
Fluoride		2	1.09	0.62	0.58	0.28	1.2	1.3
Silicon		None	-	-	-	-	15	14
Nitrate as N		10	ND	ND	ND	ND	2	2.2
Detected Trace Metal Constituents								
Chromium (Cr)	µg/L	50	ND	ND	ND	ND	<50	<50
Hexavalent Chromium (CrVI)			ND	ND	ND	ND	3.3	5.4
Iron (Fe)		300	375	ND	102	617	380	310
Selenium		50	6.43	ND	ND	ND	<5.0	26
Radiological Constituents								
Gross Alpha	pCi/L	15	-	2.46	2.13	-	8.88	9.1
Gross Beta		50	-	2.91	4.76	-	0	7.73
Uranium		20	-	0.47	1.19	-	4.97	11.5
Other Detected Constituents								
Perchlorate	µg/L	6 (NL)	ND	ND	ND	ND	2.5	2.6
Chloroform		5	ND	ND	ND	ND	1.2	<0.5
Tetrachloroethylene (PCE)		5	ND	ND	ND	ND	1.4	<0.5

NOTES:
Groundwater samples collected from a dewatering sump at each privately-owned location on May 11, 2006.
Water samples collected from City Well Nos. 2, 4, 5 and 6 in mid-2005.
mg/L = milligrams per Liter (parts per million)
µg/L = micrograms per Liter (parts per billion)
pCi/L = picocuries per Liter
NL = Notification Level
< = less than the Method Reporting Limit (MRL)

*The three listed MCLs for EC, TDS, Cl and SO_4 are recommended, upper and short-term concentrations, respectively.
All other CAM Metals and volatile organic compounds (Method 8260B constituents) not listed in table were reported as not detected.


R15W
R14W
Legend
City of Beverly Hills Existing Water Well
Former City of Beverly Hills Water Wells (destroyed)
Other Historic (destroyed) Wells
Dewatering Sumps
2
2611D
2611B
2611C
City Melrose C
Water Treatment Plant (WTP)
4
2602D
Sump
NORTH MAPLE DRIVE
Foothill No.1
Foothill No.2
Foothill No.3
Sump
2602C
WEST 3RD ST.
Foothill No.4
5
2602A
6
FOOTHILL ROAD
T1S
Hawthorne Sch
City Hall
Library
Fire Sta
Temple Emanuel
Berkeley Hall Sch
Beverly Vista Sch
BEVERLY HILLS
LOS ANGELES
WILSHIRE BLVD
CHARLEVILLE
CLIFTON
BURTON
ALDEN
1000
0
1000
Feet
N
S
E
W
Richard C. Slade & Associates LLC
Consulting Groundwater Geologists
Project No: 102-LAS05
Date: January 2008
Author: CGW
Filename: Figure 2 - Well Location Map.wor
Figure 1
Location Map
12750 Ventura Blvd., Ste. 202, Studio City, CA 91604
Phone: (818) 506-0416 Fax: (818) 506-1343



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Studio City Phone (818) 506-0418
Napa Phone (707) 963-3914
Fax (818) 506-1343

FIGURE 2A
ANNUAL RAINFALL TOTALS
LOS ANGELES CIVIC CENTER RAINGAGE

Job No. 162-05 **January 2009**

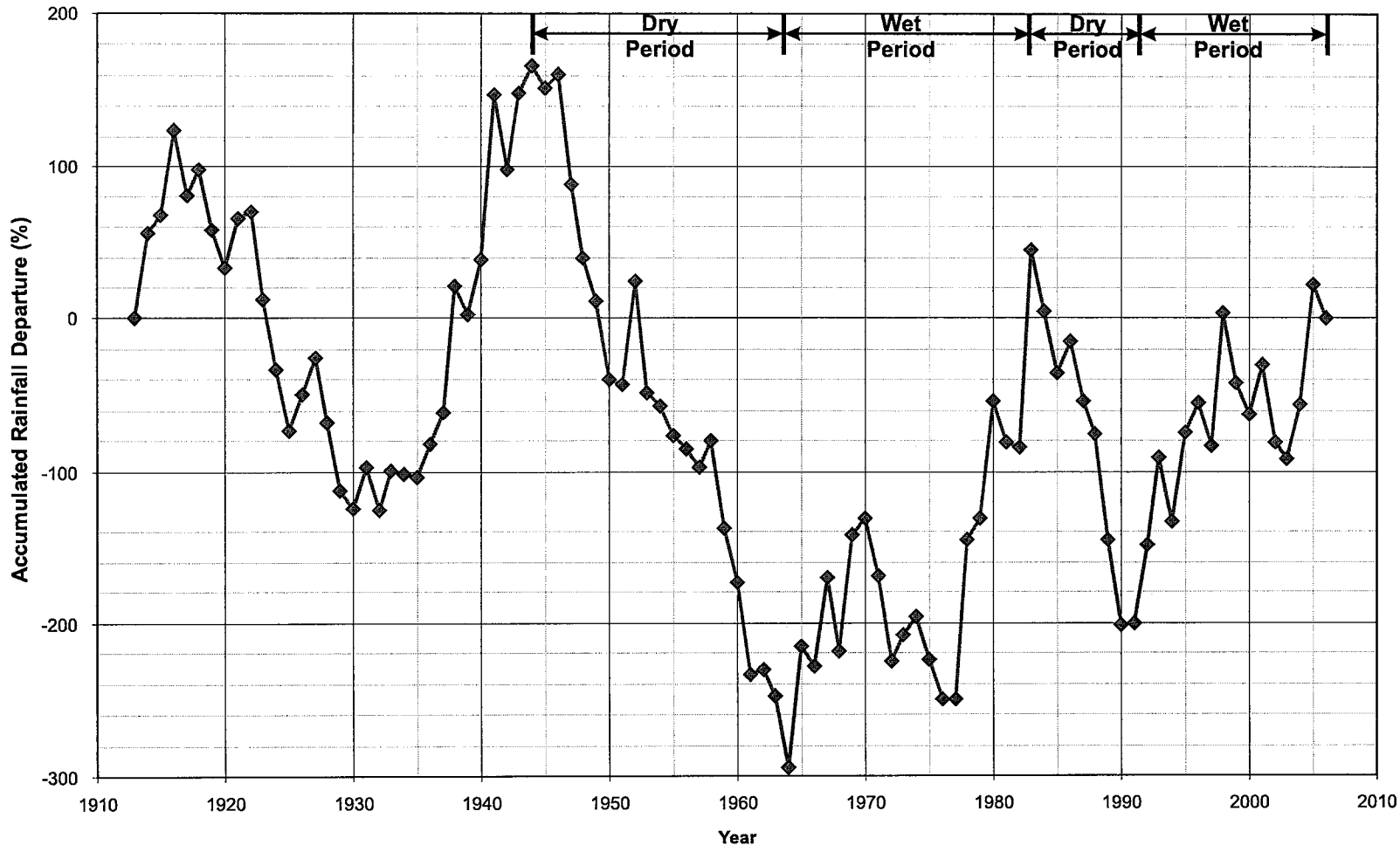

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FIGURE 2B
ACCUMULATED RAINFALL DEPARTURE
LOS ANGELES CIVIC CENTER RAINGAGE

Job No. 162-05 **January 2009**

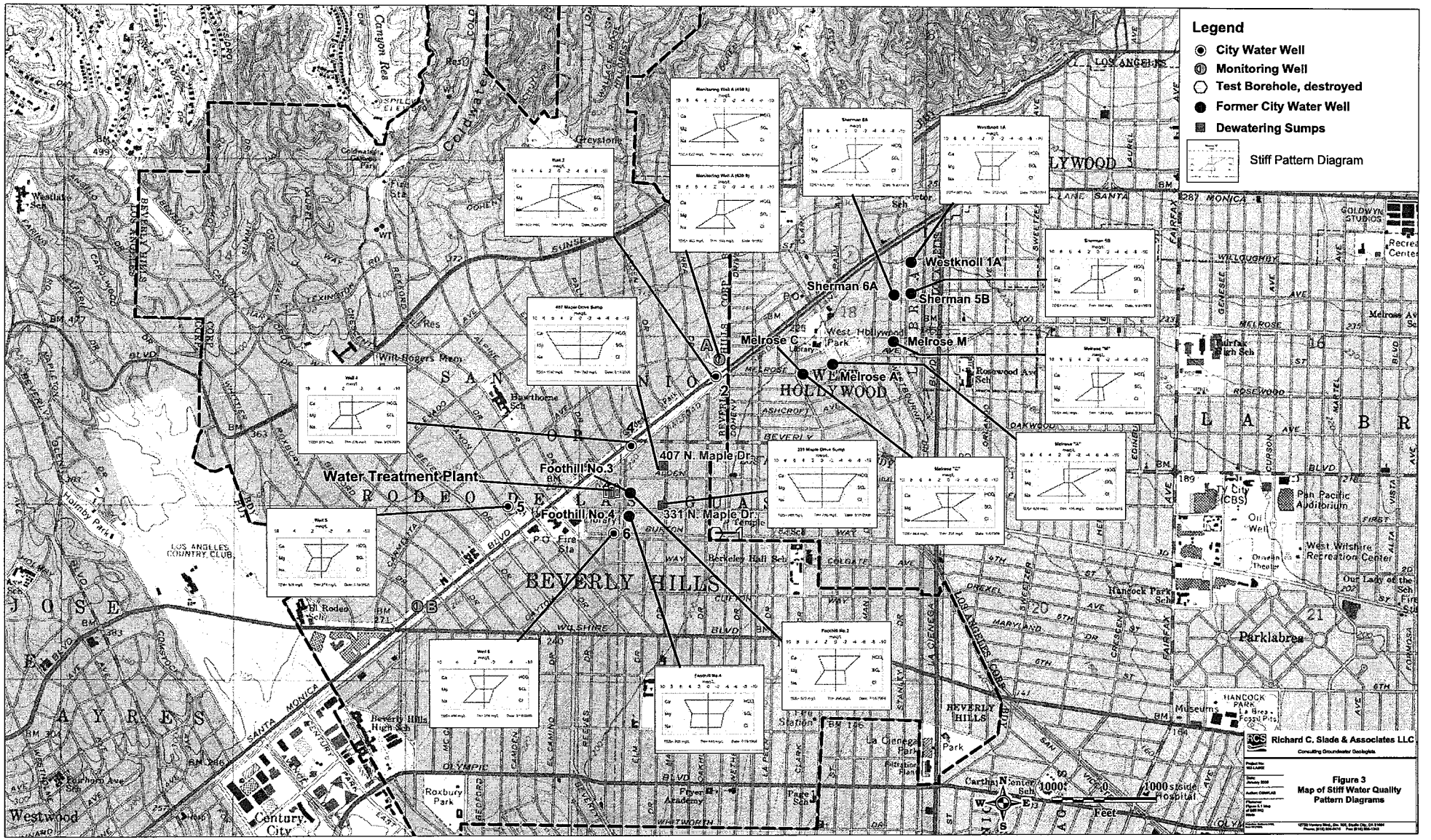
Legend
City Water Well
Monitoring Well
Test Borehole, destroyed
Former City Water Well
Dewatering Sumps
Stiff Pattern Diagram
Westknoll 1A
Sherman 6A
Sherman 5B
Melrose C
Melrose M
Melrose A
Foothill No.3
Foothill No.4
Water Treatment Plant
407 N. Maple Dr.
331 N. Maple Dr.
Richard C. Slade & Associates LLC
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Figure 3
Map of Stiff Water Quality Pattern Diagrams
1000 0 1000 Feet