June 12, 2017

VIA EMAIL

Mr. David P. Bolin, CHG
Principal Hydrogeologist
ORANGE COUNTY WATER DISTRICT
18700 Ward Street
Fountain Valley, CA 92708

Re: Summary of Data Gaps Evaluation and
Basis of Proposed Additional Groundwater Assessment Well Locations

Dear Mr. Bolin:

The Additional Groundwater Assessment Field Sampling Plan and Quality Assurance Project Plan Addendum (FSP) prepared by Hargis + Associates, Inc. (H+A) on behalf of the Orange County Water District (OCWD) for the OCWD South Basin describes additional assessment activities to be conducted in support of the Remedial Investigation and Feasibility Study (RI/FS) being conducted as part of the South Basin Groundwater Protection Project (SBGPP) primarily located in the cities of Santa Ana, Irvine, and Tustin, California (the Study Area). Specifically, the FSP describes additional groundwater assessment activities that will be conducted to further characterize the hydrogeology and extent of contamination in areas of the SBGPP that have been identified as having key data gaps; and provide data to support the development of appropriate remedial actions. This letter provides a description of the process of identifying key data gaps and results of the analysis. Following implementation of the additional groundwater assessment activities described in the FSP, results of the assessment will be evaluated and any potential new or additional data gaps requiring further assessment will be identified.

The OCWD has a small network of regional groundwater monitoring wells within the SBGPP, and more than 500 monitoring wells have been installed as part of contaminant investigation programs at “source sites” located within the SBGPP. Since 2008, the OCWD has conducted groundwater RI activities within the SBGPP and maintains a database of groundwater data within the SBGPP which includes data from the OCWD regional monitoring wells as well as individual “source site” monitoring wells for which data is readily available for download from the California State Water Resources Control Board GEOTRACKER data management system for sites that impact, or have the potential to impact, water quality in California. A Preliminary RI report for the SBGPP was prepared for OCWD by Aquilogic in October 2015.

Results of the Preliminary RI investigation indicated that contaminants have been detected at concentrations exceeding one thousand times maximum contaminant levels (MCLs) in the groundwater in the shallow aquifers less than approximately 100 feet below land surface (bfs). The principal COCs within the SBGPP include trichloroethene (TCE), tetrachloroethene (PCE, also known as perchloroethylene), 1,1-dichloroethylene (1,1-DCE), 1,4-dioxane, perchlorate, and hexavalent chromium (Cr(VI)). Detections of contaminants have also been reported in water supply wells that withdraw groundwater from the deeper aquifer units, notably supply well IRWD-3 which is screened in both the Principal Aquifer and Deep Aquifer systems. Non-pumping groundwater levels in supply well IRWD-3 and Shallow Aquifer system monitor
wells SAM-4/1 to SAM-4/3 indicate a downward vertical gradient exists between the Shallow Aquifer System and the Principal/Deep Aquifer systems (Figure 1). The downward vertical gradient indicates the potential for downward migration of principal COCs from within and to below the Shallow Aquifer System. This vertical migration potential is of primary concern and needs to be addressed by existing and proposed additional RI monitor wells within the Study Area.

The available water level, water quality, and hydrostratigraphic data was compiled and reviewed to evaluate the critical data gaps in portions of the Study Area downgradient of "source sites". Specifically, the following key questions were addressed during the data gap review:

- What is the lateral/vertical extent of principal COCs exceeding drinking water MCLs and/or Notification Levels (NL)?
- What is nature of hydrostratigraphic units and principal COC migration pathways in the Shallow Aquifer System?
- What is the direction of groundwater flow and gradient in and between hydrostratigraphic units?

The focus of the data gaps assessment was on evaluating monitor well coverage within the SBGPP at different depth intervals within the Shallow Aquifer System. Based on data from wells SAM-1 through SAM-6 and the OCWD Basin model, the bottom of the Shallow Aquifer System (Alpha Aquifer) within the Study Area ranges from approximately 100 to 190 feet bsls (Figure 2). The depth intervals evaluated for the Data Gaps analysis are as follows:

- Less than 35 feet bsls
- 35 to 55 feet bsls
- 55 to 75 feet bsls
- 75 to 130 feet bsls
- 130 to 200 feet bsls

The 10 microgram per liter plume contour for the most widespread principal COCs (TCE, PCE, 1,1-DCE), and perchlorate in the three units above 75 feet bsls from the 2012 plume maps presented in the Preliminary RI report were posted and compared to locations of existing monitor wells known to be screened within the respective depth interval (Figures 3 to 5). Additionally, 1,4-dioxane is a widespread principal COC that is not depicted in Figures 3 to 5 as the extent lies within the extent of TCE, PCE, and 1,1-DCE. Since plume maps were not prepared for the depth intervals greater than 75 feet bsls in the Preliminary RI investigation, the approach for these depth intervals included comparing color coded postings of the most recent (thru 2012) maximum individual concentration of the widespread principal COCs to locations of the existing monitor wells known to be screened within the respective depth interval (Figures 6 and 7).

This data gaps analysis resulted in identification of seven locations within the SBGPP where additional monitor wells should be installed to further characterize: the lateral/vertical extent of principal COCs; the nature of hydrostratigraphic units; and the direction of groundwater flow/gradient in and between hydrostratigraphic units (Figures 4 to 7 and Table 1). Each monitor well location would comprise 4 to 5 individual monitor wells completed at different depths (monitor well cluster). Two of the monitor well clusters (6 and 7 on Figures 4 to 7) are located interior to the commingled plumes in the SBGPP. The remaining 5 monitor well clusters are located near the perimeter of the Study Area. The northern most
monitor well cluster is not included in the FSP as this cluster was intended to be installed with a potential pilot test in this area.

If pilot testing is not pursued in this area within the next 6 months, it is anticipated that this seventh monitor well cluster would be installed using methods outlined in the FSP. A FSP addendum would be prepared if necessary.

Sincerely,

HARGIS + ASSOCIATES, INC.

Christopher G.A. Ross, PG 4594, CHG 221
Principal Hydrogeologist

Kevin L. Coons, PE
Senior Engineer

Enclosures

Table 1. Key Data Gaps

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cc w/encl: Mr. Roy L. Herndon, RG CHG, District Hydrogeologist, Orange County Water District
           Mr. William Hunt, Executive Director Operations, Orange County Water District
<table>
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<tr>
<th>Proposed Multi-Level Well Location</th>
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<td>Hydraulic control and interior plume definition - Northern Areas</td>
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<td>Hydraulic control and interior plume definition - Southern Areas</td>
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NOTES

bls = below land surface
VOCs = Volatile Organic Compounds

Figure 1. Vertical Gradient

- **SAM-4/1 screen Shallow Aquifer**: 50 to 65 feet bgs
- **SAM-4/2 screen Shallow Aquifer**: 120 to 135 feet bgs
- **SAM-4/3 screen Upper Principal Aquifer**: 185 to 195 feet bgs
- **IRWD-3/1 screen Principal Aquifer**: 484 to 1,270 feet bgs

*Shallow Aquifer System*
*Upper Principal Aquifer*
*Principal and Deep Aquifer Systems*

*Downward Vertical Gradient*
FIGURE 2.
PROPOSED WELL LOCATIONS AND DEPTH TO BOTTOM OF ALPHA AQUIFER
Proposed Interior Well Locations
Proposed Perimeter Well Locations
Monitor Wells approx 35 to 55 feet bls
TCE >10 ug/l
PCE >10 ug/l
1,1-DCE >10 ug/l
Perchlorate > 10 ug/l
Source Sites

DATA GAP ANALYSIS

55 TO 75 FEET BELOW LAND SURFACE

ORANGE COUNTY WATER DISTRICT
SOUTH BASIN GROUNDWATER PROTECTION PROJECT
FOUNTAIN VALLEY, CALIFORNIA

FIGURE 5

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IRWD-3/1

Proposed Interior Well Locations
Proposed Perimeter Well Locations
Monitor Wells approx 75 to 130 feet bls
Recent Maximum COC Concentration

COCs = TCE, PCE, 1,1-DCE, 1,4-dioxane.
Posted results are the most recent concentration thru 2012 of the COC with the maximum concentration at each location.

DATA GAP ANALYSIS
75 TO 130 FEET BELOW LAND SURFACE

Figure 6

Proposed Interior Well Locations
Proposed Perimeter Well Locations
Monitor Wells approx 75 to 130 feet bls
Recent Maximum COC Concentration

COCs = TCE, PCE, 1,1-DCE, 1,4-dioxane.
Posted results are the most recent concentration thru 2012 of the COC with the maximum concentration at each location.

DATA GAP ANALYSIS
75 TO 130 FEET BELOW LAND SURFACE

Figure 6
DATA GAP ANALYSIS
130 TO 200 FEET BELOW LAND SURFACE

COR = TCE, PCE, 1,1-DCE, 1,4-dioxane.
Posted results are the most recent concentration thru 2012 of the COC with the maximum concentration at each location.

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