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California Regional Water Quality Control Board
Central Coast Region
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401

Attention: Mr. Hector Hernandez

Dear Mr. Hernandez:

RE: REVIEW OF OLIN FOURTH QUARTER 2006 AND FIRST QUARTER 2007 GROUNDWATER MONITORING REPORTS

On behalf of the City of Morgan Hill (the City), WorleyParsons Komex has reviewed the Olin Corporation (Olin) January 30, 2007 report, "Fourth Quarter 2006, Groundwater Monitoring Report" (the Q4 Report) and the April 30, 2007 report "First Quarter 2007, Groundwater Monitoring Report" (the Q1 Report) for the Olin property at 425 Tennant Avenue, Morgan Hill, California (the Site) submitted to the Central Coast Regional Water Quality Control Board (RWQCB). Below, please find a summary of major comments on the reports, followed by additional detailed technical comments. For reader convenience, Report figures that are cited herein are included in Attachment A.

FOURTH QUARTER 2006 GROUNDWATER MONITORING REPORT

Although the Q4 Report no longer contains a separate appendix directed to the Northeast Flow area, our review focused primarily on the aspects of the Q4 Report that deal with groundwater flow and water quality in the area northeast of the Site. In particular, our review considered Appendix C (Transducer Data for Piezometers). Major comments on the Q4 Report are as follows:

a) Groundwater flow directions within the Middle and Lower Deep Aquifer zones in third quarter 2006 in the vicinity of the Site were dominantly northerly-directed. This fact is finally acknowledged by Olin, in the statement on page 3-3 of the Q4 Report, "…groundwater flow in the middle- and deep- zones north of the Site flows to the north/northwest." As of fourth quarter 2006, there were six quarters of consecutive monitoring data (third quarter 2005 to fourth quarter 2006) showing a consistently northerly component of flow in the area northeast of the Site in the Deep Aquifer zone; however, for the first time, Olin has not provided a map of groundwater elevations in the Lower Deep Aquifer zone, as has been provided in previous quarterly monitoring reports. Although Olin provide data from the northeast triad of piezometers in Appendix C, there is almost no discussion of the results in the text. To make up for this deficiency a discussion of these data is provided herein;

b) As in previous Olin groundwater monitoring reports, perchlorate results from on-Site, off-Site south and northeast are presented independently, without a single, integrated evaluation of groundwater perchlorate concentrations from the Site outward, both to the east and northeast, tying together all the data relevant to the migration from the Site to the City's northeast wells.

c) Pumping of the City's northeast wells directly affects the groundwater flow direction and hydraulic gradient in the Deep Aquifer zone to the northeast of the Site. Pumping patterns in individual City wells are also reflected in the groundwater flow direction and gradient to the northeast of the Site.

d) Pumping of the City's northeast wells effects the groundwater levels in the Deep Aquifer zone to the south extending beyond the Site. The observed drawdowns are greater than the natural head differences that would produce groundwater flow to the south.

Fourth Quarter 2006 Report Detailed Comments

1. The direct hydraulic communication through the Deep Aquifer from the City's northeast wells to the Olin Site is illustrated by the Q4 trends in both the direction and magnitude of the hydraulic gradient in the northeast triad of monitoring wells, in response to pumping from the City's wells. The gradient direction and magnitude were calculated in the Middle Deep Aquifer zone by Olin for wells PZ-02-315, PZ-01-333 and PZ-03-325, and provided in the Q4 Report in Figure C9 of Appendix C. Figure C9 includes the period when the Nordstrom well ceased pumping for the year on November 6, 2006. The significance of this event on northeast groundwater flow warrants discussion. Q4 Report Figure C9 was modified by WorleyParsons Komex to highlight some of the key information relevant to the interpretation of the data, and is included in this document as Figure 1.

   As shown in Figure 1, when all seven northeast wells were pumping (Diana #1,#2,#3, Dunne #1, #2, Nordstrom and Tenant) from October 1 to October 17, 2006, the groundwater flow direction was N40ºW to N50ºW (Note that N45ºW corresponds to due northwest); the gradient during this pumping is high, at 0.004 to 0.006. The Diana #1 well is screened from 116 to 193 feet, exclusively in the Intermediate Aquifer zone, so presumably the Deep Aquifer zone response shown in Figure 1 reflects mainly pumping from the Dunne #1 and #2 and the Diana #2 and #3 wells. The Dunne #2 well was shut down for 15 days on October 17, 2006, and there was a corresponding shift in flow direction to the west by about five degrees, and a marked decrease in the hydraulic gradient to 0.0032 from 0.0043.

2. When the Nordstrom well was shut down on November 6, a major shift in the flow direction and gradient was observed. From November 6 to early December 2006, with Tenant, Diana #1, #2 and #3, and either Dunne #1 or #2 pumping, the gradient direction shifted west, ranging N60ºW to N100ºW (Note that N90ºW corresponds to due west). The gradient during this period decreased appreciably, to about 0.002.

3. After December 7, 2006, both Dunne wells began pumping on similar schedules, in addition to the Tenant well and three Diana wells. Under these pumping conditions, the gradient direction shifted approximately 25 degrees to the north, giving flow directions of N45ºW to N65º. The gradient magnitude during this period also increased to about 0.0025. These results show that

northerly-directed flow is dominant whenever Nordstrom well is pumping, or possibly also when the two Dunne wells are pumped together, without Nordstrom pumping.

4. In addition to the larger-scale changes in flow pattern shown in Figure C9, the figure also shows that one-day pump on cycles in a single well can change the direction of the groundwater flow by more than 20 degrees (toward the north). City well pumping data provided in Q4 Report Table C-2 (not included herein) shows that Nordstrom and Tenant wells are typically pumped continuously when they are operation, whereas other City wells, notably Diana #1, #2 and #3, Dunne #1 and Dunne #2 are typically operated on a schedule of about 8 to 20 hours pumping, followed by about 4 to 8 hours off. Each such on-off cycle is clearly represented in Figure 1 (from Q4 Report Figure C9). When Dunne 1 or Dunne 2 is pumping, the flow direction shifts to the north by about 20 degrees, and there is a corresponding increase in gradient magnitude by about 0.002. During the off cycle, the flow direction and gradient both recover to their non-pumping condition. The size of these swings in gradient direction and magnitude tend to be more extreme when pump-on cycles are extended. For example, from November 6 to December 1, 2006, when pumping was alternating between the Dunne 1 and Dunne 2 wells, the flow direction shifted to the north by about 30 degrees during pumping cycles, then back to the west by a similar amount during off cycles. From November 3 to 6 and again from November 11 to 13, Dunne #2 was pumped continuously for extended periods of 66 and 44 hours, respectively, producing a very clear northward shifts in flow direction and increase in gradient, noted in Figure 1.

5. The hydrographs shown in Q4 Report Figure C8 are also illustrative of northeast flow response to City pumping. Of particular note, Figure C8 shows recovery of water levels due to shut-down of the Nordstrom well on November 6, 2006. Water levels in northeast Middle Deep Aquifer zone piezometers recovered by 10 feet (PZ-02-315), 13 feet (PZ-01-333) and 18 feet (PZ-03-325) in response to Nordstrom shut-down. Drawdowns of this magnitude can cause a substantial alteration of groundwater flow patterns in the Deep Aquifer zone, and demonstrate the high degree of hydraulic communication between the Nordstrom Well and these monitoring wells, which are within 1000 feet of the Olin Site. As shown in Figure C8, water levels in the monitoring wells declined by up to five feet during the period from December 7 to 31 when both Dunne #1 and #2 were both pumping in addition to three Diana wells and Tenant, and daily responses to pumping on-off cycles were more pronounced. This suggests that pumping the Dunne wells has appreciable influence on water levels northeast of the Olin Site.

6. Olin does not provide detailed groundwater level data or hydrographs for Deep Aquifer zone piezometers installed at MP-04– 251, 273, 291, and PZ-04-335, 375 in the Q4 Report. Consequently, it is not possible to evaluate the drawdown or recovery response at this location due to changes in the City's northeast pumping. This type of data provided by Olin in the Third Quarter of 2006 showed drawdown of up to 16 feet at MP-04 in response to City pumping. Sporadic groundwater level data included in Q4 Report Table 3.1 (not included herein) shows Middle Deep Aquifer groundwater levels rose substantially between November 1, 2006 (Nordstrom well pumping) and December 7, 2006 (Nordstrom off, and five of six remaining wells pumping). Over this period, groundwater levels at PZ-04-335 and PZ-04-375 rose by 21.95 feet and 22.54 feet, respectively. More detailed hydrographs would have to be provided

by Olin to identify water level recovery attributable only to the shut-down of Nordstrom well on November 6, 2006.

7. The distribution of perchlorate in the Deep Aquifer Zone in Q4 2006 was compiled by WorleyParsons Komex onto a single map, and contoured using Olin's isoconcentration contour levels of 6, 11 and 24.5 ug/L, plus additional contours for 3 and 4 ug/L. The maximum Deep Aquifer Zone perchlorate concentration at each monitoring location in Q4 2006 was used for contouring. The resulting map is provided in Figure 3. This map shows a continuous plume of elevated perchlorate from the Olin Site to the City's northeast wells, consistent with the Olin Site as the source of contamination. Perchlorate concentrations in the northeast triad of monitoring well/piezometer locations (MP-01/PZ-01, MP-02/PZ-02, MP-03/PZ-03) all show Deep Aquifer zone perchlorate concentrations above 4 ug/L, and the lateral extent of these concentrations is not delineated. Perchlorate data from the City's northeast wells must be viewed a minimum values since these wells all have long screens and are completed over multiple intervals, and a thus these wells are not suitable for delineating perchlorate in the Deep Aquifer zones exclusively. Additional delineation in the Deep Aquifer zone by Olin is required.

8. Olin contends in the Q4 Report that perchlorate to the northeast of their Site represents some natural or anthropogenic background condition. However, Olin provides no comprehensive assessment of background concentrations, and more important, no explanation as to why the distribution of perchlorate in the Deep Aquifer Zone northeast of the Site has the characteristics of a plume emanating from the Olin Site, rather than a random distribution of concentrations as might be expected from strictly background concentrations.

FIRST QUARTER 2007 GROUNDWATER MONITORING REPORT

The Q1 Report, like the Q4 Report, also does not include a detailed discussion of northeast flow conditions or perchlorate distribution. Northeast flow data are provided in Appendix C, with the exception of Figures 3.20 and 3.21 in the body of the report. Major comments on the Q1 Report are as follows:

a) Like the Q4 Report, the Q1 Report does not provide an integrated interpretation of perchlorate data in groundwater in the area beneath the Site and to the northeast of the Site. This deficiency remains in spite of the fact that new highs in perchlorate concentrations were observed in eight of twelve monitoring wells completed in the Middle Deep Aquifer zone during the first quarter 2007.

b) For the seventh consecutive quarter (third quarter 2005 to first quarter 2007) there is a northerly component of groundwater flow in the area northeast of the Olin Site, as reflected in the hydraulic gradient measured between the triad of piezometers PZ-02-315, PZ-01-333 and PZ-03-325. There were relatively few changes in pumping patterns in the City of Morgan Hill's northeast wells during the first quarter of 2007; therefore, the hydraulic gradient and flow direction showed little variation over the quarter. There is no map of Lower Deep Aquifer zone groundwater elevations in the Q4 Report, although previous groundwater monitoring reports

included a map of groundwater elevation in the Lower Deep Aquifer zone, which typically highlighted the northerly component of flow in this unit.

c) In the Q1 Report, Olin continues to combine perchlorate data from contaminated wells downgradient of the Site, to the northeast, with more remote wells, in their characterization of "background" concentrations, thereby yielding a biased data set that is in no way representative of anything approaching true background conditions.

First Quarter 2007 Report Detailed Comments

1. As shown in Q1 Report Figure 3.21, groundwater flow directions between the triad of piezometers PZ-02-315, PZ-01-333 and PZ-03-325 in the first quarter ranged from northwestward (N55ºW to N62ºW) when City wells were pumping, to westward (N85ºW to N90ºW) when the wells were off, in the typical daily pumping cycle described previously. As in the previous six quarters (third quarter 2005 to fourth quarter 2006), there is no indication of a southerly component to groundwater flow in the Middle Deep Aquifer zone represented by this triad of piezometers.

2. As noted above, there is no map of Lower Deep Aquifer zone groundwater elevations in the Q1 Report, despite the fact that data are now available for a new monitoring well, PZ-05-390. Previous groundwater monitoring reports (except the Q4 Report) included a map of groundwater elevation in the Lower Deep Aquifer zone, which typically highlighted the northerly component of flow in this unit. The RWQCB should require Olin to include such maps to provide a complete characterization of groundwater flow in the Deep Aquifer zone. .

3. New historical high perchlorate concentrations were observed in first quarter 2007 in five Upper Deep Aquifer monitoring wells (MP-16-229, MP-21-278, MP-52-273, MW-04B, MW-53-264); eight Middle Deep Aquifer zone monitoring wells (MW-16-363, MW-52-347, MW-21-295, MW-04C, MW-05C, plus northeast piezometers PZ-01-333 (4.6 ug/L), PZ-02-315 (4.7 ug/L) and PZ-04-335 (8.5 ug/L); and two Lower Deep Aquifer zone monitoring wells (MW-52-403, MW-54-400).

4. The newly-installed PZ-05-390, located approximately 1000 feet northeast of location PZ-04 (1500 feet east of the Site), recorded a perchlorate concentration in the Lower Deep Aquifer zone of 22 ug/L in First Quarter 2007. This piezometer was intended to provide lateral delineation of the perchlorate plume from the Site in the Deep Aquifer zone to the east; however, clearly lateral delineation in the Lower Deep Aquifer zone is incomplete. Moreover, perchlorate concentrations in the northeast monitoring well/piezometer locations (MP-01/PZ-01, MP-02/PZ-02, MP-03/PZ-03, MP-04/PZ-04) in the first quarter 2007 again all show Deep Aquifer zone perchlorate concentrations above 4 ug/L. Confirmed perchlorate concentrations greater than 4 ug/L have now been noted over consecutive quarters in several of these wells, including:

    - At MP-01/PZ-01: PZ-01-333 (2 quarters);
    - At MP-02/PZ-02: MP-02-255 (3 quarters); PZ-02-315 (4 quarters); PZ-02-415 (4 quarters);

- At MP-03/PZ-03: PZ-03-427 (4 quarters);
- At MP-04/PZ-04: MP-04-273 (4 quarters);

The most recent sampling data in the Deep Aquifer zone confirms the presence of a significant perchlorate plume to the northeast and east of the Olin Site. The lateral extent of this perchlorate plume beyond these wells is not delineated. Clearly, additional delineation by Olin of the perchlorate plume in the Deep Aquifer zone northeast and east of the Site is required.

5. In spite of this important new information on perchlorate distribution east and northeast of the Site, Olin's mapping of the perchlorate distribution in the Deep Aquifer zone continues to show the northeast perchlorate detections as isolated occurrences, for example, as illustrated in Q1 Report Figure 3.31. No rational explanation is provided by Olin for such contouring of the data.

6. The distribution of perchlorate in the Deep Aquifer Zone in Q1 2007 was compiled by WorleyParsons Komex onto a single map, contoured using Olin's isoconcentration contour levels of 6, 11 and 24.5 ug/L, plus additional contours for 3 and 4 ug/L. The maximum Deep Aquifer Zone perchlorate concentration at each monitoring location in Q1 2007 was used for contouring, as shown in Figure 4. Figure 4 shows a continuous plume of perchlorate in the Deep Aquifer to the northeast of the Olin Site, although the plume has contracted somewhat between fourth quarter 2006 and first quarter 2007, likely in response to the change in hydraulic gradient and groundwater flow direction that corresponded to the reduced pumping from the City's northeast wells during this period.

7. The trend analysis for perchlorate in the Deep Aquifer does not appear to have been thoroughly analyzed by Olin, at least in terms of their mapping of perchlorate trends in the Deep Aquifer shown in Figure 3.30. Furthermore, there is no tabulation of Mann Kendall results for monitoring wells in either the Tables or Appendices of the Q1 Report. The following 21 wells meet Olin's criteria for Mann Kendall analysis (greater than four samples, with at least half the results above the reporting limit of 4 ug/L) and yet do not appear to have been plotted by Olin on Figure 3.30 or otherwise discussed by Olin in the Q1 Report [note: in brackets, number of detections > 4 ug/L / number of samples]:

   Deep Aquifer - Upper

   - MP-02-255 (3/6)
   - MP-17-217 (8/8)
   - MP-21-278 (6/7)
   - MP-52-273 (5/5)
   - MW-04B (6/8)
   - MW-05B (4/8)
   - MW-53-195 (5/5)
   - MW-53-264 (5/5)

Deep Aquifer - Middle

- MP-21-295 (6/7)
- MP-52-295 (5/5)
- MW-04C (8/8)
- MW-05C (8/8)
- MW-16-328 (7/7)
- MW-16-363 (6/6)
- MW-21-332 (6/6)
- MW-52-347 (6/6)
- PZ-02-315 (4/6)

Deep Aquifer -Lower

- MW-52-403 (6/6)
- MW-54-400 (4/4)
- PZ-02-415 (4/7)
- PZ-03-427 (6/7)

Note that this list includes ten wells in the Deep Aquifer zone that recorded new historical high perchlorate concentrations in the first quarter 2007, yet this appears to have gone un-noticed by Olin. While Olin may be correct that the southern plume in the Shallow and Intermediate aquifers are generally stable, the perchlorate plume in the Deep Aquifer Zone is clearly getting worse, particularly in the area northeast of the Site.

8. As an indication that Olin has failed to detect this trend of increasing perchlorate concentrations in the Deep Aquifer zone, the Q1 Report concludes that "The elevated perchlorate concentrations observed at MW-06C are anomalous." (Q1 Report, p. 3-8). There is no basis for this statement. While the concentrations in this well in the Middle Deep Aquifer have been quite variable, duplicate sampling on two occasions (Q3 2006 and Q1 2007) confirmed the high concentrations (19 to 21 ug/l and 9.2 to 9.3 ug/L, respectively) detected in this well. The pattern of higher and lower concentrations in this well track very closely with those in well MW-06B, completed in the Upper Deep Aquifer at the same site, but with lower overall concentrations. It should also be noted that nearby on-Site Middle Deep Aquifer monitoring wells MW-04C and MW-05C recorded new historical high concentrations in the first quarter 2007, of 30 and 26 ug/L, respectively. Elevated perchlorate concentrations in the Deep Aquifer Zone on-Site are far from anomalous. They are characteristic of the groundwater in the Deep Aquifer beneath the Olin Site.

9. Olin's characterization of "background" perchlorate concentrations in the Q1 Report continues to utilize wells in the northeast plume that are clearly contaminated with perchlorate from the

Olin site, as illustrated in Figure 4. For example, Olin's assessment of background perchlorate represented by Figure 3.32 of the Q1 Report includes the Tenant well at 7.40 ug/L, which is indisputably contaminated with perchlorate from the Olin Site. Any characterization of background conditions clearly must exclude any and all wells that could potentially be impacted by perchlorate from the Olin Site.

CLOSING

With the data from the two above reports, a clear picture of perchlorate contamination in the Deep Aquifer Zone is emerging. The main features of this picture are:

- Direct hydraulic communication through the Deep Aquifer from the Olin Site to the City's northeast wells, as indicated by the immediate hydraulic response to City pumping;
- Consistent, long-term northerly directed flow from the Olin Site toward the City's northeast wells;
- A confirmed perchlorate plume in the Deep Aquifer northeast and east of the Olin Site, with perchlorate detections consistently in excess of 4 ug/L;
- Widespread increases in perchlorate concentrations in the Deep Aquifer zone, and a lack of lateral delineation of the plume to the east and northeast of the Site, particularly in the area between Olin's northeast monitoring well locations and the City's production wells.

WorleyParsons Komex is pleased to provide these comments to the RWQCB and we are at your disposal to discuss any of the issues noted above. If you have any questions or need additional information please contact Mark Trudell at (310) 547-6357, or by e-mail at mark.trudell@worleyparsons.com.

Sincerely,
WorleyParsons Komex

Mark Trudell, Ph.D., PG, CHG

Principal Hydrogeologist

Ralph Beck, PG

Project Director

Encl.
cc: Mr. Steve Hoch, Hatch & Parent
Mr. Jim Ashcraft, City of Morgan Hill

FIGURES

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ATTACHMENT A

CITED OLIN REPORT FIGURES

FOURTH QUARTER 2006 REPORT FIGURES

FIRST QUARTER 2007 REPORT FIGURES