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9888 Kent Street • Elk Grove CA 95624
Phone: (916) 714-1801 • Fax: (916) 714-1804

TECHNICAL MEMORANDUM

Date: January 13, 2016

Prepared for: Kristen T. Castaños, Partner, Stoel Rives LLP Attorneys at Law

CC: Ross Oliveira, Morning Star

Prepared by: Cyle Moon, M.S., E.I.T; Art O'Brien, P.E.

Subject: Settling Pond Expansion Groundwater Impacts Evaluation

REGISTERED PROFESSIONAL ENGINEER
ARTHUR J. O'BRIEN
CIVIL
STATE OF CALIFORNIA

Introduction

Morning Star operates a tomato processing plant in Williams, CA that produces bulk tomato paste. The plant operates seasonally, from July through October. Wastewater from the tomato processing operations is discharged to fields just north of the processing plant, and discharge is regulated by the Central Valley Regional Water Quality Control Board (Board) under Waste Discharge Requirements (WDRs) Order No. R5-2013-0144. The groundwater monitoring network consists of nine (9) groundwater monitoring wells. Five (5) groundwater monitoring wells (MW-5, MW-6, MW-7, MW-8, and MW-9) are associated with the land application area (LAA) and are used to monitor constituents, as specified in the Monitoring and Reporting Program (MRP) of the WDRs, for potential groundwater degradation due to land application of tomato processing wastewater. Monitoring wells MW-1, MW-2, MW-3, and MW-4 are located near the processing plant, and used to monitor impacts from the tomato processing area. The site contains a Settling Pond, which receives a portion of the wash water from the flumes used in the tomato cleaning process. This water is then used for irrigation purposes in the LAAs.

Regulatory Background

The 2013 WDRs identify the Settling Pond as occupying 1 acre, with a 5 ft depth, for a total volume of 5 acre-ft. In a November 2, 2015 inspection of the Morning Star site, Board staff observed that the Settling Pond had been expanded. The Settling Pond is estimated to now be approximately 1.98 acres, with a 7.65 ft depth (CDO, paragraph 57). This expansion was confirmed by Morning Star to have occurred between May/June 2012.

Morning Star received a Tentative Cease and Desist Order (CDO) No. R5-2016-XXXX, dated November 20, 2015, that alleged that the unpermitted Settling Pond expansion was a violation of the 2013 WDRs. The expanded Settling Pond physically existed at the time of adoption of the 2013 WDRs but was not appropriately documented in the 2013 WDRs. The CDO alleges that the expansion of the Settling Pond has the potential to impact groundwater due to an increase in percolation from the Settling Pond.

Evaluation of Groundwater Degradation due to Expansion of the Settling Pond

Monitoring wells MW-2 and MW-3 are directly downgradient of the Settling Pond. Monitoring wells MW-1 and MW-4 are upgradient to the Settling Pond. Monitoring well MW-5 is a background well, as it is upgradient of the site. To determine if the Settling Pond expansion has altered water quality in the underlying groundwater, time series of relevant parameters were prepared for monitoring wells MW-1, MW-2, MW-3, MW-4, and MW-5, and comparative statistics were computed for pre-pond expansion and post-pond expansion datasets. As described in the 2013 WDRs, Findings 43 and 45, pertinent parameters for these monitoring wells include: total dissolved solids (TDS), chloride, electrical conductivity (EC), nitrate, manganese, and iron. Manganese and iron have not been identified in the CDO as being out of compliance, and therefore, are not included in this evaluation. For the purposes of this analysis, constituent concentrations reported as non-detect (ND), less than the reporting limit (RL), or less than the method detection limit (MDL), were treated as 1/2 the RL or MDL, whichever was available.

Chloride Concentrations in MW-1, MW-2, MW-3, MW-4, and MW-5

Figure 1 shows chloride concentrations in MW-1, MW-2, MW-3, MW-4, and MW-5 since their respective installations. Since the expansion of the Settling Pond in May/June 2012, chloride concentrations in MW-2 (downgradient) have exhibited a downward trend, while chloride concentrations in MW-3 (downgradient) have trended upward. It is apparent, from Figure 1, that chloride in wells MW-2, MW-3, MW-4, and MW-5 is highly variable.

Summary statistics for chloride concentrations in the monitoring wells included in this analysis are shown in **Table 1**. A 95% confidence interval was applied to the mean of the pre-expansion chloride dataset for each well, similar to the approach used for manganese compliance in the CDO, to develop a threshold for which to compare the post-expansion dataset. Although post-expansion chloride concentrations in MW-2 and MW-3 (downgradient) have exceeded their respective pre-expansion thresholds, it is likely the case that highly variable chloride in groundwater in this region has more of an influence on the concentrations seen in MW-2 and MW-3, than influences from the Settling Pond. Notwithstanding the statistical analysis, MW-2 post-expansion trend is significantly different (downward trending) than MW-3 (upward trending). MW-4 (upgradient) and MW-5 (background) both reached chloride concentrations of 95.0 mg/L, and MW-5 (background) showed the highest average chloride concentration of all the wells in this analysis (42.1 mg/L). In addition, standard deviation for all wells, except MW-1, was of the same magnitude as the mean, indicative of the high variability.

It is evident that chloride is highly variable, and thus, post-expansion trends in chloride concentrations in wells MW-2 and MW-3 cannot be attributed to expansion of the Settling Pond.

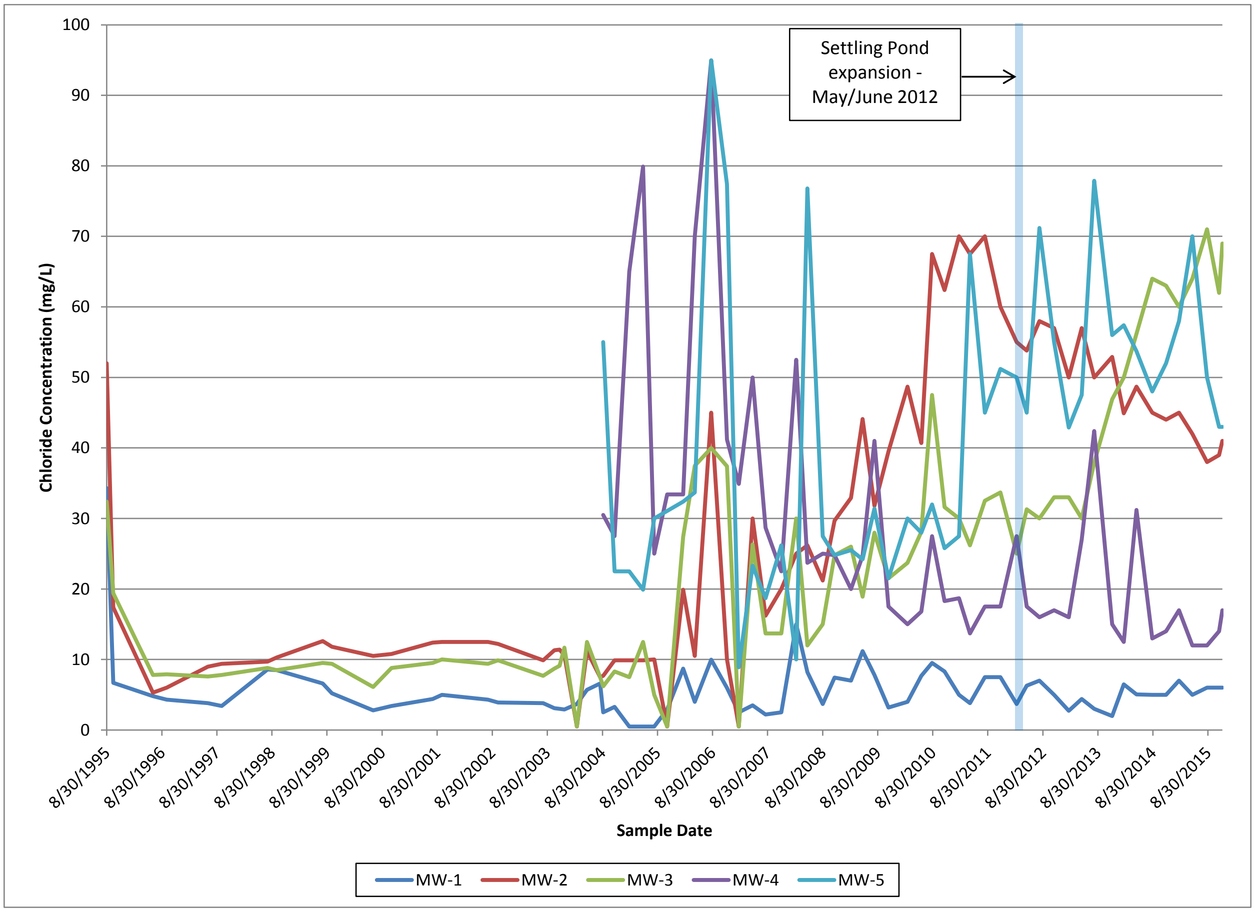

Figure 1. Chloride concentrations time series for monitoring wells MW-1, MW-2, MW-3, MW-4, and MW-5.

Table 1. Chloride concentration summary statistics for MW-1, MW-2, MW-3, MW-4, and MW-5.

Monitoring Well	Average	Standard Deviation	Minimum	Maximum	Pre-expansion 95% Confidence Threshold
MW-1	5.6	4.3	0.5	34.3	7.0
MW-2	29.1	20.8	0.5	70.0	29.5
MW-3	24.6	18.7	0.5	71.0	20.4
MW-4	28.3	18.4	12.0	95.0	39.9
MW-5	42.1	19.9	8.9	95.0	42.9

Note: all values are expressed in mg/L.

TDS Concentrations in MW-1, MW-2, MW-3, MW-4, and MW-5

Figure 2 shows TDS concentrations in MW-1, MW-2, MW-3, MW-4, and MW-5 since their respective installations. Since the expansion of the Settling Pond in May/June 2012, TDS concentrations in MW-2 and MW-3 (downgradient) have no apparent trends. It is apparent, from Figure 2, that TDS in wells MW-1, MW-4 (upgradient), and MW-5 (background) is highly variable.

Summary statistics for TDS concentrations in the monitoring wells included in this analysis are shown in **Table 2**. A 95% confidence interval was applied to the mean of the pre-expansion TDS dataset for each well to develop a threshold for which to compare the post-expansion dataset. Although post-expansion TDS concentrations in MW-2 and MW-3 (downgradient) have exceeded their respective pre-expansion thresholds, it is likely the case that highly variable TDS in groundwater in this region has more of an influence on the concentrations seen in MW-2 and MW-3 (downgradient), than influences from the Settling Pond. MW-5 (background) reached a maximum TDS concentration of 930.0 mg/L (the highest of all wells), and showed the highest average TDS concentration (606.9 mg/L) of all the wells in this analysis. It is evident that TDS is highly variable in background (MW-5) well, which likely have a greater influence on groundwater quality seen in MW-2 and MW-3 (downgradient wells).

Post-expansion trends in TDS in wells MW-2 and MW-3 cannot be attributed to expansion of the Settling Pond.

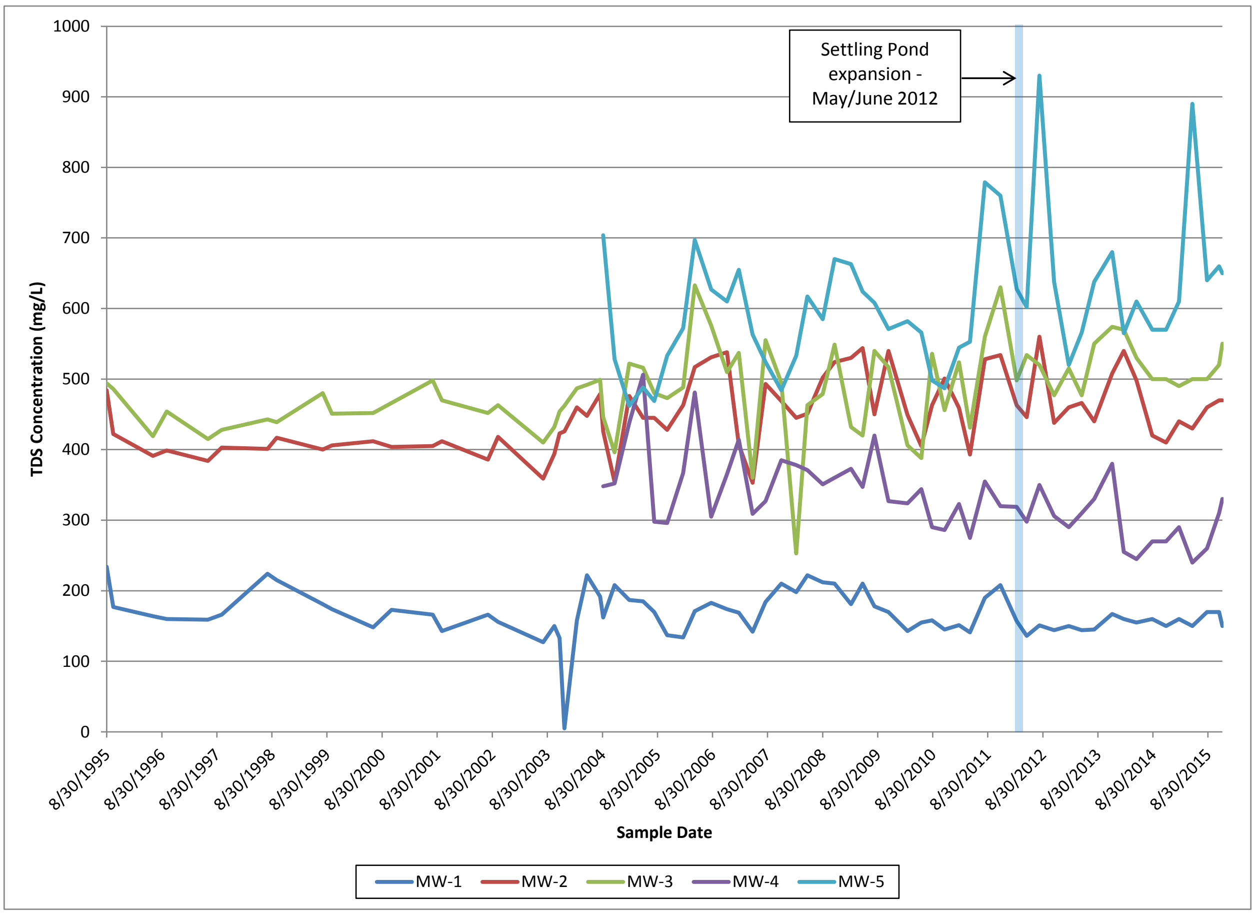

Figure 2. TDS concentrations time series for monitoring wells MW-1, MW-2, MW-3, MW-4, and MW-5.

Table 2. TDS concentration summary statistics for MW-1, MW-2, MW-3, MW-4, and MW-5. All values expressed in mg/L.

Monitoring Well	Average	Standard Deviation	Minimum	Maximum	Pre-expansion 95% Confidence Threshold
MW-1	167.1	32.1	5.0	234.0	179.8
MW-2	450.2	50.4	353.0	560.0	459.2
MW-3	484.6	60.3	253.0	633.0	492.1
MW-4	333.8	56.4	240.0	506.0	370.5
MW-5	606.9	96.2	462.0	930.0	615.1

Note: all values are expressed in mg/L.

Nitrate Concentrations in MW-1, MW-2, MW-3, MW-4, and MW-5

Figure 3 shows nitrate concentrations in MW-1, MW-2, MW-3, MW-4, and MW-5 since their respective installations. Since the expansion of the Settling Pond in May/June 2012, nitrate concentrations in MW-3 (downgradient) have showed a significant decreasing trend, while concentrations in MW-2 (downgradient) have no apparent trend. It is apparent, from Figure 3, that nitrate in the background well, MW-5, is highly variable.

Summary statistics for nitrate concentrations in the monitoring wells included in this analysis are shown in **Table 3**. A 95% confidence interval was applied to the mean of the pre-expansion nitrate dataset for each well to develop a threshold for which to compare the post-expansion dataset. MW-2 (downgradient) has not exceeded this threshold in the post-expansion samples. Although post-expansion nitrate concentrations in MW-3 (downgradient) have exceeded the pre-expansion threshold, it is likely the case that highly variable nitrate in groundwater in this region has more of an influence on the concentrations seen in MW-2 and MW-3 (downgradient), than influences from the Settling Pond. MW-5 (background) reached a maximum nitrate concentration of 83.7 mg/L, which is the highest concentration seen for any well in this analysis. In addition, the standard deviation in all wells was of the same magnitude as their respective mean, indicating nitrate in each well is highly variable. It is evident that nitrate has significant variation in the background well (MW-5), which likely have a greater influence on groundwater quality seen in MW-2 and MW-3.

Post-expansion fluctuations in nitrate concentrations in wells MW-2 and MW-3 are likely attributable to ambient groundwater quality, and thus cannot be attributed to expansion of the Settling Pond.

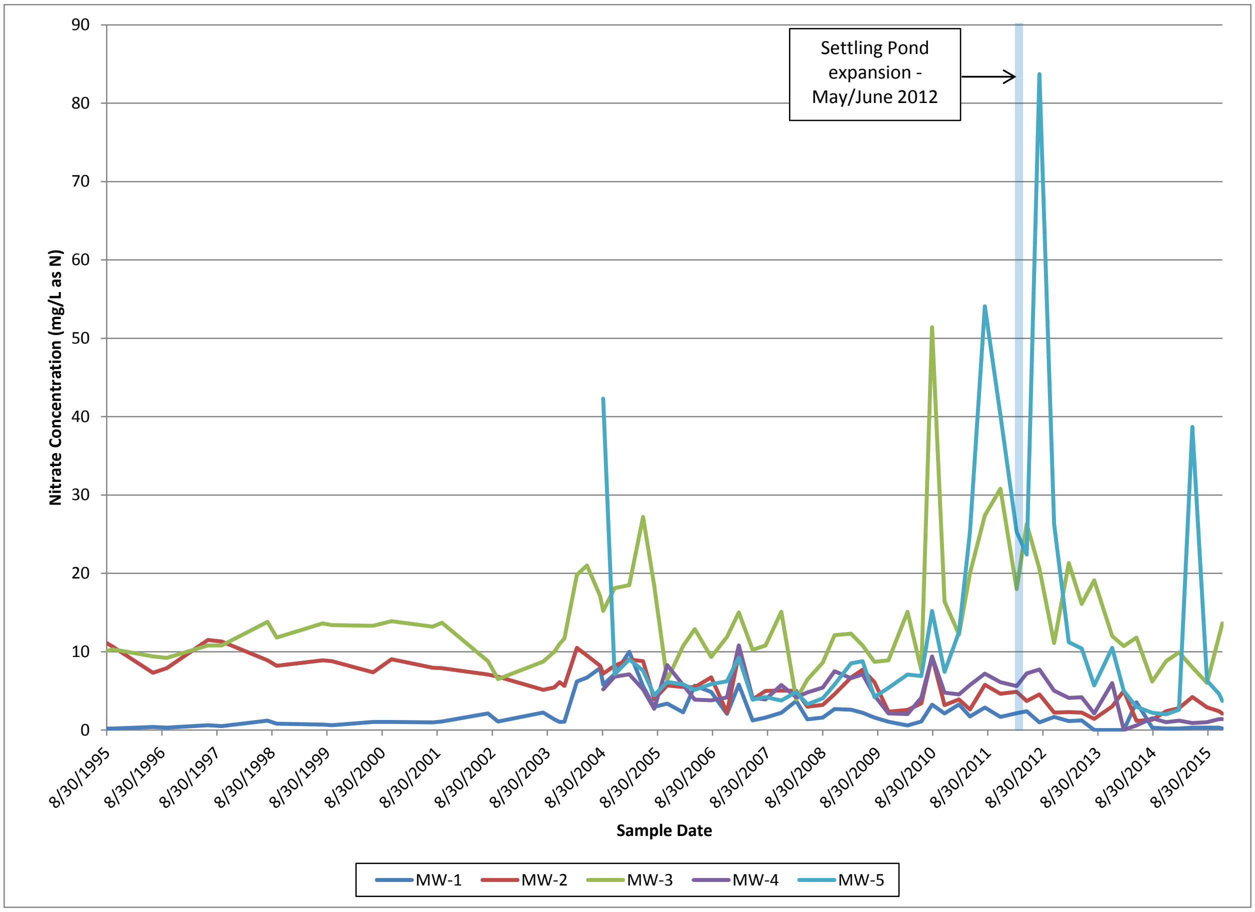

Figure 3. Nitrate concentrations time series for monitoring wells MW-1, MW-2, MW-3, MW-4, and MW-5.

Table 3. Nitrate concentration summary statistics for MW-1, MW-2, MW-3, MW-4, and MW-5.

Monitoring Well	Average	Standard Deviation	Minimum	Maximum	Pre-expansion 95% Confidence Threshold
MW-1	2.1	2.1	0.025	10.0	3.1
MW-2	5.7	2.8	1.2	11.5	7.2
MW-3	13.8	7.0	3.9	51.4	16.1
MW-4	4.6	2.5	0.025	10.8	6.2
MW-5	12.7	15.8	2.0	83.7	16.3

Note: all values are expressed in mg/L as N.

Electrical Conductivity in MW-1, MW-2, MW-3, MW-4, and MW-5

Figure 4 shows electrical conductivity in MW-1, MW-2, MW-3, MW-4, and MW-5 since their respective installations. Since the expansion of the Settling Pond in May/June 2012, EC measurements in MW-2 and MW-3(downgradient) have showed static trends. However, it is apparent, from Figure 4, that EC in wells MW-1 and MW-4 (upgradient), and MW-5 (background) encompasses a wide range of values.

Summary statistics for electrical conductivity in the monitoring wells included in this analysis are shown in **Table 4**. A 95% confidence interval was applied to the mean of the pre-expansion electrical conductivity dataset for each well to develop a threshold for which to compare the post-expansion dataset. Although post-expansion electrical conductivity measurements for MW-2 and MW-3 (downgradient) have exceeded their respective pre-expansion thresholds, it is likely the case that highly variable electrical conductivity in groundwater in this region has more of an influence on the results seen in MW-2 and MW-3, than influences from the Settling Pond. MW-5 (background) reached a maximum electrical conductivity of 1558.0 µmhos/cm, which is the highest measurement seen for any well in this analysis, and exhibited the highest average EC of all wells (991.7 µmhos/cm). It is evident that electrical conductivity has significant variation in the background well, which likely have a greater influence on groundwater quality seen in MW-2 and MW-3 influences from the Settling Pond.

Post-expansion fluctuations in EC measurements in wells MW-2 and MW-3 are likely attributable to ambient groundwater quality, and thus cannot be attributed to expansion of the Settling Pond.

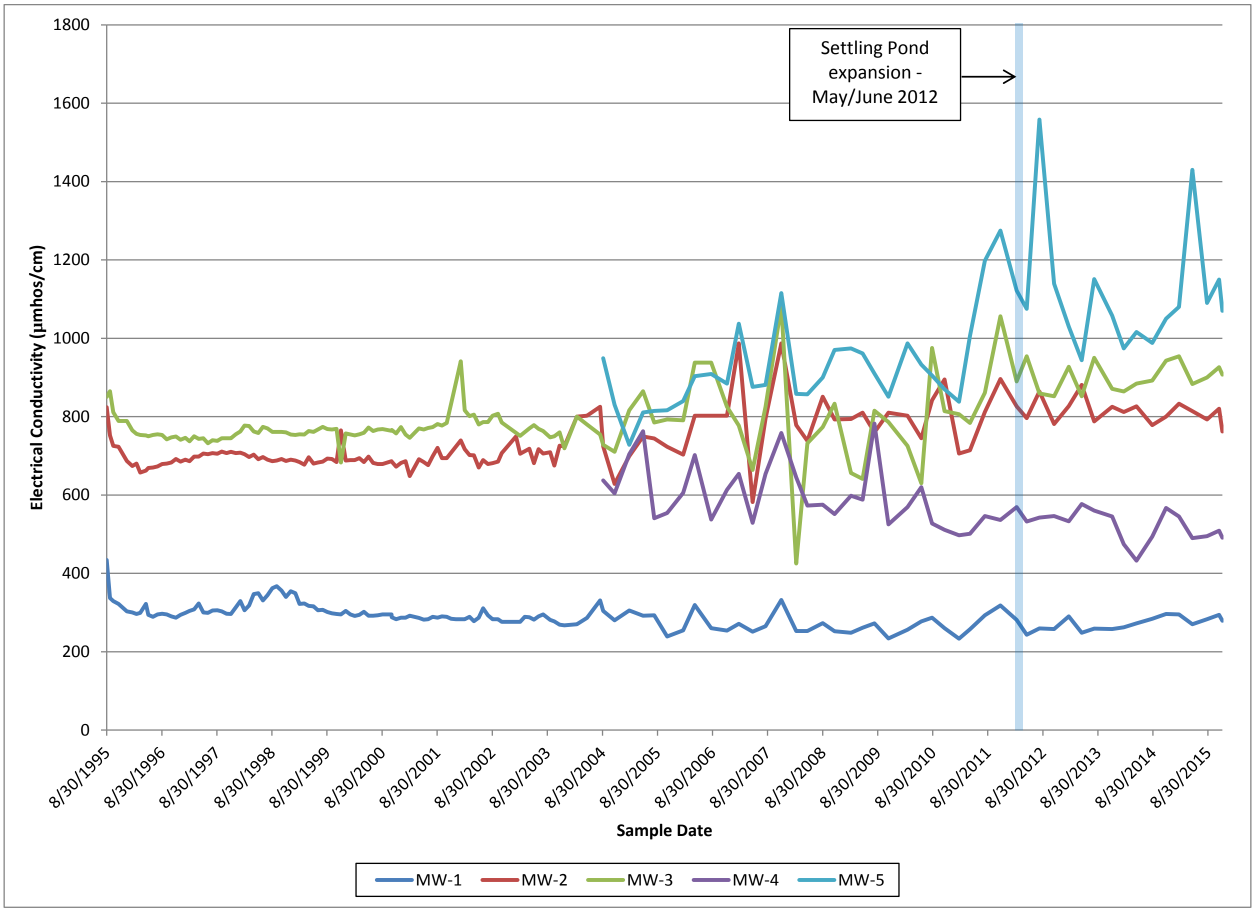

Figure 4. Electrical conductivity time series for monitoring wells MW-1, MW-2, MW-3, MW-4, and MW-5.

Table 4. Electrical conductivity summary statistics for MW-1, MW-2, MW-3, MW-4, and MW-5.

Monitoring Well	Average	Standard Deviation	Minimum	Maximum	Pre-expansion 95% Confidence Threshold
MW-1	293.0	28.5	233.0	434.0	300.1
MW-2	729.9	65.8	582.0	987.0	730.9
MW-3	788.8	77.6	425.0	1083.0	788.3
MW-4	572.3	76.6	432.2	782.0	623.8
MW-5	991.7	159.8	728.0	1558.0	975.4

Note: all values are expressed in µmhos/cm.

Conclusions

Time series analyses for chloride, TDS, nitrate, and EC in MW-1, MW-2, MW-3, MW-4, and MW-5 showed highly variable groundwater quality in background, upgradient and downgradient wells. Although post-expansion groundwater concentrations for some parameters in MW-2 and MW-3 (downgradient) have exceeded their respective pre-expansion thresholds developed from applying a 95%

confidence interval to the pre-expansion mean, the concentrations are within the range of values exhibited by the wells MW-1and MW-4 (upgradient), and well MW-5 (background). Of particular importance is that well MW-5 (background) exhibits the highest concentrations of all 4 constituents (chloride, TDS, nitrate, and EC) and typically the highest variability. It is clear that groundwater quality seen in MW-2 and MW-3 is influenced primarily by ambient groundwater quality, and not influenced by the Settling Pond. As such, groundwater quality in MW-2 and MW-3 (downgradient) is attributable to highly variable ambient groundwater quality, and thus, not attributable to the expanded Settling Pond.