

07/01/2014 12:08

# GROUNDWATER LIMITATIONS COMPLIANCE ASSESSMENT PLAN

*Prepared for*

## **THE MORNING STAR PACKING COMPANY, L.P.**

2211 Old Highway 99 W  
Williams, CA 95987  
**Colusa County**

Phone (530) 473-3600  
Fax (530) 473-3601

July 1, 2014

*Prepared by*

---

**Hilary A. Reinhard, P.E.**  
P.O. Box 365  
Madison, California 95653  
Phone: (530) 219-6892  
Email: [rh\\_reinhard@yahoo.com](mailto:rh_reinhard@yahoo.com)



## List of Tables

Table 1 MRP Groundwater Constituent Limitations

## List of Exhibits

Exhibit 1 Groundwater Statistics

## INTRODUCTION

In December 2013, The Morning Star Packing Company, L.P. (Morning Star) received Waste Discharge Requirements (WDR) Order No. R5-2014-0144. H. Provisions 1.b of this order states the following:

*By 1 July 2014, the Discharger shall submit a Groundwater Limitations Compliance Assessment Plan. The plan shall describe and justify the statistical methods proposed for use to evaluate compliance with Groundwater Limitation E.1, E.2, and E.3 of this Order for the specified compliance wells and constituents. Compliance shall be determined using appropriate statistical methods that have been selected based on site-specific information and the U.S. EPA Unified Guidance document cited in Finding 68 of this Order. The report shall explain and justify the selection of the appropriate statistical methods.*

This document has been prepared to satisfy this requirement and provides a plan for comparing collected groundwater data to background data and limitations and re-sampling action plans to be implemented when constituent tests are greater than the threshold limits.

Groundwater quality information for the facility was initially collected in three monitoring wells (MW1, MW2, and MW3). MW1 is located upgradient of the settling pond. MW2 and MW3 are located downgradient of the settling pond. Sampling activities for these wells began in August of 1995. In November 2003, additional constituent sampling was required by the Regional Water Quality Control Board (Regional Board).

In 2004, additional monitoring wells were installed at the facility and land application area (LAA). These monitoring wells included one well upgradient of the settling pond (MW4), two located upgradient of the LAA (MW5 and MW9) and three located within and downgradient of the LAA (MW6, MW7, and MW8). Groundwater gradients produced from data collected from the monitoring wells has shown that MW9 is cross gradient of the LAA and is downgradient of field MS1, a field that is only occasionally irrigated with process washwater.

In 2013, revised Monitoring and Reporting Program (MRP) No. R5-2013-0144 was adopted by the Regional Board. This MRP reduced the number of constituents tested and sampling frequency to twice annually. Morning Star has continued to sample the groundwater monitoring wells on a quarterly basis. The following constituents are sampled during monitoring events:

- Depth to groundwater
- Groundwater elevation
- Gradient magnitude
- Gradient direction
- pH

- TDS
- TKN
- Nitrate-nitrogen
- Iron
- Manganese

The following groundwater constituent limitations are provided in the 2013 MRP:

**Table 1. MRP Groundwater Constituent Limitations**

Constituent	Compliance Wells	Limitations
Nitrate Nitrogen	MW2, MW6, MW7, MW8	10 mg/L (MCL)
Nitrate Nitrogen	MW3, MW9	Current Groundwater Quality
Manganese	MW2, MW3, MW6, MW9	0.05 mg/L (MCL)
Manganese	MW7, MW8	Current Groundwater Quality

The MRP states that compliance for the above wells shall be conducted on an intrawell basis using approved statistical methods. The WDR's state that the U.S. EPA published *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (Unified Guidance) published in 2009 shall be used as a guide for the statistical analysis of the facility's groundwater.

This document outlines the methods used to determine the current groundwater quality for the wells noted and the method that will be used to determine if the well is statistically in compliance with the above limitations.

#### **COMPLIANCE ASSESSMENT APPROACH**

The assessment of compliance of the monitoring wells (MW) is achieved through an intrawell analysis where samples obtained from the wells are compared with established groundwater quality limitations or background data (where appropriate). These limitations are primarily the maximum contaminant level (MCL) or secondary MCL associated with the constituent. However, in MWs where the background groundwater quality is higher than the MCL or secondary MCL, sampling events will be compared to historical groundwater results to determine if the results are consistent with past results.

This compliance assessment plan also includes provisions for resampling monitoring wells where the results are not consistent with past results. Resampling allows for determination of whether the outlying data point is caused by analytical or clerical error and should be removed or is a part of the data set.

## **GROUNDWATER DATA**

Basic statistical characteristics including the minimum, maximum, and mean of the constituents from each of the monitoring wells were computed. This statistical information provides an indication of the variability of the data set and allows a cursory comparison of the data from the monitoring wells (**Exhibit 1**).

## **STATISTICAL ANALYSIS**

### **Method**

Results from past groundwater monitoring activities were investigated to determine appropriate compliance strategies for the data. Factors including the normality of the data and the presence of non-detect values affect the statistical analysis methods appropriate for the compliance assessment.

Because of the spatial variability found at the site and the amount of data available from each well, an intrawell analysis is proposed to determine compliance assessment. Intrawell analysis uses data from individual wells to determine compliance and removes inconsistencies due to spatial variability.

### **Outliers**

Outliers are data that lie outside of the expected range of values. Outliers may be attributed to a variety of sources such as lab error, clerical errors, sample contamination and data variability. In general, when identifying outliers as data to be excluded from the data set care should be taken to ensure that the data is not a part of the data set. It is difficult to differentiate between an erroneous value and a value that is valid. Data should only be removed if it is proven that the data is not representative of the water quality. As such, all values have been included in the data set.

### **Distribution**

The distribution of the relevant groundwater quality data needs to be considered when determining the appropriate statistical analysis for the data. The distributions of the historical Morning Star groundwater quality data were checked for normalcy to determine if the data is parametric or not. Although some of the data did fit a normal distribution, some of the data was not. Future groundwater statistical analysis will verify normalcy and ensure that appropriate groundwater statistical analysis is performed.

### **Background Based Compliance Assessment**

In wells where the existing groundwater quality was found in the WDRs to exceed the MCL or secondary MCL, groundwater samples obtained will be compared to historical groundwater results from the same well.

---

Two sample tests can be used to compare older versus newer data and determine if there are any statistically significant difference between the mean of the first population when compared with the mean of the second population, based on the results observed in the samples. Depending on whether the data is normally distributed or nonparametric, appropriate statistical methods that can be used to perform the two sample test. In general, a minimum of 4 samples is required to perform a two sample test; therefore, the quarterly sampling performed by Morning Star should be sufficient.

Manganese concentrations are frequently below the reporting limit and are therefore left-censored, in which the true magnitude of much of the data is known to exist somewhere between zero and the reporting limit. The Tarone-Ware two-sample test can be used on data with nondetects and will provide valid results even with a large fraction of unknown data.

For future determination of manganese compliance in MW7 and MW8, a Tarone Ware two-sample test with a confidence coefficient of 95% will be run comparing the four samples collected during the year with the historical data from the wells.

A similar analysis will be completed on an annual basis for the nitrogen concentration of MW3 and MW9. Nitrate results have generally had a limited number of nondetect concentrations, so a Tarone-Ware test is not required.

Nitrogen concentrations for MW3 and MW9 were checked for normalcy and were found to not have a normal distribution. Because the data is not normal, a Wilcoxon rank-sum test with a confidence coefficient of 95% will be performed to determine if the data collected during the year is consistent with historical data from the well.

Once data has been found to be statistically similar to the background data, the data will be added to the data set for future comparisons.

### **Compliance Assessment with Limitations**

Compliance with the groundwater quality limitations will be determined by comparing sample results with the limitations prescribed in the WDRs. Confidence intervals are the recommended general statistical strategy for determining compliance/assessment. Groundwater monitoring data is compared to a fixed numerical limit such as the MCL or limitation prescribed in the WDR. A comparison of the lower confidence limit (LCL) to the fixed numerical limit provides the indication that the well has become out of compliance.

Confidence intervals are designed to estimate statistical characteristics of some parameter of the sampled population. Given the statistical parameter (such as the population mean), the parameter will most likely fall within the probably concentration range defined by the upper confidence limit (UCL) and the LCL.

For data being compared to a fixed standard, where the standard is considered to represent an average of mean concentration, a confidence interval around the mean is appropriate. A confidence interval around the mean is designed to estimate the true average of the underlying population, while at the same time accounting for variability in the sample data. This method will be used to determine compliance with the manganese and nitrate MCLs.

Depending on the background data from the MW, either a parametric or nonparametric confidence interval method will be used to analyze the data. The LCL computed with the results will be compared to the MCL to determine compliance.

### **Resampling**

When constituent results from the MW have suspected outliers that do not appear to be within the normal range of data from the MW, the MW will be resampled to determine if the value was an anomaly or error. Resamples are collected sequentially over sufficiently long time periods to maintain approximate statistical independence. Additionally, resamples will be collected only from wells where the initial value exceeded the limit.

If the resampling events indicate that the data point in question is an outlier, the point will be removed from the data set and replaced by the resample results. A note will be made in the semi-annual report documenting the activities.

Morning Star Packing Company  
Groundwater Monitoring Background Statistics

Exhibit 1

Monitoring Well	Constituent	Number of Samples	Maximum	Minimum	Number of Non-Detect	% of Non-Detect	Average	Standard Deviation
MW 2	pH	137	8.5	6.5	NA	0%	NA	NA
	TDS	63	560	353	NA	0%	451	53
	TKN	45	0.85	ND	21	47%		
	Nitrate-Nitrogen	63	11.5	1.18	0	0%	6.1	2.7
	Iron	45	2.4	ND	35	78%		
	Manganese	45	ND	ND	45	100%		
MW 3	pH	135	8.4	6.7	NA	0%	NA	NA
	TDS	63	633	253	NA	0%	482	63
	TKN	45	0.99	ND	20	44%		
	Nitrate-Nitrogen	63	51.4	3.88	0	0%	14.3	7.20
	Iron	45	20	ND	34	76%		
	Manganese	45	31	ND	42	93%		
MW 6	pH	40	7.92	7.06	NA	0%	NA	NA
	TDS	40	850	600	NA	0%	725	61
	TKN	40	1.1	ND	14	35%		
	Nitrate-Nitrogen	40	16.5	3.18	0	0%	8.4	3.3
	Iron	40	23.6	ND	30	75%		
	Manganese	40	0.8	ND	34	85%		
MW 7	pH	40	8.03	7.04	NA	0%	NA	NA
	TDS	40	830	528	NA	0%	647	73
	TKN	40	0.97	ND	14	35%		
	Nitrate-Nitrogen	40	14.6	1.13	0	0%	6.6	3.7
	Iron	40	56	ND	29	73%		
	Manganese	40	2.2	ND	20	50%		
MW 8	pH	40	8.05	6.78	NA	0%	NA	NA
	TDS	40	1,090	512	NA	0%	816	113
	TKN	40	0.99	ND	14	35%		
	Nitrate-Nitrogen	40	8.96	ND	3	8%	6.6	3.7
	Iron	40	35.2	ND	29	73%		
	Manganese	40	1.9	ND	17	43%		
MW 9	pH	40	8.29	7.36	NA	0%	NA	NA
	TDS	40	1,480	732	NA	0%	950	160
	TKN	40	1.2	ND	11	28%		
	Nitrate-Nitrogen	40	36.8	0.14	0	0%	13.5	7.6
	Iron	40	4.5	ND	30	75%		
	Manganese	40	0.91	ND	28	70%		