WINZLER & KELLY

Administrative Draft - TECHNICAL MEMORANDUM

Plan for Agronomic Application of Nitrogen

PREPARED FOR: Delta Diablo Sanitation District
Ms. Amanda Roa

PREPARED BY: Mary Grace Pawson/Winzler & Kelly

REVIEWED BY: Neal Carnum/Winzler & Kelly

DATE: December 10 2009

PROJECT NUMBER: 11811-09-001

Background and Purpose

The Delta Diablo Sanitation District (District) currently operates a recycled water system in the City of Pittsburg, California under *the San Francisco Bay Regional Water Quality Control Board's General Water Reuse Order 96-011(RWQCB Order 96-011).* In October 2009, the District filed a Notice of Intent to seek coverage under the *State Water Resources Control Board's Order 2009-006 Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water (SWRCB Order 2009-006)* for its Antioch Recycled Water Project which will deliver approximately 150 acre-feet of water annually for landscape irrigation purposes.

SWRCB Order 2009-006 includes provisions that the District work with its customers to assure that nutrients, particularly nitrogen, are applied at agronomic rates. Because recycled water can contain nutrient loading that is higher than the nutrient loading in potable water, this often means that fertilization schedules need to be adjusted.

As part of its Notice of Intent, the District provided information on nitrate loading from the recycled water. However, because the District is currently not required to monitor for nitrogen under either RWQCB Order 96-011 or its NPDES permit, the loading calculation was made based on one available data point for nitrate nitrogen.

As part of its review, the SWRCB requested that the District provide information on Total Kjeldahl Nitrogen (TKN). The District collected three samples on November 18, 19 and 20 of 2009 and submitted the results to the SWRCB on December 1st, shortly after the analytical results were available. Upon review of the limited TKN results, the SWRCB expressed concern that the total calculated nitrogen load, an average of approximately 380 pounds per acre per year, could exceed the agronomic rate of application for turf grass. The purpose of this memorandum is to present the District's plan for managing nutrient loading at agronomic rates.

Fate of Nitrogen in Treated Effluent

Nitrogen exists in treated effluent, or recycled water, in several different forms including organic nitrogen, nitrite, nitrate and ammonia nitrogen (which includes ammonium and ammonia). Total Kjeldahl Nitrogen is the sum of organic and ammonia nitrogen. Each of these forms of nitrogen has a different effect on the agronomic rate calculation.[1]

The District's current data allows calculation of total nitrogen loadings but is not enough to perform definitive agronomic calculations. The District's plan should include additional sampling to develop a more complete data set.

Agronomic Rate for Turf Grass

The SWRCB has indicated that it believes the agronomic nitrogen application rate for turf grass is 174 pounds per acre per year. This is consistent with published rates from various cooperative extentions.

Plant Available Nitrogen[2]

Not all nitrogen applied through recycled water is available to meet agronomic demands. Ammonium N can be readily transformed and lost as a gas. For the purposes of preliminary calculations, it estimated that 55% of ammonium N is available and 45% is lost as gas.[3]

Organic N must go through mineralization before it is available for agronomic uptake. For the purposes of preliminary calculations it is estimated that 35% of the applied organic N is available. [4]

Application Rate Calculations

In order to estimate if the nutrients provided by recycled water rate meet agronomic standards, we will use the following equation:

Total applied nitrogen = 55% of ammonium N + 35% of organic N + nitrate/nitrite N

This accounts for the volization of ammonium N, the mineralization of organic N and the fact that nitrate/nitrite N is not included in the reported TKN. For this initial estimate, it is assumed that 80% of the TKN, is in the form organic N and 20% is in the form of ammonium N. This is based on guidance provide for biosolids and needs to be verified, by additional sampling, for the District's recycled water. Based on these assumptions and District's data the breakdown of total nitrogen is as follows:

---

1 Chemistry for Sanitary Engineers, Sawyer & McCarty

2 This discussion is drawn from PNW0511e Worksheet for Calculating Application Rates in Agricuture, Pacific Northwest Extension, Cogger and Sullivan.

3 IBID, Table 2.

4 IBID, Table 3.

Nitrogen State	Equivalent lbs per acre per year	Data Source
TKN	379 lbs/acre/year	Average November samples
Ammonium N	76 lbs/acre/year	20% of Average November samples
Organic N	303 lbs/acre/year	80% of Average November samples
Nitrate/Nitrite N	7 lbs/acre/year	Previous District Sampling

Using this data to estimate the nitrogen loading results in the following equation:

Total applied nitrogen = 0.55* (76lbs/a/yr) + 0.35* (303lbs/a/yr) + 7lbs/a/y
or
Total applied nitrogen = 155 lbs/a/y

This theoretically calculated value is less than the estimated agronomic rate which provides an allowance for ongoing mineralization of the applied organic N.

District Actions

The District currently utilizes recycled water for irrigation purposes in its Pittsburg service area without adverse impacts. While the District does not currently monitor for nutrients or conduct loading calcuations, the empirical evidence suggests that the recycled water program is not exceeding agronomic application rates. The estimated agronomic demand calcuations provided above support this empirical evidence.

Because of the very limited data available, the various fates of nitrogen in treated effluent, and the fact that different states of nitrogen impact the agronomic rate calculation, the District will need additional data to demonstrate ongoing compliance with SWRCB Order 2009-006 Provision C.5 (b). The intent of this provision is to assure that nutrients are being applied at a rate that can be utilized by the vegetation, so that over-applied nutrients do not impact groundwater quality.

Because the potential impacts are long-term, an active monitoring program is the best way to assure compliance. The following program is more aggressive then that included in the SWRCB Order 2009-006 and will allow collection of data to support the theoretical estimated calculations provided above.

- Quarterly monitoring of TKN, ammonium-N and nitrate;
- Quartely calculation of the applied nutrients;
- Quarterly submittal of data and calculations to the SWRCB

If the District begins the program now, before it brings the Antioch project on-line, we have the opportunity to support our estimated calculations before the project goes online or make adjustments based on the data.

If after two years, the actual data supports the estimated calcuations provided above, the District could then request reporting in accordance with the Reporting Schedule outlined in SWRCB Order 2009-06.