



**Sonoma
Water**

MEMORANDUM

DATE: July 10, 2019

TO: Kelsey Cody, PhD, North Coast Water Quality Control Board
Lisa Bernard, North Coast Water Quality Control Board

FROM: Neil Lassettre, PhD, Sonoma Water

PROJECT: Nutrient Offset Project Proposal, Laguna de Santa Rosa Reaches 1 and 2

SUBJECT: Revised total and annual phosphorus reduction and credit calculation

Sonoma Water collected sediment samples in the Laguna de Santa Rosa study area, as described in Sonoma Water's Nutrient Offset Project Proposal, Laguna de Santa Rosa Reaches 1 and 2 (Sonoma Water 2019) and analyzed the samples to determine phosphorous concentration (P_{sed} ; sediment total phosphorus concentration, g/kg) to calculate phosphorous load (P_{load}):

$$P_{load} = P_{sed} * \rho_{sed} * A_{sed} * D_{root} \quad [1]$$

where:

P_{load} = Sediment total phosphorus load, g
 P_{sed} = Sediment total phosphorus concentration, g/kg
 ρ_{sed} = Sediment bulk density, kg/m³
 A_{sed} = Area of sediment removal, m²
 D_{root} = Mean Ludwigia root depth, m

Sonoma Water's Stream Maintenance Program Manual recommends that for sediment removal projects of more than 250 yd³, one sample should be collected for every 500 yd³ increment (Horizon Water and Environment 2009). For project sites that require more than one sample, such as Laguna 1 and Laguna 2, as they both exceed 500 yd³ (Table 1), we selected sampling locations to target conditions at the upstream and downstream ends of the reach. Further, the SMP Manual recommends that for long reaches that are not particularly wide or deep with sediment, it would be preferable to take sediment samples for every 1,000 ft length rather than per 500 yd³ increment. But, as per amended MRP R1-2009-0049, no more than three composite samples shall be collected to characterize sediment quality from long, homogeneous reaches of sediment deposits (NCRWQCB 2016). Based upon the above standards, Sonoma

Water collected three sediment samples in May 2019, each consisting of two sediment cores (composite samples), within Laguna 1 and Laguna 2 (Table 1). The sediment samples were collected along previously established transects and within the project area and within the area of sediment removal (See Appendix C of Sonoma Water [2019] for design drawing and cross-section locations).

Table 1. Laguna 1 and Laguna 2 sediment sample locations and names.

Reach number	Length (ft)	Volume (yd ³)	Sample locations	Sample name	P concentration (g/kg) ^b
Laguna 1 ^a	1,223	2,174	Sample 1: Cores at Stations 88+57 and 89+68	1A-19-005	4.0
			Sample 2: Cores at Stations 91+37 and 93+58	1A-19-006	4.6
			Sample 3: Cores at Stations 96+52 and 98+64	1A-19-007	3.9
Laguna 2 ^a	3,053	5,156	Sample 1: Cores at Stations 105+32 and 107+30	1A-19-008	1.2
			Sample 2: Cores at Stations 115+33 and 117+49	1A-19-009	0.9
			Sample 3: Cores at Stations 127+19 and 128+30	1A-19-010	1.2

^aPer Amended MRP R1-2009-0049, Sampling Frequency and Locations: *No more than three composite samples shall be collected to characterize sediment quality from long, homogeneous reaches of sediment deposits.*

^bFrom Eurofins Calscience (2019) sediment test results, pp 103-104; average = 2.6 g/kg

As noted in Sonoma Water (2019), no field data existed for phosphorus concentration at Laguna 1 and Laguna 2. Values recorded in the mainstem Laguna de Santa Rosa ranged from 0.73 g/kg to 2.4 g/kg, likely varying with the amount of organic matter in samples. The Freshwater Trust (2017) used a value of 1.56 g/kg, which is the average of two values from sites with greater occurrence of organic matter to calculate an initial estimate of 13,500 lb (6,100 kg) of phosphorus removed by legacy sediment removal (Table 2 in Sonoma Water 2019).

Phosphorus concentration within the samples collected along Laguna 1 and Laguna 2 ranged from 4.6 to 0.9 g/kg (Eurofins Calscience 2019) (Table 1). Using the average value for all six samples (2.6 g/kg) gives a revised estimate of 22,600 lb (10,200 kg) of phosphorus potentially removed by legacy sediment removal. Updating the estimated annual and total phosphorus reduction, with a project life (3 years), and uncertainty (1.5) and retirement (0) ratios proposed in Sonoma Water (2019), yields an annual reduction of 7,500 lb, with annual credits of 5,000 lb and total credits of 15,000 lb for the life of the project (Table 2).

Table 2. Estimated annual and total phosphorus reduction, proposed uncertainty and retirement ratios, and annual and total phosphorus credits generated.

Quantification Method	Annual P Reduction lbs/yr	Proposed Eligibility Period	Uncertainty Ratio	Retirement Ratio	Annual P Credits lbs/yr (yrs)	Total P Credits total lbs (yrs)
Direct removal	7,500 ^a	3 years	1.5	0.0	5,000 ^b (3 years)	15,000 ^c (3 years)

^aDirect removal of phosphorous assumes reduction of 22,600 lbs total, with a 3 year eligibility period (7,500/lbs/yr for 3 years).

^bAnnual credits for direct removal = phosphorus reduction ([22,600lbs] / eligibility period [3 years]) / (uncertainty + retirement ratios [1.5])

^cTotal credits for direct removal = annual credits * eligibility period

The initial estimated volume of sediment removed assumed mean excavation depths (2.0 ft in Laguna 1 and 1.9 ft in Laguna 2) equal to or less than the mean rooting depth of *Ludwigia* (2 ft below the soil surface (Hussner 2010, as cited in Freshwater Trust [2017])). As-built surveys after project implementation will verify the actual excavation depth required to remove *Ludwigia* to its roots, which may exceed depths estimated from design drawings or the mean depth from Hussner (2010, as cited in Freshwater Trust [2017])). As built surveys will also verify the amount of sediment removed by Sonoma Water.

References

Eurofins Calsciences. 2019. Work Order Number: 19-05-0532. Analytical Report for Sonoma County Water Agency, Stream Maintenance Program.

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