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2.1 Watershed setting

The Laguna de Santa Rosa watershed encompasses a 254 square mile basin that drains through the Russian River to the Pacific Ocean. The 30" to 60" inches of rain received annually over the basin is partially drained via surface flow, partially absorbed in the ground and partially captured and stored for later use. Additional water is added to the basin's water budget via its municipal supply system, and additional water is removed from the basin's water budget through external discharge of treated wastewater.

The watershed encompasses the cities of Santa Rosa, Rohnert Park, Cotati, Windsor and Sebastopol. The people that live and work in the urban areas of the watershed, draw water in part from the region's underground aquifer and in part from the Russian River; this urban population—for the most part—sends their sewage through pipes to a regional wastewater treatment facility located within the watershed. Much of the water from this treatment facility is sent by pipe to the Geysers where it is used to recharge the underground chambers that drive steam-powered electricity generators. A large portion of the remaining water, that is not sent to the Geysers, is sent by pipe to a distributed network of storage ponds: these are drawn down during the spring and summer and used to irrigate hay fields, grapevines, golf courses and urban parks. In wet years, the remaining treated water is discharged into the Laguna at points between Llano Road and Guerneville Rd; in dry years, this direct discharge is small to none.

A large rural residential population inhabits the mountainous regions in the east and draws its water from wells that tap into the aquifer; for the most part these people treat their sewage locally through septic systems. A rural residential population using wells and septic systems also inhabits the plain between the cities and the Laguna de Santa Rosa. Septic tank service companies discharge to the regional wastewater treatment facility. Rain that isn't absorbed locally runs off into storm drains or roadside ditches which discharge into local creeks. Outfall from these drainage systems is managed by the cities, the County of Sonoma and the Sonoma County Water Agency. Many of the natural drainage systems, both within the cities and in the rural areas, have been significantly altered to reduce flooding and to make more land available for homes, businesses and agriculture.

2.2 Recent history

From 1990 to 1998, the Laguna de Santa Rosa watershed was listed on the Clean Water Act Section 303(d) List due to impairment by seasonally high ammonia and low dissolved oxygen levels. A Waste Reduction Strategy was implemented in 1995 as a phased TMDL; this achieved good results and the watershed was removed from the list in 1998.

In 2000, the US Army Corps of Engineers (USACE), under the leadership of the Sonoma County Water Agency (SCWA), commissioned a geomorphic investigation of the watershed, which was completed by Philip Williams and Associates (PWA) in 2001.

In 2002 the watershed was again added to the 303(d) list, this time for phosphorus, nitrogen, low dissolved oxygen, elevated temperatures and excessive sediment. The most recent 2007 303(d) listing also includes elevated mercury levels.

Immediately after completing the geomorphic investigation, PWA was commissioned to expand their work into an analysis of sediment source, rate and fate within the watershed. That work was completed in 2004.

In 2004 the California Coastal Conservancy commissioned the development of a watershed scale restoration and management plan. The Sonoma County Water Agency and the City of Santa Rosa fiscally contributed to this plan, and the work—which was done by the Laguna Foundation—was published in 2006. This plan provided a valuable coarse historical ecological context for this project.

In 2006, the US Geological Survey was commissioned by SCWA through the USACE to conduct a multi-year study of the rate of sediment accumulation along the Laguna's floodplain from Occidental Road to Wohler Road. This work is expected to be completed in 2008.

In 2006 the City of Santa Rosa, at the prompting of the Laguna Foundation, agreed to commission the development of a conceptual model of water quality for the watershed. That work proceeded from late 2006 through 2007, and the results of that work are the subject of this report.

It is anticipated that the NCRWQCB will begin the development of a TMDL for the watershed sometime in 2008. The development process is expected to last through 2011.

2.3 Project participants

The development of this report has proceeded from the collaborative efforts of several groups. At the core, team members from Tetra Tech, Philip Williams & Associates, and the Laguna Foundation, joined together to conduct the bulk of this project's work. Added to this effort was the guidance of the NCRWQCB, which assisted in the strategic direction of the core team.

> *Tetra Tech:* The professional staff at Tetra Tech, Inc. has experience in large multidisciplinary watershed studies. Recent work in this area was completed for the Santa Clara Valley Water District where a watershed stewardship plan was developed to provide a framework for protecting water supply, flood protection and ecosystem health. Tetra Tech staff have also been members of the technical support team for developing nutrient numeric endpoints for California and Nevada.

Philip Williams & Associates (PWA): The professional staff at PWA were the developers of the two SCWA-commissioned reports for the Laguna: the 2001 geomorphic investigation and the 2004 sediment study. Staff at PWA have also completed sediment transport and management analysis for the San Lorenzo River and the Pájaro River.

Laguna Foundation: The professional staff at the Laguna Foundation were the developers of the 2006 restoration and management plan for the watershed. Staff members were also responsible for the 2007 State of the Laguna Conference and Science Symposium.

The professional staff that contributed to this work from these three core groups were primarily: Clayton Creager and Limin Chen from Tetra Tech; Betty Andrews and Setenay Bozkurt from PWA; Dr. Christina Sloop and Joe Honton from the Laguna Foundation. Additional technical and administrative supports were provided by other staff members from each of these three organizations.

At three points during the work, the core team met with a Technical Advisory Group (TAG), to solicit feedback and to provide assistance with obtaining technical reports and data. The three Technical Advisory Group meetings were also attended by a small group of interested private citizens who were provided the opportunity to listen and observe, but who were not formally part of the process.

Members of the technical advisory group have come from a variety of backgrounds. They have served on the TAG without direct compensation, although many of them receive a salary from agency and city departments whose work is related to this project.

Colleen Ferguson, of the Department of Public Works at the City of Santa Rosa, is a civil engineer responsible for managing the city's storm water program which addresses storm water quality and quantity as well as stewardship and restoration of urban creeks.

Brock Dolman, of the Occidental Arts and Ecology Center, is an instructor and practitioner of watershed ecology, and has been instrumental in creating a network of community outreach programs within Sonoma County.

Dr. Lorraine Flint, of the US Geological Survey, is the hydrologist who is presently leading the investigation of sediment accumulation in the Laguna de Santa Rosa watershed.

Dr. Chris Kjeldsen, Biology professor Emeritus at Sonoma State University, has recently retired from teaching freshwater ecology; he is now in a private consulting practice. He has many years of first hand knowledge regarding the Laguna.

Rebecca Lawton, of the Sonoma Ecology Center, has expertise in geology and sedimentation, and has recently conducted a sediment source analysis for the nearby Sonoma Creek watershed.

David Lewis, of the UC Cooperative Extension, is a specialist in watershed water quality management.

Dr. Chris Potter, NASA Ames Research Center, is developing a watershed-scale model of the Laguna using the SWAT modeling program. He is an expert in modeling using remote sensing techniques.

Dr. David Smith, of Merritt Smith Consulting, is a private consultant to the City of Santa Rosa's wastewater treatment facility.

Tim Stevens, of the California Department of Fish & Game, is a biologist with professional expertise in water quality.

Sean White, of the Sonoma County Water Agency, is a biologist who has conducted fish studies in the Russian River and part of the Laguna.

2.4 Steps towards analysis and report development

The development of this report began by capturing management questions defining the goals envisioned for the watershed. The assembly of a collection of available publications, spreadsheets, and GIS shapefiles, then formed the basis for identifying what was currently known about the watershed.

The project team selected modeling tools and techniques that matched evolving industry standards while also matching the needs of the watershed itself, and presented them to the TAG showing drafts of the proposed models themselves. We developed overlapping models using very different approaches, since no single modeling technology fit the disparate needs of the three teams. A shortened form of these models was also presented to a large audience of knowledgeable professionals and the public at the 2007 State of the Laguna Conference and Science Symposium at Sonoma State University.

After selecting suitable temporal scales and geographic scales, for each modeling technique, the project team formulated the hypotheses behind each model and how each model captures the physical, chemical, or biological processes that occur within the watershed. Literature review yielded appropriate citations and general references, to justify the assumptions used and validate conclusions reached in the report.