Market-Based Tools for Air and Water Pollutant Load Reduction to Protect Lake Tahoe Clarity (HUC 16050101)

Submitted to:

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ABSTRACT

The Lake Tahoe Basin is unique in that two states and numerous entities have been engaged in watershed efforts to control storm water and non-point source pollution for years. Numeric limits on urban runoff, construction controls, and storm water treatment for existing development have been required by the Tahoe Regional Planning Agency's Regional Plan since 1987. Although research and non-point source controls are more prevalent in Tahoe than many places in the U.S., the public demands more scientifically based policies. Since the lake's clarity is still declining, more efforts are needed. Recent research indicates that in-basin atmospheric pollutants contribute significantly to the decline in clarity. The Lake Tahoe Clarity Model, scheduled for completion in 2004, will predict the impact of pollutant reductions. Now is the time to develop innovative tools to compare control measures for both terrestrial and atmospheric sources and to allow water quality trading among those responsible for generating pollution.

INTRODUCTION

Lake Tahoe is designated an Outstanding National Resource Water (ONRW) because of its extraordinary clarity. However, since 1968, scientists have measured a decline in water clarity at an alarming rate of nearly one foot per year. Population increases, air pollution, erosion, loss of wetlands, and historical sewage disposal (eliminated in 1972), have contributed to lost clarity. Nitrogen, phosphorus and fine sediment from streams, ground water, urban runoff, and atmospheric deposition are causing the loss. Improving Lake Tahoe's clarity is of vital interest to the region's $1 billion annual economy. In 1997, key stakeholders including federal, state and local governments, and regional business, environmental, and transportation groups created the Lake Tahoe Environmental Improvement Program to accelerate environmental restoration projects as mandated by the 1987 Tahoe Regional Planning Agency (TRPA) Regional Plan. Storm water treatment, erosion control and stream restoration projects have been started, but are being implemented without the benefit of systematically quantifying either the anticipated load reduction from these projects or an overall target for required load reduction.

The Lahontan RWQCB and NDEP are now collecting data and developing models to quantify existing basin-wide, land-use-specific pollutant loads and the needed reductions to complete a Total Maximum Daily Load (TMDL) for nutrient and sediment inputs to Lake Tahoe by April 2005. Over 100 individuals from a variety of institutions are involved in the TMDL research program. The program consists of monitoring urban runoff; developing statistical relationships between storm water quality and land use; modeling stream channel and upland erosion; quantifying groundwater loading; developing a predictive watershed model; quantifying atmospheric deposition; and creating a lake water clarity model to establish the pollutant loads that will achieve the lake's clarity standards. The TMDL and subsequent load allocation process,

if properly designed, will be able to inform a market-based water quality trading program for inclusion in a watershed restoration strategy.

In 2007, TRPA will be updating its 20-year Regional Plan and Water Quality Management Plan (208 Plan) to incorporate new regulations and programs including the Lake Tahoe TMDL, Storm Water NPDES requirements and the Source Water Protection Program (SWPP). California, Nevada, TRPA, the U.S. Forest Service, and others are collectively updating and integrating relevant plans and regulations to achieve program consistency across the two-state, multi-jurisdictional watershed (see map, p. A-4). Existing programs such as impervious land coverage and restoration credit/transfers, and storm water treatment requirements on new and existing development, provide support to and a model for a water quality trading program for the pollutants causing clarity decline. Stakeholders have expressed the desire to engage in science- and market-based watershed management where they can compare measures to reduce pollutant loads and select pollutant reduction strategies with the greatest opportunity to achieve clarity goals and protect drinking water supplies.

WORKPLAN DESCRIPTION

With the recently completed Lake Tahoe Clarity Model able to predict Secchi depth on the basis of lake hydrodynamics, changes in nutrient and fine sediment loading, and limnological processes, Basin water quality regulators are poised to embark on a more detailed implementation plan than has been possible previously. However, without the tools to quantify load reduction opportunities (i.e. pounds of pollutant reduction achievable by BMPs or other measures), there is a significant risk of ineffective watershed restoration. The products proposed here, in concert with ongoing regulatory and stakeholder involvement, will provide the basis and justification for establishing a flexible implementation plan that utilizes the most effective BMPs

within a water quality trading strategy. Codes and ordinances in the updated Regional Plan and revised permit requirements will provide the legal framework for implementing this strategy.

The proposed tasks will: (1) create specific 'ground-rules' for water quality trading, (2) evaluate new approaches and technologies for pollution control at Lake Tahoe, and (3) incorporate data on new and traditional BMPs into a matrix designed to determine their basin-wide potential to achieve required load reductions and to enable stakeholders to evaluate and select flexible, comprehensive strategies to restore lake clarity. Specific deliverables and a cost estimate for each task, with milestones and a final date for each deliverable, are provided in the attached spreadsheet (p. A-1). The proposed project budget is provided on p. A-2. Stakeholder involvement is described in "Outreach Activities" below.

Task #1 – Establish "Ground-rules" for Water Quality Trading –

The goal of Task #1 is to develop a water quality trading strategy for Lake Tahoe. The innovations we propose include: the use of customized watershed and lake response models (currently being developed) to link land use, atmospheric deposition, and BMPs to lake clarity; trading between agencies and local jurisdictions responsible for mitigation; and development of cross-media (i.e. air and water) trading opportunities. This strategy also requires an evaluation of interstate trading policy and options.

To achieve this we will: 1) determine the applicability of water quality trading systems nation-wide to Lake Tahoe Basin conditions, 2) assess the environmental, technical, economic, regulatory and legal feasibility of water quality trading to meet desired loading requirements; 3) create units of trade and trading areas, 4) establish pre- and post-TMDL baseline conditions under which load reduction trading can occur; 5) decide whether trading will be allowed based upon financial transactions or through actual "mitigation" projects; 6) evaluate protocols and a

process to credit, bank or transfer pollutant reductions among land owners and jurisdictions; 7) develop trading system elements that provide individual homeowners and businesses financial incentives for additional BMP implementation; 8) establish a system to track, monitor and improve trading progress and effectiveness, 9) if BMP maintenance is a feasible approach for reducing loading on a longer time scale, develop a system where credits for maintenance can be quantified, used and/or traded, and 10) establish trading ratios. This work will be conducted with stakeholder participation at each step. A final report will describe development of the trading program and process, including guidelines and administrative recommendations.

A fundamental step in this effort will be the creation of units of trade based on new and existing pollutant reduction opportunities. A unit of trade, or pollution control 'currency', is defined as the expected nutrient and fine sediment load reduction, project-by-project and basin-wide, that BMPs and other measures can achieve. Not only is this important for establishing a trading system that will be credible with stakeholders, it is essential for establishing reasonable 'trading ratios'. Critical to achieving the clarity standard is the ability to accurately estimate, track, and assign pollutant reduction credits for load reduction over time. This task will produce a set of methodologies to estimate pollutant load reductions from water quality improvement programs and projects, including commonly used BMPs at Lake Tahoe as well as new approaches such as atmospheric pollutant controls (see Task #2). Experts suggest that no existing "off-the-shelf" model can determine load reductions resulting from wide-scale BMP implementation for an area as large and complex as the Tahoe Basin; however, a combination of unit processes and statistical models may be used. Stakeholders require easily understandable methodologies that are repeatable and yield reasonably accurate results. Load reductions need to

be estimated at several different scales including individual BMPs, projects with multiple BMPs, and basin-wide programs.

As part of this task, a monitoring program will be implemented to track load reduction allocations and credits, as well as to validate the effectiveness of the load reduction estimation methodologies. We will use existing data and monitor pollutant loads at multiple locations (with stakeholder participation). We will also employ other techniques to estimate loads and load reductions, including the comprehensive watershed modeling framework developed for the US EPA (Load Simulation Program in C++) that is currently being applied to Lake. The results will be used to refine and to guide selection of appropriate estimation methodologies for each load reduction measure under consideration for water quality trading. Methodologies will be designed in partnership with stakeholders including the Lake Tahoe Interagency Monitoring Program, which provides technical assistance.

As another deliverable from this task, we will develop a nonpoint source-oriented users' manual for general distribution. The manual will focus on the stakeholder audience and provide information needed to develop a water quality trading program. Topics include, but are not limited to: background on federal policy, a survey of individual state policies, organization of stakeholder involvement, creating units of trade, consideration of structural versus non-structural BMP, cost, obstacles, required monitoring, and selected case-studies for nonpoint source trading.

Task #2 - New Approaches/Technologies for Pollution Control -

A market approach to water pollution control requires that implementers be given a full range of load reduction options, including new approaches effective at removing fine sediments and nutrients in cold climates. Data suggest that in many of the urban areas at Lake Tahoe, traditional BMPs may not be capable of the required levels of pollutant reduction. In this task,

we will produce a report that identifies and provides pollutant removal effectiveness estimates for a number of potentially feasible approaches that are not yet fully developed. These will be included in a load reduction matrix (described in Task #3) and include: 1) mitigation of air-borne pollutants, 2) technologies associated with advanced waste water or centralized storm water treatment, 3) hydrologic controls to reduce runoff, 4) BMP maintenance, and 5) stream channel restoration.

It is estimated that 50 percent of the total nitrogen loads and up to 20 percent of the total phosphorus loading may enter Lake Tahoe directly from atmospheric deposition. Since research shows that phosphorus and fine sediment are of particular concern to lake clarity, transportation is likely one of the major atmospheric pollutant sources, primarily through re-entrainment of roadside dust. Given the importance of these potential contributions, the California Air Resources Board is currently conducting a source, transport and fate study for air-borne nutrients and fine sediment. We will identify a suite of possible control strategies and quantify their effectiveness. Examples of possible controls include: road deicing/sanding options; curb and gutter construction; road surface improvement and elimination of soft-shoulders; parking restrictions; street and parking lot sweeping; controlling vehicular speed; traffic composition (including public transportation, alternative fuels, and reduced vehicle miles traveled); and public education. Controls on wood burning stove emissions, prescribed burns, and other wood combustion activities (e.g. camp fires, pile burns, etc.) will be similarly evaluated. Assessment of this type of cross media loading and potential reductions is atypical of watershed restoration plans and is transferable nation-wide.

While space limitations prohibit a detailed discussion, the following alternatives will also be assessed in detail for their load reduction potential at Lake Tahoe. BMP handbooks rarely

include plans for centralized or advanced storm water treatment facilities. Recent studies at Tahoe suggest that treatment by chemical removal, filtration, and sedimentation at a localized engineered facility may effectively treat the more contaminated sources of urban storm water, e.g. highway runoff. Controlling the quantity of urban runoff that reach the lake or its tributaries by hydrologic control methods such as water reuse, evapotranspiration, green roofs, and/or infiltration can also greatly affect load. BMP maintenance as a means to sustain load reductions has national as well as local implications, especially in areas where land is limited. Literature reviews and monitoring of demonstration projects will be done to provide guidance on the feasibility of including BMP maintenance as both a load reduction option and a required component of BMP implementation.

Task #3 – Create Matrix of Load Reduction Opportunities –

Central to the watershed restoration effort at Lake Tahoe will be the creation of a load reduction matrix or spreadsheet model (see Appendix, p. A-3, for an example), providing numerical estimates for phosphorus, nitrogen and fine sediment reduction for the identified load reduction opportunities. Specific structural and non-structural opportunities (e.g. land acquisition or policy changes) for each of the major source categories (urban and forest runoff, atmospheric deposition, stream channel erosion, and groundwater) will be identified by agency staff, public works engineers, environmental consultants and university scientists who have worked on BMP design, implementation, and monitoring for many years. Examples include infiltration basins, wetland treatment, source controls, stream bank restoration, fertilizer management, flow reductions, dust controls, BMP maintenance, building restrictions, highway management. Opportunities for new or innovative controls identified in Task #2 will be included.

Using GIS layers of existing projects, in concert with extensive field observations, the project team(s) will identify locations where additional load reduction projects can be situated. Load reduction per unit of BMP effort will be determined for each opportunity using: the load reduction estimation methodologies created in Task #1, a review of current BMP effectiveness at Lake Tahoe, new monitoring, literature guidance pertaining to cold-climate BMPs, modeling assessments of BMP performance vs. sizing and design, and best professional judgment. These results will then be paired with additional parameters to aid in evaluating and selecting mitigation strategies. These parameters could include, but are not limited to: logistical feasibility, land availability, cost, public acceptability, uncertainty concerning measurability and effectiveness, agency/legal constraints, non-water-quality environmental impacts, and others as developed with stakeholder input.

The final product will be a basin-wide load reduction potential, calculated based upon all existing and potential BMP and restoration opportunities, which will then be used to directly guide the implementation plan for watershed restoration. This will allow stakeholders to readily analyze and select a preferred watershed restoration strategy and enable transparent trading and decision-making, thereby increasing the likelihood that commitment to pollutant reductions will be sustained. Quantifying BMP performance for purposes of establishing trading values for TMDL implementation will be a significant product that is transferable to other watersheds, particularly for cold climates where BMP performance data and approaches are not well developed.

PROJECT MANAGEMENT

The Lahontan RWQCB will administer the grant work plan. The State Water Resources Control Board will be the fiscal agent. Although the Lahontan RWQCB will manage the project,

staff from NDEP and TRPA will actively participate in refining the scope of work and steering the work products. Lahontan RWQCB is currently leading the Lake Tahoe TMDL, relying on expertise of partners by routinely holding team meetings.

Dave Roberts is an Environmental Scientist and Lead for the Lake Tahoe Sediment and Nutrients TMDL at the Regional Board. He oversees all aspects of the Lake Tahoe TMDL including over three million dollars of State research contracts and will serve as Project Lead for the Watershed Initiative grant. Previously, he served as Assistant Executive Director for the League to Save Lake Tahoe where he worked on a broad range of Lake Tahoe issues and developed relationships with all state, federal, and local agencies working in the Lake Tahoe Basin. He holds three B.S. degrees, Business Administration from Chapman University, and Biology and Botany from Humboldt State University.

Dr. John E. Reuter is on the research faculty at the University of California at Davis with 25 years of experience in limnology and watershed management at Lake Tahoe. Dr. Reuter served as the Director of the Lake Tahoe Interagency Monitoring Program and is currently the Director of the Tahoe TMDL Research Program and has written and co-authored nearly 200 scientific publications and technical reports. In 1996, he received the North American Lake Management Society's award as Outstanding Scientific Researcher.

OUTREACH ACTIVITIES

The number, nature, and longevity of active stakeholder groups demonstrates the high degree of collaboration already occurring, whether on environmental project funding and management (including the Federal Advisory Committee, the Water Quality and Transportation Coalition), technical cooperation and exchange (Lake Tahoe Interagency Monitoring Program, Storm Water Quality Improvement Committee), public education and outreach (Lake Tahoe

Environmental Education Coalition), or information exchange (Tahoe Integrated Information Management System, Science Advisory Group). Furthermore, a collaborative public process is currently being designed to update the TRPA Regional Plan by 2007, including stakeholder involvement in water quality restoration planning and management. The activities and products proposed here will be developed and disseminated within Lake Tahoe Basin via existing and newly developed forums and media. Such outreach will consist of: audiovisual presentations and handouts at quarterly or semi-annual public meetings and workshops; distribution or display to the general public of posters, brochures, fact sheets, newsletters and other written materials; distribution to interested parties of technical products including final reports, articles, spreadsheets, models (in hard copy, CD-ROM or web-based format as appropriate); and maintenance of materials in electronic repository (e.g. the Tahoe Integrated Information Management System web-site).

Numerous peer-reviewed Lake Tahoe-related research papers and technical reports are produced each year. Data has been shared in many national data collection programs such as the National BMP Database, National Atmospheric Deposition Program, National Eutrophication Survey, National Surface Water Survey, and Sierra Nevada Ecosystem Project. This practice will continue with proposed products, including reports, articles, and tools. These will in addition be publicized and distributed nationally by means of: (1) publication in appropriate journals or books and presentations at forums such as the National Watershed Initiative Conferences, (2) posting products on the TIIMS website (http://eh2o.saic.com/tiimsWebsite/), and (3) providing training and direct access to information of use to other watersheds. As described in Task #1 we will also develop and disseminate a “How To” manual for nonpoint source pollutant trading.

ATTACHMENT: LAKE TAHOE WATERSHED INITIATIVE DELIVERABLES, SCHEDULE AND COSTS

Task	Deliverables	Milestones	Final Date	Cost
1	a. Report on feasibility and components of a pollutant trading system in the Lake Tahoe Basin.	Initiate Project: September 2004 Draft Report: December 2005 Peer Review: March 2006	Final Report: June 2006	$737,400
	b. Report on methodologies for assigning load reductions from pollution control measures.	Initiate Project: September 2004 Interim Report: June 2005 Draft Final Report: December 2005 Peer Review: March 2006	Final Report: June 2006	
	c. Conduct monitoring program to validate 1(b).	Initiate Project: September 2004 Finalize Program Design: October 2004 Conduct Monitoring: November 2004-October 2005 Draft Report: December 2005	Final Report: March 2006	
	d. Manual on developing water quality trading programs for nonpoint sources.	Draft Manual: December 2005 Review: March 2006	Final Manual: June 2006	
2	Report on estimates of pollutant removals from innovative control measures including: air pollution controls, centralized/advanced storm water treatment, hydrologic runoff controls, BMP project maintenance, and stream channel stabilization.	Initiate Project: September 2004 Draft Report: December 2005 Peer Review: March 2006	Final Report: June 2006	$475,000
3	a. Spreadsheet models for N, P, and fine sediments including load reductions for pollution control measures evaluated in Tasks 1(b) and 2.	Initiate Project: September 2004 Draft spreadsheets: December 2005 Peer Review: March 2006	Final Spreadsheets: June 2006	$445,000
	b. Analysis of load reduction project locations and opportunities throughout Lake Tahoe Basin.	Initiate Project: September 2004 Interim Report: June 2005 Draft Final Report: December 2005 Peer Review: March 2006	Final Report: June 2006	
	c. Comprehensive evaluation with stakeholder input of load reduction opportunities.	December 2005-June 2006	Report on evaluation: September 2006	
	d. Calculation of basin-wide load reduction potential.	Draft Report: June 2006	Final Report: September 2006	

SECTION A - BUDGET SUMMARY			
Watershed Project Activity	**Federal**	**Non-Federal**	**Total**
1. Water Quality Trading Ground Rules	$610,000	$127,400	$737,400
2. New Approaches and Technologies for Pollution Control	$390,000	$85,000	$475,000
3. Create Matrix of Load Reduction Opportunities	$290,000	$155,000	$445,000
Totals	**$1,290,000**	**$367,400**	**$1,657,400**

SECTION B - BUDGET CATEGORIES				
	Watershed Project, Activity or Work Element			
Category	(1)	(2)	(3)	Total
a. Personnel (a)	$43,000	$10,000	$10,000	$63,000
b. Fringe Benefits (b)	$12,900	$3,000	$3,000	$18,900
c. Travel	$1,000			$1,000
d. Equipment				$0
e. Supplies	$1,000	$500	$500	$2,000
f. Contractual	$630,000	$450,000	$420,000	$1,500,000
g. Construction				$0
h. Other				$0
i. Total Direct Charges (sum a-h)	$687,900	$463,500	$433,500	$1,584,900
j. Indirect Charges (c)	49,500	11,500	11,500	$72,500
Totals (sum line i-j)	**$737,400**	**$475,000**	**$445,000**	**$1,657,400**

Notes: (a) Based on one PY at 1/2 time for 1 month (FY03/04), and 2 x 12 months (FY04/05 -FY05/06)

(b) 30% x Personnel Salaries

(c) 88.53% x Personnel and Fringe Benefits

APPENDIX

Example Load Reduction Matrix

Sources	Effectiveness	Cost	Contstraints	Etc.	Estimated Load Reduction
URBAN					
Infiltration	4	$	2		xx kg/yr
Wetland Treatment	7	$$	7		xx kg/yr
Source Control	6	$	1		xx kg/yr
Chemical Enhancement	9	$$$	8		xx kg/yr
ATMOSPHERIC					
Vehicle Emission Control	4	$$	4		xx kg/yr
Wood Stove Management	5	$$	3		xx kg/yr
Out-of-Basin Source Control	2	$$$	9		xx kg/yr
Dust Management	7	$	2		xx kg/yr
STREAM CHANNELS					
Stream Restoration	7	$$$	5		xx kg/yr
Bank Stabilization	7	$$	3		xx kg/yr
Hydrological Controls	5	$	2		xx kg/yr
GROUND WATER					
Fertilizer Management	3	$$	7		xx kg/yr
Source Control	8	$	2		xx kg/yr
FORESTED AREAS					
Road Management	6	$$$	6		xx kg/yr
Trail Management	5	$$	5		xx kg/yr
Fire Restoration	7	$$	4		xx kg/yr
			Total Possible Load Reduction		**xx kg/yr**

Note: Example above is for illustrative purposes only.

Task #3 describes development of a load reduction matrix that identifies all available measures to remove a given pollutant load (N, P, or fine sediments) from each significant source. The table above provides a conceptual example of such a matrix. A variety of source categories (including urban and forest runoff, atmospheric deposition, stream channel erosion, and groundwater) and specific load reduction measures are identified in the first column. Criteria by which each measure may be evaluated are listed along the top. Specific criteria that may be added include: logistical feasibility, land availability, cost, public acceptability, uncertainty concerning measurability and effectiveness, agency/legal constraints, non-water-quality environmental impacts, and others as developed with stakeholder input. Separate matrices will be developed for each pollutant of concern. The matrices will be used to determine basin-wide load reduction potential and to select a watershed restoration strategy.