LAKE TAHOE NUTRIENT AND SEDIMENT TOTAL MAXIMUM DAILY LOAD

SUMMER/FALL 2006 NEWSLETTER

Nevada Division of Environmental Protection   Lahontan Regional Water Quality Control Board

After four years of research, the Lake Tahoe TMDL project has reached a watershed event… we've developed a comprehensive, basin-wide budget of pollutant loads that are responsible for the loss of the Lake's fabled clarity, and have applied those values to estimating the total load reductions necessary to restore clarity to its approximately 100-foot Secchi depth standard. Although results should still be considered preliminary and subject to revision, the article below reports on the first updated budget since 2000 of nutrient loads coming from all significant TMDL source categories, and on the first ever estimate of fine sediment loads reaching the Lake. The following article then provides initial outputs of the Lake Tahoe Clarity Model on the percentage reductions of these loads necessary to achieve desired clarity.

Figuring out how to achieve those reductions requires a way to determine the degree to which urban storm water runoff, the most significant pollutant source, can be reduced through implementing Best Management Practices (BMPs) and other pollution control projects. A prototype spreadsheet model to do that, albeit also very precursory, is described in the third article below. The model is expected to play a critical role in Phase 2 of TMDL development: Load Allocation and Implementation Planning. A comprehensive project to achieve the load allocation—Development of an Integrated Water Quality Management Strategy for Lake Clarity—is finally underway, and the subject of the final article.

TMDL RESEARCH PRODUCES PRELIMINARY UPDATED POLLUTANT BUDGET

When Lake Tahoe TMDL research was initiated in 2002, an initial budget was available for two of the three pollutants of concern for Lake clarity: total nitrogen and total phosphorus. The budget had been most recently updated in the 2000 USFS publication "Lake Tahoe Watershed Assessment," which was issued at about the same time as critical new research revealed that fine sediment constitutes an equal, if not greater, threat to clarity. It became a top priority for TMDL research to verify and update the nutrient budget and to develop the first budget for sediment loading to the Lake. Following four years of research, Lahontan Water Board TMDL researchers and staff have developed an update of the nutrient budget along with a preliminary fine sediment budget, and are currently presenting it to interested constituencies within the basin. It is also being incorporated into the Lake Tahoe Pollutant Loading Report (heretofor referred to as the "Technical TMDL Report"), which is to be produced later this year. A copy of the presentation made to the Pathway Forum on April 27, 2006, including discussion of the updated pollutant budget, may be found at: http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/pathway_forum_presentation_apr272006.pdf.

It is critical to emphasize that the loading estimates presented here are the result of source-specific studies that were commissioned by Lahontan to provide input to TMDL models, most importantly the Lake Tahoe Clarity Model. Results of the stream channel erosion and air deposition studies have been re-interpreted and modified based on other information sources to provide as integrated and complete a set of input data to the Clarity Model as possible. For example, stream channel erosion estimates were combined with output from the Watershed Model and reconciled with that model's surface runoff estimates before generating the estimates provided here. Application of the Watershed and Clarity Models may result in further revisions to these source estimates. Final estimates of loading from particular source categories resulting from Phase 1 research will only be made available in the Lake Tahoe Pollutant Loading Report, and these initial estimates are provided for informational and illustrative purposes only.

The current revised nutrient budget does not deviate significantly from the initial (2002) budget, but estimates of sediment loading show that fine particles enter the Lake at rates between one and two orders of magnitude greater than those for nutrients (see Fig. 1). With the Lake Clarity Model showing that fine sediment accounts for 60% of the Secchi disk value on average (see: http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/Summer-Fall_2003_TMDL_Newsletter_v2.pdf), sediment reductions will likely be essential to achieving the clarity targets of the TMDL. The remainder of this article summarizes the basis for the updated pollutant budget.

Updated Pollutant Budget (Metric Tons per Year)

Source Category		Total Nitrogen	Total Phosphorus	Total Fines*
Upland Runoff	Stream Loading	97 (25%)	23 (46%)	6,900 (47%)
	Intervening Zones	30 (8%)	8 (16%)	2,200 (15%)
Stream Channel Erosion		10 (2.5%)	2 (4%)	3,800 (25%)
Atmospheric Deposition		203 (52%)	8 (16%)	1,400 (9%)
Groundwater		50 (13%)	7 (14%)	NA
Shoreline Erosion		2 (0.5%)	2 (4%)	500 (4%)
TOTAL		**392 MT/yr**	**50 MT/yr**	**14,800 MT/yr**

* Fines are defined as particles ≤63 μm diameter for all sources except air. Air particles are ≤20 μm.

Previous Nutrient Budget (Metric Tons per Year)

Source	Total Nitrogen	Total Phosphorus
Stream Loading	82 (20%)	13.3 (31%)
Direct Runoff	23 (5%)	12.3 (28%)
Atmospheric Deposition	234 (59%)	12.4 (28%)
Groundwater	60 (15%)	4 (9%)
Shoreline Erosion	1 (1%)	1.6 (4%)
Total	**400 MT/yr**	**43.6 MT/yr**

Figure 1: Updated Pollutant Budget (2006) and Previous Nutrient Budget (2000). The updated budget includes the first basinwide estimate of fine sediment loading and revised nutrient loading estimates. In addition, the 2000 stream loading budget has been separated into components due to upland runoff into streams and stream channel erosion. Direct runoff is the same as upland runoff from intervening zones.

Upland Runoff

TMDL research confirmed the primary importance of storm water runoff for the pollutants of greatest concern for Lake clarity. Based on estimates from the Watershed Model (see: http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/winter_04_05_tmdl_newsltr.pdf and http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/Winter_2002-03_TMDL_Newsletter.pdf), surface runoff from modeled land uses accounts for 62% of the total loading to the Lake for phosphorus and fine sediments, and for 33% of nitrogen loading. The Watershed Model has the capability to represent these loads by land use type and by subwatershed, and will be applied to a variety of future climate and development scenarios. Forested areas are the most significant single current source of sediment loads, due to the predominant forest land area in the watershed (nearly 90%), but impervious urban areas, especially roads, are also significant sources, especially of fine sediment (see Fig. 2).

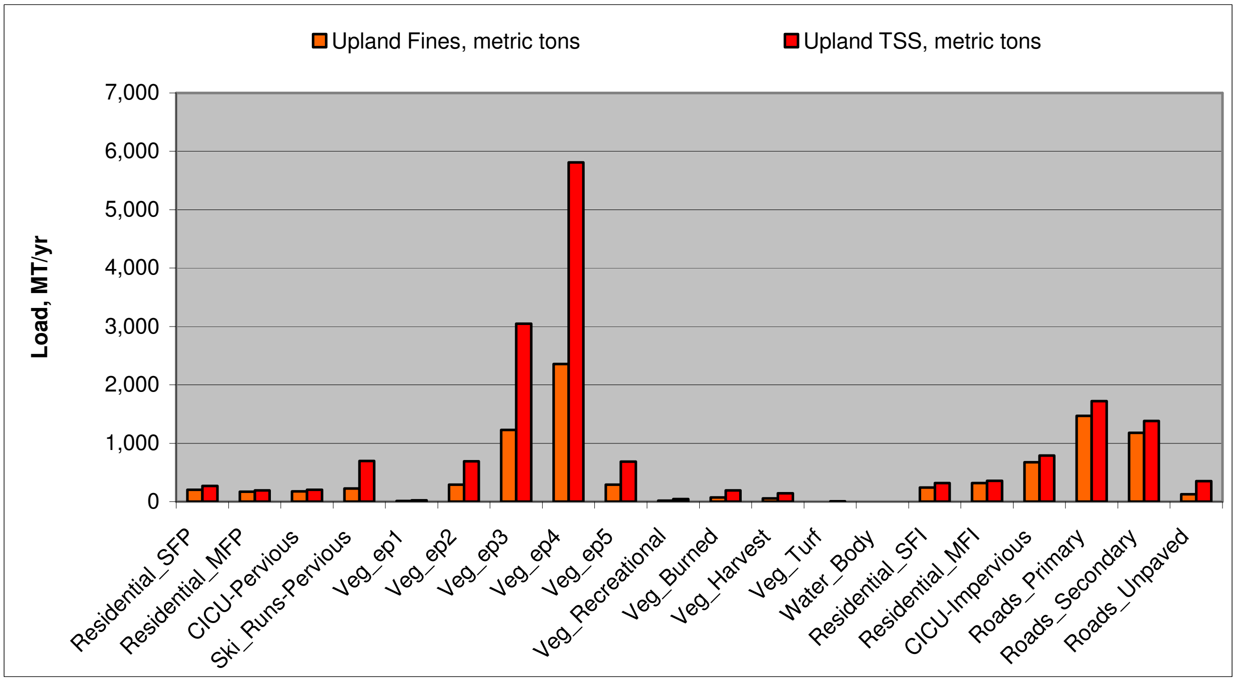


Figure 2. Annual total suspended solids (TSS) and fine sediment (<63um) loads from Basin land uses into Lake Tahoe. Veg_ep1-ep5 represents unimpacted forested lands along a gradient from low (1) to high (5) erosion potential due to natural conditions such as soil type, slope, etc. These lands deliver significant loads due to their large area. Roads—both primary (highways) and secondary (other paved roads)—produce a significant sediment load as well as a higher proportion of fines. Other urban land uses—especially the impervious portions of commercial, institutional, communications and utilities (CICU) parcels and single- and multi-family homes (SFR and MFR)—also convey substantial amounts of fine and total sediment to the Lake.

The watershed model also provides sediment and nutrient loading estimates by subwatershed and any combination of subwatersheds desired (i.e. by tributary, by hydrologic or other region, by jurisdiction, etc). Fig. 3 shows model output for current sediment loading by tributary stream and by intervening zone (the areas between streams that discharge directly into the Lake). It demonstrates the prominence of a limited number of streams such as the Upper Truckee River and Blackwood and Ward Creeks, as well as the significance of intervening zones (IVZs).

Stream Channel Erosion

Channel erosion accounts for an estimated one quarter of fine sediment loading to Lake Tahoe. It is of proportionally less concern for nutrients due to their lower bioavailability in stream bank sediments. This source was evaluated by the National Sedimentation Laboratory (NSL, see: http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/Summer-Fall_2003_TMDL_Newsletter_v2.pdf). Calibrating the Watershed Model to represent stream channel erosion and upland loads in a manner comparable to the NSL's model has been challenging.

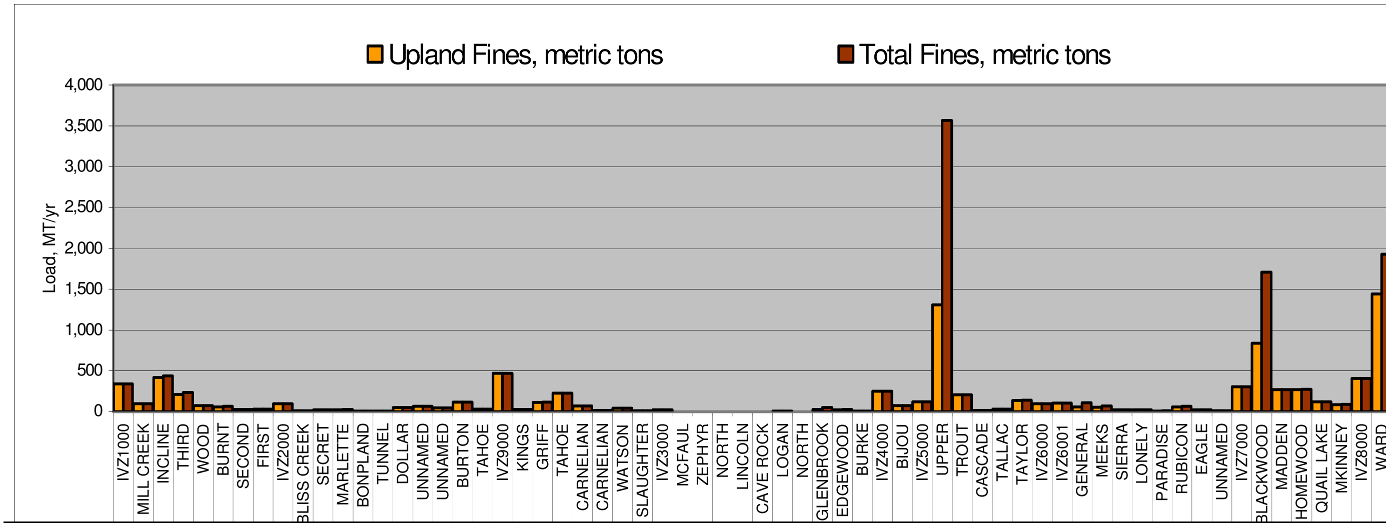


Figure 3: Upland and Total (i.e. upland + channel erosion) fine sediment load estimates from the Watershed Model, by tributary stream and intervening zone (IVZ, represented by TRPA's nine hydrologic zones) around Lake Tahoe Basin.

Tributary	Watershed Model Estimates (MT/yr of Fine Sediment)	Tributary	Watershed Model Estimates (MT/yr of Fine Sediment)
Tahoe State Park	0	Cave Rock	0
Burton Creek	1	Lincoln Creek	0
Barton Creek	0	North Zephyr Creek	0
Lake Forest Creek	0	Zephyr Creek	0
Dollar Creek	1	McFaul Creek	0
Cedar Flats Creek	1	Burke Creek	0
Watson Creek	0	Edgewood Creek	5
Carnelian Bay Creek	0	Bijou Park	0
Carnelian Canyon Creek	0	Bijou Creek	0
Tahoe Vista	2	Trout Creek	2
Griff Creek	5	**Upper Truckee**	**2259**
Kings Beach	0	Taylor Creek	3
First Creek	0	Tallac Creek	0
Second Creek	0	Cascade Creek	0
Burnt Creek	4	Eagle Creek	0
Wood Creek	0	Bliss State Park	0
Third Creek	23	Rubicon Creek	3
Incline	16	Paradise Flat	0
Mill Creek (a)	0	Lonely Gulch Creek	0
Tunnel Creek	0	Sierra Creek	0
Bonpland	0	Meeks Creek	12
Marlette Creek (a)	2	General	48
Secret Harbour	0	McKinney Creek	0
Bliss Creek	0	Quail Lake Creek	0
Dead Mans Point	0	Homewood Creek	0
Slaughterhouse	1	Madden Creek	0
Glenbrook Creek	21	**Blackwood Creek**	**871**
North Logan House Creek	0	**Ward**	**484**
Logan House Creek	0	**TOTAL**	**3,764**

Figure 4. Estimates of loading due to stream channel erosion (in metric tons per year) generated by the Watershed Model. Note that the Upper Truckee River, Blackwood Creek, and Ward Creek combine to contribute approximately 96 percent of the loading.

Watershed Model estimates of stream channel loads are provided in Figure 4. Ninety-six percent of the total fine-grained (silt and clay) particles arriving in Lake Tahoe due to stream channel erosion come from the Upper Truckee River, Blackwood Creek, or Ward Creek, the first two of which are the focus of current stream stabilization and restoration projects.

Atmospheric Deposition

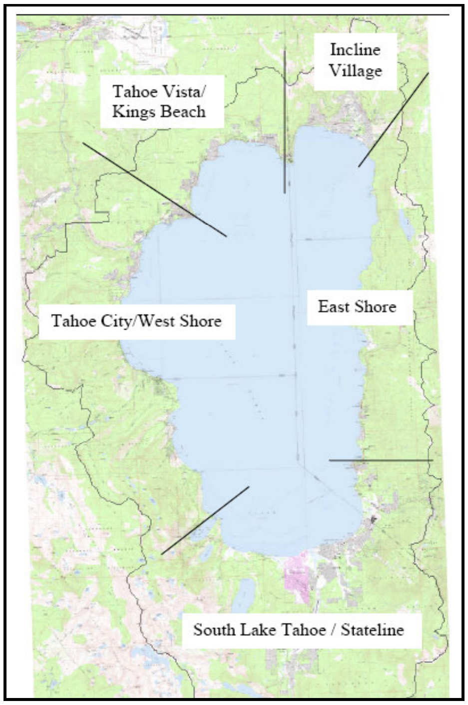
This source category was evaluated by the Lake Tahoe Atmospheric Deposition Study (see: http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/Winter_2003-04_TMDL_Newsletter.pdf), conducted between 2002-2006 by the California Air Resources Board (CARB). The TMDL is utilizing annual deposition estimates for particulates (fine sediment) based on CARB's data and analyses, while nutrient estimates are a result of combining CARB's estimates with those of U.C. Davis and Desert Research Institute researchers (see Figure 5). CARB and other researchers have concluded that most air pollutants impacting Lake clarity originate within the basin (up to 90% of nitrogen and more than half of the phosphorus and particulates), rather than being transported in from upwind areas. The most significant sources of particulates and likely of phosphorus are road dust for particulate matter (PM) $\geq 2.5\ \mu m$ and wood combustion (both from home stoves or fireplaces and from either prescribed or natural forest fires) for PM $<2.5\ \mu m$. The most significant source of nitrogen is vehicle emissions.

	Dry Deposition (MT/yr)	Wet Deposition (MT/yr)
Nitrogen		
NO3	28	18
NH4	77	17
DIN	106	35
DON	32	22
TON	38	24
PN	6	2
TN	**144**	**59**
Phosphorus		
SRP	1.3	1.0
TDP	2.4	1.8
TP	**5.4**	**2.8**
Particulate Matter		
PM 2.5	60	399
PM Coarse (<10)	170	351
PM Large (>10)	350	104
PM Total	**580**	**854**

Figure 5. Preliminary atmospheric deposition estimates during dry and wet weather for species of nitrogen (not additive), phosphorus, and particulates, from CARB and U.C. Davis (2006).

Groundwater

The TMDL research program did not measure groundwater loading directly, but estimates were developed based on existing well data (see: http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/Summer-Fall_2003_TMDL_Newsletter_v2.pdf). Inflows to the Lake's southern region are relatively small compared to the north and west shores, where volcanic soils also contribute to relatively high nutrient concentrations. Figure 6 shows the relative groundwater loads by region around the Lake. Sediment loads from groundwater are considered negligible.



Region	Total Nitrogen (MT/yr)	Total Phosphorus (MT/yr)
South Lake Tahoe/Stateline	2.4	0.43
East Shore	6.2	0.14
Incline Village/Crystal Bay	4.2	0.77
Tahoe Vista/Kings Beach	9.4	1.1
Tahoe City/West Shore	28.0	4.4
Total	**50.0**	**6.8**

Figure 6: Direct groundwater loading estimates to Lake Tahoe by shoreline region.

Application of Loading Estimates

The information above has been used to calibrate the Lake Clarity Model and enable the modeling team from U.C. Davis to estimate the pollutant load reductions necessary to achieve desired Lake clarity (see following article). The next phase of TMDL development, determining load allocations and planning implementation, will use these estimates to guide the work of Source Category Groups to develop overall maximum feasible load reductions for each category. Then a Source Category Integration Committee will determine achievable basin-wide load reduction scenarios or strategies (see final article below).

PRELIMINARY CLARITY MODEL OUTPUTS

The pollutant load (TMDL) that Lake Tahoe can assimilate and achieve its approximate 30 meters of clarity target can now be estimated by the Lake Tahoe Clarity Model developed by UC Davis (see: http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/Spring_2003_TMDL_Newsletter.pdf). An infinite number of potential combinations of nutrient and sediment load reductions are possible, of which a few are presented in the figures below. These and other initial model results were presented to the Pathway Forum by Geoff Schladow of UC Davis and Dave Roberts of Lahontan on July 27, 2006 (see: http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/clarity_presentation2fForum_27july06.pdf). An effort is currently underway to identify an effective, feasible, and defensible load allocation strategy (that is, a combination of load reductions from all the major source categories) to reach desired clarity in a reasonable timeframe (see following article).

Before presenting model results, a few caveats and cautions are in order. To identify and to understand and ultimately seek to manage the primary factors that influence Lake clarity, a deterministic or process-based model like the Lake Tahoe Clarity Model is far preferable to a "black box" or statistical model that simply projects future conditions based on an extrapolation of past conditions. This is because the latter model ignores cause-and-effect relationships in the ecosystem (e.g. the effect of weather on lake mixing and nutrient assimilation) and assumes that future clarity will vary over time more or less as it has in past. The more a model attempts to represent the complex set of interactions that govern the transparency of Lake Tahoe waters (of which 31 are contained in the Clarity Model), the more research is needed to understand each component of that system. A particularly difficult process to understand is the fate of fine particles in the Lake: how they move, aggregate, and ultimately settle or drop out of the photic zone (the portion of the Lake in which light penetrates and submerged objects are potentially visible, above the darkened depths).

Once such processes are sufficiently well represented, the model can be used to determine how much influence each process has on Lake clarity, and what might happen if that process or model "driver" (e.g. meteorology or pollutant loading from the major sources) changes in the future. Although we are only beginning to apply the Lake Tahoe Clarity Model, we are confident that this state-of-the-art tool will adequately estimate the lake's response to alternative pollutant loading scenarios for purposes of initial TMDL load allocation and development of a restoration strategy. Our confidence derives from the extensive peer review and large number of different versions of the model that have been developed and successfully applied around the world in the past decade. However, the model requires continual monitoring of the major processes represented in it and will be refined in the future as new information becomes available. Currently, the greatest source of uncertainty in the model is in our estimates of pollutant loading to the lake (see previous article).

The following graphs provide a first view of model simulations made by the Clarity Model. Actually recorded clarity, as measured by Secchi depth readings at the index station, is shown as the blue triangles. Each simulation depicts one combination of pollutant reduction strategies

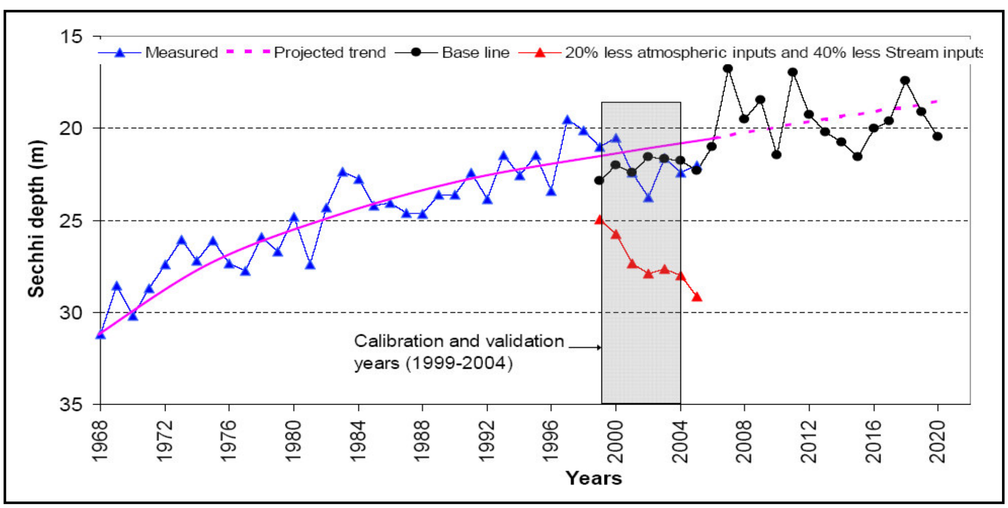


Figure 7: Simulated results (in red) of a progressive 20 percent stream load reduction (1%/yr) and 40 percent atmospheric load reduction (2%/yr) for 20 years. Magenta line represents the best fit through actually measured Secchi depth from 1968-2005 (solid line) and the projected trend if there's no change in current pollutant loading rates. The Black diamonds and line represent simulated "baseline" Secchi depths given projected 1999-2020 precipitation rates representative of the past 37 years of precipitation.

implemented over a 21 year period, 1999-2020, and it is assumed for the purpose of these simulations that the reductions of each pollutant of concern—fine sediment, phosphorus, and nitrogen—are the same. Calculated future changes in Secchi depth over time are based on various pollutant load reduction strategies and projected weather based on historical meteorological observations (a random selection of wet and dry years representative of the past 37 years, with no alteration based on climate change). Clarity model outputs were calibrated and validated using data collected from 1999 to 2004. Black projections represent simulated Secchi depth if current conditions do not change. Red projections represent simulated Secchi depths with specified pollutant load reductions, starting in 1999.

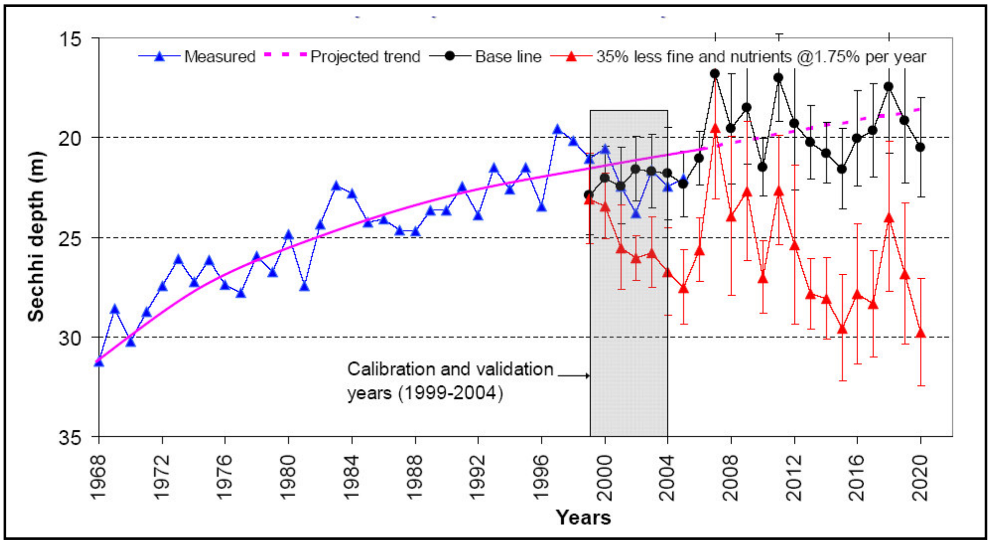


Figure 8: Simulated results of a 35% reduction in fines and nutrient pollutant loads – 1.75% per year for 20 years.

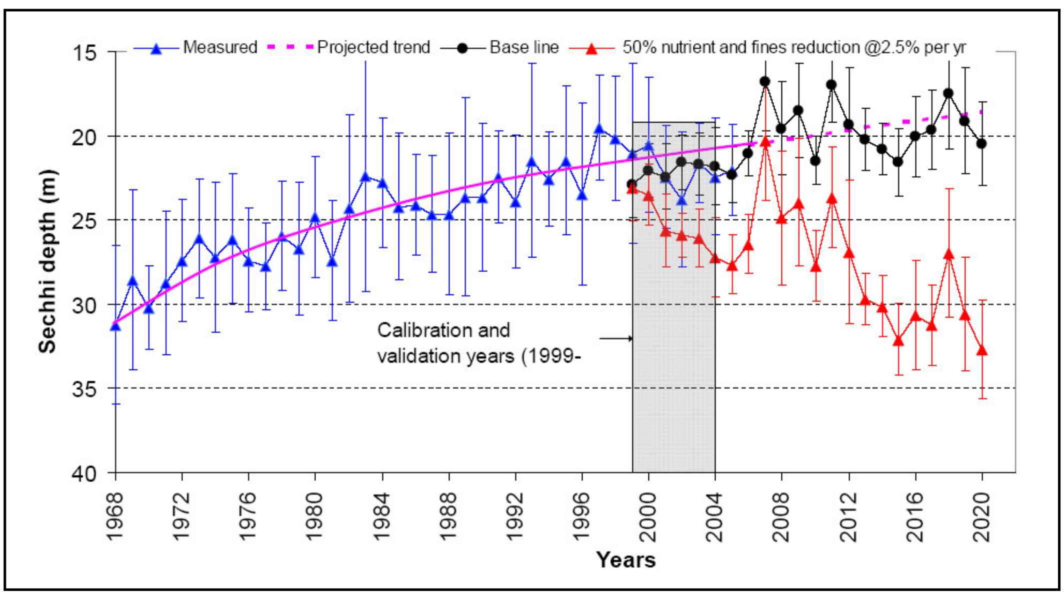


Figure 9: Simulated results of a 50% fines and nutrients reduction – 2.5% per year for 20 years

Although these model results are preliminary and subject to change as the model is refined further and applied to additional future scenarios, initial conclusions are as follows:

- The largest uncertainties associated with model output result from the uncertainties associated with pollutant loading estimates.
- Model output varies according to which pollutants (particles or nutrients) are controlled (though initial runs have assumed they will all be reduced in equal proportions).
- Model output also varies according to the degree to which different sources are controlled (e.g. atmospheric controls appear to have a greater benefit per pound of load reduced than do stream channel or upland runoff controls).
- Lahontan and NDEP have not identified a single, optimum set of pollution or source controls to achieve desired clarity. The final mix of which loads and sources to reduce and by how much is an issue to be addressed in TMDL Phase 2—load allocation and implementation planning—currently underway.
- Far from avoiding the need to continue monitoring Lake Tahoe and its primary pollutant sources, the Clarity Model (as well as all TMDL models) rely on such monitoring for their future application and refinement, in order to tell us when conditions (e.g. climate) have changed.

COMPLETION OF INITIAL METHODOLOGY TO ESTIMATE POLLUTANT LOAD REDUCTIONS FROM URBAN STORM WATER QUALITY IMPROVEMENT PROJECTS IN LAKE TAHOE BASIN

TMDL researchers Northwest Hydraulic and GeoSyntec Consultants recently completed the first version of a key tool to assist the Lahontan Water Board and NDEP to develop and track implementation of the Lake Tahoe TMDL: a spreadsheet model to estimate reductions of nutrients and fine sediments from urban storm water quality improvement projects. The study was sponsored by the U.S. Army Corps of Engineers with funding from the Southern Nevada Public Lands Management Act and oversight by the Army Corps, Lahontan and U.C. Davis. It is the first iteration in what is likely to be a long-term research program to quantify the effectiveness of all pollution control projects in Lake Tahoe Basin that will contribute to TMDL implementation. This study addresses storm water management and treatment projects such as hydrologic and pollutant source controls, wet and dry basins, wetland treatments, bioswales, infiltration galleries, and filtration systems. Additional research projects will be needed to quantify the benefit of efforts to reduce the loading in runoff from vegetated areas, stream channel erosion, groundwater, and atmospheric deposition. Such methodologies are necessary to determine the contributions of each pollution control project around the Basin and whether, in combination, they achieve the overall load reduction targets that will be determined in the implementation planning and load allocation stage of the TMDL. They are also a necessary precondition for a system whereby pollution reduction projects and programs may eventually be traded to achieve the most efficient overall mix of measures to implement the TMDL.

To meet project objectives, the so-called “pollutant load reduction estimator—spreadsheet for Tahoe storm water” conceptual methodology (“PLRE-STS”; suggestions for catchier acronyms are welcome…) was developed to operate at different scales (regional, project, and individual BMP) and to address both source control and treatment projects, as well as project maintenance and monitoring. Once similar methodologies are developed for other major pollutant source categories, TMDL implementation efforts of all kinds may be quantified and compared.

Although the original project scope of work did not require development of a working model, the PLRE-STS spreadsheet may be considered a prototype computational tool that may be used to test and evaluate the conceptual methodology.

Producing the methodology involved three major tasks: investigating local and regional water quality practices, summarizing efforts to estimate BMP effectiveness around the country, and actual screening, development, testing and roll-out of a Tahoe-specific methodology. A literature review of national water quality practices showed that an effective load reduction methodology must have both hydrology and water quality components of load generation and reduction. Although hydrologic processes were analyzed deterministically, water quality is by necessity more easily characterized empirically at this time. As our understanding of water quality processes improves and more data become available, our goal is to represent these processes deterministically as well.

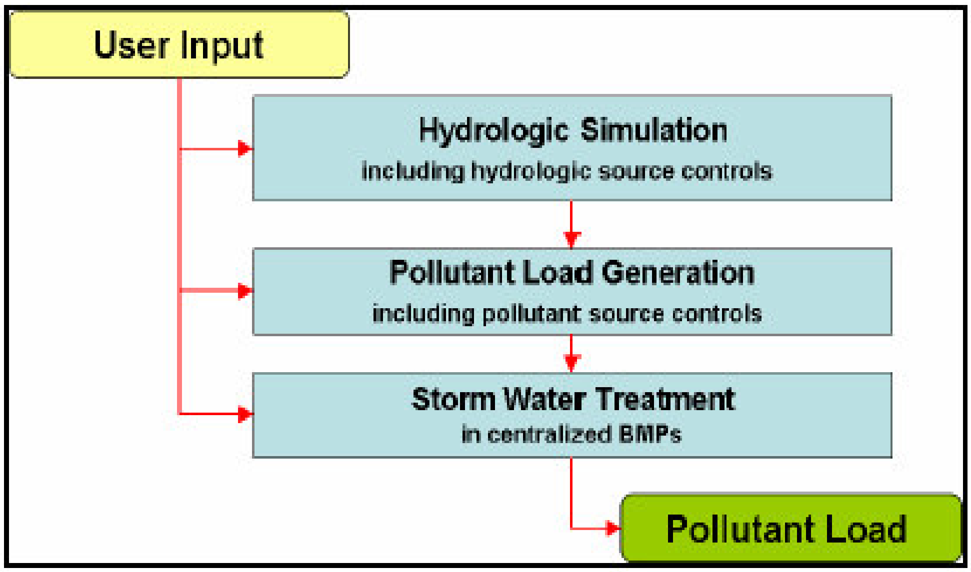


Figure 10: Conceptual structure of Methodology to Estimate Pollutant Load Reductions

Our initial prototype tool characterizes the effectiveness of three primary urban storm water project components, in sequence (see Fig. 10): (1) hydrology (including hydrologic source controls such as on-site storm water infiltration), (2) pollutant load generation (also including source controls, e.g. street sweeping or sand management, project maintenance, and land stabilization practices), and finally (3) centralized treatment of the storm water. A significant factor in designing the model was to choose an appropriate project scale while providing the ability to interface with the larger LSPC Watershed Model that characterizes surface runoff throughout LTB for the TMDL. Projects with catchments of 5-100 acres (the size of most in-basin water quality improvement projects) are represented by the current version of this model though this range can be expanded in future refinements. For the hydrologic component of the model, the MM5 reconstructed long-term meteorological database was used (see: http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/Spring_2003_TMDL_Newsletter.pdf) to drive a process-based estimate of runoff, despite shortcomings with the existing MM5 calibration that will be addressed in subsequent phases of model development. For pollutant load generation, the approach selected was to combine land use-based empirical estimates with estimates of loads for potentially large specific sources such as eroding gullies and road cuts or areas where road sand is applied. Land use-based loading values are calculated using the same runoff concentrations developed for particular urban land uses in order to calibrate the Watershed Model, based on stream and direct runoff monitoring data. The conceptual structure of the pollutant load generation methodology is represented in Fig. 11.

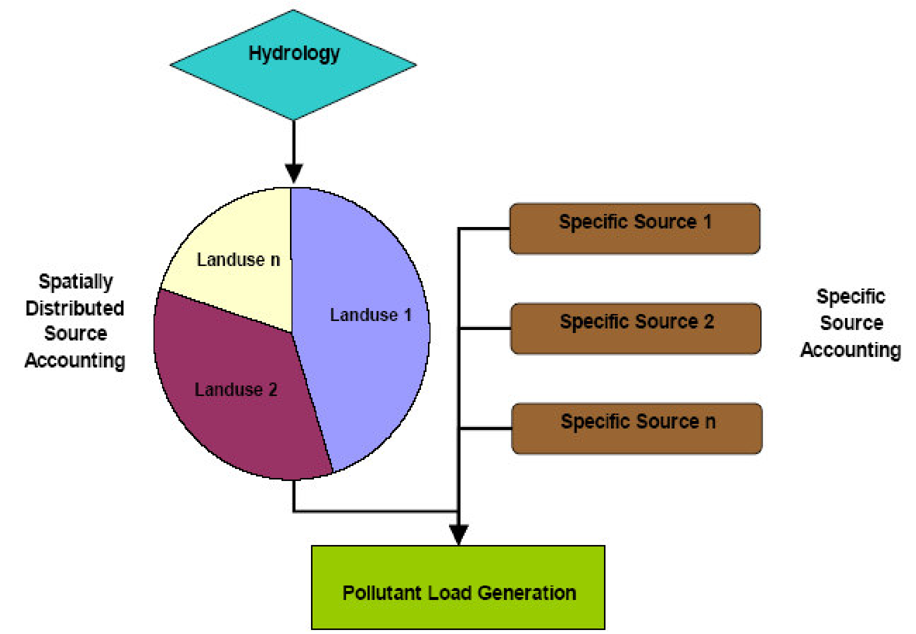


Figure 11: Simplified Pollutant Load Generation Methodology

Although we are currently unable to estimate the effectiveness of pollutant source controls, we considered it necessary to incorporate source control BMPs into the methodology as they represent an important factor in the overall performance of a storm water management system. Similarly, there is neither enough information at present on BMP effectiveness nor on the variability in effectiveness under different hydraulic conditions (e.g. residence time), to produce a process-based estimate of treatment effectiveness. However, it was possible to use particle settling theory to estimate fine sediment removal in volume-based storm water treatment BMPs based on variable hydraulic conditions, and empirical estimates of typical effluent concentrations were used for nutrients and flow-based BMPs. Figure 12 illustrates conceptually the pollutant load reduction associated with a storm water treatment BMP. The influent load (determined by the pollutant load generation methodology) enters the BMP, which has a known water quality design volume or flow rate as well as an achievable effluent quality. The method calculates how much water is treated vs. by-passed by the BMP, and assigns the achievable effluent concentration to the treated amount. The bypassed flow receives no treatment but may be routed to a subsequent BMP; up to three BMPs can be simulated at the bottom of a drainage area, either in parallel or in series.

Storm water treatment BMPs represented in the methodology were selected based on common facilities and designs currently implemented in the Tahoe Basin. The prototype methodology is a relatively complete computational tool that is ready for initial testing and further development. It accepts user-defined inputs for project area characteristics and design criteria and provides output on hydrologic characteristics, pollutant loads, and pollutant load reductions. The overall design of the PLRE-STS is intended to be practical for BMP project implementers to apply. It provides a simplified and flexible interface to U.S. EPA's Storm Water Management Model (SWMM, the hydrologic engine for continuous simulation), which is in turn driven by the MM5 40-year meteorological database.

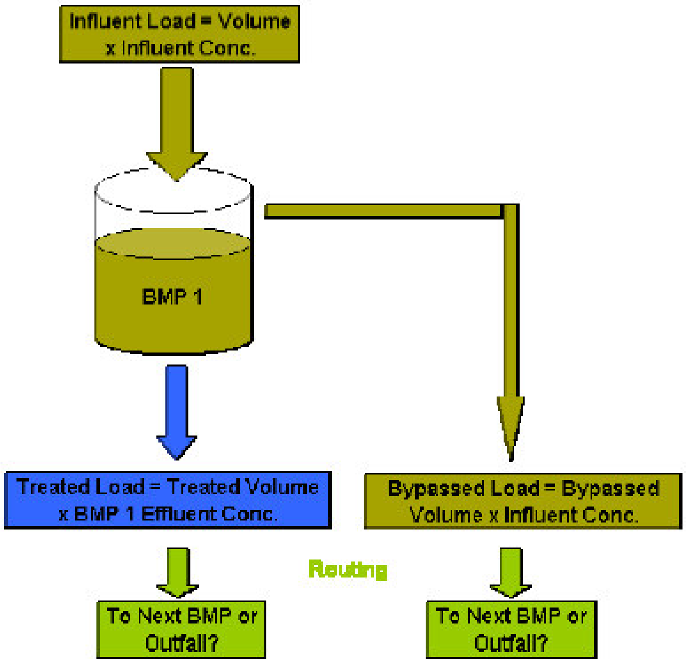


Figure 12: Conceptual BMP Routing Diagram

In addition to the automated techniques, the structure of the PLRE-STS was designed for transparency and flexibility. For example, default values are provided in look-up tables for many of the pertinent input parameters for hydrologic and water quality analysis in the Lake Tahoe Basin (e.g. soils data, BMP effluent concentrations, characteristic land use concentrations, etc.). The lookup tables have been designed to allow a user to deviate from the default values if project specific data or professional judgment warrants. This built-in flexibility allows for simple refinements to the methodology in the event that new monitoring data or policy cause the current data assumptions in the PLRE-STS to be revised.

The methodology and the associated spreadsheet model should be viewed as the first step toward developing quantitative analytical tools for estimating Tahoe Basin pollutant loads. The conceptual methodology is a major advance in the approach to calculating pollutant load reductions in the Tahoe Basin, but it should be recognized that the computational tools have only been developed to the prototype level at present. Much additional work is necessary to refine this methodology so that it can be used broadly by project proponents and accepted by regulatory agencies.

The following development tasks are needed to upgrade the prototype model to a "beta version" (that is, a computational tool that can be independently tested and applied by intended users at the project scale):

- Incorporate revised MM5 meteorological data and create rainfall and temperature interface files;
- Test and verify parameters in the PLRE-STS using Tahoe Basin monitoring data;
- Conduct test applications at the project scale;
- Provide clearer reporting and review tools and develop an abbreviated users manual;
- Refine representation of spatially distributed source control techniques and accounting of specific sources (e.g. eroding gullies);
- Consider refinements for estimating pollutant load reductions in BMPs and for accounting for private property BMP implementation;
- Improve hydraulic routing in BMPs and representation of maintenance effects; and
- Develop methods for application of flow-duration information.

IWQMS UNDERWAY!

The previous newsletter, http://www.swrcb.ca.gov/rwqcb6/TMDL/Tahoe/winter2005-06_tmdl_newsletter.pdf, described a project with the objective of determining "who should do what" to achieve the pollutant load reductions necessary to restore Lake Tahoe's legendary clarity. This project was initiated in June by the Project Team, consisting of contractors Tetra Tech, Inc (see http://www.swrcb.ca.gov/rwqcb6/TMDL/Tahoe/Winter_2002-03_TMDL_Newsletter.pdf) and their local partners Environmental Incentives, LLC (EI)—profiled in the box article, next page.

The first task of the project was to flesh out the process of developing an Integrated Water Quality Management Strategy (IWQMS) to achieve desired Lake clarity and to define the purpose and roles of the component products and groups involved. Source Category Groups (SCGs) for each major pollutant source (urban runoff, forest runoff, stream channel erosion, atmospheric deposition and groundwater) will conduct detailed technical analyses of potential load reductions achievable throughout Lake Tahoe Basin and summarize their findings in a Load Reduction Matrix (LRM). SCGs consist of a product manager focused on developing the LRM for that source category, a facilitator and research assistant, and several subject matter expert contributors who can direct or complete load reduction estimates and conduct research to provide necessary information. Appropriate Pathway 2007 Technical Working Groups, along with other Basin entities such as the Storm Water Quality Improvement Committee and additional subject matter experts if necessary, will review draft LRM products or reports. EI has developed a packet of information and responsibilities that will assist and direct members of each SCG. SCG leads have been chosen and are currently selecting contributors and preparing a proposal describing the methodology their group will use to estimate basin-wide load reduction potential and the level of effort, schedule and milestones of more detailed investigations.

These proposals will be evaluated by the Project Team and the Source Category Integration Committee (SCIC), and will be used to direct subsequent work. The SCIC is responsible for integrating each SCG's product into a set of alternative management strategies to restore Lake clarity. The SCIC consists of Lahontan's project manager Bob Larsen and Tahoe TMDL lead Dave Roberts, NDEP's Jason Kuchnicki (also a member of the Pathway Steering Team), and TMDL Science/Research Coordinator John Reuter. The IWQMS project schedule and product milestones are as follows:

- SCG formation and proposals: August-September 2006
- Initial Load Reduction Analysis Report and LRM: September-October 2006
- Detailed investigations for Draft LRM: November 2006-May 2007
- SCIC Development of IWQMS alternatives: May 2007-July 2007
- Selection of Preferred IWQMS: July-November 2007
- Development of Load Allocations: November 2007-January 2008
- Development of Pollutant Load Reduction Tracking System: January 2007-February 2008

As this project will take 18 months to complete and constitutes the most participatory and collaborative of TMDL research efforts up to this point, regular updates will be provided in these pages…

INTRODUCING ENVIRONMENTAL INCENTIVES (LLC)

The second phase of the Lake Tahoe TMDL involves two major projects. The first project utilizes small teams of technical experts, called Source Category Groups, to determine the effectiveness and feasibility of pollutant control options. The second, called the Water Quality Trading Project, explores the potential for trading nutrient and sediment "credits" as a means of economically restoring Tahoe's famed clarity. Environmental Incentives, LLC will assist Tetra Tech, Inc. with the first project and is the lead consultant for the Water Quality Trading project.

Environmental Incentives, LLC was created to develop and apply innovative incentives and market-based policies in combination with regulations as tools for environmental improvement. Environmental Incentives is founded on the belief that engaging the creativity and power of landowners, entrepreneurs and public entities is the most effective means of achieving environmental goals. Environmental Incentives' key staff, Jeremy Sokulsky and Chad Praul, are committed to the success of the TMDL project.

Jeremy Sokulsky, P.E., MBA has pursued innovative means to improve the environment from the public, private and non-profit sectors for over a decade. Jeremy has managed teams and led projects analyzing market mechanisms for environmental management. He has investigated nutrient, metals and bacterial pollution to water bodies, and has developed wind energy projects. His experience in the Lake Tahoe Basin began in 2000 with project compliance inspections. He was involved in the early stages of development of the Lake Tahoe TMDL. Jeremy worked extensively with the Pathway 2007 agencies in the development of Desired Conditions and Indicators and is assisting the Pathway Agencies in developing an Adaptive Management System.

Chad Praul and Jeremy Sokulsky of Environmental Incentives, LLP

Chad Praul, B.S.M.E., has developed water quality project performance monitoring programs, operated automated samplers in the snow, and reviewed project designs. In cooperation with Lahontan staff, Chad produced the first comprehensive inventory of Water Quality, Erosion Control and Wetland Restoration projects for Lake Tahoe, which he developed into a GIS-enabled tool. Chad led the Lake Tahoe Interagency Monitoring Program's Working Group which provides a forum for discussing water quality monitoring issues and presenting new research. Chad's experience working on projects and regulatory programs gives him important insight into the complex landscape of Lake Tahoe's resource management agencies.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD,
LAHONTAN REGION
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150

Contact Information

Doug Smith – Tahoe TMDL Unit Chief
(530) 542-5453
DFSmith@waterboards.ca.gov
Dave Roberts – California Project Lead
(530) 542-5469
droberts@waterboards.ca.gov
Bob Larsen
(530) 542-5439
RLarsen@waterboards.ca.gov
Kim Gorman
(530) 542-5466
KGorman@waterboards.ca.gov
Jack Landy
(530) 542-5443
JLandy@waterboards.ca.gov
John Reuter – Research Director
University of California Davis
(530) 304-1473
jereuter@ucdavis.edu
Jason Kuchnicki – Nevada Lead
Nevada Division of Environmental Protection
(775) 687-9450
jkuchnic@ndep.nv.gov

Lahontan RWQCB Lake Tahoe TMDL Website:
http://www.waterboards.ca.gov/lahontan/TMDL/Tahoe/Tahoe_Index.htm

Nevada Division of Environmental Protection Website:
www.ndep.state.nv.us