TAHOE: STATE OF THE LAKE REPORT 2010

NUTRIENTS AND PARTICLES

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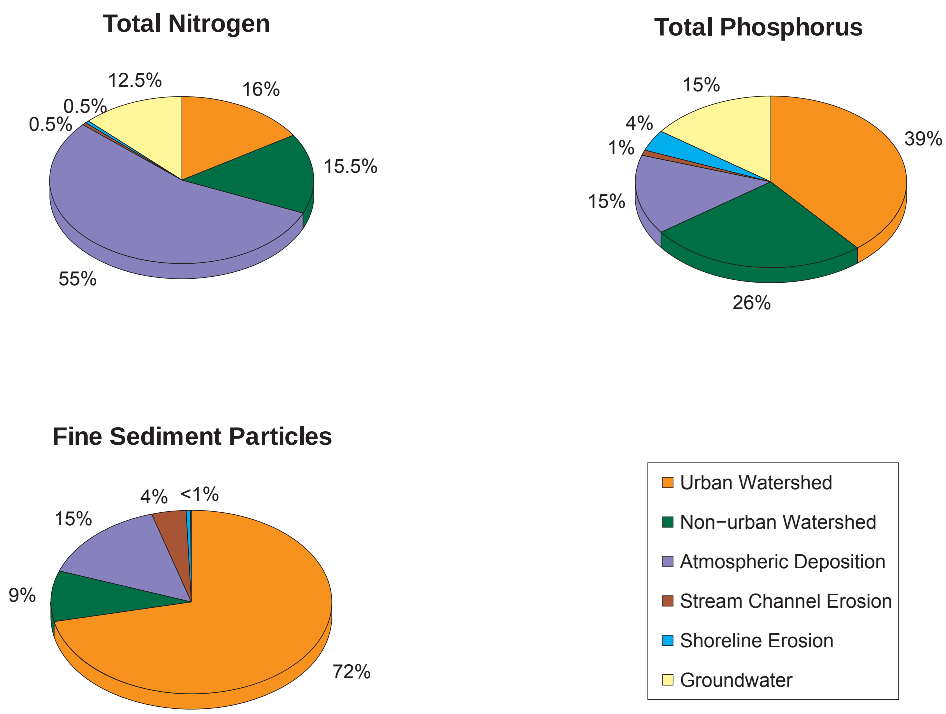
NUTRIENTS AND PARTICLES

Sources of clarity-reducing pollutants

Previous research has quantified the primary sources of nutrients (nitrogen and phosphorus) and particulate material that are causing Lake Tahoe to lose clarity in its upper waters. Extremely fine particles, the major contributor to clarity decline, primarily originate from the urban watershed (70-75 percent), even though these areas cover only 10 percent of the land area. For nitrogen, atmospheric deposition is the major source (55 percent). Phosphorus is primarily introduced by the urban (39 percent) and non-urban (26 percent) watersheds. These categories of pollutant sources form the basis of a strategy to restore Lake Tahoe's open-water clarity by agencies including the Lahontan Regional Water Quality Control Board, the Nevada Division of Environmental Protection, and the Tahoe Regional Planning Agency. (Data were generated for the Lake Tahoe TMDL Program and this figure also appeared in last year's State of the Lake Report 2009.)

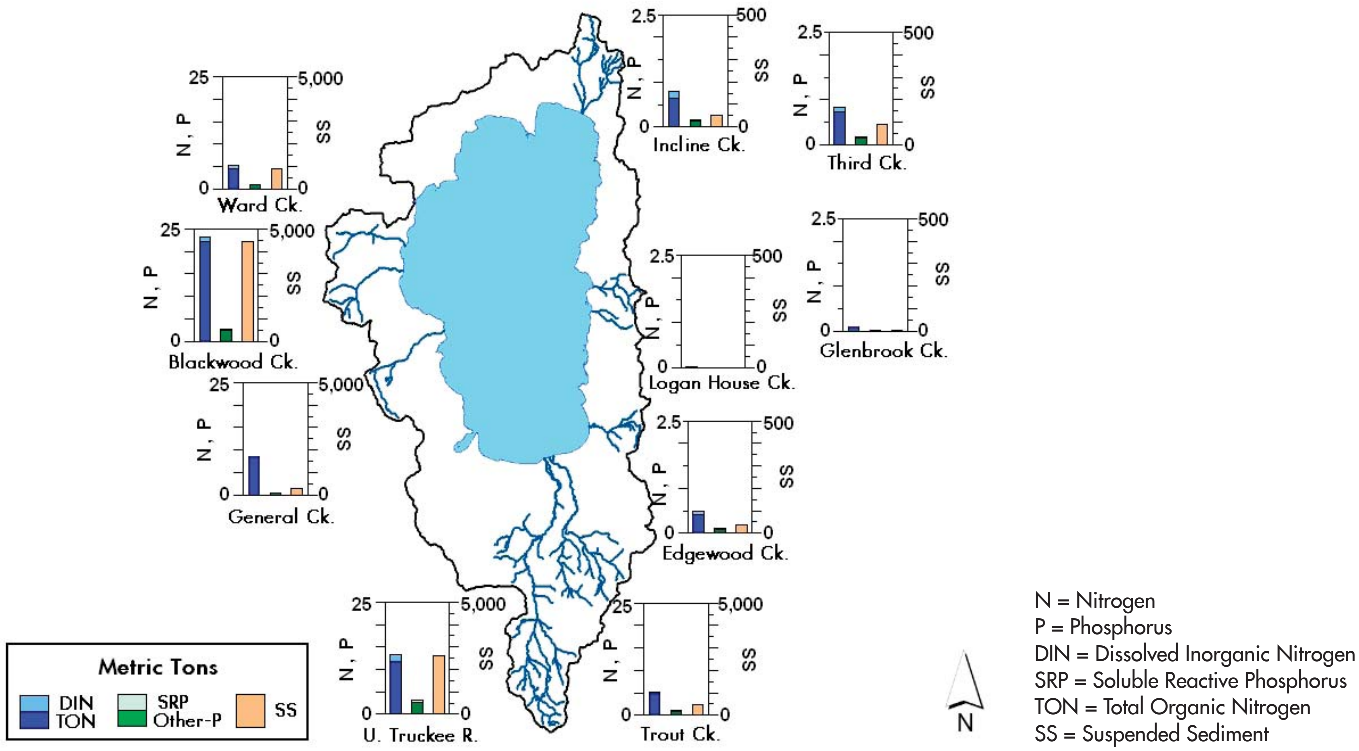


NUTRIENTS AND PARTICLES

Pollutant loads from 10 watersheds

The Lake Tahoe Interagency Monitoring Program (LTIMP) measures nutrient and sediment input from 10 of the 63 watershed streams – these account for approximately half of all stream flow into the lake. Most of the suspended sediment contained in the 10 LTIMP streams is from the Upper Truckee River, Blackwood Creek, Trout Creek and Ward Creek, with the first two being the largest contributors. Over 75 percent of the phosphorus and nitrogen comes from the Upper Truckee River, Trout Creek and Blackwood Creek. Pollutant loads from the west-side streams were significantly higher in 2009 compared to the previous year (3-fold); however, year-to-year variation is high as a result of annual precipitation patterns.

The east-side stream loads were similar to the previous year. The LTIMP stream water quality program is managed by the U.S. Geological Survey in Carson City, Nevada, UC Davis TERC and the Tahoe Regional Planning Agency. Additional funding was provided by the USFS – Lake Tahoe Basin Management Unit.

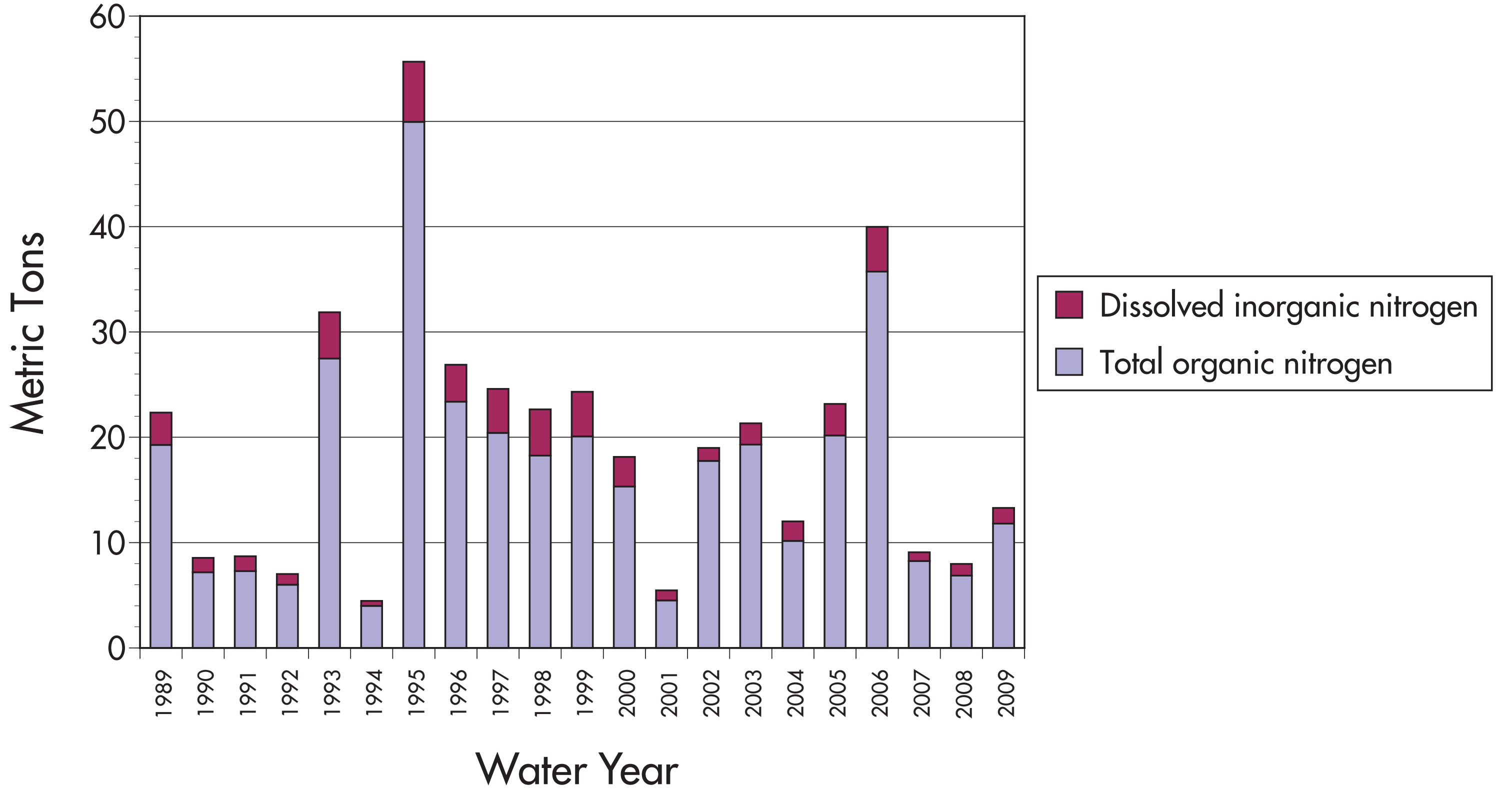


NUTRIENTS AND PARTICLES

Nitrogen contribution by Upper Truckee River

Since 1989

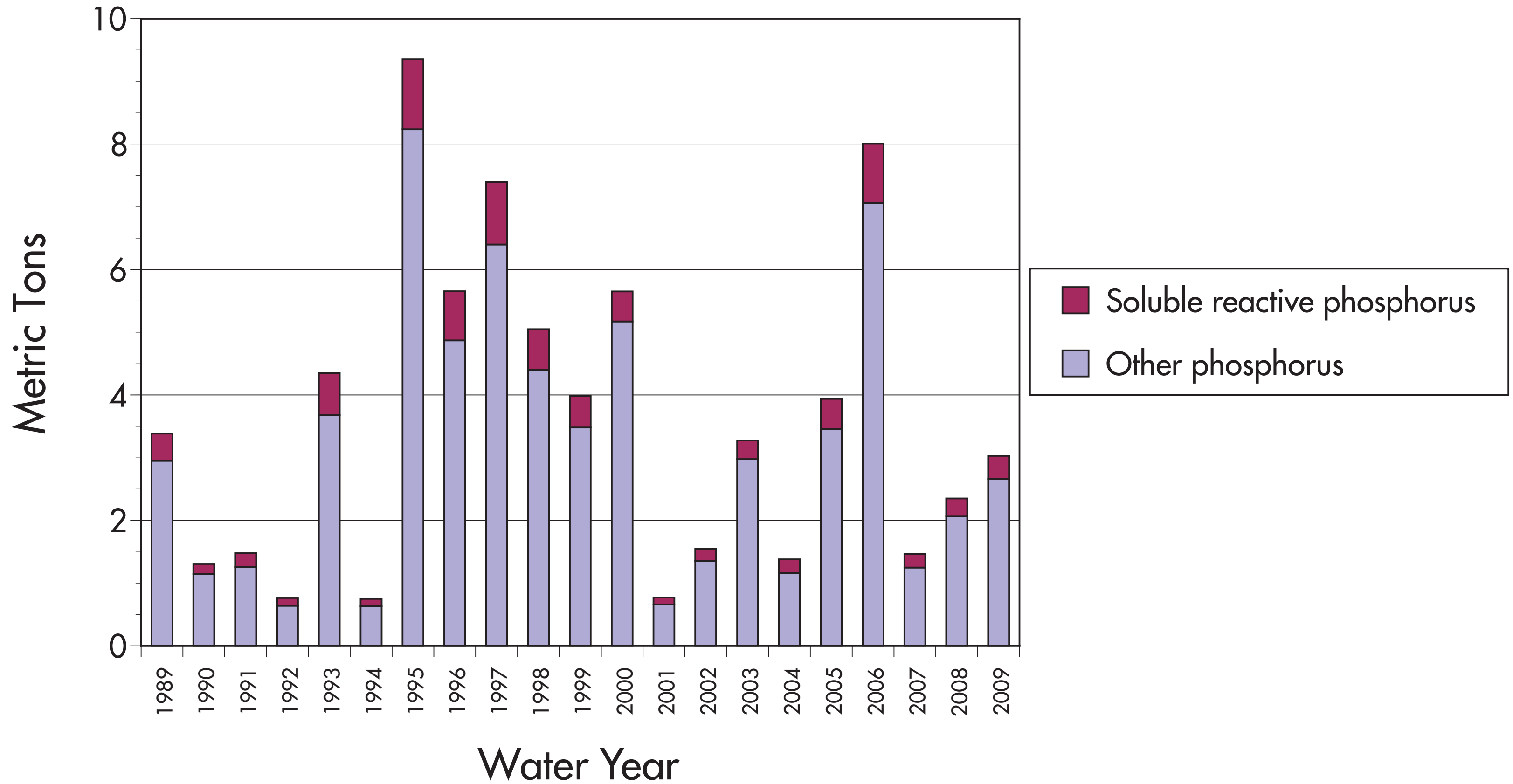
Nitrogen (N) is important because it, along with phosphorus (P), stimulates algal growth (Fig. 9.1 shows the major sources of N and P to Lake Tahoe). The Upper Truckee River is the largest of the 63 streams that flow into Lake Tahoe, contributing about 25 percent of the inflowing water. The river's contribution of dissolved inorganic nitrogen (nitrate and ammonium) and total organic nitrogen loads are shown here. The year-to-year variations primarily reflect changes in precipitation. For example, 1994 had 16.6 inches of precipitation and a low nitrogen load, while 1995 had 60.8 inches of precipitation and a very high nitrogen load. Near-average precipitation in 2009 resulted in a nitrogen load that was larger than the previous year. The watershed burned in the Angora Fire (June 2007) drains directly to the Upper Truckee River. (One metric ton = 2,205 pounds.)



Phosphorus contribution by Upper Truckee River

Yearly since 1989

Soluble reactive phosphorus (SRP) is that fraction of phosphorus immediately available for algal growth. As with nitrogen (Fig. 9.3), the year-to-year variation in load largely reflects the changes in precipitation. Near-average precipitation in 2009 resulted in an increase in phosphorus load over the previous year. Total phosphorus is the sum of SRP and other phosphorus, which includes organic phosphorus and phosphorus associated with particles. (One metric ton = 2,205 pounds.)



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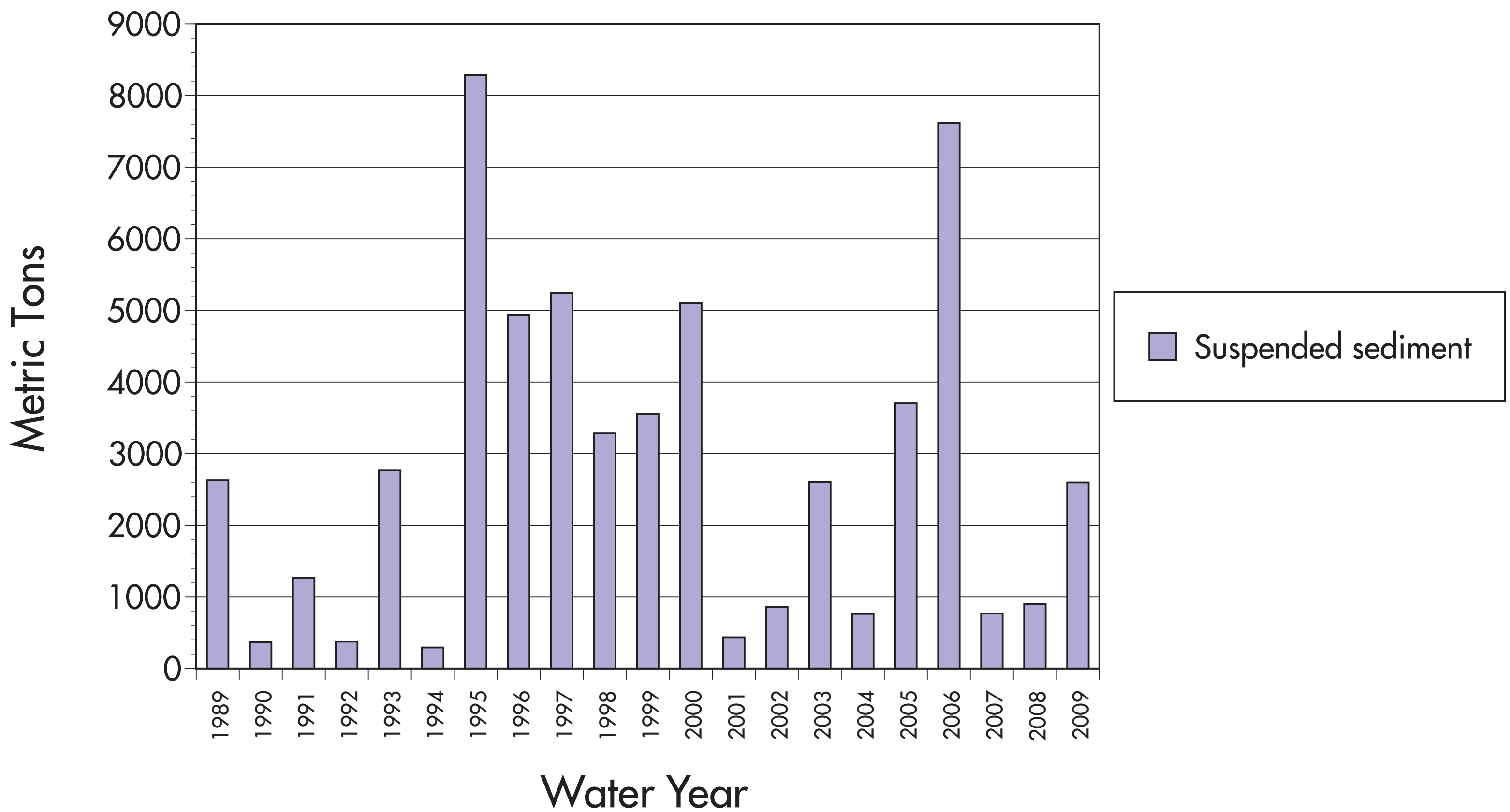
Suspended sediment contribution by Upper Truckee River

Yearly since 1989

The load of suspended sediment delivered to the lake by the Upper Truckee is related to landscape condition and erosion as well as to precipitation and stream flow. Certainly, interannual variation in sediment load over shorter time scales is more related to the latter. Near-average precipitation in 2009 resulted in a sharp jump (factor of three) in the suspended sediment load. This and the previous two figures illustrate how greatly changes in hydrological conditions affect pollutant loads.

Plans to restore lake clarity emphasize reducing loads of very fine suspended sediment (less than 20 microns in diameter). Efforts to restore natural stream function and watershed condition focus on reducing loads of total sediment regardless of size.



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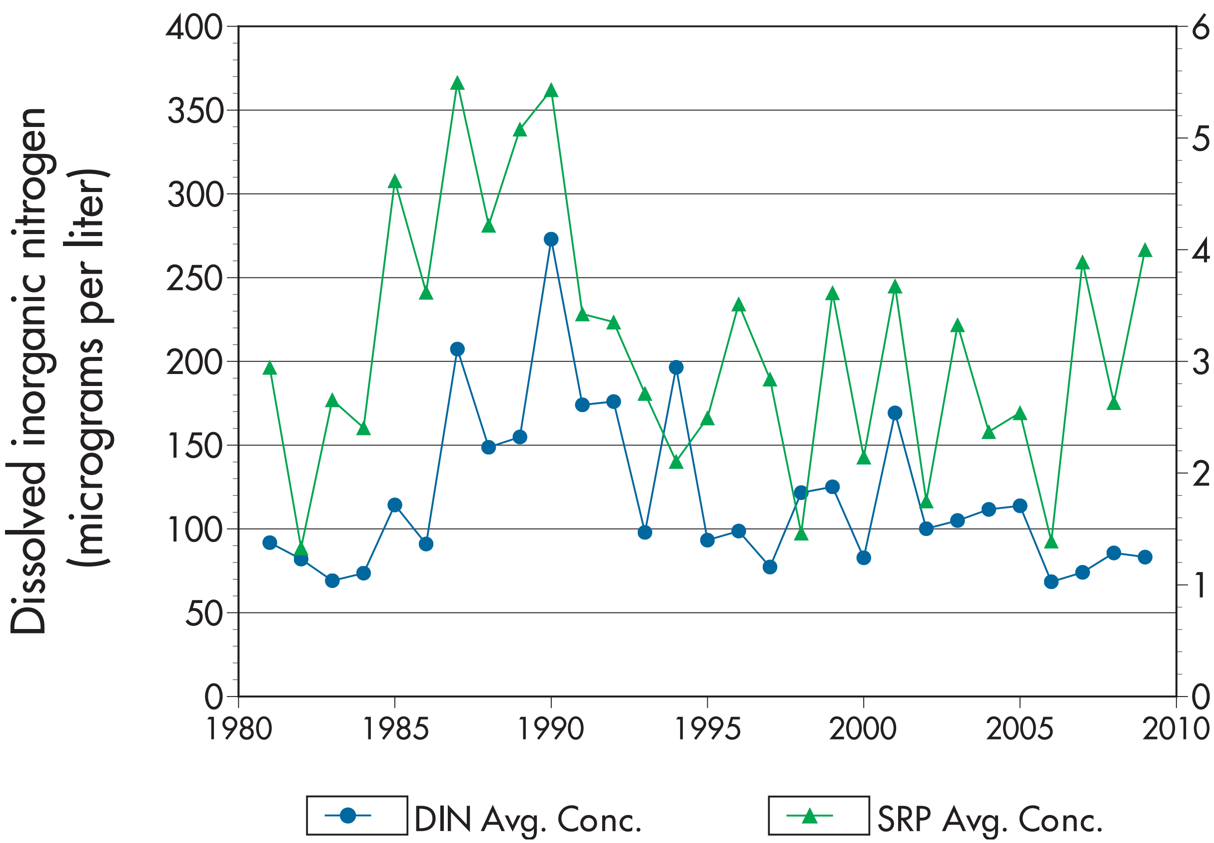
Nutrient concentrations in rain and snow

Yearly since 1981

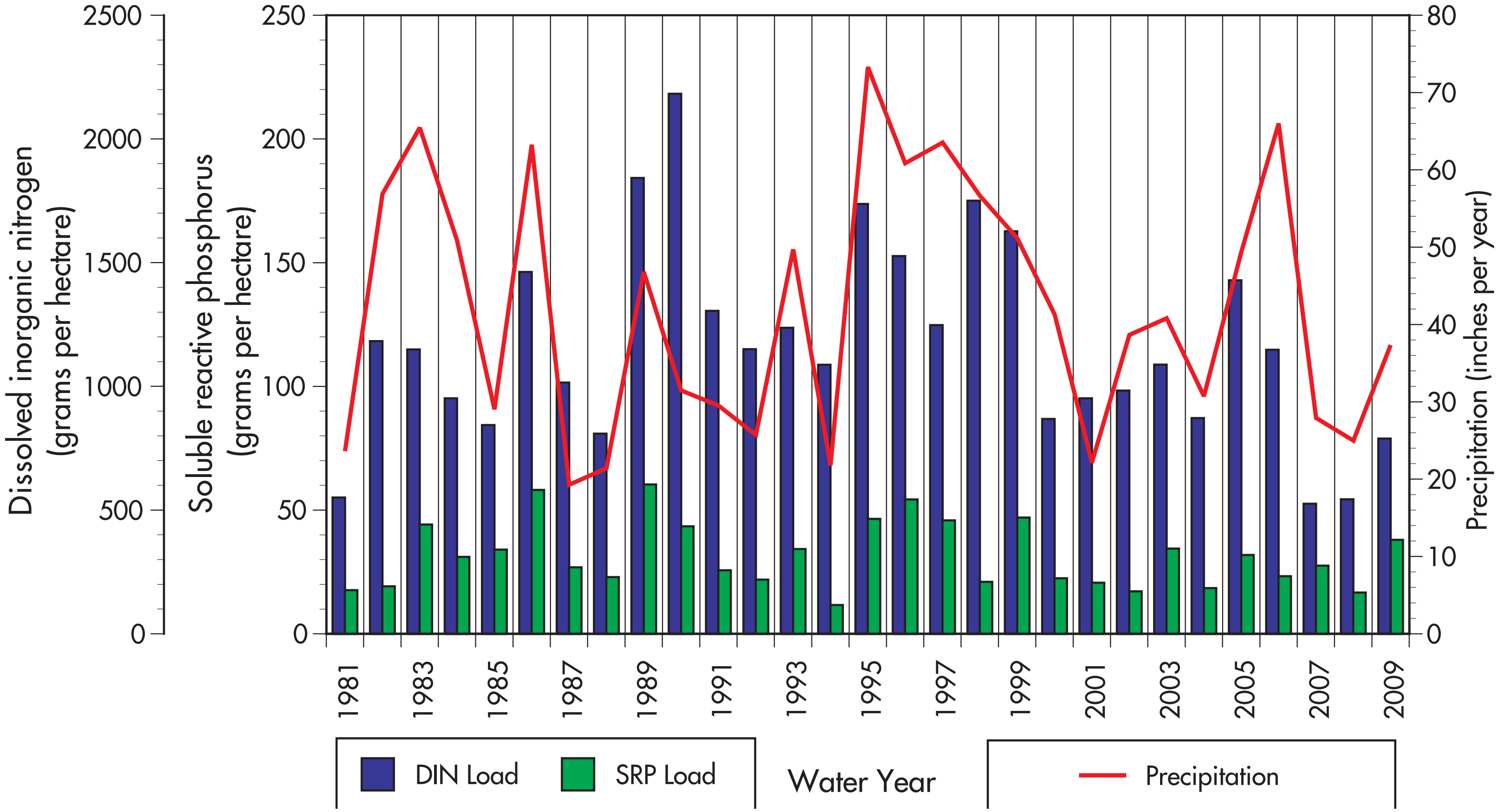
Nutrients in rainwater and snow (called wet deposition) contribute large amounts of nitrogen, but also significant phosphorus, to Lake Tahoe. Nutrients in precipitation have been measured near Ward Creek since 1981, and show no consistent upward or downward trend. Annual concentrations in precipitation of dissolved inorganic nitrogen (DIN) and soluble reactive phosphorus (SRP) vary from year to year. In 2009, concentrations of DIN in precipitation remained unchanged from the 2008 value, whereas the SRP concentration increased by 50 percent. A high degree of interannual variation in SRP concentration has been a common feature of the long term data set.



Nutrient loads in rain and snow

Since 1981

The annual load for wet deposition is calculated by multiplying the concentration of dissolved inorganic nitrogen (nitrate and ammonium) and soluble reactive phosphorus (in the previous graph) by total annual precipitation. While nitrogen and phosphorus loads from precipitation have varied from year to year at the Ward Creek monitoring site, no obvious long-term trend has emerged. In 2009, the nitrogen and phosphorus loads were close to the long-term averages.



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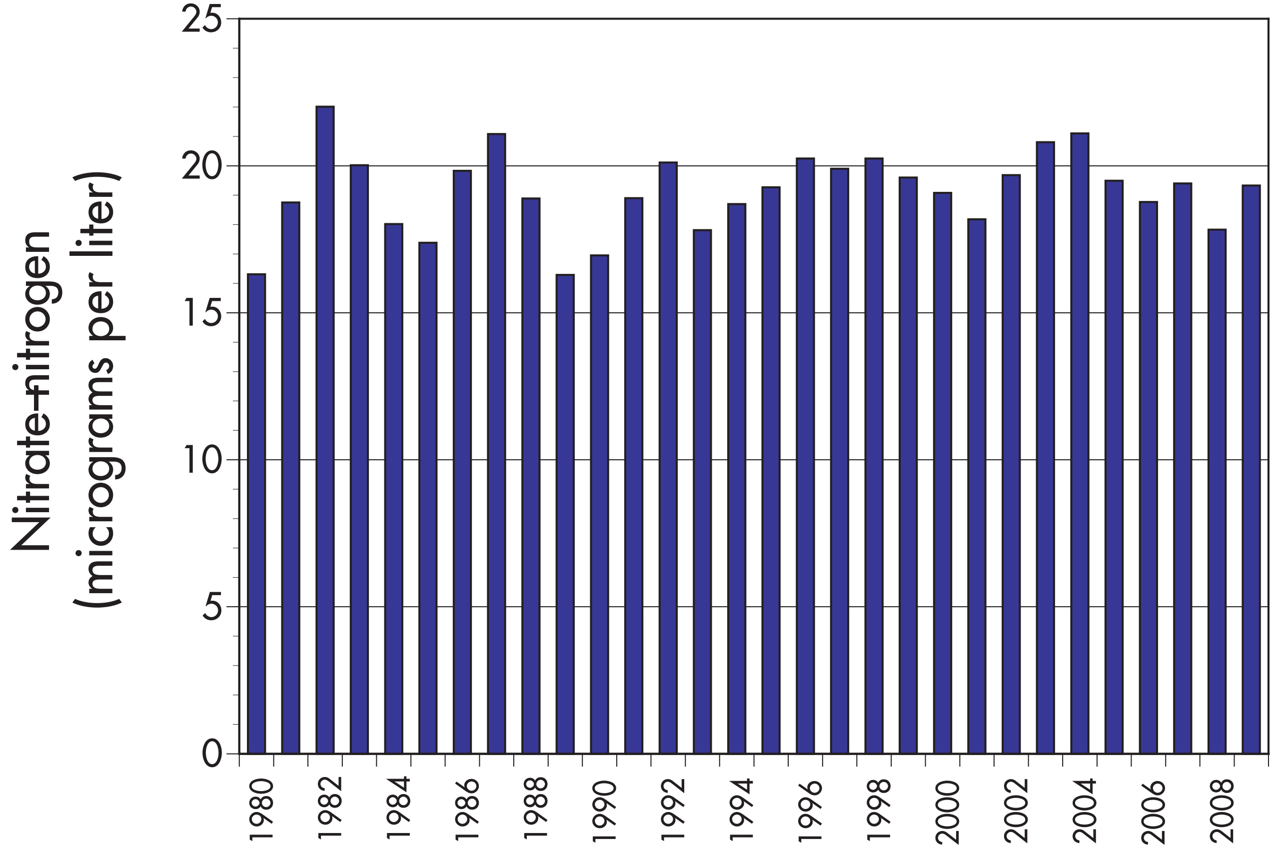
Lake nitrate concentration

Yearly since 1980

Since 1980, the lake nitrate concentration has remained relatively constant, ranging between 16 and 22 micrograms per liter. In 2009, the volume-weighted annual average concentration of nitrate was approximately 19.3 micrograms per liter (or parts per billion). These measurements are taken at the MLTP (mid-lake) station. Water samples could not be collected in February, July and November in 2009.



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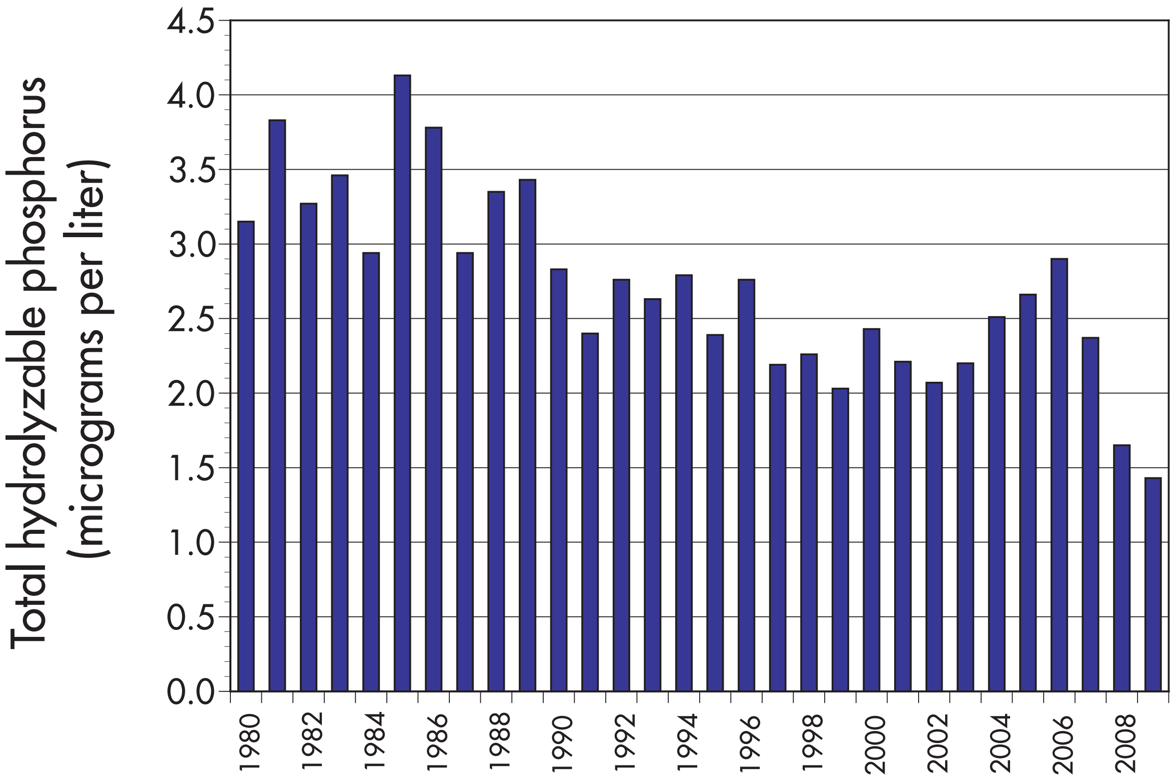
Lake phosphorus concentration

Yearly since 1980

Phosphorus naturally occurs in Tahoe Basin soils and enters the lake from soil disturbance and erosion. Total hydrolyzable phosphorus, or THP, is a measure of the fraction of phosphorus algae can use to grow. It is similar to the SRP that is measured in the streams. Since 1980, THP has tended to decline. In 2009, the volume-weighted annual average concentration of THP was 1.4 micrograms per liter, the lowest annual average since monitoring of this parameter began in 1980. Water samples could not be collected in February, July and November in 2009.



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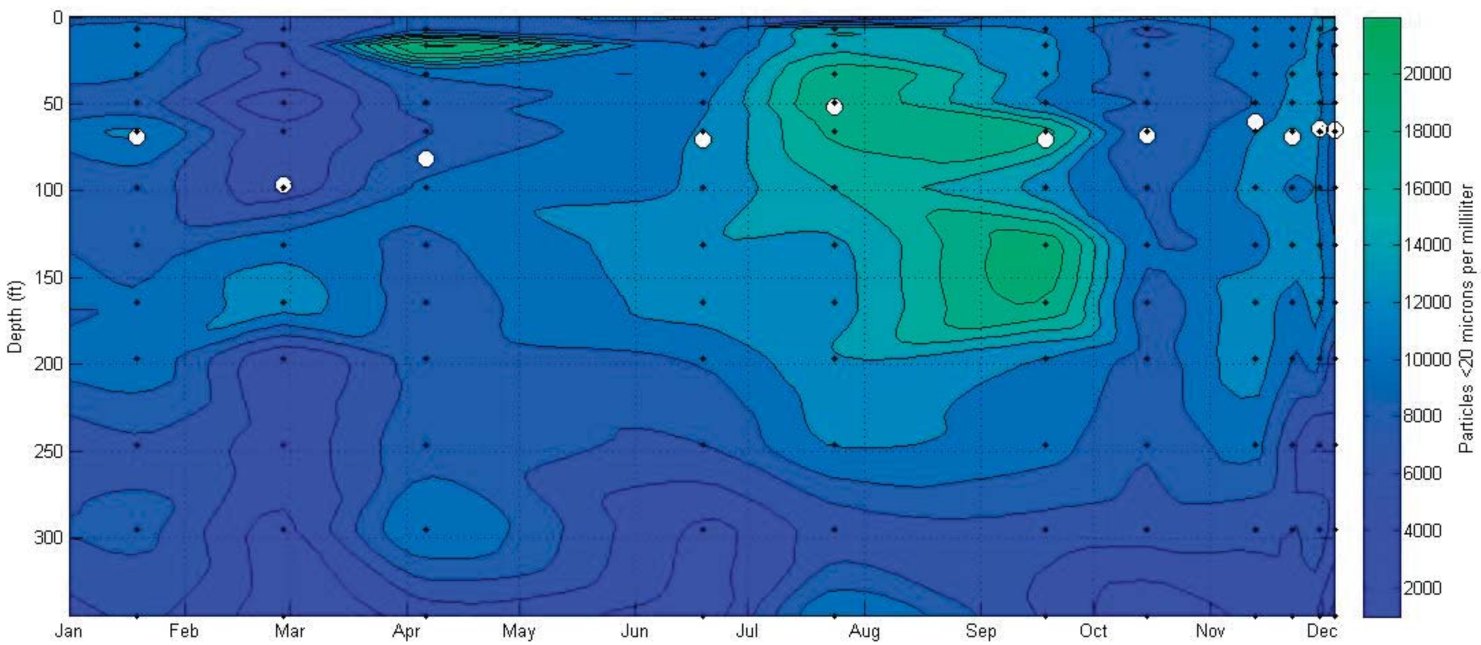
Lake fine particle concentration

In 2009

Fine particle (diameter < 20 microns) concentrations from samples collected at multiple depths in the lake are measured in the laboratory using laser diffraction principles. Here, color contours of particle concentrations at the Index Station (on the west side of the lake) are shown for lake depth and time throughout the year. The black dots indicate the dates and depths at which water samples were taken. The white circles show the corresponding Secchi depths taken on the same dates. Generally the more particles in the water column, the lower the Secchi depth. Of particular note is February 27, when a Secchi depth of 96 feet was recorded, corresponding to the lowest particle concentrations in the upper water column. The high concentration of particles in April is due to the spring snowmelt (see Fig. 8.10).



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Stream fine particle concentration

In 2009

The annual average concentration of fine particles (diameter < 20 microns) in the 10 monitored LTIMP streams is shown in descending order below. The Upper Truckee River, Ward Creek, Trout Creek, Incline Creek and Blackwood Creek have the highest concentrations. The actual load of fine particles delivered by the streams also depends on the flow rate of the stream. It is important to note that fine particle concentration is different than suspended sediment concentration. The latter includes coarse silt and sand, which have little lasting impact on lake clarity, but which can affect stream condition.