LAKE TAHOE WATER QUALITY MANAGEMENT

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Abstract: For years the Lake Tahoe Basin has been one of the most controversial environmental issues in the entire United States. Avid conservationists are insisting that development be stopped and the environment be preserved in somewhat its natural state. Regulatory agencies, including the newly created bi-state Tahoe Regional Planning Agency, permit large corporations to continue development under their sanction at an ever-increasing rate. This report is a detailed review of the water quality aspects of the environmental problem at Lake Tahoe.

DESCRIPTION OF LAKE TAHOE

Lake Tahoe, located in the Sierra Nevada Mountains on the California-Nevada border, is presently one of the clearest and most beautiful lakes in the world. The lake, together with the magnificent snowcapped mountain backdrop, evokes a magical and wonderful appeal which attracts people by the thousands to the area.

Table 1 lists some of the unique physical properties of Lake Tahoe. With a maximum depth of 548 meters, Tahoe ranks number 11 in depth (Hutchinson 1957) when considering all the lakes in the world. Although not a leader in volume, the lake contains sufficient water to cover the area of the States of California and Nevada combined to a depth exceeding eight inches, or sufficient to supply the domestic and industrial freshwater needs of the entire population of the United States for over five years. Tahoe's truly unique feature is its clarity. Of all the major lakes in the world, only Crater Lake in Oregon rivals Tahoe for clarity of water.

Table 1. Physical properties of Lake Tahoe.

Surface Area of Tahoe Watershed	-	500 square miles
Surface Area of Lake Tahoe	-	193 square miles
Length of Lake Tahoe	-	22 miles
Width of Lake Tahoe	-	12 miles
Length of Shoreline	-	71 miles
Maximum Depth of Lake	-	1,645 feet
Average Depth of Lake	-	989 feet
Volume of Water in Lake	-	122 million acre-feet
Clarity of Lake Waters	-	Such that light penetrates to a depth exceeding 400 feet

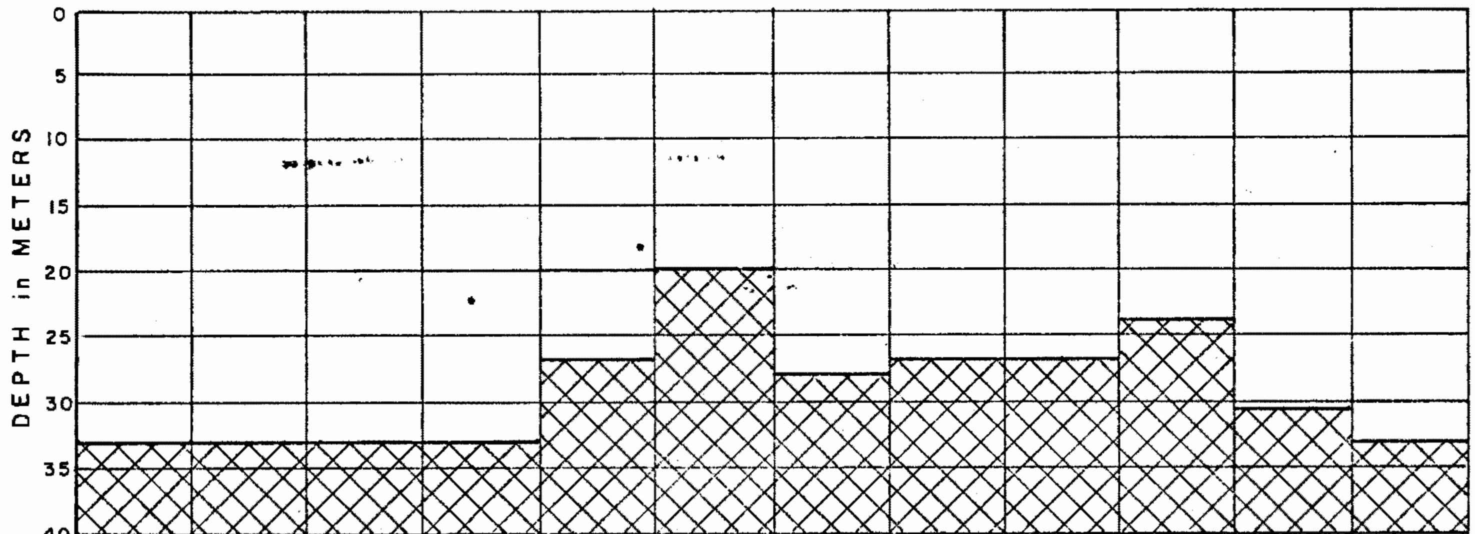
PRESENT WATER QUALITY CONDITION

For the past five years, the States of California and Nevada and the Federal Government have participated in a cooperative study to precisely define the trophic state of Lake Tahoe (California Department of Water Resources 1970). The study is purposely oriented to the deeper offshore waters rather than the shoreline areas where problems are known to exist. The results of the study are summarized herein.

Water Clarity

The truly unique characteristic of Lake Tahoe is its water clarity. Figure I summarizes all historic records of secchi disc transparency (McGauhey et al 1963) and the data collected by the cooperative surveillance program at offshore stations. The data show a

Figure 1. LAKE TAHOE
SECCHI DISC TRANSPARENCY



	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
MEAN	—	33	33	33	27	20	28	27	27	24	31	33
1969			34 37			19 14	25 23	23 29		23 25	25 29	
1968			27				24 27		32 17		33 35	
1967					>30			27				27
1962				33	21 28		30 36		30			35
1960		33										36
1959						27		27	24		32	32
1913							28					
1904						20						
1873									33			

significant reduction in clarity during the early summer months and a second less pronounced reduction in early fall. Sufficient information is not available to conclude that such a clarity cycle does in fact exist; however, the apparent cycle is similar to that which is normally observed in lakes--a primary algal density increase in early summer and a secondary increase in the fall.

There is no indication that the clarity of Lake Tahoe has decreased since first measured in 1873. The minimum secchi disc transparency recorded at an offshore station is 14 meters measured in June of 1969. The maximum transparency of 37 meters was recorded in March of 1969. The greater apparent variation in recent years is likely due to the increased frequency of measurement.

During the past four years measurements of water clarity have also been made using a two-celled submarine hydrophotometer. This instrument measures the intensity of sunlight on a photoelectric cell lowered in the water. When compared to the intensity of sunlight on a cell located at the surface, the percent light transmittance at various depths of water is obtained.

Figure 2 summarizes the hydrophotometer data for the offshore areas of Lake Tahoe collected during 32 observations over the past four years. It is significant to note the percent of sunlight which reaches a depth of 100 meters. On the average, 0.5% of the available surface light reaches 100 meters, the minimum recorded at 100 meters is 0.025%, and the maximum 8%.

Also plotted on Figure 2 for comparison are the average light transmittance values for Folsom Lake, Lake Berryessa, and Lake Almanor. The data on these waters are very limited and should be considered only approximations. It is interesting to compare the depth at which 1% of the surface light remains, which is an indication of the depth below which photosynthesis cannot occur. These depths are approximately 8 meters at Folsom, 12 meters at Berryessa, and 17 meters at Almanor compared to an average of 87 meters at Lake Tahoe. Attempts to define a seasonal cycle of light transmittance for Lake Tahoe have not been successful.

A third measure of the clarity of Lake Tahoe is the recovery of living plants from depths exceeding 120 meters which is proof of light penetration to that depth.

Temperature Characteristics

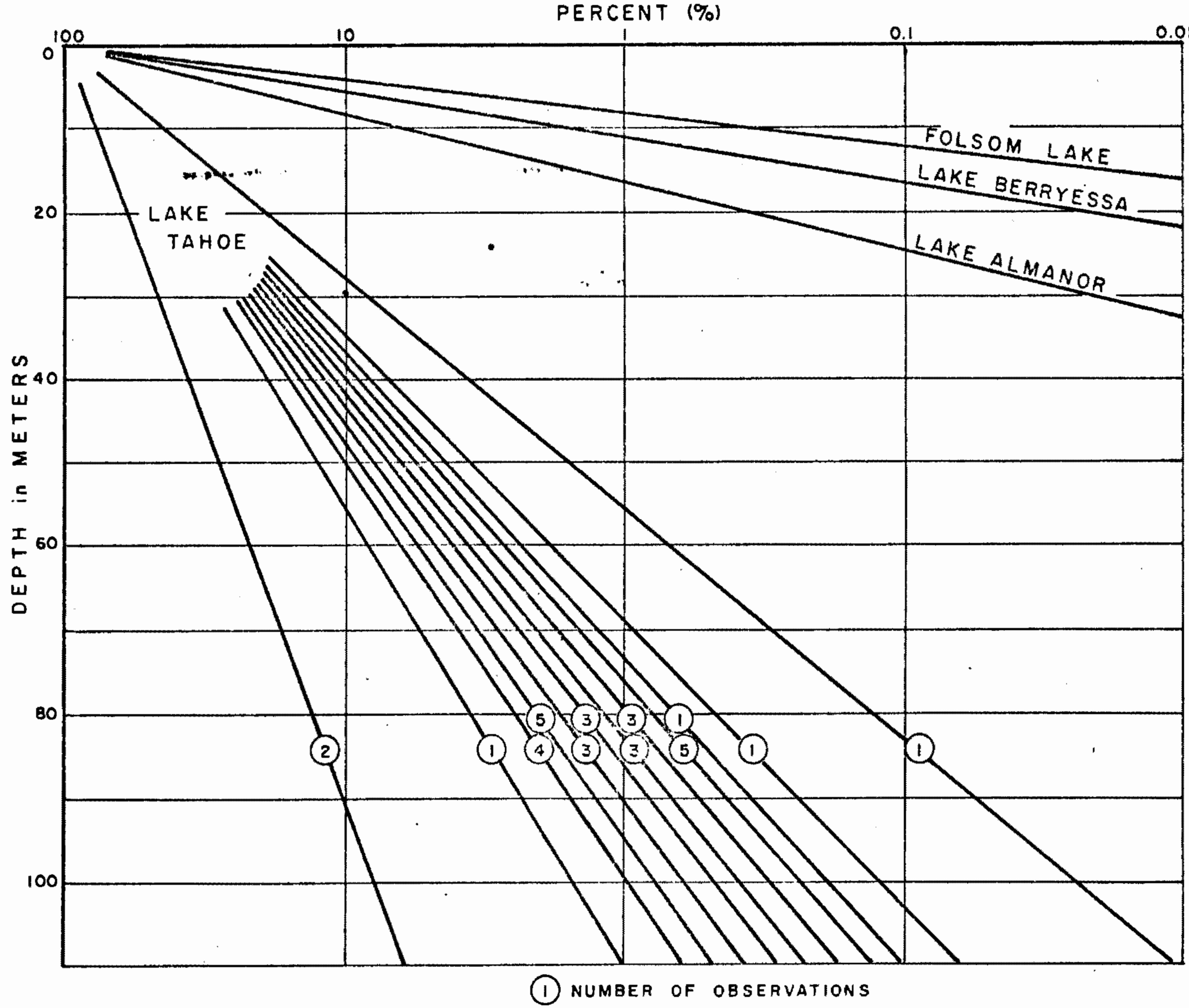
The offshore temperature characteristics of Lake Tahoe are shown on Figure 3. Thermal characteristics correspond to the classic profile with rapid cooling of stratified warm surface water and slow warming of deep waters during the fall approaching a common temperature in the water column by mid-winter. Surface temperatures are lowest in the early spring when they approach 6°C and highest in late summer when the surface temperatures normally reach 21°C. During the summer there is pronounced thermal stratification above 20 meters. Temperatures between 90 and 130 meters usually remain between 4.5 and 5.8°C throughout the year. The temperatures at 130 meters indicate a decrease toward the theoretical maximum density temperature of 4°C at greater depth.

There is no record of the surface of Lake Tahoe freezing. The lake does not stratify significantly in winter to allow sufficient reduction in surface temperature. The nearly homothermous condition which exists throughout the winter provides an ideal opportunity for mixing to considerable depth and results in broad dispersion of materials which enter the lake from surface streams.

Chemical Characteristics

The chemical characteristics of Lake Tahoe are well defined in some respects and poorly defined in others. This is due to the extremely low concentrations of nutrients which test our ability to determine the true values using present-day techniques and to the lack of reliable data to define the annual cycle of the lake.

Figure 2. LAKE TAHOE — LIGHT TRANSMITTANCE



Dissolved Oxygen - The oxygen concentration of Lake Tahoe is consistently within a couple percent of the surface saturation values throughout the water depth. The recovery of fish from depths up to 400 meters (P. Baker, personal communication) supports the fact that oxygen depletion does not occur in the deep waters.

Nutrient Concentrations - The concentrations of nitrogen and phosphorus in Lake Tahoe are very low. Data collected during 12 cruises over the past four years are presented in Table 2. The data show that nearly all of the nitrogen is in the organic form supporting the theory that the lake is nitrogen sensitive. Nitrogen concentrations in the shoreline areas are consistently higher than those found in offshore waters.

Table 2. Lake Tahoe - Nutrient Concentrations. (micrograms per liter)

	NO_3-N	NO_2-N	Org. N	NH_3-N	Total N	PO_4-P
OFFSHORE*						
Minimum	1.4	0.02	30	3.0	34.4	2.0
Median	2.4	0.2	92	6.0	100.6	3.0
Maximum	8.6	1.0	185	20.6	215.2	4.2
SHORELINE**						
Minimum	2.8	0.02	32.4	3.0	38.2	3.0
Median	2.8	0.6	134.0	14.8	152.2	3.0
Maximum	5.0	1.4	316.0	21.8	344.2	5.0

* Samples taken 1 meter below lake surface at a station located in the south center portion of the lake in an area exceeding 300 meters in depth.

** Samples taken at 1 meter below lake surface in the northwest portion of the lake near Tahoe City in an area of approximately 3 meters of depth. Of the 6 shoreline stations, this station consistently shows higher nutrient concentrations than the others.

Bacteriological Parameters

Coliform Organisms - Over the past three years routine analyses have been conducted for coliform organisms. In 1961 a detailed study was made by the California State Health Department (California Department of Public Health 1961). These studies show that the offshore waters are virtually free of coliform organisms. Rarely do offshore samples show concentrations exceeding drinking water standards. Coliform organisms are found at the heavily used beach areas at Lake Tahoe. Concentrations are normally quite low and can be related to the intensity of body contact use in the area.

Biological Parameters

Phytoplankton - Phytoplankton data collected at the five shoreline stations located in areas of the lake varying from 3 to 10 meters in depth and specifically chosen to reflect the result of man's activities in the watershed are summarized in Table 3. The results are a summary of 30 samples taken over the past three years. Total phytoplankton concentrations in Lake Tahoe are very low and did not exceed 300 cells per milliliter in any case. Diatoms constitute more than half of the total population. The concentrations and distribution of algae are typical of an oligotrophic lake.

Figure 3.

LAKE TAHOE
TEMPERATURE PROFILE

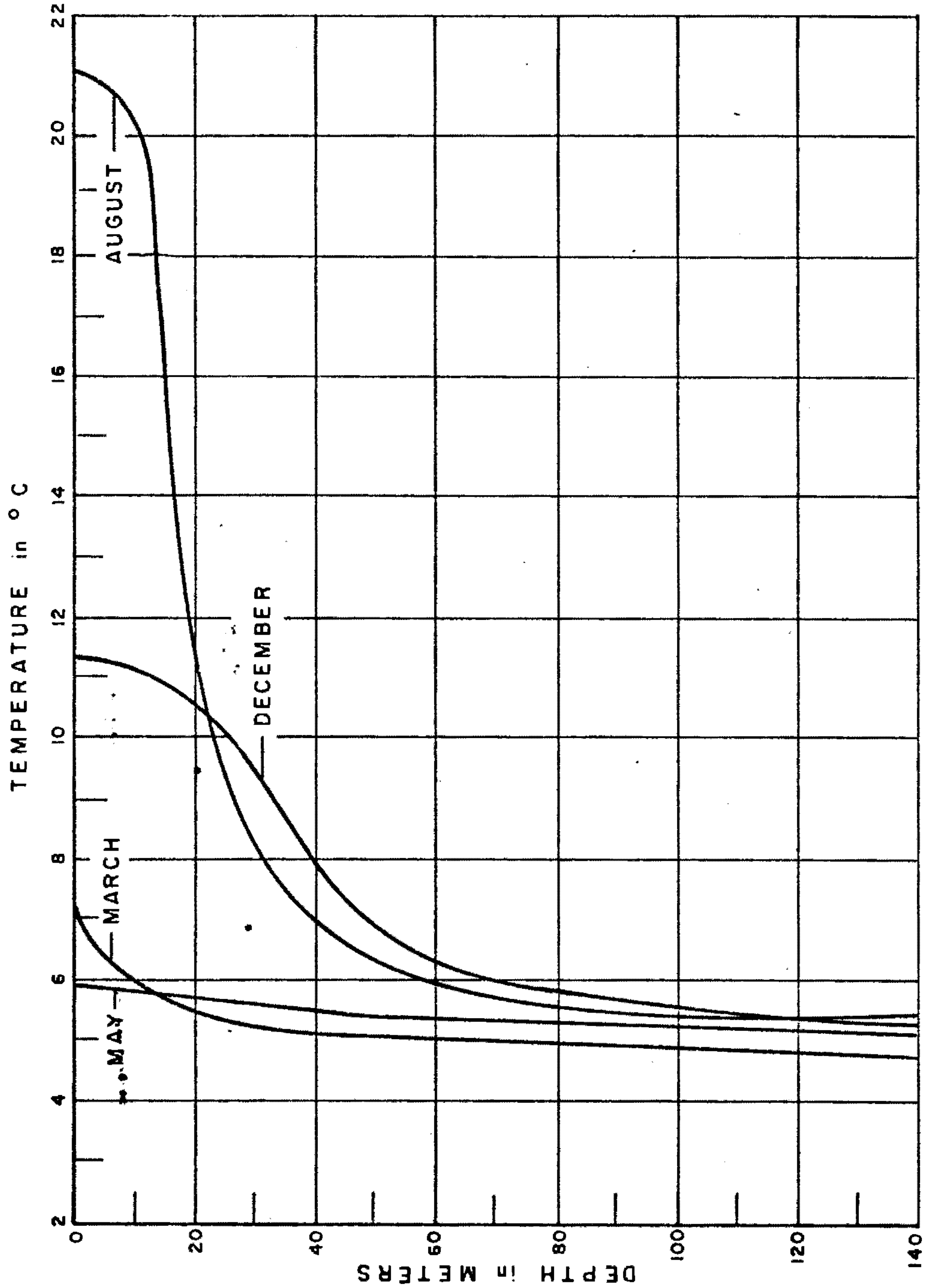


Table 3. Total live algae in Lake Tahoe.
(cells per milliliter)

	Minimum	Median	Maximum
Coccoid Blue-Greens	0	0	0
Filamentous Blue-Greens	0	0	0
Coccoid Greens	0	0	32
Filamentous Greens	0	0	0
Green Flagellates	0	0	15
Other Falgellates	0	0	48
Diatoms	0	22	224
Total Live Algae	0	30	272

The Water Quality Problem

To clearly understand the water quality problem at Lake Tahoe, it is necessary to understand that Tahoe, as all lakes, must go through a life cycle. Tahoe is presently an oligotrophic lake; that is, low in nutrient material with very slight concentrations of algae and other aquatic plants and animals. It is a young, unproductive lake.

Lake Tahoe is crystal clear due to the extreme low density of algae cells and other suspended materials in the water. Tahoe appears blue in color because of an insufficient density of algae cells to reflect the green light of algae cells which is common to most waters. Eutrophication, a natural phenomenon, is defined as the maturing process or aging of a lake. Eutrophication is accompanied by increasing algae densities, loss of clarity, and change in lake color from blue to green. It can be proved that Tahoe, if not the clearest, is presently one of the two clearest major lakes in the world; but it must be understood that with time, possibly in 100 years but maybe not for 100,000 years or more, Lake Tahoe will lose its clarity.

Nitrogen and phosphorus are said by many to be the most important elements or normally the limiting factors of eutrophication. The experts generally agree that at phosphate concentrations of 10 ugP/l (micrograms phosphorus per liter) or less, no blooms of algae will occur with combined soluble nitrogen concentrations below about 50 ugN/l (micrograms nitrogen per liter). Heavy algae growth is likely, however, should the combined soluble nitrogen concentration exceed 100 ugN/l for the same phosphate level (McGauhey et al 1963). The existing phosphate concentration of Lake Tahoe water is approximately 3 ugP/l as previously shown on Table 2.

The concentration of soluble nitrogen in Lake Tahoe averages approximately 10 ugN/l. Many experts have said that because the concentration of phosphorus is already relatively high in Lake Tahoe, any significant increase in nitrogen might start an intensive algae development (McGauhey, Pearson, and Rohlich 1968).

It is fairly well agreed that Tahoe is nitrogen sensitive, but the amount of nitrogen it would take to upset existing conditions is at best only an estimate. There are many Alpine lakes with relatively dense algae populations and with phosphorus concentrations similar to Tahoe's; however, their nitrogen concentrations are generally about 10 times higher than Tahoe's (McGauhey, Pearson, and Rohlich 1968).

Table 4 summarizes the past, present, and estimated future potential sources of nitrogen to Lake Tahoe. The table shows that for the many years prior to man's intrusion into the basin, an estimated 420,000 pounds of nitrogen per year entered the lake. (For discussion purposes, 332,000 pounds of a substance perfectly mixed with Tahoe's water would provide 1 ug/l (1 microgram per liter). The pre-man supply of 420,000 pounds nitrogen is only slightly more than a 1 ugN/liter supply to the lake. It is obvious from the water's present high quality condition that the lake has assimilated this addition with no detrimental effect for thousands of years.

Table 4. Lake Tahoe potential nitrogen sources.
(pounds nitrogen per year)

	Pre-Man (Pre-1844)	Present (Avg. Pop. 40,000)	Ultimate (2010) (Avg. Pop. 250,000)
Rain	220,000	220,000 220,000	220,000
Streams	200,000	200,000	200,000
Urban Runoff	None	54,000	110,000
Fertilizer	None	55,000	110,000
Refuse	None	60,000	380,000
Sewage	None	360,000	2,700,000
Total	420,000	949,000	3,720,000
Total with Export of Sewage & Refuse	420,000	529,000	640,000

Prior to export of sewage there were nearly 950,000 pounds of nitrogen available annually to the lake waters. This is more than twice that under natural conditions and approaching a 3 ugN/l supply to the lake. Data indicate that the nitrogen concentration did not increase under that condition, and it appeared that the lake could assimilate that addition with no noticeable change in quality. This does not imply that the lake could assimilate indefinitely this quantity or any quantity of nitrogen above background levels. Even the uncontrollable or natural sources of nitrogen and other nutrient materials may, with time, decrease the clarity of Tahoe.

Under ultimate development, an estimated average population of approximately 250,000, the total available nitrogen soars to 3.72 million pounds per year--a supply exceeding 10 ugN/l. The experts feel that the lake cannot assimilate that much nitrogen without some detrimental effect (McGauhey, Pearson, and Rohlich 1968).

Figure 4 quickly shows why the decision was made to eliminate sewage as a source of nitrogen to the lake. It also shows that the largest potential sources of nitrogen are controllable and that with the export of dewage and refuse, the ultimate nitrogen input to Lake Tahoe will be approximately 640,000 pounds per year which is 52% greater than that under the conditions which existed before man inhabited the Tahoe Basin. Without export of sewage and refuse the ultimate supply of 3.72 million pounds per year is nearly an 800% increase in available nitrogen.

With sewage exported, refuse exported, and reasonable erosion and fertilization controls imposed, the nutrient input to Tahoe will be held near that level which exists naturally, and most important, near that level at which Tahoe has retained its outstanding qualities.

Sewage Export Projects

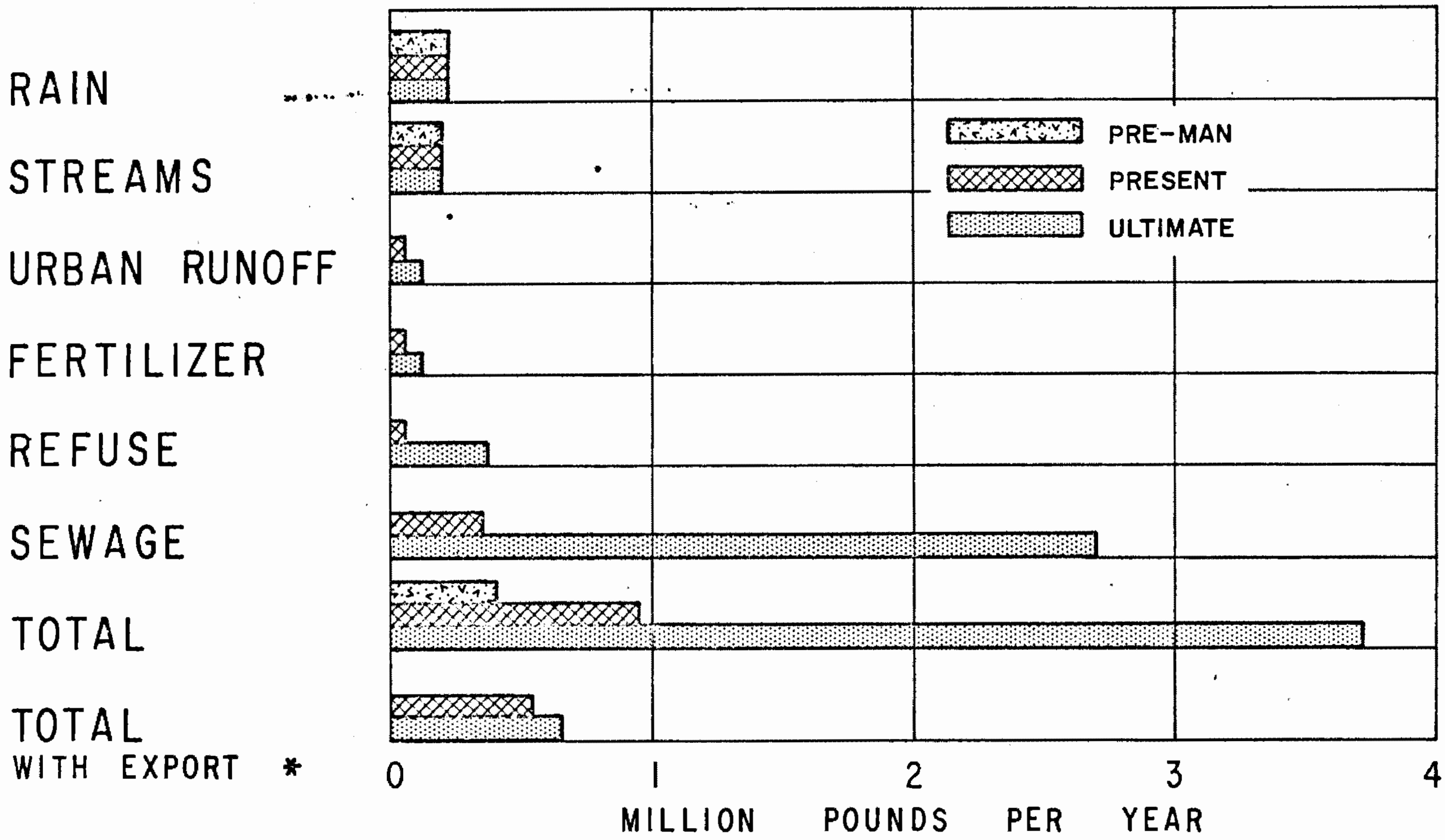
Shortly before 1950 the regulatory agencies of Nevada and California responsible for protecting the water quality of Lake Tahoe reached a firm agreement that under no circumstances would any sewage be allowed to enter surface waters of the Tahoe Basin. This policy is still in effect in both States and has now been expanded to a policy prohibiting land disposal of sewage within the watershed, thus requiring dewage export.

Prior to 1950, the sewage disposal problems at Lake Tahoe were not critical. Minor difficulties arose in isolated areas during the summer months when heavier population loads were experienced. The winter population was almost negligible, and no one suspected the area to soon support a year-round economy.

Figure 5 shows the sewage systems which are planned or have been completed to export wastewaters from the Basin. Following is a status report on each system.

Figure 4.

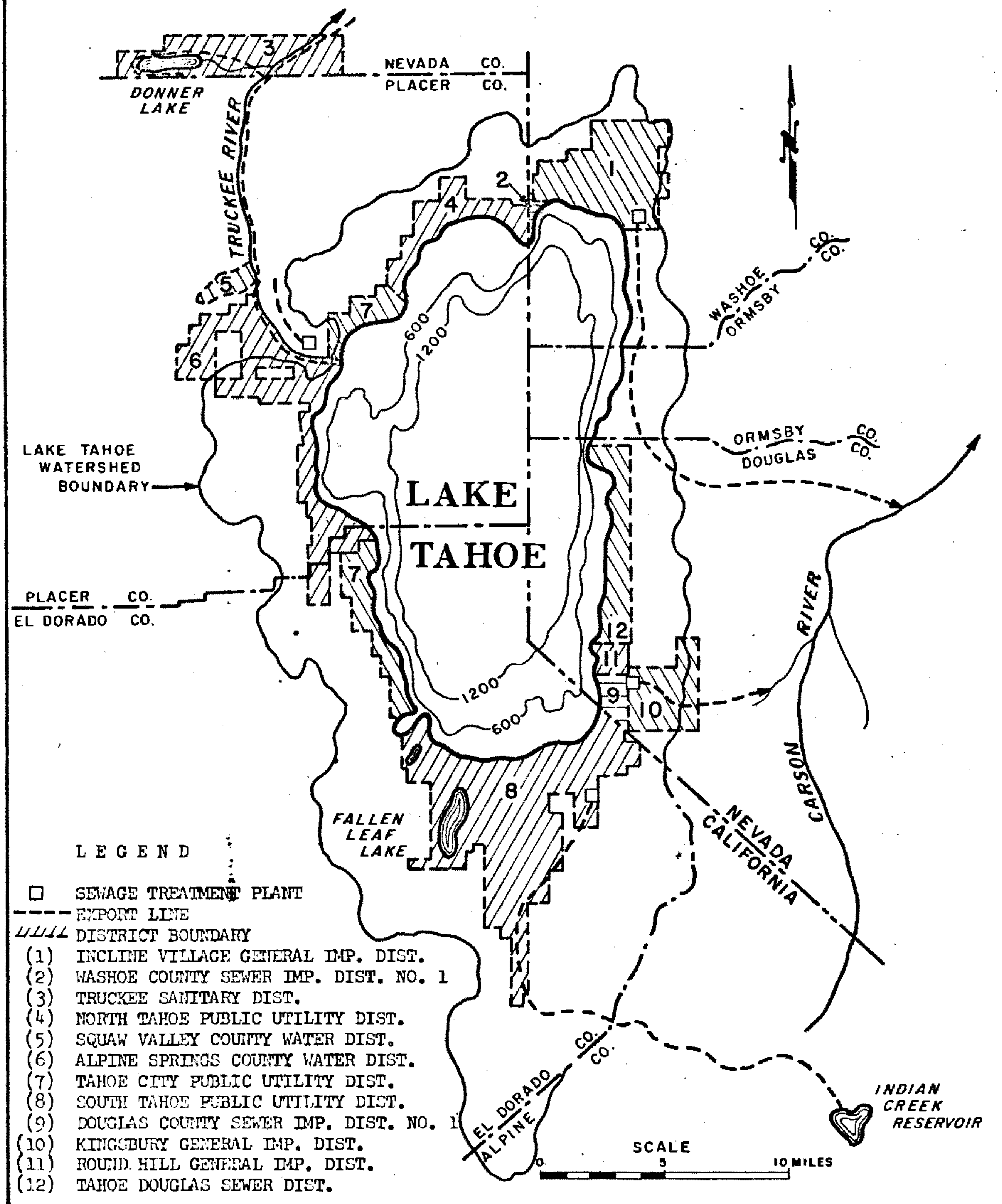
POTENTIAL NITROGEN SOURCES TO LAKE TAHOE



* WITH EXPORT OF REFUSE AND SEWAGE

Figure 5.

LAKE TAHOE WATER QUALITY CONTROL SYSTEMS



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South Tahoe Public Utility District

It is well known that the South Tahoe Public Utility District has been successfully operating their water reclamation plant and export facility since April 1968. Indian Creek Reservoir, the 3,200 acre-feet reservoir in Alpine County which is filled exclusively with the reclaimed wastewater is now stocked with 38,000 hybrid rainbow-cutthroat trout.

The lake was opened for fishing on May 2, 1970. During the first two days of the trout season, approximately 920 anglers caught a total of 1,250 fish exceeding an average weight of one pound. The largest fish caught was 14.5 inches in length and weighed 27 ounces. The fish were planted in August 1969 as catchables and fry and have exhibited a phenomenal growth rate.

The California Regional Water Quality Control Board, Lahontan Region, recently approved use of the reservoir for body contact sports including swimming. The clarity of the waters varied significantly during the initial years of operation of the reservoir. A secchi disc transparency of 6 meters was measured in the fall of 1969.

Water withdrawn from the reservoir is being used for irrigation of approximately 2,000 acres of pasture lands and livestock forage crops in California and Nevada.

North Tahoe and Tahoe City Public Utility District

The North Tahoe and Tahoe City Districts began exporting in April 1970. The major trunk line in the north shore area from Stateline, including the casinos, west to Tahoe City is completed and operating. The trunk line down the west shore from Tahoe City has been completed to Sugar Pine Point State Park just south of the Placer-El Dorado County line. On November 19, 1970, the Districts called for bids on the last segment of the collection line which will extend south to the Emerald Bay area.

All sewage is now being transported to a primary sewage treatment plant located near Tahoe City. After treatment the effluent is pumped 1,200 feet in elevation to a volcanic cinder cone where it is disposed of through trenches.

It is recognized that this solution is temporary because of the limited disposal capacity of the cinder cone which has been calculated at approximately 2.8 million gallons per day (McLaren, Dubois, and Albert 1970). The two utility districts at North Tahoe are presently working with the Alpine Springs County Water District, the Squaw Valley County Water District, and the Truckee Sanitary District on a master plan to serve the entire North Tahoe-Truckee River area. No acceptable program for disposal or reuse has been developed to date.

Incline Village

An export system was recently completed to serve the Incline Village area of Nevada. The system consists of a secondary treatment plant located at Incline Village followed by an export line down the east shore over Spooner Summit, and down into the Carson River.

Douglas County Sewer Improvement District - Round Hill General Improvement District

These two districts began exporting in March 1969. Sewage is collected from the south shore Stateline casinos and from other densely populated areas in Douglas County. An activated sludge system provides secondary treatment, and the effluent is pumped over Daggatt Pass into the irrigation system of Carson Valley and eventually enters the Carson River.

Summary

Progress is going well in all sewage export projects. The January 1, 1972 deadline will be met in both California and Nevada with the exception of providing collection service to a few remote, sparsely populated areas.

The ultimate cost of local and regional collection, treatment, export, and disposal facilities is presently estimated at over $200 million.

Solid Waste Export

At present, solid wastes are disposed of within the watershed with the exception of those generated in the Incline Village area which are exported to a sanitary landfill in the Carson Valley. Existing disposal sites are located in the south shore area, Meeks Bay, Tahoe City, and Kingsbury. Work is proceeding rapidly toward the abandonment of these sites.

North shore solid wastes will be disposed of in a new sanitary landfill just recently approved by the U. S. Forest Service located approximately ten miles from Tahoe City toward Truckee. Refuse from the entire south shore area in both California and Nevada will be hauled into the Carson Valley to a site recently acquired. A transfer station is under construction for this system. It appears that total solid waste export will be accomplished prior to 1972.

Unresolved Water Quality Problems

In addition to potential nutrient loadings on Lake Tahoe from sewage and solid waste disposal, water quality is also influenced by fertilizer use and by siltation caused by erosion in the watershed. Both problems are very significant and little is being done to solve them. It is hoped that the newly formulated bi-state agency will soon become involved and play an active role in these areas.

Fertilizers

At present, there is approximately 55,000 pounds of nitrogen per year contained in the fertilizers used within the Lake Tahoe Basin (Leggett and McLaren 1969). Fertilizers contribute approximately 10% of the total nitrogen available to Lake Tahoe. Under ultimate development this figure will likely double or become even more significant unless steps are taken to control fertilizer use.

As you know, fertilizers are specifically designed to promote plant growth. Aquatic plants, including suspended algal cells and the attached easily visible plants, are supported by the same nutrients present in fertilizers. The export of sewage and refuse is proceeding at a tremendous cost to the citizens of the Tahoe Basin because it is not acceptable to allow nutrient material to enter the lake from these sources. At the same time, fertilizers are being imported to the Tahoe Basin in large quantities.

There has been much discussion of the use of slow yield chemical and organic fertilizers with the idea that these will not contribute significantly to the water quality problem of the lake. This is not true. We cannot rationally consider water quality control on a short term basis. It is proper to assume that slow yield fertilizers will allow a larger percentage uptake of nitrogen and other nutrients by the plant and less immediate loss in the original application. The end result, however, is identical, that being that all the nutrient material will eventually enter the lake.

The effect of fertilizers on the lake is not dependent upon the initial loading from the nutrients which pass quickly through the root zone and into the ground water and the lake, but rather on the ultimate quantity of nutrients which enter the lake regardless of whether those nutrients are tied up in plant tissue or soil for a period of time.

The one sure method of eliminating this source of nutrients is through a total prohibition on the use of all fertilizers in the Basin. The main problem arises at golf courses constructed on highly permeable soils which require heavy fertilization and irrigation as is the case with most of the golf courses in the watershed.

It is possible to construct a golf course which would not contribute nutrients to Lake Tahoe, yet allow fertilizer use. Such a course would have an underdrain system to collect irrigation waters for return to the surface after passage through the soil. A second alternative is to construct golf courses only in natural meadows which need no fertilization if the course is properly designed using native landscaping and vegetation.

Urban Runoff

There are several independent but related problems with respect to nutrient materials and other pollutants being carried into Lake Tahoe from this source. First, there is now an estimated 54,000 pounds per year of nitrogen entering the lake from developed areas. This figure does not reflect the nutrient or other pollutant contribution from erosion in the watershed but simply the runoff from streets, roofs, parking lots, lawns, and other areas common to an established community.

The magnitude of the contribution from this source will be dependent almost totally upon the area of the Basin permitted to be developed and the number of people, vehicles, animals, etc., which are permitted in these areas. Density control appears to be the only possible approach to the problem at this time. The interim plan recently adopted by the bi-state Tahoe Regional Planning Agency will permit a population in the Basin exceeding 250,000 persons. This five-fold increase over the present population will greatly increase the nutrient contribution.

Siltation

Data are not presently available on the nutrient contribution from land erosion problems. It has been proven that those streams which drain developing and developed areas in the Tahoe Basin contain significantly higher concentrations of nutrients and will produce much denser algae populations than natural Lake Tahoe water. It is most interesting to note that streams which drain undisturbed watersheds, in general, contain lower nutrient concentrations and algal growth potentials than Lake Tahoe itself. (McGauhey et al 1968; McLaren, et al 1970; Leggett and McLaren 1969; and McGauhey et al 1969). At present, we do not have sufficient information to specify just what watershed uses contribute what percentage of the total nutrient loading.

Water quality degradation caused by erosion in the Tahoe Basin is much broader than the nutrient contribution alone. Unnatural turbid or muddy waters now enter the lake through every stream where development is proceeding in the watershed. This turbid water resulted in a large mat of algae floating to the shore at Kings Beach during the summer of 1967. The algae mat was not supported by a controllable nutrient inflow but rather was killed by a turbid water inflow from a stream which reduced the clarity of the water and thereby did not permit the penetration of light necessary for plant life.

The first recorded algae bloom in Lake Tahoe occurred during the summer of 1969 along the south shore. It is the opinion of the author that such blooms will occur annually and will become more extensive in area and in algae density unless erosion in the Trout Creek-Upper Truckee River Watershed is significantly reduced. Constant turbid water inflows from the Upper Truckee River throughout the spring and summer of 1969 supplied the necessary base for the dense algae bloom.

Destruction of the marsh at the mouth of the Upper Truckee River has resulted in loss of the natural water treatment facility which previously removed clay, sand, silt, nutrients, and organic materials. Turbid waters warm more quickly than clear waters thus increasing the rate of algae production. Once algae blooms occur, they help support themselves by creating a system which can gather the necessary nutrient materials from the air, water, and bottom sediments.

The State Water Resources Control Board and the Lahontan Regional Board recently embarked on a program to control siltation from the major sources. A water quality control policy has been adopted prohibiting all man-caused discharges of silt. Waste discharge requirements have been adopted on 30 major subdivisions and on the El Dorado County Airport District, California Division of Highways, California Department of Parks and Recreation, Placer County, El Dorado County, and the City of South Lake Tahoe. Nearly all of these requirements were necessary because of erosion problems resulting from roadway construction.

The restrictions imposed by the State and Regional Board are resulting in major improvements in many of the seriously eroding areas, however, it is well recognized that this is at best only a holding tactic that will correct the extreme problems. With the continual approval of land developments by the Tahoe Regional Planning Agency, we are assured that erosion problems will increase at a rate far exceeding our ability to control them.

The Outlook for Lake Tahoe

The future of Lake Tahoe and the Tahoe Basin as a desirable place to live and vacation is dependent upon the willingness and desires of the members of the Tahoe Regional Planning Agency (the bi-state agency legally formulated by Congress) to use their authorities. There is no question of the legal ability of the agency to adopt and enforce all necessary controls to assure protection of the environment. There is serious question of the willingness and desire of the agency members to act effectively.

From strictly a water quality viewpoint, we can look forward to more serious problems in the highly developed shoreline areas of the South Shore, Incline Village, and Tahoe City. The Problem is not waste disposal but rather siltation caused by poor land use practices. Of the five Counties and the City which are involved in the Tahoe Basin, only Placer County is actively attempting to solve the problems and that County is hampered by a lack of funds and personnel.

If Tahoe is to retain the characteristics which have made it a desirable place to vacation, development must stop until we learn how to provide the facilities which people demand without totally destroying the natural environment. The ultimate holding capacity of the Tahoe Basin may be 250,000, as proposed by the Tahoe Regional Planning Agency, or even greater. That judgment cannot be made at this time. With present-day methods of land development, transportation, and providing public services and facilities the holding capacity of the Basin is less than the existing population. This fact is obvious to anyone who has recently visited Tahoe. The actions of the Tahoe Regional Planning Agency which endorse continual inadequately controlled growth will assure the total destruction of Lake Tahoe within our generation (Leggett and McLaren 1971).

LITERATURE CITED

California Department of Public Health. 1961. Lake Tahoe Basin water quality survey. California Regional Water Quality Control Board, Sacramento, Calif. 207 p.

California Department of Water Resources. 1970. California-Nevada-Federal joint water quality investigation of Lake Tahoe. Fourth Annual Summary, July '68 - June '69. Calif. Dept. Water Resources, Sacramento, Calif. 186 p.

Hutchinson, G. Evelyn. 1957. A treatise on limnology. Volume 1. John Wiley, Inc. N.Y. 1015 p.

Leggett, J. T. and F. R. McLaren. 1969. The Lake Tahoe water quality problem-history and prospectus. California Water Pollution Control Assoc., Sacramento, Calif. p. 6-11.

________________. 1971. Lake Tahoe revisited. California Water Pollution Control Assoc., Sacramento, Calif. p. 6-11.

McGauhey, P. H., R. Eliassen, G. Rohlich, H. F. Ludwig, and E. A. Pearson. 1963. Comprehensive study on protection of water resources of Lake Tahoe Basin through controlled waste disposal. Lake Tahoe Area Council, Tahoe, Calif. 162 p.

McGauhey, P. H., E. A. Pearson, and G. A. Rohlich. 1968. Eutrophication of surface waters--Lake Tahoe. Lake Tahoe Area Council, Tahoe, Calif. 109 p.

________________. 1969. Eutrophication of surface waters--Lake Tahoe. Lake Tahoe Area Council, Lake Tahoe, Calif. 180 p.

McLaren, F. C., D. Dubois, and M. Albert. 1970. A comprehensive report on the disposal of sewage from the North Tahoe Public Utility District and the Tahoe City Public Utility District. Regional Water Quality Board, Sacramento, Calif. 23 p.