FIELD TRIP STOP 7

TAHOE-TRUCKEE WATER RECLAMATION PLANT

TRUCKEE, CALIFORNIA

F. A. MUMPTON

Department of the Earth Sciences
State University College
Brockport, New York 14420

INTRODUCTION

Based on the pioneering work in the early 1960s of L. L.Ames, Jr. and B. W. Mercer at the Northwest Laboratories of Battelle Memorial Institute in Richland, Washington (see Ames, 1960; Mercer et al., 1970), the use of natural zeolites for ammonia removal has developed into a viable alternative to breakpoint chlorination and other forms of nitrogen removal from municipal, industrial, and agricultural waste waters. At the present time, the cation-exchange selectivity of clinoptilolite for $NH4^{+}$ has been harnessed to remove ammoniacal nitrogen from the tertiary effluent of several wastewater treatment facilities in the United States, including the Upper Occoquan installation near Washington, D.C., and similar plants in Japan and other countries. An adaptation of these systems is also employed in at least seven fish hatcheries in the Pacific Northwest to reduce the ammonia content of recirculating waters to tolerable levels. A clinoptilolite-exchange system for nitrogen removal is also being developed for the Denver, Colorado, water-reuse project.

Field trip Stop 7 is the Water Reclamation Plant of the Tahoe—Truckee Sanitation Agency, about three miles east of Truckee, Nevada County, California (see Figure 36). Here, 4.8 million gallons of sewage per day (18,300 m^3 /day or 212 liter/sec) from communities on the north and west shores of

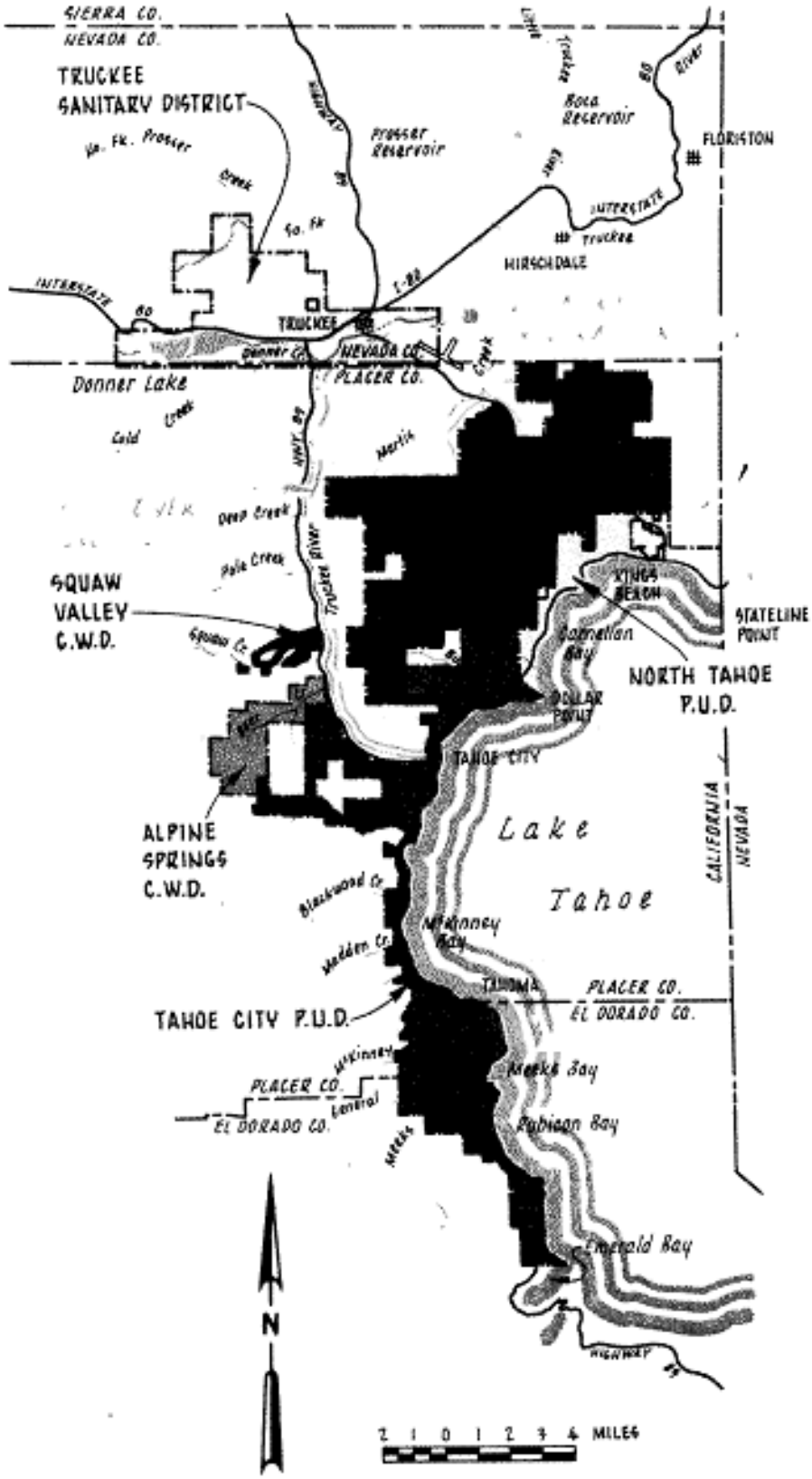

Figure 36. Lake Tahoe—Truckee River drainage area served by the Tahoe—Truckee Water Reclamation Plant, Truckee, California, at field trip Stop 7.

Lake Tahoe and along the Truckee River corridor from Lake Tahoe to Truckee, California, is treated by clinoptilolite ion exchange to reduce effluent nitrogen levels to less than 2 ppm. In another part of the facility, oxygen is generated for use in the activated sludge process by means of a pressure-swing adsorption system that employs synthetic CaA zeolite. Thus, in a single sewage treatment plant, zeolite materials are used for two separate purposes: nitrogen removal from tertiary effluent by cation-exchange; and oxygen generation by pressure-swing adsorption for sludge oxygenation, strong testimony to the versatility of these materials in wastewater management.

PLANT OPERATION

The Water Reclamation Plant of the Tahoe-Truckee Sanitation Agency (TTSA) was designed by CH2M-Hill and constructed at a total cost of $32,000,000. The first sewage was treated on February 1, 1978. The following descriptions are excerpted from publications of TTSA and from Smith et al. (1979), as well as from information generously provided by TTSA chief engineer, 0. R. Butterfield, and TTSA operations supervisor, C. F. Woods, Truckee, California.

An artist’s conception of the TTSA facility is shown in Figure 37. Raw sewage from various parts of the Lake Tahoe Basin is carried to the plant in the Martis Valley by means of interceptor line from Tahoe City. The sewage flows to a headworks complex (1) where solids are shredded and grit is removed. Settleable solids are removed in dome-covered primary clarifiers (2), and the clarifier effluent flows to oxygenation basins (3). Oxygen produced in the oxygen-generation room (14) by a pressure-swing adsorption process using synthetic zeolite CaA is pumped into the clarified sewage. Soluble and suspended pollutants are consumed by micro-organisms which are allowed to settle out in secondary clarifiers (4) and recycled back to the oxygenation basins.

Lime and polymer are added to the secondary clarifier effluent in the flocculation basins (5), raising the pH above 11. Phosphorus is precipitated here, and the remaining suspended solids are coagulated. The lime sludge is removed in chemical clarifiers (6). The pH of the chemical clari-

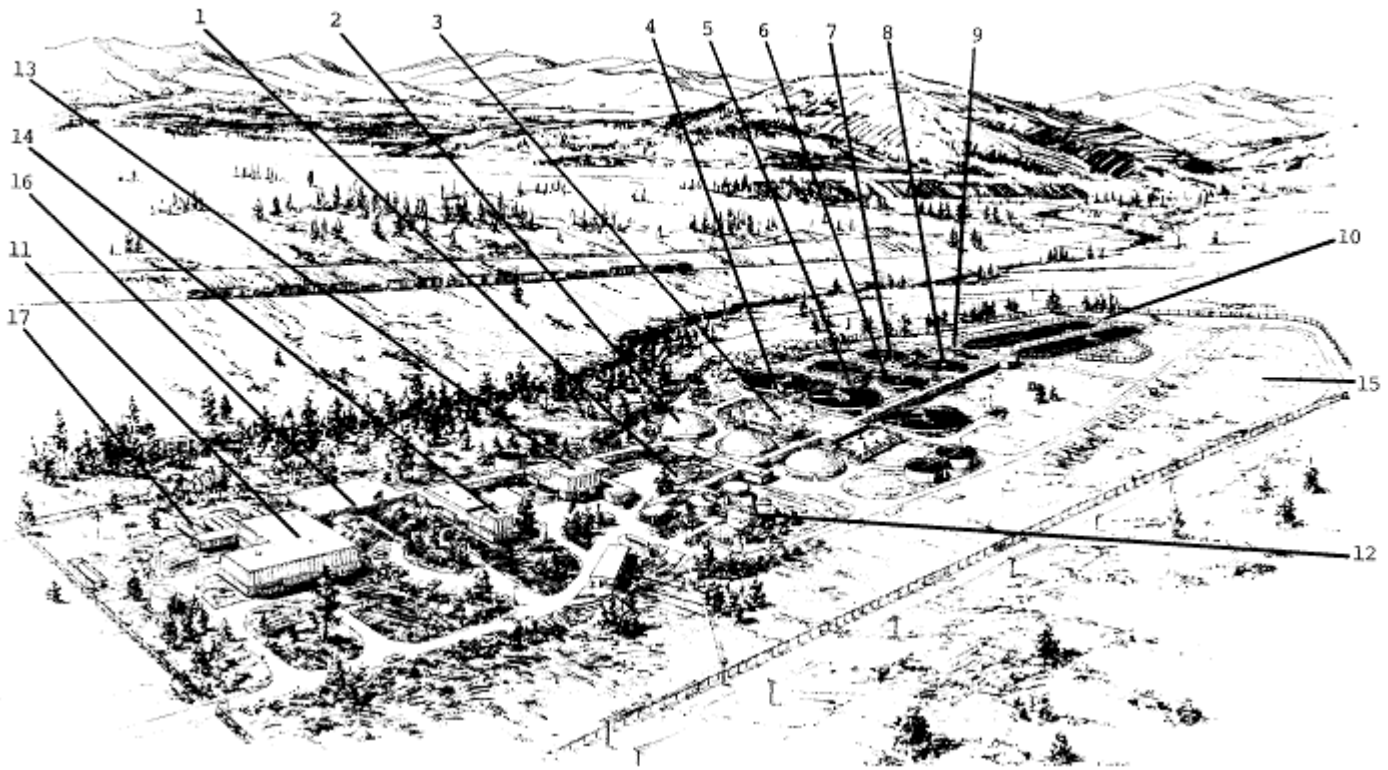

Figure 37. Artist’s conception of the Tahoe—Truckee Water Reclamation Plant, Truckee, California. Numerals refer to sites and operations described in the text.

fier effluent is lowerd to 7.5 by the injection of CO_2 in recarbonation processes (7), (8), (9). The chemically treated effluent is pumped from the ballast ponds (10) to the main treatment building (11) where it is filtered and allowed to pass through a carbon adsorption process and an ammonia removal process (17), the latter employing beds of natural clinoptilolite. These three processes significantly reduce the concentrations of suspended solids, dissolved organic compounds, and nitrogen in the wastewater. Chlorine is then injected for disinfection purposes. The treated effluent is discharged into a leach field where it percolates into the permeable glacial soil and moves underground to the Truckee River after a period of 3-6 months.

Organic sludges are stabilized in anaerobic digesters (12) and dewatered in a filter press (13). An emergency retention basin (15) with about 5 days' storage capacity is provided in the event of a major equipment or process failure. Offices and laboratories are located in the main Operations Building (16).

The TTSA plant is capable of handling 4.83 mgd of raw sewage which contains an average of 175-250 mg/liter BOD, 175-225 mg/liter total suspended solids, 10 mg/liter phosphorus, and 40mg/liter nitrogen. Methane gas produced in the anaerobic digesters is burned in the plant's boilers to produce heat to maintain the temperature of the digesters and to heat the buildings. CO2, a byproduct of the combustion, is used in the recarbonation process.

AMMONIA REMOVAL BY CLINOPTILOLITE

The treated effluent is passed through four horizontal columns of clinoptilolite, shown at (17) in Figure 37 behind the main treatment building (11). The ion-exchange vessels are about 30 ft long and 10 ft in diameter and contain 4-ft deep beds of 20 x 50 mesh zeolite. The clinoptilolite ion-exchange treatment removes 95% of the nitrogen present during a 36-hr cycle to a concentration of less than 2 ppm. The zeolite is regenerated by backwashing with a 3% NaCl solution. Ammonia is stripped from the wash solution containing about 30 mg/liter NH_3 and precipitated as ammonium sulfate (about 2 tons daily) for fertilizer use in the

Central Valley of California. Approximately 10-20% of the clinoptilolite is lost during a year's time by attritioning and must be replaced. Currently, clinoptilolite from the Death Valley Junction, California, deposit is used.

OXYGEN GENERATION BY ZEOLITE ADSORPTION

The TTSA facility employs Union Carbide's UNOX Wastewater Treatment System in its pure-oxygen activated sludge process (3). A pressure-swing adsorption unit is housed in the oxygen generation building (14) and is capable of producing 4 tons of high-purity oxygen per day. The three-bed system yields a water- and $C0_2$- free product containing 90% 02, 6% N_2, and 4% Ar. Each vessel is 8 ft high, 5 ft in diameter, and holds about 3 tons of CaA zeolite. The oxygen product represents only about 8% of the air fed to the system; the remainder is vented to the atmosphere during the regeneration of the zeolite bed. A backup supply of liquid oxygen is available in case of equipment failure.

REFERENCES

Ames, L. L., Jr. (1960) Zeolitic removal of ammonium ions from agricultural wastewaters: Proc. 13th Pacific Northwest Indust. Waste Conf., Washington State Univ., Pullman, Washington, 135—152.

Mercer, B. W., Ames, L. L., Jr., Touhill, C. J., Van Slyke, W. J., and Dean, R. B. (1970) Ammonia removal from sec-ondary effluent by selective ion exchange: J. Water Poll. Control Fed. 42, R95—R107.

Smith, S. A., Chapman, R. L., and Butterfield, 0. R. (1979) Tahoe—Truckee water reclamation plant: First year in review: Proc. Water Reuse Symp. 2, 1435—1445.