Chapter 9

Metropolitan Water District's Diemer Filtration Plant

INTRODUCTION

We believe that this exercise will provide you with an excellent overview of the elaborate system established to provide water for the populous southern California area. The walk-through and relevant discussions will provide a unique overview of this valuable resource. See Figure 1 for a map showing how to get to the Diemer Plant.

OBJECTIVES FOR THIS EXERCISE

(1) To understand the geography and intricacies of the California water distribution system.
(2) To evaluate the probable biological/ecological impacts of massive water diversions to natural ecosystems.
(3) To emphasize and explain the implications of water importation systems and energy use.
(4) To observe and discuss the processes necessary to obtain a quality finished potable water from a modern filtration facility.
(5) To discuss and interpret basic water quality parameters, testing procedures, and important primary/secondary drinking water standards.

WHAT YOU'LL BE TURNING IN

1) Please submit your typed answers to the questions that appear below.

WHAT TO BRING AND HOW TO GET THERE

Bring the following:
(1) Adequate walking shoes (there will be a fair amount of walking).
(2) Clipboard for working on this exercise.

Other notes:
(1) Follow the map (Figure 1) carefully. We will meet at the top of the hill by the administration building (near the flagpole).
(2) Please allow adequate time for travel to Diemer — try to arrive 5-10 minutes early.
(3) Sometime <u>before</u> you arrive at Diemer, carefully read the following descriptive material and carefully examine the questions that follow. Please note that a library exercise must be completed as part of this exercise.

BRINGING WATER TO SOUTHERN CALIFORNIA

For several decades the residents of southern California have taken water for granted. Recent droughts and subsequent shortages have emphasized the fragile nature of our water supply. Broad media attention has focused on the origin, transport, treatment and final distribution of this precious resource. Figure 2 provides a map showing the three major aqueduct systems of California. Southern California's Mediterranean like climate has attracted a large population base into a rather small and semi-arid geographic area. Some 75% of our state's population resides in southern California. This same mild climate is stingy with precipitation and other natural forms of water supplies. Between 18-25% of the state's precipitation total is supplied to the southern California area — the rest of the 75% falls in the less-populous central and northern parts of the state. This inherent "shortage" has necessitated the construction of far-reaching water projects beginning with the early 1900s. Noteworthy is the fact that every time southern California has obtained a water source outside of our local environs, mistrust, controversy and political intrigue has always followed.

LOS ANGELES AQUEDUCT: The first water-importation project completed was the Los Angeles Aqueduct. This gravity-flow system, completed in 1914, was the brain-child of William Mulholland, the water engineer for the Los Angeles Department of Water and Power (DWP). The aqueduct serves only the City of Los Angeles and brings water from the eastern slopes of the Sierra Nevada (from the Lee Vining and Mammoth Lake area and down through the Owens Valley region to the south). This water diversion project has created decades of concern relative to the desertification of the Owens Valley and the biological/ environmental threats to Mono Lake.

COLORADO AQUEDUCT: Water engineers continued to look for further imported sources as a rapidly-expanding population was attracted to the "beautiful and mild climate" of southern California. With the formation of the new Metropolitan Water District of Southern California (MWD), Congress authorized the construction of the Colorado River Aqueduct. Completed in 1941, the aqueduct moves Colorado River water some 242 miles from Lake Havasu across the Mojave Desert to Lake Matthews in Riverside County. From here the water is pumped to various filtration plants (including the Diemer facility). The map shown in Figure 3 details the systems within southern California. Controversy over water rights to the Colorado River system was partially solved by a Supreme Court ruling during the early 1960s when Arizona was awarded a significant share of water previously designated for California. Other controversies involve Mexico's share and disputes over tribal water rights in both Arizona and California.

CALIFORNIA AQUEDUCT: The third and most ambitious aqueduct system for water importation originated in northern California. Designated the Feather River Project in 1951, the project included construction of the Oroville Dam on the Feather River. This system was to provide water for agricultural purposes in the Central Valley area. By 1957 the California water plan was enlarged to include a massive intertie of several dammed river systems and was renamed the State Water Project. This project culminated in the completion of the California Aqueduct, a system running some 444 miles into southern California. The MWD takes on the pumping and delivery costs at the southern end of the Central Valley near the base of the Tehachapi Mountains. Here the Edmonston Pumping Plant lifts the water up and over the Tehachapi Mountains. This single lift pumping system of 2,000 feet is the highest vertical lift in the world. The electric energy used to power the massive pumps is the equivalent of the total electric usage for the entire city of San Francisco. MWD has offset some of this electrical use with the installation of inline mini-hydroelectric plants. The water then moves to Pyramid and Castaic Lakes for distribution into the Los Angeles area. A western branch of the project carries water past Palmdale to Silverwood Lake and Lake Perris for distribution to parts of San Bernardino, Riverside and San Diego Counties. Orange County receives some of the California Aqueduct water via a feeder pipeline running from the Weymouth facility in LaVerne to Diemer. Water leaving the Diemer facility for distribution to member agencies is a blend of northern California and Colorado River water.

SACRAMENTO DELTA: The continued reduction in the amount of water California can legally take from the Colorado River underscores the increasing importance of water supplies from the California Aqueduct. The weak link in the northern California system is an area where the Sacramento and San Joaquin Rivers meet—the Sacramento-San Joaquin Delta. This intricate and interlocking maze of waterways eventually flows into an estuary system into San Francisco Bay. Water flowing through the Delta follows more than 700 miles of earthen levees where some of the water is picked up at the southern end for placement into the California Aqueduct. The system is plagued with salinity and other water quality problems that make this water more difficult to treat at facilities like Diemer. Water quality for estuarine organisms and several endangered animals are also of critical concern in both San Francisco Bay and the Delta.

DIEMER FILTRATION PLANT: Metropolitan Water District facilities like Diemer are water wholesalers for various cities and other retail water companies in southern California.

TREATMENT PROCESSES: Before the water is sold, a series of treatment processes occur that insures a high quality product. The four basic processes of flocculation, sedimentation, filtration and disinfection are described below:

(1) Flocculation- When needed, chemicals like alum and organic polyelectrolytes may be mixed with the water—they react with it to form fluffy particles called floc. The floc is mechanically stirred in the water by paddles or propellers—here it attracts suspended organics and bacteria before settling to the bottom of the basins.

(2) Sedimentation- With the bulk of the impurities settled in large basins, the sediment is removed by a mechanical scrapper. The sediment is then pumped out and the water is skimmed and moved onto the filter bed area.

(3) Filtration- The water now percolates down through a double filter composed of a top layer of anthracite coal and a bottom layer of very fine sand. The double filter system removes any remaining sediment and most bacteria. A backwashing process routinely clears the filters of accumulated sediment.

(4) Disinfection- For the past half-century, every major American water utility used chlorine as the standard water disinfectant. Extensive research by the EPA and other agencies has shown that chlorine sometimes combines with natural bromide and organic materials in drinking water to form carcinogens called trihalomethanes (THM's). Chloroform is but one of several types of THM's that can be formed in the reaction with chlorine. EPA regulations have prompted water agencies to begin working on alternative disinfection methods such as chloramine and ozonation. The chloramine system adds ammonia to the chlorine during the disinfection process. The THM level in the chloramine-treated water is considerably lower than with straight chlorine disinfection. Additional advantages of chloramine include a low dissipation rate and the traditional chlorine taste is missing. As regulations on THM levels are tightened each year, the ozonation process appears to be the treatment process of choice. With ozonation treatment the ozone gas is bubbled through the water, killing all living organisms. The ozone then rapidly diffuses out of the water leaving an organism-free water that has no taste impairment and with extremely low THM levels.

QUALITY CONTROL: In the water quality laboratory at Diemer the chemist will note several water quality parameters. A discussion of inorganic chemicals involves the mineral levels in the water. The total amount of minerals found dissolved in a water source is referred to as total dissolved solids (TDS). These highly mineralized waters often have taste problems. Water from the Corona-Norco area is highly mineralized and is unpleasant to drink. The hardness of water is determined by the total amount of calcium (Ca) and magnesium (Mg) present in a given water source. Hard waters often leave deposits and spots on surfaces after drying.

The chemist will also discuss organic chemicals such as THM's and pesticides. Turbidity factors relate to dirt particles in the water. Microbiological contaminants include bacteria, viruses, protozoans and other living organisms.

DIFFERENT WATER SOURCES: The two aqueduct systems that serve the MWD differ widely in water quality parameters. Water from the Colorado River, although typically high in TDS and hardness, is low in "biological load" or microbe contamination. The California Aqueduct water contains a very high biological load due to farming activities in the San Joaquin Valley, organic runoff and other sources. On the plus side, the northern California water has a very low TDS and hardness rate. The processing costs of water containing a high biological load are higher than their low-load equivalents. With diminished pumping rights to the Colorado River necessitating increased pumping from the California Aqueduct system, water rates are predicted to skyrocket through the next several years. No other single political resource issue has so divided northern and southern California than the allocations of water from the State Water Project.

Answer these questions

Please answer the following questions concisely and authoritatively (Must be typed):

You may type your answers in the spaces provided below, or submit them on separate sheets.

(1) Describe the geographic routings of the two aqueduct systems that provide "raw water" for the Diemer facility. Indicate the locations of these aqueducts on the map at right. Clearly label them.

a. Colorado River Aqueduct-

b. California Aqueduct-

(2) Define the concepts of: 1) Total Dissolved Solids (TDS); and 2) Hardness Level as they relate to drinking water. Note why the measured levels of these two parameters differ in the waters of the two aqueduct systems.

(3) Biological load is a serious problem in California Aqueduct water. Define the term, Biological Load, and explain where it comes from.

(4) Differentiate between primary and secondary drinking water standards and give several examples of each.

(5) What types of substances and/or impurities do The MWD staff chemists and microbiologists monitor? Give examples of:

a. inorganic chemicals-

b. organic chemicals-

c. turbidity-

d. microbiological contaminants-

(6) How does the quality of bottled water differ from the finished water product leaving the Diemer facility?

(7) Occasional complaints over peculiar tastes or odors in drinking water sources sometimes make the local newspapers. What are the reasons for these problems and are they potentially dangerous to human health?

(8) Answer the following questions regarding the Eastside Reservoir Project.

a. Where will it be located?

b. How will it be significant to southern California water storage?

c. What types of environmental mitigations have occurred that will allow this large project to proceed? Include the endangered Stephen's Kangaroo Rat and note the coastal sage scrub community in your discussion.

(9) The following question will require a bit of research on your part. Discuss one of the following concepts as a possible means to increase the amount of potable water for southern California. Choose one to write on.

a. Cloud seeding.
b. Desalinization
c. Wastewater treatment for certain uses.

REFERENCES

California Dept. of Water Resources. (1980) Ground Water Basins in California. Bulletin No. 118-80.

Dennis, Harry. (1981) Water and Power. Friends of the Earth, San Francisco.

Englebret, Ernest, and Ann Scheuring. (1982) California Water. University of California Press, Berkeley.

Nadeau, Remi A. (1950) The Water Seekers. Doubleday and Co.

Parratt, Mark W. (1990) Environmental Readings. PRC Publ. Co., Garden Grove.

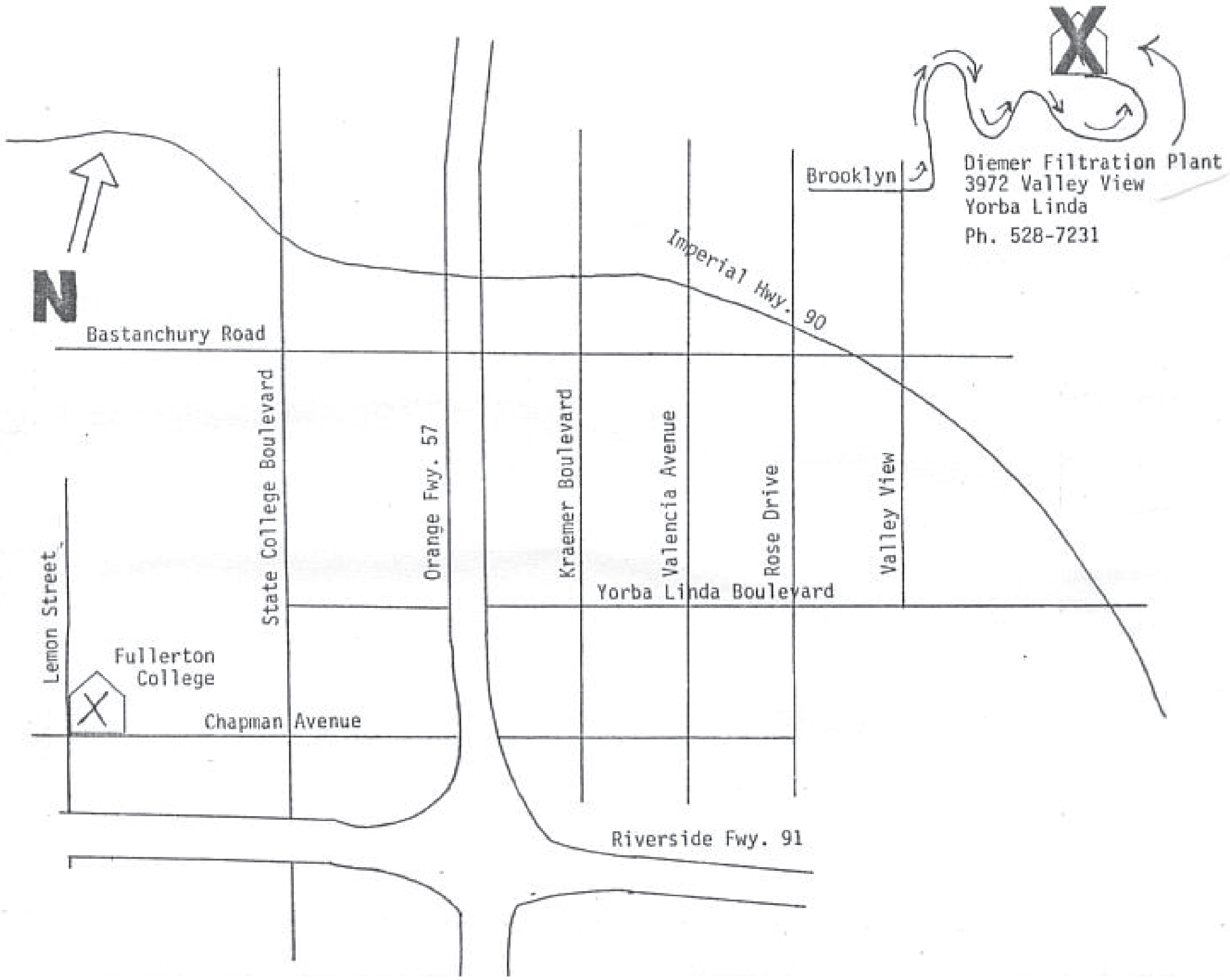

Figure 1
Location Map
Diemer Filtration Plant
Yorba Linda, CA

Figure 2 A sketch map showing California's three major aqueduct systems -- all delivering water to "thirsty" southern California.

Figure 3 A sketch map of southern California showing some of the major distribution aqueducts and their arterials.