DWP SANITARY ENGINEERING

WILLIAM RUSSELL REE

Interviewed by Dick Nelson

One of a series of oral histories covering the growth and development of the Los Angeles Department of Water and Power as seen by the participants - its employees.

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TAPE NUMBER: 1, SIDE ONE

WILLIAM R. REE

GIVEN THURSDAY, MARCH 4, 1991

AT

HIS HOME IN VENTURA, CALIFORNIA

THE INTERVIEWER IS DICK NELSON

NELSON: Okay Bill, would you fill us in on your early years, where you were born, where you grew up?

REE: This is Bill Ree and I was born in Ventura County, in Oxnard, California. I grew up in the town of Saticoy, which at

that time was a rural area east of Ventura. I lived on a walnut ranch during my early years, attending grammar school at Saticoy, and high school at Santa Paula. I then attended one year of college at Cal Tech and then transferred to USC, majoring in chemical engineering. I was attending USC in the engineering school and entered the Navy V-12 program and went on active duty there on July 1, 1943. I stayed in the V-12 program for two semesters and then was transferred by the Navy to the Reserve Midshipman's School at Annapolis Maryland. I graduated from that school as an ensign in the Naval Reserve then was assigned to destroyer escorts. The first one was at Tampa, Florida, and had just been commissioned and was going on a shake-down cruise. After completion of the shake-down cruise, I was transferred to a destroyer escort in the fleet, the J. Richard Ward, DE 243, which was serving in the North Atlantic on anti-submarine patrol with an escort aircraft carrier.

Most of my service was in the Atlantic theater. The DE-243 came through the Panama Canal, heading for the Pacific one day before V-J Day. We went as far as Pearl Harbor, spent some time there in training exercises and turned around and came back to the States; the Navy finally decommissioned the ship at Green Cove Springs, Florida where it was mothballed.

After getting out of the Navy, I returned to USC and completed my engineering degree. I graduated from USC in February 1947 and on February 10, 1947 I went to work for the Department. This first employment was on a temporary appointment as Civil Engineering Assistant and I worked there a short while, about six

months, and was picked up on a permanent appointment by the Department of Public Works and I transferred over there. Within a matter of about two months, I transferred back to the Department of Water and Power on a permanent appointment as a Civil Engineering Assistant.

NELSON: Bill what were your duties as a civil engineering Assistant?

REE: I was in what was then the Sanitary Engineering Division, working in the laboratory running chemical tests on water samples and also in the field doing water quality tests checking water quality throughout the system. At that time the Department was carrying out what they called a "corrosion study." It was a study determining the effective corrosion or amount of pickup the water had as it went through the system; primarily what the water quality changes were, and particularly what changes in the corrosion products such as iron and so forth, were occurring.

Another part of the work was to keep track of where in the City the various supplies, the Aqueduct, River Supply Conduit, local wells and MWD (Metropolitan Water District of Southern California) supplies were being served. This was done by setting up a series of sample points that were routinely checked and running analysis on the water to find which water was there. Each of these water supplies has some different chemical characteristics.

NELSON: Who were your superiors at that time?

REE: At that time the division head was Raymond Goudey and my immediate section head was Don Graham. I worked directly under the supervision of Mr. Graham.

NELSON: How many people were involved in this corrosion study?

REE: It was just a one-man operation. A series of sample points were established throughout the system from San Fernando reservoir down to San Pedro. I checked these sample locations once a month and maintained a plot or a record of the findings of various chemical characteristics, such as alkalinity, dissolved oxygen, pH, and temperature at these various points. If necessary, we would arrange that the mains in the area would be flushed to freshen the water and get rid of water that was deteriorating.

NELSON: What was a typical sample point?

REE: Many of these were the front faucet at a house, listed by address. Some of them were sample taps which had been installed directly on the main, special taps for that purpose. In some cases, I would actually take a sample out of a fire hydrant. This was particularly useful where there was a low flow area and there were no services around that were tapped on the mains.

NELSON: Would you do any analysis on the spot or would all the samples be taken back to the laboratory?

REE: Several of the determinations were run on the spot, such as temperature, alkalinity, pH, and dissolved oxygen. These are tests that are easily run in the field, and they change with time, storage, and handling, so a more accurate test is made by running them in the field. At the same time that the field sample was taken, a separate sample would be taken for return to the lab; this was the one that was used for other tests such as iron, conductivity or whatever other tests were required.

NELSON: Did you use a special vehicle for this or was this a regular pool or division vehicle with a tool box, so to speak?

REE: I assembled a test kit that carried the chemical reagents and the laboratory glassware that was needed for the field tests. The kit was carried in the back of a car. It was a portable set that could be transferred from one car to the other. At that time the Division had one vehicle that was assigned to this work or to this type of field work. It was used by two of us at various times, one doing reservoir testing and myself in the system water quality work. Between us we would work out a schedule as to who would use the car on a given day.

When I wasn't in the field, I would be in the lab or office either recording the data or preparing a map showing where the

various supplies were being served as a result of our testing, or keeping up with the office work. This was kind of the balance of the work. Part was in the laboratory, part was doing office work and record keeping and part in the field collecting the data and doing the field work.

NELSON: Did the two of you, take all of the field samples for the Department?

REE: No. At the same time there were three people that were employed as water sample collectors. There were two of them working each day and it was their responsibility to make the rounds of established points in the system and collect the necessary samples that were required for verification of the system so far as bacteriological quality was concerned. These samples were taken from reservoir outlets, both before and after chlorination, and at established or permanent sample points throughout the system. They also collected additional samples for chemical analysis which were brought into the laboratory for complete analysis. There were also two other persons who collected reservoir samples and water samples from the Owens Valley.

NELSON: What was your opinion of the DWP sanitary laboratory at that time? Was it a high quality, was it a large laboratory, a very modern laboratory?

REE: The laboratory was modern in that they were using what at that time was the state-of-the-art equipment. In present day view it was rather primitive. There was very little available in the way of instrumental methods of analysis; about the only instrument that was used at that time was a spectrophotometer that was used for some of the mineral tests. Otherwise they were primarily gravimetric, volumetric, or colorometric tests, performed in accordance to the Standard Methods of that time.

It actually predated a lot of the instrumental analysis that is now available.

NELSON: I guess I need to go back and ask one question which occurs to me and that is your training and education as a chemical engineer. How in the world did you get to the Department of Water and Power? I wouldn't think that would be the choice of employment for most chemical engineers.

REE: Most of the people in my graduating class and for several years prior, had gone to work for either large chemical companies, such as Allied Chemical or General Chemical, into the petroleum industry at one of the refineries, or were with one of the equipment suppliers or engineering firms like C.F. Braun, or Fluor Corporation doing design work, installation work or plant operations. The other alternatives were back east in some of the chemical manufacturing plants.

Prior to graduation, I interviewed with several companies from the east and was interested in some of the offers they made.

I also interviewed with chemical companies, oil companies and manufacturers here in the local area, Southern California. I didn't really want to leave Southern California which ruled out the eastern manufacturing plants. Neither did I really want to get into the petroleum industry. When I was trying to make up my mind, there was a bulletin posted on the bulletin board in the engineering building that advertised a job with the Department of Water and Power; it emphasized the fact that the job would be running chemical tests, doing engineering studies and so forth. This was in the same area that I was interested, having started off as a chemist and finally switching over into chemical engineering.

I went down to the Department for an interview. They felt that maybe I had the right training; actually they were looking for somebody that had a chemical and an engineering background, that knew something about chemistry and could be trained in water chemistry. Apparently I met the bill because they offered me an emergency appointment, which I accepted. The next 32 years developed from there.

NELSON: You had worked for the Department for six months or so and then you went to Public Works temporarily. What did you do over there?

REE: At Public Works I was primarily working as a data collector and draftsman. A lot of the work was done in the drafting field preparing maps of areas for display, and record keeping. It

seemed like every day was a new job; there was no continuity to it. It was just whatever "brush fire" was on that day. This was one of the things I didn't like about Public Works; there didn't seem to be any continuity from day to day in the work, at least that which was assigned to me. I was glad to get the opportunity to transfer back to the Department of Water and Power where I felt there was a continuity of work.

I might mention, too that at Water and Power the division head and the senior engineers at that time were trained in sanitary engineering, and were graduates of the University of California. It took some doing to explain to them that a chemical engineering graduate from USC could do the work of a sanitary engineer. It took some patience on their part and a lot of learning on my part. I was familiar with laboratory procedures, but not with these specific tests that were for water analysis. Neither was I particularly trained in the unit processes that were used in the water treatment and water purification. Basically they're just a specialized form of the general unit processes that we had studied in chemical engineering and that was for filtration and sedimentation and gas transfer regarding chlorination and so forth. So actually the transfer was fairly easy and apparently it was successful.

NELSON: Are you saying it was somewhat "clickish" in that if you were a UC grad things were a little easier?

REE: For many years prior to that the University of California had dominated the sanitary engineering field. Professor Langmuir was the chief, I guess, up in the area at the school in Berkeley and it was not a widely available course of study. At that time Cal was the only school in California that offered a degree in sanitary engineering. USC did not, at that time, offer it nor did any other schools in the area, so if you went into sanitary engineering, you almost automatically went to Cal. This was one of the reasons that it took a little doing on my part to convince the powers that be that someone other than a Cal graduate could function as a sanitary engineer.

NELSON: So you came back to the Department of Water and Power and back to sanitary engineering?

REE: The Department was able to pick me up then on the permanent appointment after this couple of months delay; I transferred back to the Department, probably about August, 1947. I picked up where I had left off when I went over to Public Works, doing the same work in corrosion studies in the field and working in the laboratory. I worked primarily in what was called the, "sanitary water lab." There were four fundamental laboratories in the Division - the sanitary lab, the mineral lab, the bacteriological lab and the microscopical, or plankton lab.

The sanitary lab ran the tests and determinations that were essentially of a sanitary nature, such as alkalinity, ammonia, dissolved oxygen, and the mineral lab would run those mineral constituents such as calcium, magnesium, sodium and that.

My training was primarily in the sanitary lab running those types of tests that were run there.

NELSON: Were you the only chemical engineer discipline in the Sanitary Engineering Division at that time?

REE: At the time I was hired, I believe I was the only one with a chemical engineering background. Most of the people in the laboratory were either trained in chemistry or bacteriology or biology and the ones that worked primarily in the laboratory and were assigned to the laboratory as laboratory assistants or chemists, would work all of the time, full time, in the lab running these tests. They very rarely would be out in the field. Samples were brought in daily. There were samples brought in by sample collectors for analysis then it would take more than just a day to run a series of mineral analyses and so forth that were run, but these were run by people who had been trained or were primarily chemists or laboratory type people.

NELSON: Did you have women in the professionals working in sanitary engineering at that time?

REE: At that time the one in charge of the chemical lab was a woman. Her training as a chemist was from UCLA. Women were also in charge of the bacteriological and plankton laboratories. Several of the laboratory assistants were women and had college degrees.

NELSON: Can you recall their names?

REE: The woman in charge of the chemical lab was Louise Schauer, now Louise Carty. The woman in charge of the bacteriological lab was Madeline Lake and the one that did the microscopical examinations was Florence Stienstra. One of the other technicians as a laboratory assistant was Betty Southam. She worked primarily in the sanitary lab.

NELSON: Did you happen to know, did any of these have engineering designations, or were these technical designations?

REE: These designations were either as chemists, bacteriologists, or laboratory assistant. They did not have engineering background, and did not carry an engineering name in their civil service title.

NELSON: Where was the lab located at that time?

REE: The lab was on the tenth floor of the Second Street Building, Room 1Ø28 at 316 W. Second Street. The lab took over or comprised about 2/3 of the tenth floor of that building. The remaining part of the tenth floor was taken up by the division offices.

NELSON: Does that building exist today?

REE: I think the building is still there. At the time the General Office Building was built in 1965, we moved out of there and into the new facilities on Hope Street. The building was sold and the last I knew it had been renovated and was still existing. There were actually three buildings there that kind of dove-tailed together or met in a corner. There was the Broadway Building, the Second Street Building, and the Hill Street Building. The Hill Street building opened out onto Hill Street and housed the parking garage with offices on the upper floors. The Second Street building was essentially offices with the medical department on the first floor. The Broadway building housed the main offices, the commercial office and business office on the first floor and the general manager's office on the upper floors.

The Second Street building was the taller of the three buildings. We were on the tenth floor. The Hill Street building was only eight floors tall and I don't remember the height of the Broadway building, but it was about the same as the Hill Street building.

NELSON: At that time, was Sanitary Engineering an autonomous division or was it a section of another division? What was the reporting scheme?

REE: The Sanitary Engineering Division was a separate division. It was supervised and led by the division head, Ray Goudey, who reported to the system head. Mr. Goudey left about four or five months after I started to work there. He was replaced as division

head by Ray L. Derby, who had been serving as one of the senior engineers under him. Ray Derby served then as division head until his retirement in 1964.

NELSON: You say Raymond Goudey left, he retired?

REE: No. There was a little internal pressure brought to bear. He had done some improper actions and improper use of Department funds and he was actually terminated. I had not been there during the time that this turmoil had gone on. Apparently, in retrospect, there was a lot of feeling against him. As soon as it was brought out in the open, people started coming forth with more and more items and it was pretty obvious that he had been in trouble for quite a while. It was a matter of improper use of Department facilities and materials and so forth and he was terminated.

I really wasn't aware of the implications or the pending investigations and so forth. I was in the field one day and came in with my usual sample load and the news on the floor was, "Did you know that Mr. Goudey was gone?" That was the first I knew that he had been terminated.

NELSON: It happened very quickly.

REE: It happened quickly and quietly. There was quite a lot of repercussions afterwards, but it was sustained. I think I only saw Ray Goudey once after that.

NELSON: You said Mr. Goudey was an autocratic type of person?

REE: Yes. He was rather dogmatic, very positive in his decisions. In some respects this was good. He was respected in the sanitary engineering field. At that time I think he was one of the top men in the sanitary field so far as the country was concerned. He was well thought of, I know, in the journals. He had written articles for the Water Works Journal and so forth and he had a good reputation as a sanitary engineer.

He did have some very dogmatic ideas, I remember one time as part of my work I had been keeping track of where the various waters were served within the distribution system. There were three or four of us, Don Graham, my supervisor, and a couple of others who I don't remember and Mr. Goudey and myself in a meeting, and Mr. Goudey asked where the River Supply Conduit water had been served this last month? I explained and showed him on the sketch and map where it had been served. I knew from the tests and so forth where it had been in the system. He said, "No I don't think so." He really never accepted my statement. His final remark was, "Well, I think next month you'll find it will be different." When his mind was made up, you didn't change it.

NELSON: Didn't you tell me earlier before the tape was on about his ideas about chlorination?

REE: Yes, this was an idea that he had regarding the operation of the system and it refers, I guess, to the operation of the chlorination stations which at that time were at the major reservoir outlets such as San Fernando Reservoir, Stone Franklin and Hollywood Reservoirs and at the River Supply Conduit.

Mr. Goudey's edict was that during the summer time, when there was no runoff, and no pollution getting into the reservoir, that a single chlorination was all that was required. So the aqueduct supply was chlorinated at San Fernando as it entered the system, the River Supply Conduit supply was chlorinated at that chlorination station and wells, such as the Manhattan Wells and those were used without chlorination.

The only time that chlorination was turned on and used at the distribution reservoir such as Stone, Franklin, and Hollywood Reservoirs was during the winter time. During the dry weather when there was no runoff pollution danger, there was no chlorination at those points and, therefore, no residual in the system.

NELSON: At that time, in the mid to late 40's, what was the composition of the water being received percentage-wise being distributed customers? Do you have an idea of Owens Aqueduct water versus ...?

REE: Well it was probably 80% - 82% Aqueduct water, about 15% River Supply Conduit (well water from the San Fernando Valley wells) and 2% - 3% MWD, with the balance from local wells in the

city. I don't believe that any of the wells were used the year around, but they were used only for summer peaking. It was used really as a supplementary supply. The main supplies, at that time, were from the Aqueduct and ground water from the River Supply Conduit wells and also through well systems such as Pollock Wells, Manhattan Wells, 9th Street Well and Lomita that were scattered around throughout the city.

NELSON: Bill, you mentioned the River Supply Conduit. Could you explain that a little bit? Just what did that include?

REE: The River Supply Conduit was a gravity flow conduit that collected well water and surface water from the L.A. River which had infiltrated at the spreading grounds. This conduit started near Travel Town in Griffith Park and terminated at the Ivanhoe - Silver Lake reservoir complex. A later extension continued to the North Hollywood Pumping Plant to intercept water from several valley well fields as well as Aqueduct water.

Prior to the River Supply Conduit, the Crystal Springs Conduit, another gravity conduit, had collected water from the wells near Griffith Park and delivered that water to a pumping plant and also directly to Buena Vista Reservoir. This Crystal Conduit has been abandoned for years.

TAPE NUMBER: 1, SIDE TWO

WILLIAM R. REE

NELSON: Bill, you were telling us about Mr. Goudey leaving the Department and the Division then being taken over by Ray Derby. What was Derby's management style and how did it vary from Mr. Goudey's?

REE: I think that Mr. Derby was more concerned with water quality protection and a little more control over the water quality than Mr. Goudey had been. Under Mr. Derby, all-year chlorination was instigated at all stations and additional stations were added, at Silver Lake outlet, for example. Gradually, over a period of time, it was expanded to the point that all of the water entering the distribution system was continuously chlorinated including that from the deep wells such as Manhattan and Lomita and Pollack and 99th Street, the major well systems.

In addition to year-around chlorination to improve the bacteriological quality, Mr. Derby also had the chlorination residual that entered the system increased considerably.

Under Mr. Goudey's system, the chlorine residuals used were very minimal, giving a very low residual of perhaps a tenth to fifteen hundredths of a part per million immediately after chlorination. The residual would be rather rapidly dissipated in the system and would disappear.

Under Mr. Derby, the residuals were carried much higher. A higher free residual was carried and additional programs were started to monitor the quality out in the system by checking chlorine residuals throughout the system. This was to assure that the chlorine residual carried as far into the system as possible, ideally to the extremities of the system.

This served two purposes. First, as long as long as you had a chlorine residual present, there was good assurance that there was not any external pollution getting in and that the water was safe. Second, the presence of the chlorine residual would in general, improve the quality of the water so that it was better from a taste and odor standpoint.

Mr. Derby also undertook a rather intensive study of reservoir quality, studying the water quality within the reservoirs. This had been done to a limited extent under Mr. Goudey, but it was expanded considerably. In fact, additional personnel were employed specifically as reservoir biologists with the primary duty of following the water quality within the reservoirs and trying to obtain the best water from the reservoir. These were additional limnological studies that had been done on a very limited basis under Mr. Goudey, but under Mr. Derby they assumed

a lot more importance and were done more frequently and in more detail.

NELSON: Was chlorine the only additive used on the supply at that time?

REE: So far as disinfectants were concerned, chlorination was the only treatment that was done. The other chemical that was used fairly large amount was copper sulfate. This was used essentially for treating reservoirs and for controlling algae growth. These are growths that are fostered by warmth, moisture and sunlight and they can impart an undesirable quality to the water either as a taste or odor or, in extreme conditions, they will cause green coloration.

Silver Lake reservoir was a particular troublesome reservoir because it received well water which was warmer than the aqueduct water and higher in nutrients, it was a shallow reservoir, and there was a relatively low flow or circulation. There was a long retention within Silver Lake and being shallow and warm in the summer time, it would warm even more and some very heavy algae blooms would occur. Growths of Synedra, one of the organisms that was quite common, would develop in Silver Lake reservoir and would grow to an extent that a depth of water in a bathtub would have a definite greenish cast. If the water was filtered, it would tend to clog the filter very rapidly. It would cause industrial complaints, it caused consumer complaints, and, of course, if the

material was carried out into the system and then settled out, it eventually would cause taste and odor problems.

I remember one of the water quality inspectors had gone out to one of the industries in response to a complaint. This particular industry was known as the Clearwater Chemical Company and they prepared developer for x-ray laboratories. Their process was to buy the concentrated developer, mix it in a large tank with water, rebottle it, and sell it to the x-ray trade. Unfortunately the plant location was in an area that received water from Silver Lake Reservoir. When they got the bacterial growths or algae growths, it would cause a discoloration, would affect the operation of the developers, and in extreme cases the algae would actually deposit on the processed x-ray film and cause problems. We had had several meetings with the operator who was running this plant, and he had been advised that, for his protection, he should install filtration on the water supply prior to mixing the developer. In this way he would have control over any disturbance of sediment from the mains that might occur due to a fire in the area and he would have continual protection against the algae that was causing the problem. Steadfastly he refused to do anything about it. In exasperation at one point in time I know the inspector that had gone out there said, "Well, you're operating under the name of Clearwater Chemical, I think you have two choices. You should either move or change the name of the company."

NELSON: He never brought suit against the City or anything?

REE: No, there was no follow-up on that. I don't know what the final outcome was. It was kind of a marginal operation anyhow. It was a very small building that he was operating in, almost like out of a garage and it was just a matter of buying concentrated mixes from Eastman or some other supplier and adding water and rebottling it and selling it as developer. It was something that the x-ray labs could have done themselves if they had wanted.

NELSON: You mentioned about these reservoir studies under Ray Derby and I'm wondering, the fenced reservoirs, was access controlled at that time that you came in?

REE: Yes, they were all fenced. They were well protected from that standpoint. There was no public access to any of the reservoirs. I believe that at Lower Hollywood Reservoir public access was allowed to the roadway surrounding the reservoir for hikers, naturalists, bicyclists, and so forth. They were permitted to ride around the road that surrounded the reservoir. At that time the fence was right at the edge of the parapet wall on the inside towards the reservoir and they were not permitted inside the fence.

NELSON: From a contamination standpoint, can ten or fifteen people contaminate a reservoir of considerable size?

REE: No, there's been a lot of calculations done on what would be required to do any damage in the way of contamination. Because of the volume of water involved and the dilution effect and also the effect of chlorination on the outlet, it would take a massive dosage of chemicals or anything like that to cause a problem.

During World War II, Mr. Goudey had barrels installed at the outlet lines from Hollywood Reservoir, with a stream of water from each line passing through a barrel. Goldfish kept in the barrels served as visual indicators that the water was free of hazardous chemicals or poisons.

NELSON: They were kind of the "canaries in the mine."

REE: That's the idea. I don't know that it was done in any other plant other than at Hollywood. I recall seeing them there, but they were kept there for many years. This was in the post war years in 1947 and I understood that that had been started during the war.

NELSON: What was your job on your next assignment?

REE: My next assignment, or promotion, was in 1954 when I was promoted to Sanitary Engineering Associate. By that time the Department had contained a Sanitary Engineering series within the civil service classification and what formally had been classed as Civil Engineering was now classed as Sanitary Engineering. So the Sanitary Engineering Division was drawing from a different list

than the true civil engineering engineers that were going into design or the Operating Division. The sanitary lists were used by both our division in the Water System and by the Sanitation Division in the Department of Public Works and the City Health Department. So they were used in both departments in the City.

My work as Sanitary Engineering Associate, after 1954, was in water treatment operation and research. It consisted primarily of investigating alternate methods of treatment, new methods of treatment, and trying out new equipment that was available on the market.

I remember one unit that we were given to test. It was a little chlorinator machine and we were asked to study it and see how it worked and whether it appeared to be feasible and reliable.

One of the things we found out was that it was intermittent in operation. At maximum feed it was adding chlorine perhaps 3/4 of the time and if the dosage was reduced, the amount of time that it would add chlorine was also reduced. So it was functionally all right, but did not provide continuous chlorination. It did the job of adding chlorine, but it would require that downstream from the point of addition that there would have to be some kind of a retention or mixing chamber to provide adequate mixing of the chlorinated water because otherwise something approaching 1/3 or 1/2 of the water would go by untreated.

At this time we were developing a laboratory study of diatomaceous earth filtration. This was a study that was being conducted there at the Hollywood Experimental Filtration Plant on the property where the Hollywood chlorination station was located.

A small laboratory had been built there. This study had actually been started under Mr. Goudey's direction and the studies were being done then to determine what operating characteristics, what type of materials would be optimum to use if diatomaceous earth filtration was to be used.

One of the reasons that diatomaceous earth was under consideration was that even at that point in time it was felt that, some time in the future, filtration would be required. If it was needed at the reservoirs like Stone, Franklin and Hollywood, that were in deep canyons, it would be extremely hard to locate a conventional filtration plant there because of the large area that would be required. The diatomaceous earth filtration could be done under pressure in a fairly limited area.

This study on diatomatious earth was carried on from 1946. So it was an ongoing program when I went into that section in 1954 and it was continued for several years after that, collecting data, particularly operating data. It showed the effective diatomaceous earth under various conditions of water quality from the Hollywood reservoir. I think all of the work that was done on the diatomaceous earth was done on water coming from the Hollywood reservoirs.

My group also got involved in doing some chlorination work, studies in the chlorination field. About that time one of the manufacturers of chlorination equipment, Wallace and Tiernan, came on the market with a chlorine residual recorder. This was a piece of equipment that would give a continuous chart recording of the chlorine residual. This was something that had not been available

prior to that time. It was one of the first pieces of instrumentation that came out in the water works field.

We had one of these residual recorders installed at the Hollywood Chlorination Station. There were some requirements or limitations on the operation of chlorinators that they would only respond for a certain flow variation and sometimes the flow variation was out of band or wider than what the machines would follow. The question arose then, can the residual recorder be adopted to become a controller? We worked on that for quite a while and did develop a system that would enable the chlorinators to be controlled by the residual recorder. This was used there at Hollywood Reservoir. It was also used at Silver Lake Reservoir and several of the other locations where there would be a wide change in flow rates, wider than the chlorinators were designed to cover.

Also at this time, another section in our Division had been doing reservoir studies and determined that many of the taste and odor problems in the reservoirs could be eliminated by chlorination in the reservoir. In other words by adding chlorine directly to the reservoir, you could inhibit the algae growth. Also there was a plan developed to chlorinate the bottom reservoir water that often would develop sulfide odors, would become stagnant and would impart odors that later on would be distributed throughout the reservoir.

With the addition of chlorine in the reservoir, then there was always the possibility that chlorine from the reservoir would appear at the reservoir outlet so that instead of having zero

residual at the outlet, you were chlorinating a water that already had a low amount of chlorine in there. So when that occurred, why naturally the residual on the outlet would increase and it would be necessary to trim or cut back on the feed.

This residual recorder controller apparatus was used in that operation. This was particularly useful at Silver Lake Reservoir because being a very shallow reservoir, the chlorine residual in the reservoir was carried fairly high and at night time it would blanket the reservoir and in daytime it would disappear. So you would have a variable residual at the outlet and yet treating it with a given amount and by using the controller it eliminated the heavy swings or high swings and eliminated the high dosage during the night time flows.

Another program that we studied in this water treatment research was the development of a chlorine leak detector. One of the problems that always exists in a chlorination station is a chlorine gas leak. A gas leak in one of those stations can be rather disastrous. This was brought to light by a leak that did occur one night in the Hollywood Chlorination Station. One of the tank connections, a connection from the ton cylinder chlorine to the piping in the station sprung a leak and was releasing gaseous chlorine into the air. When the chlorination operators arrived on the scene the next morning, everything in the building was dripping green and yellow liquid from the effect of the chlorine on metal, and of course, the building was filled with chlorine. It was necessary to practically rebuild the station including pulling new wires through the electrical conduits because the

chlorine would get into the conduit and cause corrosion in the copper wires. So this required practically a complete rebuilding of the Hollywood station.

The chlorine leak detector was successful. I think we built about 12 of them after the experimental model. It was built with a little aspirator that was operated by water and it would actually draw air from either the tank room or from the machine room in the chlorination station, into the leak detector and it would bubble it through a vessel of water. In so doing, it would pass the water solution past a little cell that would detect the presence of chlorine.

If any chlorine was present, the meter reading would increase, closing a circuit and initiating an alarm. These alarms were installed at the water trouble boards which were manned 24 hours a day. The operators there would then alert the chlorine operators in case they got an alarm.

This was the first type of leak detector that was developed. At that time there were none available on the market. Several years following that several of the companies, including Wallace and Tiernan, came on the market with commercial units. Those are the ones that are now being installed in the stations currently. Some of the early units had limited uses. They were sensitive to chlorine, but they were also sensitive to other materials.

I remember one at a water works convention where an early commercial unit was on display. Everyone was making the supplier tear his hair out because every time they'd blow cigarette smoke at it, it would trigger.

Part of the work that the water biologists were doing at this time were determining a temperature profile within the reservoirs. They were actually taking samples for temperature measurement at various depths throughout the reservoirs. It was found that there was stratification occurring during the summer time in the reservoirs and the zone below the zone of stratification, below the thermocline, was relatively stagnant and ultimately could develop sulfide odors and be unusable. This would eliminate as much as half of the reservoir capacity from being available for use, plus the fact that later on in the season, as fall came about, that water in the lower zone would be mixed with the upper zone and would cause very bad taste and odors.

In order to determine this temperature profile, the biologists would have to take a sample of water with their depth sampler at various depths down throughout the reservoir. Initially they wouldn't know where the thermocline was. It was a matter of taking enough samples at various depths. It was a laborious and time consuming job to draw up samples from as much as 100 feet down in the reservoir so some type of equipment was needed to run a temperature profile.

The device known as a thermistor came on the electronic market. It is actually a thermally sensitive resistor, consisting of a little glass bead, about the size of a needle with a very sharp change in resistance with temperature. This unit was incorporated into a little plastic holder that could be attached to a cable and lowered into the reservoir. In this way the biologist could be at the reservoir tower or out in one of the

reservoir boats and drop the unit down through the reservoir and watching the meter, could tell exactly where the thermocline was and you'd get a very quick profile of the thermal conditions of the reservoir. It eliminated drawing up samples from multiple depths which was very time consuming.

These units were built and were used by the water biologists in their water quality studies. At the time this was done, there was nothing like that on the market.

NELSON: How many people were working with you in the section at that time?

REE: At that time there was a laboratory assistant who was later promoted to a laboratory technician. He would do most of the laboratory testing and the laboratory-type work. Also we had one water treatment operator who had extensive experience in operation of chlorination equipment. He had worked for the Department for a number of years and he knew the operation of chlorination equipment. Those two men, plus myself, comprised that group.

NELSON: Were you the section head?

REE: It was a subsection actually. It was a group within the water treatment section which at that time was under the direction of Joe Sanchis.

Another one of our responsibilities was conducting the radiological monitoring of the Department's water supplies.

Samples were brought into the laboratory by the sample collectors. We were running the tests for radiation which at that time were very limited. I believe that the radiation testing was started in 1950 and the Department of Water and Power and the MWD were two of the first water agencies in California to start monitoring the radiological levels in their water.

NELSON: Was this because of a fear of the nuclear testing that was done?

REE: It was basically an outgrowth of the possibility of fallout from atmospheric testing of nuclear devices. Initially it was done only on the water. Later we were involved working in coordination with the California Office of Civil Defense (OCD), at that time at the California Disaster Office. We were operating a mobile laboratory also which they had outfitted.

Through the disaster office, we became concerned over the radiation levels in the air as well as in the water. The air contamination could be a precursor or indication of what ultimately might later show up in the water. We started running a daily air filter at Hollywood Reservoir. This was done at Hollywood Reservoir for a number of years and then later was transferred down to the GOB.

There was another facet that was covered. This was partly on our own initiative and partly from the disaster office. There was concern because rainfall will wash out any radioactive impurities or materials that are in the air. We started getting samples from

rain gauges at various Department locations such as Stone Canyon Reservoir, San Fernando Reservoir, and Hollywood Reservoir particularly. These were checked for activity following the rain. Our intention here was to get a sample of the first rain that fell because this would naturally be highest in contamination because it would be washing out any material that was in the air.

This was an interesting study because it was being carried out at the same time that the nuclear testing was going on in the South Pacific. Also there were several detonations put off by Russia during this period. We did find very high radioactivities in the air samples.

Through the Disaster Office, we also got some samples of snow that fell up in the Sierras. One sample from Quincy, California, was extremely high in activity. In fact, the activity was high enough that we were able to determine the radioactivity levels over a long time period and plot a decay curve. This decay curve followed exactly what the "textbook" decay curve for fission products from atomic bombs. Extrapolating backwards, it corresponded exactly with one of the dates that Russia had detonated a device in their test program.

TAPE NUMBER: 2, SIDE ONE

WILLIAM R. REE

NELSON: Bill, we go on from your work in the Water Research section.

REE: Okay, I left the Water Research section, I believe it was in 1962 and transferred in class into the Water Quality section which was the section that I had worked in previously as an assistant. I was in charge of the sample collection program, in charge of the people that were investigating consumer complaints, and in charge of the people that were investigating water quality in the distribution system. This required a blend of office work and field work and was an interesting time in my life. I enjoyed it very much. It was a balance of two fields that I enjoyed. I stayed in this section until 1969.

In the meantime, about 1968, Donald Graham had retired as Section Head in charge of the water quality section. He had retired, but the position had not been refilled. It was left vacant for some time and I finally at long last, passed the State Board Registration exam for Civil Engineer and was then qualified to accept and be appointed to the engineer position which Donald Graham had vacated.

There were organizational changes made in the division at that time. I was appointed as a Sanitary Engineer: however, I was transferred to a different section. I was put in charge of the water treatment section. This was the section I had served in as an Associate in prior years. In this operation I was concerned with the operation of the chlorination stations, operation of whatever treatment was required in the way of treatment at distribution points with the exception of reservoir treatment. Any system treatment was under my section.

I also directed the water treatment research section which was continuing to develop methods of treatment. At this time the Department was concerned with methods of turbidity control for clarification of storm waters in the reservoirs. We had had some problems in intervening years, particularly in 1962 when we had extreme terbidity problems. This was due to turbidities in San Fernando Reservoir, storm waters in large amounts entering the San Fernando reservoir, uncontrolled amounts entering the reservoir. Again in 1966 and 1968, heavy runoff caused high turbidities, both in the Aqueduct and in storage reservoirs. This required treatment with alum for clarification to drop the turbidities down to acceptable levels.

About 1969 or the early 1970's a new branch of products came out. Prior to that time the primary coagulant used was either ferric chloride, which would add iron to the system which was undesirable because it would develop crenothrix and iron bacteria. The other coagulant would be aluminum sulphate which was very

usable, formed a good floc, but it would settle to the bottom of the reservoir in fairly large quantities.

In the late 1960's and early 1970's several of the chemical companies developed synthetic coagulants. These polymers required much lower dosages, in a fraction of a part per million instead of several parts per million. A lot of experimental work was done in using these polymers for clarification of storm waters and ultimately for use in treatment plants.

NELSON: Let me pick up a couple of things here. You mentioned consumer complaints. What were the typical or the most numerous consumer complaint?

REE: I think in general each year the largest number of complaints were due to dirty or turbid water. Year in and year out this would occur. It sometimes was due to the condition of the supply; sometimes it was due to a local disturbance caused by line work, closing off certain mains and reversing the flow in the system. Sometimes it was caused by perhaps a fire in the area, very localized, but you would get 50 or 100 calls a day from people in the immediate area where this occurred. This type of disturbance, use of a fire hydrant by the fire department or by the street sweeper is very short-lived, but it causes a number of complaints when it does occur.

If the supply itself is less than satisfactory and is causing problems, then it's a longer life problem and it would go on for days or weeks. In some cases if the calls are persistent and we

feel that it can be improved, we would make arrangements with the water operating division. They would send a gate crew to flush the mains in the area; if it was an area that repeatedly had the problem, we felt it could be alleviated, they would flush out the accumulated material, rust and whatever other accumulations might be in the mains. In some cases we either went into an area flushing entire areas of the city that consistently seemed to have problems.

NELSON: In some cases, however, this is the consumers problem.

REE: In the case of domestic use, a lot can be tolerated. The turbid water would be perhaps undesirable from an aesthetic standpoint. It would not cause illness in any way, so from a true domestic user standpoint, the water was okay; it was safe. It may not be attractive and it may not be desirable, definitely not desirable. From an industrial standpoint, we clearly explained to the people that we attempted to give them water that was satisfactory for all uses, but that there were a lot of times, due to circumstances beyond our control, such as a fire in the area or any disturbance from the system operation, when suspended or accumulated material in the system could be riled up and they could get dirty water.

If their process was one that required extremely clear water for their process, that they should assure themselves that by installing filtration. Examples would be in a film processing plant, an ice making plant, a laundry, or anything that was

dependent on having good clean water. For these, the user was advised to provide their own control so to speak.

This was particularly true and they were very eager to do so in two industries that moved into the Valley area. These were the Schlitz brewery and the Anhauser-Busch brewery. Of course, they were very particular about their water quality. In fact, we had several discussions with them and I spent a day with each of the design crews that were coming to build these plants when they were in their concept stage and they were interested in the water quality and they found that it was satisfactory for their brewing needs. Two of the things that they were concerned with were the presence of algae which could cause an off-taste in their product and the other was that it be clear and not cause any turbidity or clouding their product. So they did provide filtration at each of those installations and really had complete control over their supply of water.

It was necessary for a critical product like that because even a presence of an excessive chlorine residual could effect the product, cause an unusual or improper taste in their beer that would result in some complaints. So they realized that they were, we'll say, at the mercy of water quality, but at the same time that they should provide the protection.

NELSON: Who followed Ray Derby as division head?

REE: Ray Derby retired, I believe, in 1964 and he was followed by Joe Sanchis. Joe Sanchis moved up from the senior engineer

position that he had held for several years to division head and served in this position from 1964 to about 1966. At that time he retired and George Adrian became the division head; he was there for a little over ten years.

NELSON: One other issue. I believe it was the late 1960's, the continuing debate about adding the fluorides to the water came up and as I recall it was not added artificially to the L.A. water and that was because why?

REE: The primary source of water, the aqueduct supply, contained an appreciable amount of fluoride, approximately 6/10 of a part per million, which was close to the optimum amount that was required. In other words, a lot of the studies that had been done were done comparing zero fluoride with an optimum amount. There were very few studies done and what benefits would occur if you went from say 6/10 of a part per million to an optimum amount of 8/10 or one part per million.

We felt that the amount to be gained by that small increment was not worthy of it. We already had the natural occurring fluoride in this supply. It came into the supply primarily in the Hot Creek area up in the Owens Valley and it served as a benefit in that supply. The other supplies carried relatively lower amounts of fluoride, but because of the multiple points of entry, it was felt that it was not feasible to add the fluoride to them.

NELSON: Until very recently, I guess until 1987, the city water supply was not filtered. Then the Los Angeles Filtration plant was put into operation at the Los Angeles Reservoir. Was there a realization that filtration was going to be required at some point and why a central filtration plant versus smaller filtration plants at each reservoir, each outlet?

REE: I think there was a basic feeling in the division as far back as perhaps in the 1950's, maybe even the late 1940's, that at some point in time, filtration would be required. This was the reason that they had started some experimental work in the diatomite filtration. Sand filtration or rapid sand filtration, conventional treatment plant was pretty standard at that time. It was not necessary to do a lot of study on that, but diatomite or diatomaceous earth filtration was a "new wrinkle" so to speak. There were no design criteria, loading, plant size criteria and so forth and this was part of what was done in the Hollywood Experimental Filtration Plant (HEFP).

Obviously there was a feeling even that far back that at some point in time, filtration would be required. I think there were two things that delayed it in the Department. One was Department's own department management's concern that basically the water was pretty clear, had not caused any problems, any illness or anything like that and that it was safe to use and they didn't want to put out the capital investment for a treatment plant.

The other thing was that over the period of years starting back in 1914, a series of water quality criteria was established. First, these were applied by the Treasury Department on the interstate carriers and later they were expanded by the health service to include all public water supplies. Over the years these gradually were expanded. Initially very few items that were covered, or criteria that were covered; mainly they were ones that would cause gastronomical upsets such as high sulphates or high magnesium or copper or something like this that would cause a physiological problem.

Over the years these were tightened and made more restrictive and then in recent years, particularly after 1974 when the Safe Drinking Water Act was enacted by Congress, EPA came out with a series of requirements that were very restrictive, much more extensive, and covered a lot more criteria. These really tightened the requirements so far as turbidity from on the order of perhaps ten at one time, down to five, and ultimately down to less than one unit. As this became more restrictive on the Department, it was more difficult to meet without filtration so the extremely low turbidity requirements were one of the primary things that forced the Department to rethink it's requirements and add the filtration on the surface supply from the aqueduct.

In the years I mentioned, 1962, 1966, and 1968, turbidity levels as high as 30 units were often found entering Haiwee Reservoir. Due to Haiwee Reservoir's size and so forth, the outlet very seldom got above ten and there was some remedial treatment added up there to assure that it didn't get over that.

Even with ten units turbidity coming out of Haiwee, this would be virtually the turbidity entering the distribution system at Van Norman; this is one hundred fold above the present limits. There was no question that at certain times in the year, with lack of filtration, the Department could not meet drinking water standards.

I think two things occurred. One, the Department's attitude changed and it was either guided or at least accelerated somewhat by the federal standards that were tighter. At the present time, the health department is accepting the system without filtration at the other reservoirs such as Stone Franklin, Hollywood, Silver Lake, but the Department under pressure, and is considering filtration now at those locations and they are even undergoing studies on covering the reservoirs. This was one of the design considerations and location considerations that was given in locating the plant at L.A. Reservoir. The question was whether the aqueduct water should be brought into L.A. Reservoir, then filtered and go through a clear well and then directly into the system or whether the water should come directly into the plant to be filtered and then be stored in Los Angeles Reservoir. The latter was finally elected so that the reservoir stores filtered water. It is still uncovered which does leave it open to some types of airborne pollution and so forth which is not perhaps the best operation.

NELSON: From 1969 when you became engineer, what did you do in the next few years? Did you basically have the same assignments?

REE: I supervised two groups. The water treatment section, was involved in operating the treatment plants, and chlorination station. The other section, the water treatment research section was into a very intensive study on water reclamation. This involved taking waste water, secondary effluent from the Hyperion Treatment Plant, treating the secondary effluent with a tertiary treatment and making water that was suitable for reuse.

Two principle uses were under consideration then. The primary one was supplying tertiary treated water for injection into a sea water barrier in the El Segundo, Redondo Beach area. This barrier was stopping sea water from intruding into the west basin.

The other would be for industrial use in industrial processes or as a cooling water. One of the uses that was in close proximity was the Standard Oil refinery in El Segundo. If that proved feasible, this tertiary treated water could be piped south into the Torrance area or towards the harbor to possibly serve other refineries such as Union, Texaco and the others that were down in the Wilmington, Torrance area.

The study was done in a pilot plant located at Hyperion Treatment Plant. It was taking secondary effluent from what was normally being discharged off shore, passing it through a granular activated carbon column which would absorb organics and turbidity, leaving a tertiary treated water suitable for injection or for cooling towers.

The water being used at that time for the sea water injection barrier was from the Colorado River Supply. It was being sold at

$25 an acre foot to the West Basin Municipal Water District for injection into their barrier. So our goal was to provide a reclaimed water at or below the price of $25 an acre foot. We found that it could be done; it was feasible. The reason that it was not adopted was the concerns the State Health Department expressed for trace organics which they knew were present in the secondary effluent, but were undetectable in the tertiary effluent. The public health agencies were still concerned that any of those that might be present, might cause long lasting effects if it was used domestically and they didn't want to inject a water into the underground that they were unhappy with, that they had any qualms over. This was the reason that the State Health Department would not give us the clearance to use this reclaimed water for injection.

Another use for reclaimed water that was also considered was for green belt irrigation. The disadvantage there is that a separate system, a separate distribution system would be required to transport this water to wherever it's point of use might be. One of the uses that was considered was irrigation of the freeway dividing strip, or the landscape irrigation. This would entail a rather peculiar distribution system because it would be like 50 miles long and 50 feet wide and it was just not feasible to build a long, narrow distribution. If you had reclamation stations located along the freeways so that you distribution systems were reasonable length of pipe, it might be feasible.

Other irrigation uses that were considered were irrigation such as in the parks. Actually there is some reclamation of water

being done now with water from the upstream plant area in Glendale, reclaiming water at that site and using it for irrigation in Griffith Park. Their irrigation piping system in Griffith Park is separate from their domestic piping in the park and by having the two separate systems, they could use reclaimed water.

Actually the consideration of reclaiming water dates back many, many years, under Mr. Goudey's tenure back in the early 1930's. A lot of experimental work was done on the waste water coming from the north outfall sewer line in the vicinity of Griffith Park. Even back in the early 1930's, the Department was interested in the possibility of reclaiming water, but it was never economical. It was feasible, but not economical.

NELSON: When did you take over as acting head of the Sanitary Engineering division?

REE: I moved into the assistant division head position in, I believe it was 1983 or 1984. I don't really remember whether it was 1983 or 1984. It was upon the retirement of Bill Weight. He had been in that position for several years and he retired and I moved into there. I served as assistant division head for several years, probably three, before George Adrian retired as Principal Engineer and division head. He left the Department and went to San Jose and I assumed his duties, serving as acting division head while still a senior engineer. I was never promoted to Principal Engineer so I was only considered the acting division head.

NELSON: Were you on the Principal Engineer list?

REE: No. I don't believe there had been a Principal exam given for a number of years, at least during the time that I was working as a senior. My name never was on a Principal list.

NELSON: What about as you look back. Are there any people that you worked with that you particularly fondly remember? Or people who might have served in part as role models? People that you felt did a good job in some areas and you tried to emulate?

REE: There were two that stick out in my mind very strong. One was Harry Hayes, who was the assistant division head when I went to work there and the other was Donald Graham who was the section head that I worked under when I was first employed. My feelings might be tilted just a little bit here because these were the two people that had interviewed me initially and had hired me on an emergency appointment. But as I got to know them throughout the years, they were extremely concerned. They were very dedicated to the work and they were very good to work for. They were not demanding. They were considerate, very thoughtful. It was actually under Don Graham's direction, at the time that Ray Derby was division head, that a lot of the changes were made in the chlorination requirements/dosages that the reservoir quality studies were expanded, that a lot of more detailed work on system quality. It was actually a wholesale extension of some of the early corrosion studies that I had done when I first went to work

there, but it was done on a much more intensive and continuing program and studying a lot more parameters.

I think that in the years, early 1950's up in to the mid 1960's that large strides were made under these two people that were concerned with water quality and they were concerned with a lot of the developing methods of testing it and methods of improving it. At that time Don Graham was also in charge of the laboratory section which was under the guidance of Lester Louden, who was the chief chemist and Graham was very instrumental in following new techniques as they were developed. He served on several committees with the A.W.W.A. and Lester served on several committees with American Water Works Association and also the American Society for Testing Materials in determining procedures, laboratory procedures and so forth for making determinations and testing water.

TAPE NUMBER: 2, SIDE TWO

WILLIAM R. REE

NELSON: Bill, what was your interaction with the water system in the sanitary division?

REE: I think we got pretty good inter-reaction with the operating divisions. If we had a need for a main flushing or if we had a need for the construction crews to do some work at the station and so forth, they would get on it right away. They would do a good job. I got the feeling that there was, perhaps, a lack of understanding of what our mission in life was so far as some of the management at that time. In the early years they really didn't appreciate or understand what the Division was supposed to do, what the problems were that we were involved with and it was the Department's responsibility to maintain water treatment continually. It wasn't something that you could do without. It had to be reliable and the equipment had to be reliable and operating. There seemed to be a tendency that, "I'll put it off until next year, let's replace that machine later or do it later."

I think in later years there's been a lot more receptive action to the needs in the division. Perhaps it's due to the effect of the widespread knowledge and the distribution of the Safe Drinking Water Act. It has been described in a lot of the water works journals so that others outside of our division read it and realize that there is an outside mandate from the Federal down to the State and ultimately down to the municipal organization that certain things have to be done and that on the local or municipal level, you really don't have a lot of options. Thou shalt do so and so and that's it.

I think that's one of the reasons that, well in the 1940's or 1950's, that there would be no way that the Department would have ever built a filter plant at Van Norman and we now have one. As stated earier, it's due to two reasons: one in the requirements and mandates and also the Department's philosophy and thinking.

NELSON: I have heard over the years that the DWP sanitary lab was one of the best equipped, best personnel in the state. Is that true?

REE: We were told, at one time, by some of the inspectors who'd come by from the State to certify the laboratory that they felt that we were one of the top water laboratories west of the Mississippi. Another very good one locally is that operated by the Metropolitan Water District at their treatment plant at La Verne and we had a good rapport with them back and forth, checking

back and forth on analysis and procedures and so forth. We always had a good rapport with them over the years.

I think that in past years the laboratory personnel, laboratory section in our division, would have trouble in getting new equipment approved as a budget item. I'm thinking in terms of the cost of the dollars and cents for investment budget item for new equipment.

At one time the Department delayed getting the initial gas chromatograph which by today's standards would be a very crude one. The field of instrumental analysis has changed markedly. It has changed the nature of the laboratory; instead of running the gravimetric and colormetric determinations they are now run on various instruments and the budgetory aproval and acquisition of these instruments has always been a problem. That seems to be less of a problem now because the lab is well supplied with several of the latest spectrophotometers and gas chromatographs so I would say that the lab is keeping pace with the developments in the industry and is moving ahead as necessary as new tests will require. The current management is supporting that movement.

NELSON: Well Bill, in summing up, you had about 33 plus years with the Department, how would you sum it up, enjoyable? Drudgery?

REE: I never looked on it as a drudgery. I always enjoyed it. I was always glad to go to work. I enjoyed the type of work. I enjoyed the people I was interfacing with and working with both in

our division, in the field and whoever, other agencies and so forth. I would say, over all, it was a very enjoyable and profitable time spent. I appreciated the fact that my job was partly an indoor one, partly an outdoor one, that it involved occasional trips up into the Owens Valley which were always pleasurable. The variety, I think, was part of what I liked. I wasn't stuck behind a desk or doing the same thing day in and day out. It was plenty of variety and there was enough freedom that if you got bored with yourself, you could always say, "Well I've got to out to Hollywood Reservoir," and take the boat and go out and do some sampling on the reservoir just to get away from things.

I enjoyed the people that I worked with very much there. They were all very helpful and cooperative. Basically I have no regrets at all. We have some friends that worked in L.A. for an oil company and his kids and my kids had gone to school together. We went on vacations together and a couple of times when we'd come back from vacation, he would say, "Oh I've got to go back to work tomorrow," and his kids would say, "Well how come you dread going back to work, Bill's ready to go back to work?" So I think in general I looked on it as a very good employment. I'm glad I did not go into the oil refinery prospect or into the chemical business. I'm glad that they put that notice on the bulletin board back in 1947.

NELSON: Okay, thank you very much, Bill.