Narrative - C. S. D.

A M RAWN

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Compilation and Printing Authorized

by

DIRECTORS OF THE COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY, JUNE 26, 1963

NARRATIVE — C. S. D.

An account of certain facts and incidents occuring during the formative and growth years of the County Sanitation Districts of Los Angeles County — 1923 to 1961.

by

A M Rawn

Assistant Chief Engineer

and

Chief Engineer and General Manager

1924 -- 1958

COUNTY SANITATION DISTRICTS OF LOS ANGELES COUNTY

1965

FOREWORD

Following World War I, Southern California, particularly Los Angeles County, experienced phenomenal and unpredictable industrial and residential expansion. Public demand for all utilities was acute, but perhaps one of the most perplexing problems to be solved was the safe and economical treatment and disposal of the ever-increasing volume of sewage and industrial waste. Sewerage was to be complicated not only by a crazy-quilt pattern of development, but also by the innate suspicions and jealousies which seem to characterize urban development. Sanitary engineering practice was subject to much controversy and some conjecture.

To further complicate this situation, a comprehensive program of financing, administration, and operation of sewerage facilities on an integrated basis was a completely new concept. The author, A M Rawn, has paid tribute to A. K. Warren, the District's first Chief Engineer, for his vision and ability as an engineer and administrator. Warren was apparently, also, a good judge, and leader, of men. Upon his untimely death in 1940, the Sanitation District concept, having survived the early years and matured, was quickly solidified under the new Chief Engineer, A M Rawn. It is interesting to note that while some of the early feuds are lightly touched upon in the text by Mr. Rawn, to the participants they were deadly serious, and bitter feelings undoubtedly existed. Fortunately, later generations have not had to battle similar odds and enmities.

While the Warren administration could be properly classified as the "formative years" of the Sanitation Districts, the period under Rawn can best be described as the "progressive and stabilizing years." During this latter period the sanitary engineering profession grew in stature and public respect. Sanitation District policy developed a reputation for fast prompt action and economic operation, much of which was based on the personal reputation of Mr. Rawn. Upon his retirement at the age of 70 in 1958, he had prepared an organization ready to carry on under the able leadership of Mr. C. R. Compton. Retirement of Mr. Compton in 1961 truly marked the end of an era. With the exception of Mr. Harry Chapman, Superintendent of Maintenance, all of the men who had contributed so much of themselves toward building and guiding the early destiny of the Districts had passed from the active scene. Only time will tell how well we, who have been given the privilege of carrying on, will meet the challenge. Certainly the opportunity is all that we can ask.

John D. Parkhurst
Chief Engineer and General Manager
COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

PREFACE

The Narrative spans a period of years in the life of Los Angeles County during which the County Sanitation Districts were a significant factor in the County's development. With inclusion of each new District into the joint system, provision was made for trunk and outfall sewers and for sewage disposal for the entire new District area, encompassing, in most cases, large tracts of undeveloped land. Residential development and industry were quick to take advantage of the already resolved sewerage problem. It is not unlikely that availability of adequate sewerage was a deciding factor in determining the course of expansion.

The Districts' relation to the era seemed worth recording, particularly with respect to some of the events which live only in the minds and memories of those who were in the picture from the start. It is hoped that the Narrative reflects these recollections; it is not presented as an engineering report nor yet, as a documentary accounting.

It has been difficult to write this story and not mention the names, and comment on the helpful assistance of, the scores of District Directors. These men and women, Mayors of District Cities and Supervisors of the County, numbered some seven hundred over the nearly forty years covered by the Narrative. Some served for short intervals, many for a decade or more. Their policy determinations and helpful guidance have maintained the District joint enterprise as a truly sound, democratic force. Their constant guidance and confidence has been a source of pride to the employed staff.

As portions of the story were written by the author they were submitted to members of the present staff for comment and criticism, which same was tendered in large doses. The fact that the critics were probably in grammar school or kindergarten when the first District bonds were voted did not, in any sense detract from their interest in the story. Their helpful comments were gratefully accepted.

Despite the impressive growth of the Sanitation Districts' facilities and the sturdy, useful system of sewerage and refuse disposal which District effort has created, it is obvious that there will need be continued expansion and improvement of it to keep pace with the growth of the great metropolitan area which the system serves.

A M Rawn

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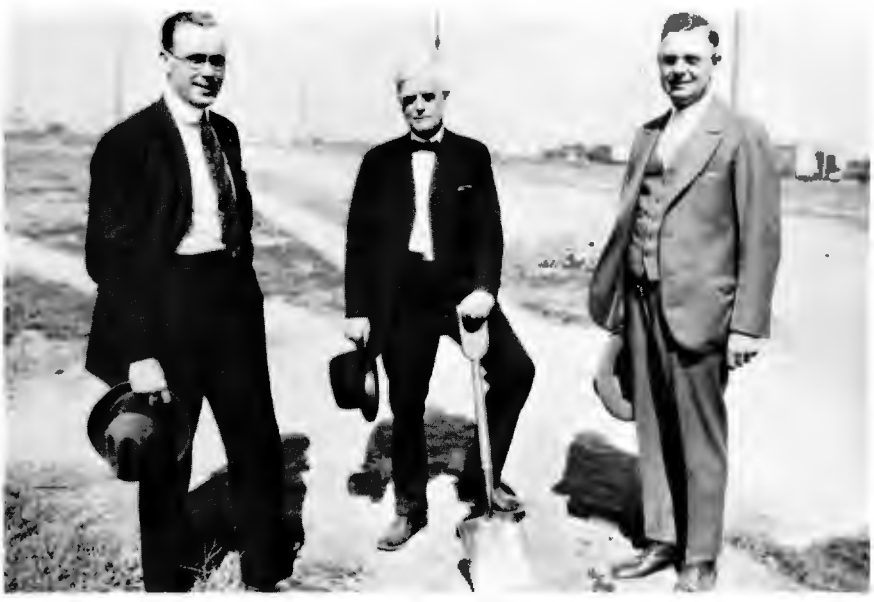
Chapter 1

DISTRICT ORIGIN

The broad concept of County Sanitation Districts in Los Angeles County originated in the minds and vision of A. K. Warren, Hugh Pomeroy, and R. F. McClellen.

Albert Kendall Warren was employed by the Los Angeles County Surveyor on September 1, 1914 as an instrument man. He was promoted three times and by March 1, 1924, had achieved the grade of Construction Engineer. His field of activity was storm drainage. He was a man of great determination; one with whom action followed closely on the heels of inspiration. Warren had few close friends and fewer activities outside of his professional life. His knowledge of the County was phenomenal. He was particularly well informed about the political and physical characteristics of the County area in which drainage of storm waters was becoming increasingly important as the County was populated. While technically Warren was working under the direction of John Rockhold, County Surveyor, there is little doubt but that his plan for sewerage of the southern plain of the County on a District-wide basis contemplated himself as its Chief Engineer. He was so indissolubly associated with the plan that those who supported it never evidenced consideration of any other candidate and Warren had a clear field. Nothing could have been better for the future success of the Districts than his appointment.



INAUGURATING THE JOINT OUTFALL SYSTEM — Although the South Bay sewers were well along, the first job to be constructed in the joint outfall system was the Wright Road trunk. Ground was broken September, 1925, near the intersection of Atlantic Boulevard and Fruitland Avenue, north of the north boundary of Maywood, by (from l. to r.) Hugh Pomeroy, Supervisor R. F. McClellen, and Sanitation Districts Chief Engineer A. K. Warren. The shovel is now in the office of the present Chief Engineer, John D. Parkhurst.

Hugh Pomeroy was elected to the State Assembly in 1922 and served through the 1923-24 term, representing the south Santa Monica Bay cities area. He was appointed Director of County planning in 1924 and served ex-officio as Secretary of the Boards of Directors of the County Sanitation Districts until the appointment of C. J. S. Williamson in 1925. Pomeroy was a man of strong personality, eloquent, and of exemplary conduct. He was well-schooled in politics and debate and endowed with a natural ability to capture an audience on most any question. In 1923, he introduced, and guided through the Legislature, the Bill, which became the District law.

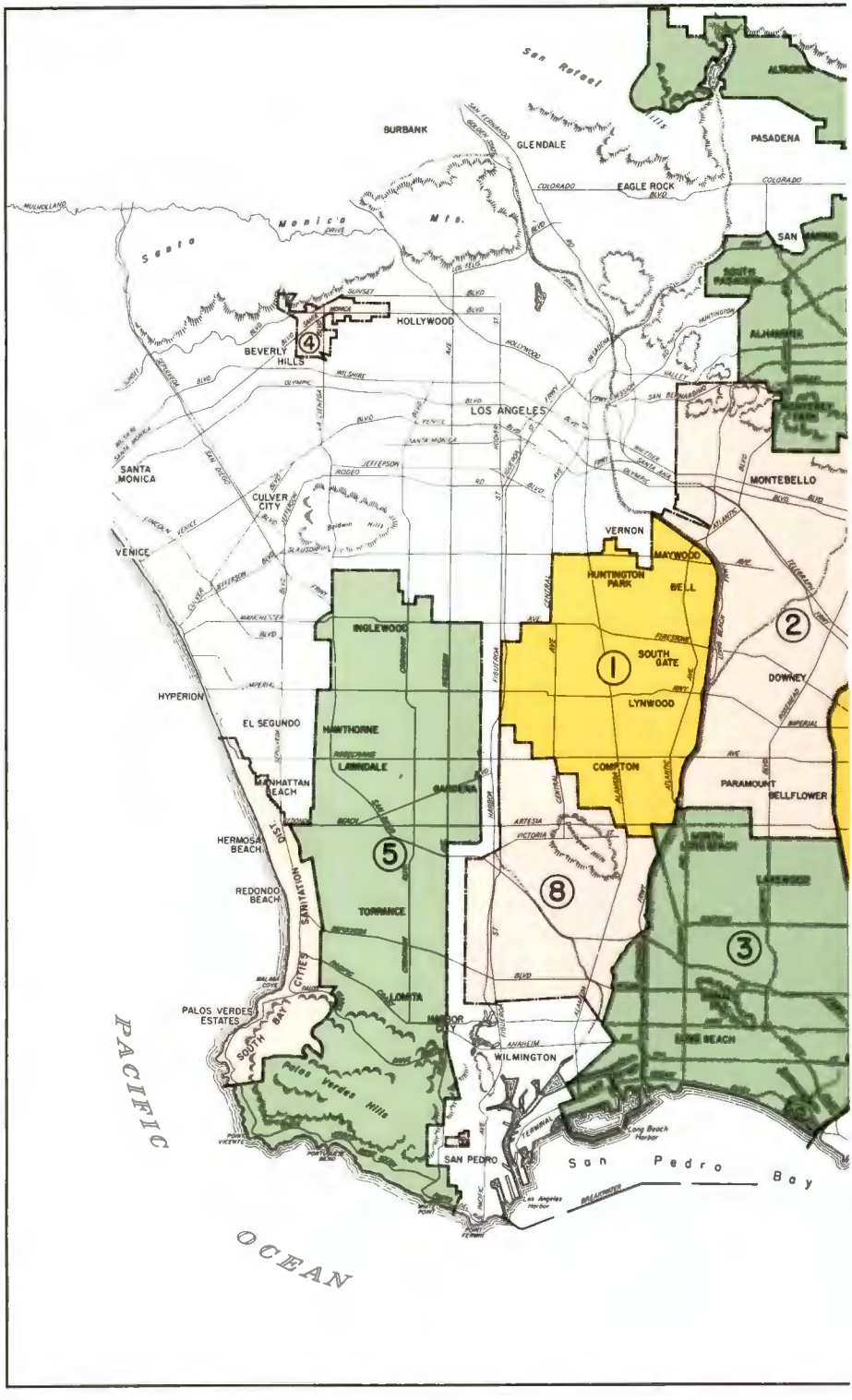
R. F. McClellen was Chairman of the Los Angeles County Board of Supervisors at the time the County Sanitation District Act became law. He was an important figure in District formation and government. McClellen was wholeheartedly in favor of the

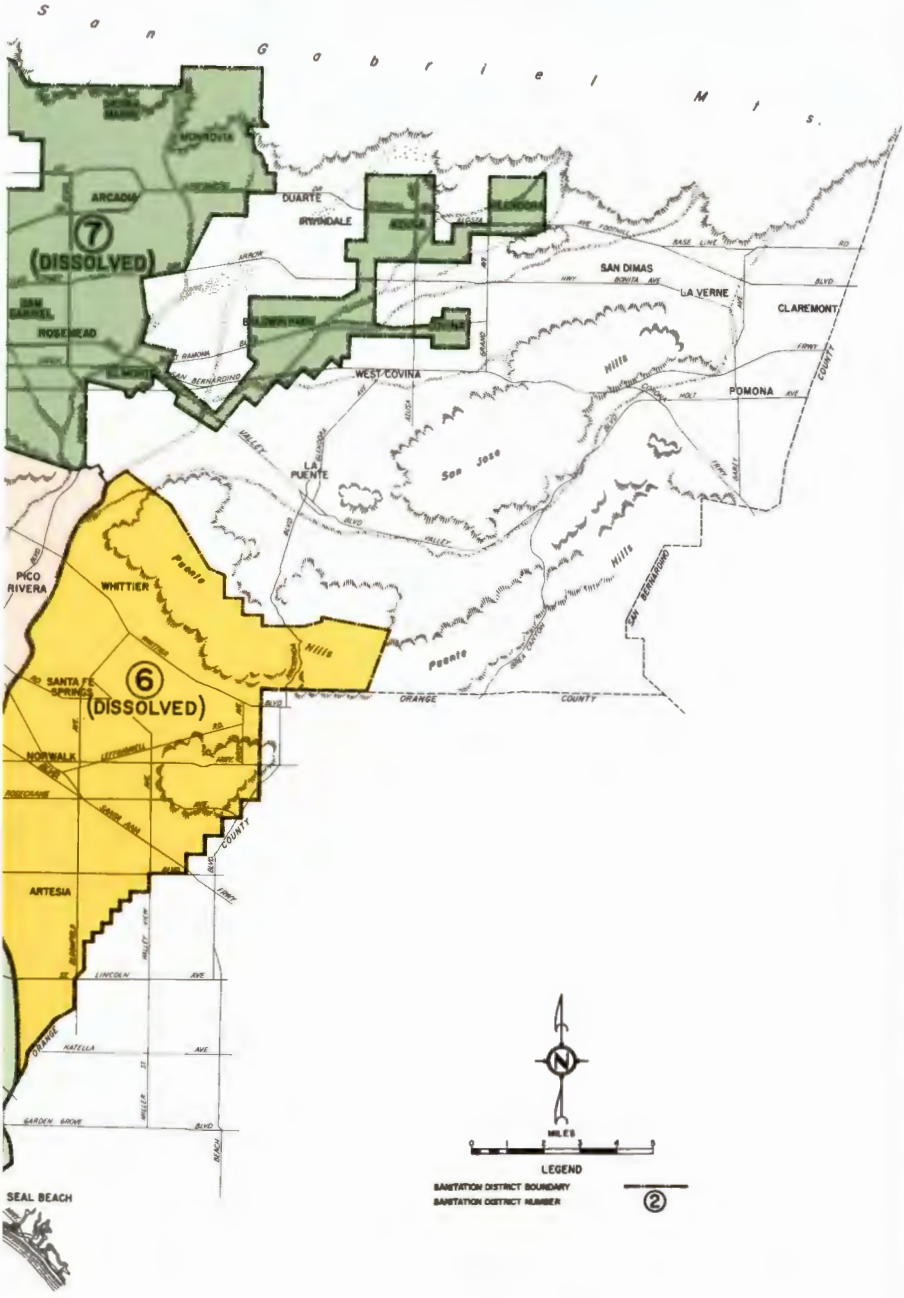
Districts and supported, without stint, the furtherance of the Act and setting its provisions in motion. He was a formidable man, an old "Sourdough," who carried his Alaskan characteristics into his everyday life and was well known for his clear ideals of honesty and justice. A very highly respected and much loved man, he had great faith in Warren.

No doubt Warren's experience in use of the Drainage District Improvement (DDI) Act influenced his thinking when, in the early 1920's, he contemplated the sewerage situation in the southern plain of Los Angeles County. The regional features of that law probably seemed to him applicable to the situation which was developing, and indeed had developed, in, or about a number of the more settled areas. Neighboring city boundaries met in a number of locations and, at times, relief was sought by joint action in disposal of sewage; few of the existing sewerage works were adequate or properly operated. Some cities were vainly trying to find suitable locations for sewerage works within, or without, city boundaries. Warren and his associates saw an intolerable condition in the making and concluded, wisely, that it could not be solved piece-meal, but rather as a whole. Fortunately, they had the courage to tackle the problem with that vision in mind.

There was little actual precedent for such a plan as was contemplated. Systems were elsewhere in the making, seeking to correct situations similar to that which could occur in the Los Angeles County area in the absence of preliminary corrective measures, but nowhere appeared a system of trunk sewers known to be built, or contemplated, for an undeveloped area, as extensive as that envisioned. Certainly no one but a man of great courage and vision would undertake the promotion of a plan which, while being financed by all of the land which it could serve at some distant date, was of immediate benefit to but a small fraction of the debtor area.

The southern plain and valleys of the county are topographically separated from the northern county area by a range of hills extending east and south from south of Glendale to join the Puente Hills north of Whittier. This range of hills is broken at two points; one lets the Los Angeles River through and the other, a wider gap, passes the San Gabriel River and the Rio Hondo into the lower


San Rafael
Hills
BURBANK
GLENDALE
PASADENA
EAGLE ROCK
COLORADO BLVD.
MULHOLLAND DRIVE
Santa Monica Mts.
SAN MARINO
ALHAMBRA
SUNSET BLVD.
HOLLYWOOD
BEVERLY HILLS
4
WILSHIRE BLVD.
OLYMPIC BLVD.
LOS ANGELES
SAN BERNARDINO FWY.
SANTA MONICA
SAN DIEGO FWY.
CULVER CITY
JEFFERSON BLVD.
RODEO RD.
MONTEBELLO
VERNON
MAYWOOD
VENICE
HUNTINGTON PARK
BELL
INGLEWOOD
1
SOUTH GATE
2
DOWNEY
HYPERION
EL SEGUNDO
HAWTHORNE
LYNWOOD
LENNOX
LAWNDALE
GARDENA
COMPTON
PARAMOUNT
BELLFLOWER
MANHATTAN BEACH
HERMOSA BEACH
5
8
3
REDONDO BEACH
TORRANCE
LAKEWOOD
PALOS VERDES ESTATES
SOUTH BAY CITIES SANITATION DIST.
LOMITA
HARBOR CITY
ANAHEIM
WILMINGTON
LONG BEACH
Palos Verdes Hills
Long Beach Harbor
SAN PEDRO
San Pedro Bay
Los Angeles Harbor
PACIFIC
OCEAN



COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY, CALIF.

ORIGINAL SANITATION DISTRICTS (1924)

plain. North of the Puente Hills lie the San Gabriel Mountains and between the two ranges, extending east and northerly lies the San Gabriel Valley.

From the westerly pass through the hills, the Los Angeles River flows southerly to join with the Rio Hondo and discharge into the Pacific at Long Beach. The Rio Hondo flows through the eastern pass, thence west and south to join the Los Angeles River, while the San Gabriel, flowing through the eastern pass, continues south, joins Coyote Creek, and discharges at the east county line. Above the eastern pass, the San Gabriel is joined by San Jose and Puente Creeks.

The lower course of the Los Angeles River is determined by the Dominguez Hills and Signal Hill. The river flows between them and is kept in its channel and prevented from following its old course toward Redondo Beach, by the Dominguez Hills. The San Gabriel is prevented from joining the Los Angeles and flowing west by Signal Hill, the same topographical feature that keeps the Los Angeles from flowing east. Actually; the only surface outlet into the ocean to the south is San Pedro Bay, which is, and has been for many years, the harbor area of Los Angeles and Long Beach.

The entire southerly plain of the county has a general slope to the south, but the sand hills along the western shore, the San Pedro Hills and Signal Hill to the south, and the Los Angeles County Boundary limit a gravity surface outlet to the general harbor area. The influence of these topographical features and the east county boundary are apparent in the eventual choice of a route for disposal of District sewage to the sea.

Even had there been a natural surface outlet to the west from the southerly plain, it is likely that it would not have influenced District consideration of ocean disposal very much and for very good reasons. There was a desire to preserve the beaches of Santa Monica Bay and those at Long Beach from danger of contamination by discharge of large quantities of sewage effluent into the littoral waters. The City of Los Angeles, which had followed the course of Ballona Creek to the west with its system to discharge sewage, and later, sewage plant effluent almost in the geographical center of Santa Monica Bay beaches, was in deep trouble

with the Bay Cities. Los Angeles was in the process of constructing a more modern sewage treatment plant and ocean outfall which, it was hoped, would cure the deplorably insanitary condition which the city sewage was creating. It was felt by all concerned in the District plan that the best protection to recreational waters, particularly those used for bathing, was to locate sewer outlets, if possible, in an area remote from such waters.

In the early 1920's, when the Districts were being first considered, there were more than five hundred water districts or water dispensing agencies in Los Angeles County. It must be admitted that some of the supply, from wells being pumped, originated as sewage. Flowing underground, the water from individual cesspools, septic tanks, percolation beds, and municipal sewage treatment plants reached underground sources, purified to the extent of safe use for domestic purposes. Particularly in dry cycles, this was a factor in replenishing subsurface water pools. Storm runoff reached the underground only via percolation along the natural drainage routes. With increasing population and consequent water use, the water tables were getting lower year by year and the wasting of fresh water to the ocean in the form of sewage, was condemned by many. These critics felt that the sewage should be treated in land-based plants until it was in safe condition for use in industry and agriculture. The District proponents, while admitting the possibility of such conservation, reasoned that the primary consideration was unfailing sewage disposal which did not depend upon complete purification for disposal. As a counterproposal it was argued that, once the disposal system, as such, was completed, sewage from selected residential areas could be used as a raw water supply and water conservation accomplished by separate treatment.

The proponents of the Districts and the plan for sewage disposal to the ocean were not unmindful of the need for both water conservation and increased importations from distant sources. The Owens River water had been delivered to Los Angeles City through the efforts of the great William Mulholland; yet, although it was anticipated that the acquisition of this supply was sufficient for the needs of two and a half million population, speculation was in the air that more would be needed for the metropolitan area and

engineers were looking towards the Colorado. Those who urged treatment of District sewage to a degree such as would produce usable water and, at the same time, dispose of the sewage problem, were not easily convinced of the Districts' intentions. In advancing their own arguments, however, they contributed to the cause of sewerage by bringing to light the complexities of the job and the potential possibilities on a districtwide scale.

In 1923, when the County Sanitation District Act became law, the population of the County was estimated to be 1,300,000 of whom 775,000 resided in Los Angeles City. There were forty incorporated cities in the county at the time; thirty-two in the proposed District area and eight which, for one reason or another could not be readily served by the District plan. In addition, there were many unincorporated settlements or communities. Of the communities, thirty-nine were in the anticipated District area. Much of the area was given to agricultural pursuits and supported a rural population.

No part of Los Angeles City was included in the original District scheme. This proved to be a very wise move, since it avoided conflict of interests with an already established large sewerage authority. It was apparent, however, that certain small areas proposed to be served by the Districts could best be served through the system of the City and vice versa. All was not harmonious between the City (Los Angeles) and the smaller cities and unincorporated villages in the early 1920's. This antipathy engendered distrust, manifested, naturally, by the weaker and less powerful. There can be no doubt but that inclusion of Los Angeles City, or any part of it, in the original District plan would have been a deterrent to the plan's acceptance by many in the suburban and rural areas. It was not proposed that Los Angeles participate. Had it been, it is doubtful that Los Angeles city authorities would have accepted it without concessions greatly to the advantage of Los Angeles.

There was some ill-feeling at the time between engineers of the City and those engaged in the District enterprise. Mostly, it was resentment at the show of arrogance displayed by Los Angeles officials at any attempt on the part of the rest of the County to act collectively, independent of the big City. H. A. Van Norman was

City Engineer in the early 1920's, and his assistants in charge of City sewerage activities were W. T. Knowlton and H. G. Smith. These three men took an active interest in the proposed District scheme and Van Norman devoted considerable time to inspection and study of the entire proposal once the District Act was law. Van Norman was a man of great influence in Los Angeles affairs. He supported Warren in the latter's efforts and was wholly in sympathy with the proposed District plan of coordinated effort and ocean disposal. Warren often spoke of the value of his help.

Despite the friendship and help of Van Norman, Knowlton and Smith, there was a feeling on the part of Knowlton and Smith which inspired them to hold somewhat aloof from active participation with the Districts. They would brook no criticism of the City's sewerage system despite the deplorable condition which existed, not only at the ocean outfall at Hyperion, but in many of the main trunk sewers which were rapidly being destroyed by inadequate control of hydrogen sulfide generated in the sewage. Knowledge of sulfide control, as well as sewage dispersion in sea water, was not well understood at the time, and the City had made little effort to determine a proper course of action. It seemed to disturb them to have the Districts embark upon a plan which had as major objectives the correction of errors which were so evident in the City's lines and outfall. Also, they were embarrassed at having the City outfall permanently located in the center of one of the most popular and, certainly, most valuable recreational beaches in the world, when it could readily have followed the course proposed for the District trunks, with discharge into ocean waters in an area unfit for bathing or most any other water sport except boating.

Assistance in furthering the District plan was forthcoming from most of the engineers and managers of the cities proposed to be included in the District plan. Opposition developed in three cities, however, and for an understandable reason in each: Long Beach, Pasadena and Pomona each had a satisfactory sewerage system in operation and these cities were not inclined to promote the further expenditure of money for a job which they felt was, for them, adequately completed. Their city engineers quite properly reflected this view. Little support was had from the engineers in private practice in the area, nor was any great contribution expect-

ed from them. It was apparent that the District plan would obviate the necessity for small sewage treatment plants in and about the cities and towns in the County and the reluctance to support a plan which would diminish prospects for themselves was understandable. Some pretty harsh things were said publicly about Warren and his plan, but the statements had little effect upon his proposals and absolutely none upon Warren himself.

Some years prior to the proposals which led to the District plan, the Los Angeles County Surveyor, John Rockhold, had effected an agreement with the United States Geological Service whereby the two agencies, U.S. and County, were to jointly prepare standard geological maps of the entire area of the south plain of the County. Some of the maps were completed before the District plan was proposed; others were in preliminary form, but usable. All of the area was covered by the vital information which is the "hallmark" of these maps. To say that the maps were helpful would be a gross understatement. Actually, they made possible a preliminary office study of the area that would otherwise have taken months of expensive field surveys and an impressive amount of money not then available.

As conceived by Warren and his associates, the area proposed to be sewered by the District plan, comprising some 550 square miles, was (a) that portion of the southerly plain of Los Angeles County lying between the western boundary of the Los Angeles City "shoestring" strip and the Pacific and extending from the north boundary of Inglewood and Manhattan Beach, to, and including, the Palos Verdes Hills; (b) all of the area in Los Angeles County lying south and southeast of the southerly boundary of Los Angeles City, Monterey Hills, Whittier Narrows, and Puente and San Jose Hills, excepting any part of Los Angeles City; and (c) all of the county lying south of the San Gabriel Mountains in the San Gabriel Valley.

Of the 32 incorporated cities in the proposed District area, 19 were unsewered, depending entirely upon individual cesspools and septic tanks for disposal of domestic and limited industrial waste. Of the 39 unincorporated villages, one was partially sewered. No sewers were extended into the rural settlement areas. Thirteen of the incorporated cities had built sewage collection

systems and disposal works, mostly of indifferent quality and limited capacity. There were but five adequately designed small plants.

A considerable part of the City of Long Beach was sewered to a screening plant at the Long Beach harbor entrance. A portion of the sewage of Hermosa Beach was treated in a septic tank under the City Hall and part of Redondo Beach sewage was run into percolation beds near the northeast corner of the city. Compton was sewered in part to an Imhoff Tank which discharged effluent to Compton Creek in an area which now is a small municipal park.

Sherman (unincorporated) in West Hollywood was served by a sprinkling filter plant that had been constructed there to serve the commercial section of the settlement. Effluent from the plant flowed through an open ditch to a tributary of Ballona Creek.

Torrance was sewered to an Imhoff Tank near El Prado and Western Avenue. Effluent from the plant flowed into ponds of "storm runoff" which accumulated to the northeast of Torrance.

Pasadena had built an activated sludge plant in cooperation with South Pasadena and Alhambra. Later a contract with San Marino permitted that city to sewer to the plant. The Tri-Cities Plant (as it was called) discharged to the Rio Hondo and much of the discharged water or effluent found its way into the underground pools from which water was pumped for unrestricted use. The plant was well and expertly operated, presented a pleasing appearance, and, for the most part, produced a satisfactory effluent. Troubles were experienced with odors and the disposal of sludge, but the plant was of such character as to delay the District plan in the San Gabriel Valley for many years.

Pomona built a plant similar to the one at Pasadena. It served Pomona and La Verne, (and later, Claremont,) discharging its effluent to San Jose Creek or selling it, when needed, to neighboring ranches. Capacity of the plant was increased in a commendable manner. Like the plant at Pasadena, it served its purpose well as a substitute for regional sewerage. El Monte sewered to a sprinkling filter plant situated southwest of town and discharged plant effluent to the river, whence it flowed to join the Pasadena plant effluent and replenish the underground pools.

Monrovia sewered to a septic tank near the Rio Hondo wash

at Peck Road and Live Oak Avenue. Effluent was discharged to the wash and probably found its way to the underground pools.

Whittier disposed of sewage from a city collecting system through an outfall to a sprinkling filter plant near Imperial Highway and Carmenita Road. It was a well run plant and effluent from the plant replenished the underground pools in the area or was diverted directly from the open effluent channel to agriculture.

It was surprising to learn how few citizens knew that household sewage was an important source of well water. Cesspools and leaching beds contributed water from sewage to the soil whence it eventually joined pools from which domestic water supplies were drawn. On rare occasions, tastes and odors from aromatic substances in the waste water source apprised the user of its nature, resulting usually in complaints, soon forgotten. That some were aware of the value of local disposal of sewage as a means of replenishing water pools was reflected in their opposition to the District plan of ocean disposal, although it is possible that the thought of using sewage as a domestic water source stirred up such revulsion of feeling in most that it won as many supporters to the District plan as were lost by cold economies and logic.

In the 1920's, there were many unincorporated communities in the County which could have incorporated had they so desired. A number of them were of greater population than some other of the incorporated cities. How many of the incorporated cities had taken that step in order to be in position to forestall location of a neighboring city's sewerage works in their midst is not known to this narrator, but two examples come to mind—Monterey Park and West Covina. It is said that the Tri-cities plant had designs on establishment of a sewer farm in the area where Monterey Park now stands, and Covina had designs of a similar nature on the West Covina Area. It seems reasonable to surmise that other cities in the area, clustered together in groups, were organized in that manner for similar protection. It seems fair to say that lack of adequate sewerage, or the fear of encroachment from the sewerage works of neighboring cities, carried considerable weight in the decision to incorporate. Further validity is given this

conjecture by the knowledge that incorporation of cities came almost to a stop with the advent of the Sanitation District plan, and was dormant until 1956, at which latter date the tax situation induced many communities to incorporate. From 1927 to 1954 there were but four incorporations. From 1954 to 1964 there were 27. Both references are with respect to cities served by the Districts.

Chapter 2

ORIGINAL DISTRICTS FORMED

There was no great resistance to passage of the County Sanitation District Act in the State Legislature. At the time (1923) the Act was thought by most legislators to apply to Los Angeles County quite specifically and would have little, if any, effect upon other areas in the State. Pomeroy probably fostered the same thought. Indeed, in 1923, there was little reason to believe that other metropolitan areas in California would be troubled by lack of sewerage in the foreseeable future, at least to the extent that was anticipated in Los Angeles County.

The new law assigned to the County Board of Supervisors the duty of forming County Sanitation Districts. The law required that the resolution of intention to form the District should contain, among other features, a description of the proposed District boundaries or a statement of its area. In two of the proposed Districts under consideration in 1923 and 1924 it was easy to meet this requirement but in the others a great deal of study was necessary. For instance in the case of District 4, the area to be included could be none other than the full extent of a small county island, entirely surrounded by Los Angeles and Beverly Hills with disposal of sewage to the Los Angeles system. In the case of South Bay Cities Sanitation District the District area was obviously limited to Bay Cities on South Santa Monica Bay shore and

small portions of county territory in the neighborhood. Sand hills to the east of the cities and lack of any sewerage facilities east of the sand hills effectively established the eastern border of the District, while the new, and presumably adequate, sewerage works of the City of Los Angeles plus the City's willingness to treat and dispose of the South Bay sewage, adequately defined the extent and boundaries of the Bay Cities District.

Defining the extent and limits of the other larger districts was not without its difficulties. All of the many relevant factors entering into a determination of the extent of a large sewerage area were present in each and, while no cost estimates were required to be furnished to the Supervisors prior to submission of their resolution of intention to form the District, such were required for comparative purposes in arriving at the proper area to be considered as a unit, or District. Additionally it was necessary to be reasonably sure that the need for adequate sewerage was recognized by influences within the proposed District and that there would be as little as possible lack of harmony in Districts affairs, once the District was formed. Unfortunately there was no provision in the District law, at the time, for funds for financing the cost of such investigations. Fortunately other means were at hand. Their application to the problems faced at the time is not without interest.

Again it may be emphasized that the U.S.G.S. maps prepared by U.S. and County forces almost concurrently with inception of the Sanitation District plan, were of such importance to the plan that it is difficult to imagine how it could have gotten off the ground without them. These maps not only supplied all of the basic data required for a preliminary reconnaissance of sewer grades and appropriate routes, but also District boundaries, distances and elevations (the latter adjusted to a single datum plane). Had the proponents of the Districts been confronted with the necessity for making any significant part of the surveys required in their preliminary investigations and comparisons the early promotions could have dragged on for years without some other adequate means of financing than the District Act offered.

Financing investigation of the Districts was achieved in two ways. Beginning in early 1924 Warren, at that time in charge of

the storm drainage department of the County Surveyor's office, employed a limited number of engineers to assist in design and construction of projects initiated under the Drainage District Improvement Act (DDI) of 1921. For this purpose he was authorized to employ some individuals not classified under County Civil Service. It is likely that both Warren and the County Surveyor (his boss) appreciated that there was considerable work and investigation ahead in connection with the County Sanitation Districts for which no specific financial support had been arranged and that it would be necessary for the county to supply the technical help required at its (the county's) expense. This, it was thought could best be done by utilizing Warren's storm drainage staff to help as needed in the pending Sanitation District preliminaries. Following this course of action four engineers assigned to assist in storm drainage were also engaged for a material part of their time in the Sanitation District study.

Another very important contribution to the cost of preliminary investigation and planning in the Sanitation Districts was the use made of the Improvement Act of 1911, as applied to County Improvements. Under this law the county forces were authorized to conduct investigation in, and prepare proceedings for, local sewerage construction. At any stage in the proceedings the project could be abandoned for cause and the cost up to the time of abandonment absorbed by the county. Although it was unnecessary to present an estimate of the cost of improvements in a resolution of intention to form a Sanitation District it was necessary in making comparison between possible alternative plans; furthermore, once the District was formed a fairly precise estimate of cost was needed upon which to base a bond election. Use of the C.I.D. Act of 1921 permitted the investigating engineers in Warren's staff to divide each proposed Sanitation District into potential Improvement Districts and in the investigation of the latter, coupled with predetermined factors and methods of sewage treatment and disposal, to prepare comprehensive plans and estimates for the trunk sewers and disposal facilities of each Sanitation District under consideration. Once the plan and estimate for each was completed the local C.I.D. proceedings were abandoned.

Barring limited operation and maintenance funds in South

Bay Cities Sanitation District, which probably became available in late 1924, the Sanitation Districts were without funds of their own until sale of bonds in Districts 1, 2 and 5 in June 1925. A joint administration agreement, to which all active Districts were signatory, was probably invoked to carry the limited staff salaries for April and May, 1925.

It seemed necessary to relate the foregoing financial difficulties and arrangements, and the relation of the engineering employees engaged on District work to their job, in order to point out that records covering this phase of Sanitation District development in Los Angeles County are unavailable, except for the memory of two or three former District employees who have not yet passed on and the daily log, or diary, kept by Rawn who was employed by the county in April 1924, appointed Assistant Chief Engineer of the Districts in May 1925, succeeded Warren as Chief Engineer and General Manager in 1940 upon Warren's death, and retired in December 1958. This record, professional in content has been drawn upon to furnish factual data, and refresh memory for parts of this story, and to supplement recorded data elsewhere.

It was obvious to the most casual observer that if the area (some 550 square miles) was to be sewered on a regional basis, sewage would need be concentrated in the southerly reaches of the area. Dealing with it there, or at intermediate points, could await determination of the best plan available under the circumstances. Additionally obvious was the fact that time was of the essence and that even though a full and complete program and plan could not be developed immediately, certain elements in any scheme selected would be sufficiently similar to all others under consideration as to effect relative costs very little. This had the final effect of determining District boundaries on factors other than final method of disposal, and allowed adapting the District areas to drainage possibilities and community cooperation. Importance of the time element rested in the Districts' need of money and the inability to get any until the Districts were formed allowing the Districts' Directors to authorize a two cent levy on District property or float bonds for construction funds.

Warren took advantage of this to define the boundaries of all of the Districts under consideration at that time and submit to the

CHIEF ENGINEER AND CONSULTANTS AT WHITE'S POINT — The Chicago firm of Pierce, Greely and Hansen was retained to report on the feasibility of the Districts' plans and to assist, if required, in the R/W condemnation proceedings for White's Point. Pictured left to right: Pierce, Warren, and Greely.

Board of Supervisors the information needed in the Board's resolutions of Intention to form the several Districts. District South Bay Cities was formed in late 1923 following a formation election held in the area for that purpose. Districts 1, 2, 3, 4 and 5 were formed in 1924 and Districts 6 and 7 (both later dissolved) were formed in 1925 as was District 8. All Districts were formed without protest and, except for South Bay Cities, without election.

Concurrent with the investigation requisite to defining District boundaries, a good deal of attention had been given to methods and means of treatment and disposal of District sewage. The choice, of course, was either complete treatment with disposal of effluent to storm drains or flood control channels, or primary treatment only, with disposal of the plant effluent to the ocean. The comparison had all of the questions and perplexities usually attendant upon such a choice, however, the conclusion

reached was that the area could best be served by an infallible system incorporating removal of the grosser suspended solids from the sewage at works situated on shore, leaving to the ocean waters the job of final purification.

Topographic features, heretofore described, limited access to the ocean for disposal of sewage to three possible routes; (a) an outfall through the Los Angeles or Long Beach Harbor, to discharge seaward of the breakwater, (b) a large diameter line atop the westerly breakwater to discharge seaward near the end thereof and (c) a tunnel under, or a pump system over, the Palos Verdes Hills with discharge offshore from the south shore thereof. Of the three only one, (c), appeared possible. To build through either Long Beach or Los Angeles in order to reach Harbor waters required the unanimous consent of the City Council of the city through which the sewer was to be built and, although it is not believed that either Council took official action in the matter, it was well understood that neither City would consent if petitioned. Thus the choice was limited to reaching the south Palos Verdes shore without encroachment upon public property in either Long Beach or Los Angeles.

Having decided upon a plan, or plans, for treatment and disposal of sewage from the several Districts under consideration and having delineated the area and boundaries of such Districts, it was required that an engineering report and plan for each District be presented to the respective District Board of Directors for public hearing and approval. The estimate of cost accompanying the report formed the basis of a bond election designed to provide funds for construction of the necessary works. Plans for Districts 4 and South Bay Cities provided disposal, under contract, to the system of the City of Los Angeles. Plans for Districts 1, 2, 3, 5 and 8 were developed anticipating that the sewage of all of these Districts was to be collected into one location, treated there in a jointly owned and operated plant, and discharged to sea through jointly owned facilities. Obviously in such a plan, economy would result in the ownership and use of jointly owned trunk sewers.

Although there was no provision in the District law specifically authorizing joint action in the ownership and use of facilities, such action was deemed proper by District Counsel and

accepted as appropriate by the District Boards. Successful bond elections were held by Districts South Bay Cities, 1 2, 4 and 5 between September 1924 and June 1925. District 8 voted bonds in April 1929 after losing a try in January 1926. Districts 3, 6 and 7 failed to authorize elections and 6 and 7 later dissolved.

With five Districts financed, and another impending, the Districts were ready to separate entirely from the County Engineer's Department and organize their Joint Administrative and Engineering Authority. This was accomplished in March 1925 on the fourth day of which month, A. K. Warren, to no one's surprise, was appointed Chief Engineer and General Manager, and instructed to organize a staff of permanent District employees. A number of the events which occurred in the year or so preceeding establishment of the Districts as an independent office and which had a pronounced bearing on the future of the Districts seem worth a little comment.

Chapter 3

SELECTING DISPOSAL SITE

The characteristics of the south Palos Verdes shore appeared so favorable for the location of an ocean outfall that, coupled with the fact that all others were inaccessible without consent of Long Beach or Los Angeles, intention was soon crystalized to reach the shore and discharge primary treatment plant effluent in the offshore waters there. Other plans were investigated and compared with ocean disposal but none held out the promise of security inherent in the ocean disposal plan. It was concluded early in the investigation that not only would every effort be made to promote joint action among the larger Districts in the construction of all facilities that were readily susceptible to joint ownership and operation but that all sewage of Districts, not otherwise excluded for good cause, would be brought together at one location in the southerly reaches of the Districts, treated there and disposed via jointly owned structures to some accessible location along the Palos Verdes coast.

To get the sewage of all of the larger Districts together it was necessary that the Los Angeles City annexation known as the "Shoestring" be crossed, first, by the sewers of District 5 to flow sewage of that District from west to east, and then to convey from east to west, all of the sewage of the Districts tributary to a mutual treatment plant, to a line leading to final disposal in

WHITE'S POINT — The tunnel emerged from the right at inert elev. -12 ft., U.S.G.S. datum. The ocean outfall extended seaward (to the left), following along the near side of the reef (center of picture).

the ocean. Recognizing that this might encounter sufficient opposition in the City Council of Los Angeles to prevent or seriously delay procedure, negotiations were first opened by suggesting to the City that the long narrow shoestring strip would some day need sewerage facilities and, since it was not in any District, would probably have to look for service to the Sanitation Districts, which bordered it on both sides. The City readily agreed to grant authority to cross with District 5 sewage in return for which the Districts tendered a contract for service to the shoestring when needed.

While the law provided that to cross one city with the sewer line of another might be prohibited, the prohibition applied only if the sewer in question crossed public property, such as a street, etc. The shoestring annexation to Los Angeles, while many miles in length averages only a half mile in width and a study of the situation disclosed that at about the most appropriate place to cross it with a line leading from the tentatively selected site for a mutual plant, there was a location where it could be crossed without interfering with, or crossing under, any publicly owned

property of any kind. In this area the Districts purchased an adequate right-of-way for sewerage purposes and had it duly recorded. Later, when it was discovered that the Districts had a crossing right which could be used for constructing the required line to convey sewage to the west, Los Angeles requested that the shoestring territory be annexed to the adjacent District 5, which, of course was done, and by virtue of which no further prohibitions to crossing existed, since a Sanitation District is given the right to use most public streets and highways in the District as right-of-way for sewers and appurtenant structures.

Completely confident that an outfall sewer to the south Palos Verdes coast could now be attained the engineering staff proceeded to base plans and estimates of Districts 1, 2, 3, 5, and 8 on a jointly owned sewage treatment plant, conveyed thereto in jointly owned and operated trunk sewers and flowing thence, after treatment, to the ocean to be discharged, well offshore, at some selected point along the coast bordering the Palos Verdes Hills.

At the head of Bixby Slough, near the settlement of Lomita and just north of the north boundary of Wilmington, (a part of Los Angeles City) is a low lying area which, in the 1920's was customarily flooded in winter. This land afforded an ideal place for a sewage treatment plant with access to a future outlet leading to the Palos Verdes south shore. Because of its strategic location and elevation (about plus 20 feet, USGS datum) it presented the desirable factors that made it an admirable choice for a jointly operated sewage treatment works. Warren commenced negotiations for purchase of some twenty-four acres of it. Nothing could be lost even if the plan to go to the ocean south of Palos Verdes failed to materialize, since the site was well located to serve any type or kind of system which might be proposed.

It is worth commenting, at this point, on a plan of sewerage presented by the then County Engineer, John Rockhold. Economics ruled it out, but the value of water compelled its careful consideration. The Rockhold Plan subtracted nothing from the joint ownership and operation idea but proposed pumping all, or the major part of the area sewage to the Antelope Valley for treatment and ultimate use in agriculture. It had strong appeal but appeared impractical at the time. Its rejection was fortunate in the

light of subsequent industrial development of the District area with attendent industrial wastes, and the overwhelming influx of population. Difficulty in disposing of even small quantities of well purified sewage effluent, developed and treated in the Antelope Valley, years later, indicate the soundness of the decision against the plan.

Combined, storm water and sanitary waste, sewers were dismissed from serious consideration for good reasons. The most compelling was probably the general pattern of rainfall in the Southern California coastal area. Precipitation usually comes in bursts; more often than not it is light at first and much heavier near the close of the storm, after the ground has been pretty well soaked and the natural channels are flowing quite heavily. It was wisely concluded that only complete separation of storm water and sewage would, or could, preserve cleanliness of the south harbor, or the beaches near where flood control and storm water discharges occurred. There were many other considerations current in most any choice between the two concepts. Fortunately there were a great many examples to illustrate the matter and most, if not quite all, of them pointed to the plan of separation. It is rather doubtful if there is any sewerage system south of San Francisco, California designed, originally or otherwise, on the combining basis.

Analysis of the possible outlets for sewage to the ocean along the south shore of the county disclosed that in addition to being the safest and most appropriate, the plan leading to disposal along the south shore of the Palos Verdes Hills was probably the least expensive. Certainly conditions along the shore presented many of the features promoting safe construction, excellent dispersion of sewage, largely unusable shores and little opportunity for any water sports except fishing. The ocean floor, as judged by the areas where kelp found anchorage on rock, was such as to adequately support and protect a large diameter pipe through the breaker zone and on to a depth of about fifty feet a half mile or so from shore. Currents along shore were such as to prevent sand deposition, indicating ability to diffuse, widely, the discharged sewage. The shore was narrow, strewn with rocks above high water and similarly rough and broken between high and low water. Backing

up the narrow shore were high precipitous cliffs. Access to the beach was almost totally lacking, except at two or three partially developed recreational coves.

Dissemination of information was not as easily accomplished in 1923 and 1924 as it is in 1960, plus or minus a few years. There were not too many radios, no television, no talking pictures and a rather widely scattered population to acquaint with what was going on in the Districts and why, and what the citizen's role was in the proceedings. In addition to addressing meetings throughout the Districts' area, short reels of motion pictures were prepared and shown in local theaters, accompanied, at times, by a three or four minute talk from the stage. The picture came on between reels or pictures, depending on the status of the theater. Local papers, not so abundant as now, carried stories for, and at times against, District endeavors. At times, dodgers were printed and distributed at meetings of service clubs, lodges and the like. Few of the limited opportunities offered to give publicity to the District effort were neglected. In particular Warren wanted a spokesman from the staff at every meeting or group which he, or his associates could induce to listen to the District story. Warren attended all of the meetings which he could find time for and turned the remainder over to his principal assistant at the time, the author of this story. It was not unusual for each to address a luncheon meeting, an afternoon gathering, a dinner meeting and a later evening appointment.

It is undoubtedly true that the early staff employed by Warren was not such as to inspire great confidence in the minds of California State Department of Public Health engineers. Precise sewerage practice in America was not well developed at that time. Complete treatment, other than as supplied by rock filters, was largely experimental in 1920. Actually, there was but one employee on the District staff whom the State engineers and their advisors would classify as a sanitary engineer. This feeling resulted in somewhat strained relations between the two agencies, a feeling that was only partially allayed by the employment of Xanthus Goodnough, State Sanitary Engineer of Massachusetts, and the Chicago firm of Pierce, Greeley, and Hanson to act as District Consultants after the plan of the Districts had been set in motion.

Representations by the State Health Department engineers to the State Board of Health were not particularly favorable to the Districts at any time, but in the 1920's they had little effect upon the actions of that Board whose chairman supported Warren consistently as one who had a good solution to a perplexing problem and was doing something about it.

In defense of the State Health Department Engineers' attitude, it must be remembered that in 1924 sewage disposal conditions along the California coast were deplorable, to say the least. San Francisco Bay shores were grossly polluted throughout large areas and from San Luis Obispo to San Diego there was no place where ocean disposal of sewage was being practiced so as to satisfactorily control contamination of shore waters. This condition was particularly bad in Santa Monica Bay where the outfall of Los Angeles emptied sewage plant effluent off the end of a 2000-foot trestle at Hyperion, and Santa Monica did likewise, close by. Had the Districts intended to perpetuate such practice, skepticism of its outcome would have been justified. The District staff recognized the pitfalls in a careless approach to the matter and not only selected a location for construction of an outfall to sea waters quite isolated and lacking in recreational advantages, but also proposed further to explore the phenomenon of diffusion of sewage in sea water to the end that properly clarified, sewage plant effluent would be discharged in such a manner as to utilize all natural forces present in combating contamination of adjacent shores.

For a while, during early consideration of what sewage treatment process might be appropriate for District use, it was thought that a type of plant similar to that to be incorporated in the new Los Angeles works at Hyperion would adequately serve the purpose. One of the large sewage plant equipment manufacturers had contracted to fashion twelve-foot diameter drum-shaped, fine screens for the City, much larger than any others then in use, at least in America. The City's decision to use such equipment in its proposed treatment process and to then discharge the liquid passing the screens through an outfall which would empty its contents 5000 feet offshore appeared to fit the District picture pretty well. Analysis of the liquid and small solids passing such a screen was discouraging, however, and the final conclusion was to invoke a

sedimentation process which would not only remove much more solid material from the sewage prior to final disposal, but would fit into the re-use of temporary activated sludge plant structures for, and in, the primary settling tanks to eventually be used.

The Districts' decision in the matter was a wise one. The process adopted initially has prevailed continuously in the District plant and, together with development of a well-designed and adequate submarine outfall has served to dispose of District sewage with a minimum of shore pollution. Experience with sewage screens has been discouraging and such form of sewage treatment has been almost universally abandoned for the more efficient sedimentation process.

Selection of an outfall site on the south Palos Verdes shore was made only after the entire shore had been inspected from land and from the ocean. Not satisfied completely with his own estimate of the security and wisdom of the choice, Warren arranged numerous trips of inspection of the shore from Point Fermin to Portuguese Bend and Point Vicente. Although many such inspections were made by District officials unaccompanied by others, trips along shore were made by as many interested officials as could be persuaded to go. These included the City Engineer of Los Angeles and members of his staff, the Long Beach City Engineer and Directors of District 3, the Los Angeles County Engineer, representatives of the press, both metropolitan and rural, and citizens from many District areas. Except for some individuals who lived along the bluff and others from San Pedro, there seemed pretty unanimous agreement that the general location was well chosen.

It must be remembered, that while the District plan had been set legally in motion in 1924, it was not required that the ocean method of disposal would be invoked until the late 1930's which, it was surmised, would allow ample time for investigation and analysis of a selected site and method of disposal before the Districts were definitely committed.

Some of the highlights influencing the selection of White's Point for ocean discharge of plant effluent are of interest. Although much more work was done and many more investigations made before final determination of suitability of the site, the scope of inquiry is indicated by the following which are in a generally

chronological order.

On June 26, 1924, engineers Bolton and Rawn of Warren's staff submitted to Warren a preliminary plan and estimate of cost for construction of a sewer tunnel under the Palos Verdes Hills. The tunnel was to originate at a possible sewage treatment plant site near the northwest corner of Wilmington at the head of Bixby Slough and terminate at some point along the south Palos Verdes shore between Point Fermin and Portuguese Bend. Any point along the shore between these two locations was about equally distant from the proposed plant site.

Warren reacted to the suggestion with characteristic promptness and on Sunday June 29, 1924, accompanied by the two engineers, inspected the shore from the land side, from Point Fermin to Portuguese Bend. On July 1, 1924, with W. T. Knowlton, Sewerage Engineer for Los Angeles City and appropriate members of the District staff, he inspected the shore from the ocean side from Point Fermin to Malaga Cove. Both Warren and Knowlton were greatly impressed with the possibilities of the plan, particularly the White's Point Terminus. It seemed obvious that White's Point would lend itself well to the proposal. It was included, with others, for further study and investigation.

In April, 1925, following his appointment as Chief Engineer of the Districts, Warren authorized extensive studies at White's Point to determine the direction and intensity of prevailing ocean currents. Investigation of the ocean bottom conditions was likewise authorized. Work on both of these tasks was commenced by mid-April and carried to completion during the summer. At the same time, investigation of the phenomenon of diffusion of sewage effluent in sea water, about which precise knowledge was unavailable, was commenced. Two years were required to complete the diffusion investigation and report.

On May 15, 1925, Los Angeles City Engineer, Van Norman, advised his sewerage engineer of his approval of the White's Point location and on June 10, 1925, the tunnel location and outfall site were inspected by engineers from the area and approved as well-suited for the purpose intended. Present at the inspection were: H. A. Van Norman, W. T. Knowlton, Fred A. Batty (Los Angeles City Engineer's office); Schofield, Gardner, and Rice (of Merritt

SEWAGE DIFFUSION STUDIES — Floating barge and equipment at Los Angeles Harbor used in determining formulae for predetermining extent of field of contamination over a sewer outlet into seawater. Dr. H. K. Palmer is shown conducting investigation.

Chapman Scott); the Mayor and City Engineer of Long Beach; Warren, Rawn, and Taylor of the Districts.

During the latter part of 1925, the owner of a resort at White's Point effected some improvements to his recreational facilities at the Point. A swimming pool, in the form of a small boat harbor, was constructed as was a considerable landfill of native soil and rock from adjacent cliffs. It was proposed that eventually a resort hotel would be constructed on the fill, which latter extended seaward a hundred or so feet and was exposed to the open sea. The improvement gesture was possibly intended to indicate the value potential of the property if it were taken for sewerage purposes.

Unfortunately for the owner, early February, 1926, was very stormy with waves quite damaging to White's Point improvements. What had been erected there many years before stood the storm well, but the new fill material was largely washed away by the high waves. When the storms had subsided, the fill for the hotel site was gone, the soil had disappeared, and the rock and boulders which it had contained filled the mouth of the little boat harbor. The

GRAVEL WASHED INTO SWIMMING POOL, WHITE'S POINT — In February, 1926, a storm blew in from the southeast and washed away a fill placed there a few months previously. The rock in the fill was, quite largely, washed into the mouth of a combination swimming pool and small boat harbor.

concrete wall of the small harbor was badly damaged. This storm did much to dictate the type of embedment and foundation necessary for the stem end of the proposed outfall.

On February 14, 1926, an important meeting was held at the White's Point site. Luncheon was served to the Los Angeles City Council members who, together with County Supervisors Wright and Cogswell; members of the Sepulveda family (owners of the property), Warren and Rawn, heard the Palos Verdes Hills principal owner, Vanderlip, relate his reasons for purchasing the vast estate and his hopes for its future development. His remarks, as well as his conduct and demeanor, were very impressive. At this meeting, the opposition of the Councilman representing San Pedro on the City Council was made abundantly clear. No official action was taken.

Xanthus Goodnough, Chief Sanitary Engineer of Massachusetts, retained by Warren to advise the Districts upon a course of procedure arrived in Los Angeles January 27, 1926. During the two weeks which he spent in Los Angeles, he reviewed what had

SLIDE AT POINT FERMIN — In late 1929, a landslip with characteristic land settlement, developed at Point Fermin. At White's Point a reef extends seaward from the base of the cliff giving some assurance that such a land failure will not occur at the selected outfall site in the foreseeable future.

been done, met with interested engineers and public officials, visited local plants including that of Los Angeles City, and gave his wholehearted support and approval to the entire District concept and plan, including particularly, disposal of plant effluent at White's Point in the manner proposed. In particular Goodnough and Warren met in Warren's office on February 8, 1926, with Shaw, Knowlton, Hussey, Mathewson, Goudy, Van Alstyne, Bolton and Rawn. At this meeting, it was concluded that but two locations for the outfall deserved further consideration, viz., Point Fermin and White's Point, and that no further consideration should be given Alamitos Bay or the Long Beach Flood Control channel. Goodnough returned to Massachusetts on the morning of February 10.

On March 12, 1926, Warren, Hugh Gordon (Attorney for the Districts), and Rawn attended a meeting of the Chamber of Commerce at San Pedro. It was apparent that a friendlier feeling prevailed at this meeting than had been evidenced at earlier sessions probably as a result of open discussion of the care with which the Districts were approaching a conclusion regarding the outfall. Later, at a meeting at Long Beach July 8, 1926, the Districts' proposal to discharge at White's Point was warmly endorsed.

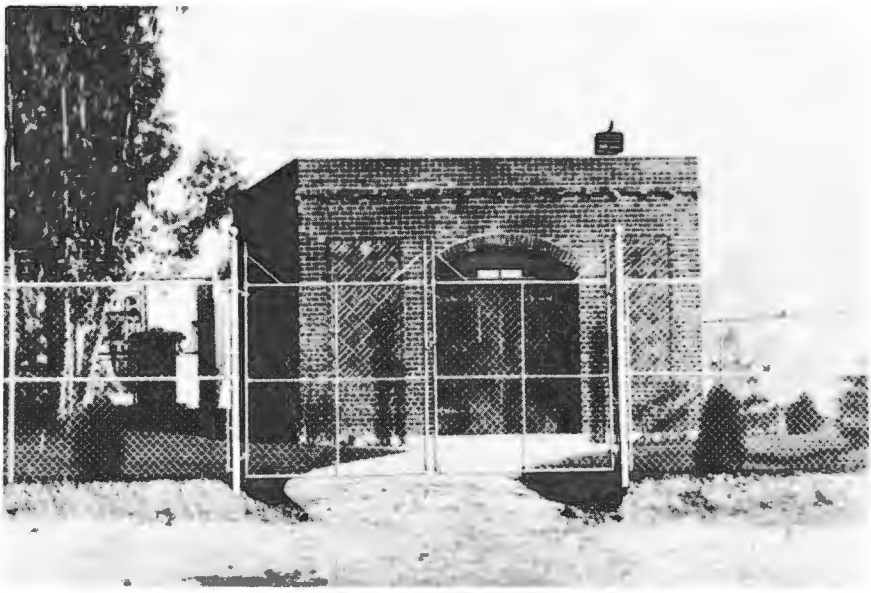
On August 25, 1926, Warren arranged an inspection of outfall sites which had been considered from time to time. The inspection was from the ocean side and in the party were Van Norman, C. T. Leeds, Franklin Thomas (Caltech), Van Alstyne, and Williams (Long Beach), Knowlton, Warren, and Rawn. This inspection and the approval of those who were in the party fairly well crystalized the thinking in favor of White's Point, barring unfavorable developments in future investigations.

Chapter 4

EARLY CONSTRUCTION

Concurrently with progress in selecting the White's Point Outfall site, the Districts were at work in many places elsewhere. Early in 1925, bonds had been voted in Districts 1, 2, 4, 5 and South Bay Cities. With the sale of these bonds, and the availability of Districts' funds, Warren organized his staff selecting from the engineers who had worked with him in 1924 and 1925 and pursuaded one additional County employee (Fred Bowlus) to join the District staff. By May of 1925, the District staff comprised Warren (Chief Engineer); C. R. Compton (Office Engineer); H. R. Bolton (Engineer of Joint Outfall); Fred Bowlus (Engineer District 2); Arthur Cory (Engineer Districts 4 and 5); Clyde Smith (Engineer District 1 and Disposal Works); C. S. J. Williamson (Secretary); A M Rawn (Assistant Chief Engineer). Lucille Bracco, who was Warren's secretary, continued in that position until after Warren's death in 1940. Carl Reeves (Engineer South Bay Cities) had been appointed prior to the others because of the early start of work in South Bay Cities in 1924.

Field offices were established in Lawndale, Lomita, and Downey by mid-1925 and field engineering forces were collecting data to be used in design of sewers for the several areas. These offices were maintained until their use had run out in 1928.



EARLY SEWAGE PUMPING STATION — The Gardena Sewage Pumping Station. This type of architecture was used in the structures in the very early days of the District life. Later, it was supplanted by concrete buildings.

In the meantime it was concluded that a temporary sewage treatment plant at the upper end of Bixby Slough near the settlement of Lomita should be built as a joint venture of the five large Districts to the south. Despite the fact that this location would necessitate flowing sewage from north and east of Dominguez Gap across, or under, a higher level plain, the Bixby site was well located to drain all of the northern area and, additionally, would fit well into either complete treatment with discharge of effluent directly south through Bixby Slough, or with primary treatment alone and discharge to White's Point or any other selected site along the Palos Verdes coast. As heretofore noted, 24 acres were purchased at the Bixby site from the rather extensive Bixby family holdings in the area, at a cost of some $4,000 per acre, reflecting the relatively high property values at the time and, perhaps, some apprehension regarding the effect that the location of a sewage treatment plant in the area might have on the remainder of the Estate's property. An interesting side light on this purchase was an attempt by a District employee to overpay the owner. The owner was sufficiently honorable to call Warren's attention to the fact.

The employee, involved in the questionable matter, was discharged forthwith. It is interesting to note at this point that District land ownership in the Bixby site area has increased ten fold since the original purchase in the 1920's.

It was quite obvious to the engineers designing the District-wide system in 1924 and 1925 that joint ownership of some of the structures was essential if the plan were to succeed. In fact, joint ownership, operation, and administration constituted the very keystone of success in the entire plan. The Act of 1923 did not specifically authorize such action but there was nothing in the Act prohibiting it and, since the plan could not readily proceed without it, Districts 1, 2, 3 and 5 entered into a Joint Outfall contract dated November 19, 1924. Districts 1, 2, 3, 4, 5 and South Bay Cities joined in an Administration contract dated March 4, 1925. The purpose of the joint ownership and joint administrative agreements, was to provide a practical plan for construction and operation of major trunk lines and disposal works for the joint use of Districts tributary thereto, and for an administrative organization to serve all of the Districts. Obviously such procedure would avoid a great deal of duplication in construction, maintenance and operation of the sewerage works as well as engagement of managers, engineers, legal counsel and office personnel. The economy of such joint action was substantial and, as proved by experience the efficiency of the entire project was greatly enhanced. Joint action on the part of the Districts apparently did not affect District relations with County officials in such matters as the approval and payment of warrants, etc., or in Board of Supervisors' actions relating to District procedure. It was questioned by those interested in the District bonds and their security and hence was clarified by amendment in 1931.

The strategy of joining the Districts in the two agreements and operating thereunder for a number of years was very effective. If the Districts had awaited an amendment to clarify the situation, the delay could have seriously hampered the entire plan and, if perchance the amendment were defeated, would have put the whole plan in jeopardy. By waiting until 1931 for clarifying legislation, opposition was rendered futile and the Districts were authorized to go forward with a well-established program and

plan. Bond counsel apparently did not feel the security of the bonds was endangered at any time, but did favor the 1931 amendments. The 1925 agreements, as executed, were prepared by Hugh Gordon who had previously been requested by Supervisor McClellen to serve as District Counsel, if and when the Districts were financed. Mr. Gordon served as the Districts' General Counsel from March, 1925 until 1953.

By May 1925, the Districts were operating on three fronts. The South Bay Cities District was to be sewered to the Los Angeles newly-built sewage treatment plant at Hyperion. This necessitated a contract with the City covering terms and conditions under which such disposal would be allowed. Los Angeles was agreeable to the arrangement for obvious reasons; foremost was the fact that if the Los Angeles City plant, which had just been completed, operated to contaminate the beaches of the South Bay Cities, the latter were not likely to complain since they would each be contributors to the contamination; secondly, Los Angeles had a large investment in Hyperion and, so they thought, a good plant which would satisfactorily control beach pollution. In large measure, their confidence was shared by engineers of the District who, in addition, felt that the South Bay Cities' sewage would be but a small fraction of that flowing to Hyperion and that it was better to connect to the Hyperion works initially and then, if unsatisfactory, to find other means of disposal. Finally, the fact that Hyperion offered an immediate disposal facility cannot be ruled out as a persuasive factor in the choice.

County Sanitation District 4 was also to be sewered through the Los Angeles facilities, the connection to be made at Third Street and La Cienega Boulevard. When originally formed, District 4 was entirely unincorporated territory, surrounded on three sides by Los Angeles and on the fourth by Beverly Hills. District 4 was formed primarily to provide an agency with which to contract with Los Angeles for sewage disposal. Incidentally, it was presumed that the District would provide certain trunk sewers to which Improvement Act local sewers could be connected, and would also build a trunk sewer, part of which had to be built within Los Angeles City limits, to connect with the City line. The terms offered by the City were reasonable, but the District bought

DOMINGUEZ SLOUGH, 1932 — Effluent from the temporary activated sludge plant at Bixby was discharged into the slough and, with diverse refinery wastes, flowed to West Basin. Suit of the California Yacht Club sought to enjoin the Districts from using the channel. Refer to Appendix for this narrative.

and paid for more capacity than it needed or ever used during the life of the original contract. District 4 proceeded with construction of its sewers and connected its system to the City lines in 1927.

Districts 1, 2 and 5 were to convey their District sewage to the temporary plant at the Bixby site. From the south boundary of District 2 at about Artesia Street or a little south thereof, it was planned that the District Outfall Trunk Sewer would pick up any flow from District 3 which could be reached and, after crossing under the Los Angeles Flood Control channel, would intercept the flow from District 1 and later District 8. Continuing southwest, it would join with the main trunk from District 5 and the combined sewage would then flow into the plant at Bixby Slough for treatment. During the life of the temporary plant at Bixby and until ocean disposal to White's Point could be effected, it was planned that effluent from the temporary plant would be pumped back to Dominguez Slough and flow thence to the harbor West Basin.

The plan, exploiting joint action on the part of the several Districts, was obviously the best course to pursue although each

CONSTRUCTION OF MONTEBELLO TRUNK — Picture shows condition of development in late '20s. Area now densely developed.

District could, in fact, have taken individual care of its problem. The difficulties inherent in such an individual course of action were severe. Had the Districts not consolidated their disposal efforts initially, but proceeded each with its own separately, the results could have become chaotic. Need for joint ownership and administration were resolved at this point to the great good fortune of the Districts and their efforts.

The origin of appointing District 2 as the administrating agent in the Joint Outfall and Joint Administration Agreements is interesting. There were two good reasons for the action in 1924 and 1925, but both have long since disappeared and District 2 persists in its original capacity largely from custom. When joint action was originally proposed, District 2 was the only District which would have a share in all parts of the jointly owned system, but better still, the District at that time contained only one incorporated city within its boundaries. Thus, its Board of Directors comprised two members of the County Board of Supervisors and but one incorporated city official, the Mayor of Montebello. The advantages of working with such a board were quite obvious during the early, and somewhat uncertain days of District activity.

FIRST SEWAGE INTO TEMPORARY PLANT — On February 4, 1928, Chief Engineer Warren opened the gates from the joint outfall into the activated sludge plant at Bixby. The action set the plant in motion which continued—with minor interruptions and difficulties—for nearly ten years. Warren (right), Rawn (left).

Incidentally, the Board of Directors of the original District 2 were McClellen and Cogswell of the Board of Supervisors and W. D. Stephens, Mayor of Montebello. As of the date of this writing (1964), there are twenty directors in District 2, representing nineteen incorporated cities and the County Board of Supervisors. District 2 is now pretty well in the geographical center of the Districts.

Design and construction of sewers proceeded simultaneously

EFFLUENT LINE TO DOMINGUEZ — Two effluent lines were constructed by District forces to convey plant effluent from the temporary plant at Bixby to Dominguez Slough. The first was a 24" diameter pipe (see picture). Use of the temporary plant outlasted the steel pipe and it (the pipe) was supplanted by a 36" diameter reinforced concrete pipe.

in Districts 1, 2 and 5 and on the joint outfall trunk leading from the south boundary of District 2 to the Bixby plant site. Construction of a temporary activated sludge plant at the Bixby site was in progress and was ready for operation by February 3, 1928, on which date Warren opened the gate into the primary sedimentation tank to set the plant in operation.

The trunk sewer leading from Compton was finished in time to turn effluent from the Imhoff Tank, serving that city, into the District system on September 19, 1927. This partially treated

HOLLYWOOD-RIVIERA PUMP STATION — Because of its surroundings the Hollywood-Riviera Pump Plant was all placed below ground and disguised on the surface with a pergola. Some of the posts served as vents for the pump room.

sewage, which had flowed through Compton Creek for years, thereafter was confined to the sewer as far as an outlet into Dominguez Slough, where it wasted until the opening of the Bixby Plant in 1928. Following completion of the Bixby Plant, sewage of Compton was connected directly to the District lines and the local Compton plant abandoned and demolished. Sewage from Torrance, in District 5 was cut into the District system April 23, 1928, and the primary plant serving that town abandoned. Local sewerage of other cities and towns in Districts 1 and 5 proceeded apace, largely under the Municipal Improvement Act of 1911. The Districts had no control over local sewer construction at the outset, but insisted upon District approval of plans of all new sewers to be connected to District lines and inspection of completed work prior to allowing connection. A subsequent amendment to the Sanitation District Act authorized a sanitation district Board of Directors to substitute for a Board of Supervisors or a City Council in 1911 Act proceedings, but this amendment was neither made at the request of Los Angeles County Districts nor ever invoked by them.

There were the usual troubles during construction of sewers and pumping stations projected for the several Districts, but since all of the work at the time was being done by contract, the outcome, so far as the Districts were concerned, was foregone. Most of the contractors made money. Some of them actually admitted to small profits. Work was not overly plentiful and occasionally a bidder got over enthusiastic and lost a little, but by and large the jobs proceeded without more than ordinary difficulty.

In South Bay Cities, the District Engineer made the mistake of arbitrarily changing the grade of the main sewer along the beach front. Unfortunately, he lowered it to a degree that inspired the contractor to make a claim for extra payment because of water encountered. Of course, the contractor would have hit water in any event, but perhaps not quite as soon as developed. There being no way to change back to the original grade, the contractor made life miserable for all concerned, calling on heaven to witness his peril and threatening to sue the District for every cent it possessed. The change in grade was undoubtedly good engineering, but the method employed by the engineer was not, and it caused trouble. The contractor had taken bonds of the District in payment for the work, which left the District with nothing in its construction fund and very little desire to secure any more. The matter was finally settled to mutual satisfaction, but not before all and sundry in the District camp had undergone a siege of wailing that would tear the heart strings of a wooden Indian. The District Engineer, a good and reliable professional man, took a lot of ribbing. He wound up his career as engineer of maintenance of sewers for the County of Los Angeles.

The first job of any consequence in the jointly operating Districts, to be let, was in District 1 in Atlantic Boulevard. Warren, McClellen, and Pomeroy all participated in turning the first shovel full of excavation. At the time, Atlantic Boulevard was a narrow road through Maywood, paved with bituminous concrete and from the surface, the job looked quite easy. At sewer depth, however, it was wet and in quicksand, a combination to perplex all but the most experienced contractor. The contractor, Lawrence Massa, undertook to effect a railroad crossing at his opening shot at the job and it proved his undoing. He relinquished the job to

TILE-LINED PIPE IN TUNNEL, DISTRICT 5 — Tunnel construction in the District 5 main trunk, January, 1928. Note tile lining in pipe, placed to protect against deterioration of concrete from oxidized hydrogen sulfide.

one of the best and most experienced sewer contractors in the west, Mike Mlagenovich, whose firm, Mlagenovich and Gillespie, finished the work, but not without considerable difficulty. It was a somewhat inauspicious start for the District enterprise, but a good experience and a real pleasure to see Mlagenovich iron out the difficulties. Men like Mike were scarce then as they are now, Mlagenovich, Vido Artukovich, and Frank Thibido were among the best.

Construction of the Los Angeles Central Outfall Sewer from Los Angeles to Hyperion was commenced in 1904 and completed in 1908. The fact that it traverses the City of Inglewood from northeast to southwest is undoubtedly accounted for by the fact that Inglewood was unincorporated territory until 1908. It was incorporated in February of that year. When District 5 was formed, it included Inglewood within its boundaries despite the presence of an operating Los Angeles City sewer trunk in which, it has been stated, the City would have provided capacity for Inglewood sewage. Before the Sanitation Districts were being discussed, the sewerage situation in Inglewood had become serious. Cesspools serving private dwellings, income property, and business establishments were crowded into the rear of lots and parking strips; room for new construction was running out and building was actually being restricted because of lack of public sewerage. So far as the topographical features of the town were concerned, the District system offered no advantage over the Los Angeles system and with respect to the outlook in the early 1920's, the Los Angeles City system offered by far the cheaper and faster solution, yet, so great was the opposition to the ocean disposal works of the City at Hyperion as well as the presence of the central outfall through town, that the citizens and the officials of Inglewood supported firmly the District plan and decided to await District sewerage rather than contribute permanently to the Los Angeles line. A great deal of animosity was created by odors from the Los Angeles sewer. Sewage from Los Angeles and beyond was rankly septic by the time it got as far down the system as Inglewood and not only was offensive to citizens in the town, but was actually destroying the sewer. Steps taken by Los Angeles to confine gases to the sewer by covering manholes with concrete did much to improve the odor situation in the area. Repairs to the line have made it serviceable for many years to come and conditions at Hyperion have been vastly improved.

Without the enthusiastic support of the County Supervisors and City Mayors, acting in their respective roles as Directors of the Districts, the task of the Chief Engineer and his staff would have been much more difficult than it was. Indeed, it could have well been impossible. Only three interested officials come to mind who

DISTRICT DIRECTORS INSPECT WORKS, SEPTEMBER 1, 1927 — Directors of Districts 1, 2, 3 and 5 included: McClellen, Los Angeles County; Hugh B. Lawrence, Inglewood; Dr. R. Parmelee, Montebello; A. J. Schoby, South Gate; C. A. Dickison, Compton; W. E. Hinshaw, Signal Hill; C. E. Greenmeyer, Lynwood; J. J. Furlong, Vernon; John Dennis, Torrance; Robert Ramage, Hawthorne; Wm. H. Schleppy, Maywood; Jerome V. Schofield, Huntington Park; Filmore Condit and Oscar Hauge, Long Beach; Charles Campbell, Alhambra; and William Bonelli, Los Angeles.

rather wholeheartedly opposed the District plan. Each, undoubtedly, felt that his position in opposition was well taken, but each, in turn, succumbed to the overwhelming support and confidence of the many others.

Director Hinshaw, Mayor of Signal Hill, was so completely convinced of the necessity of conservation of water by reclaiming it from sewage that he exerted every effort to defeat the District plan, as proposed by Warren, and to substitute for it a plan designed to conserve sewage water for use in agriculture and industry. He effected the construction of a complete treatment plant for his City and later succeeded in guiding the withdrawal of the City of Signal Hill from District 3. At the dedication of the Signal Hill plant, a luncheon which Rawn attended at the request of one of the South Bay Cities' Directors, Mr. Hinshaw disclosed that water from the treatment process was to be sold to an oil

company for something over $50 per million gallons. At the time, sewage flow to the new Signal Hill plant was about thirty-five thousand gallons per day or about a million gallons per month. All costs considered, the water produced at the new plant seemed destined to cost Signal Hill between five hundred and a thousand dollars per million gallons to produce, a matter which was given some publicity by the South Bay Cities Directors. The plant was eventually abandoned and arrangements made for the District to effect disposal of the Signal Hill's sewage.

Mayor Bravender of Hermosa Beach was quite opposed to the plan to contract with Los Angeles City for disposal of South Bay Cities sewage into the new Hyperion Plant, suggesting instead that the District construct its own separate plant. At a public meeting in Hermosa Beach, well attended, the citizens gave the Mayor a pretty bad time of it and insisted upon going ahead with the plan proposed by the District. Looking back over the years and having in mind the experience with the Los Angeles plant in the interim, one is not so sure but that the Mayor may have been a little on the clairvoyant side. In 1948 the District discontinued use of the Hyperion facilities and joined with other owners of the Districts' joint sewage treatment plant at Bixby.

Director Klusman, Mayor of Torrance in 1932 and 1933, appeared very much opposed to the White's Point plan. As an individual he attracted considerable attention because of his "old world" attitude regarding the "public image" to be projected by the Mayor of the City. As a Director of Sanitation District 5, he exercised his parliamentary privileges in Board of Director meetings to criticize the District plan, claiming engineering knowledge and generally siding with those who opposed White's Point. His protestations were thoroughly discounted by the Board and the engineer and his arguments had little, if any, effect upon the final outcome.

During the days of so-called prohibition and while the great and noble experiment was being carried on, the Districts were forced by circumstances to enter the lists on the side of the law in rooting out illicit stills. The first such occurrence was the receipt of an unusual waste at the Davidson City Pumping Station in District 8. This waste had the odor of molasses, the activity of

yeast, and the corrosive effect of acid. The District chemist pronounced it as still slops and the field forces traced it through the sewers to its source. Whether or not the still was operating under protection, the District employees never tried to find out, but the operator was advised to move to some other place. He did so very promptly. In moving, he employed a prominent trucking firm in Los Angeles and found a spot on Bandini Boulevard which both he and the trucking company erroneously thought was served by sewers tributary to the Los Angeles City system where his still residue would not be easily detected because of the great volume of flow of other sewage. He may have been advised in this matter by employees of the Sanitation Districts.

Unfortunately, the Bandini sewer discharged into the District system and the effect upon the temporary plant of the Districts indicated presence of the waste almost immediately. Again the field forces traced the waste to its source on Bandini and this time the Assistant Chief Engineer called at the still site, inspected the works well enough to determine what it was, and although he saw no one during his inspection, left word for the operator to get out. Returning to Los Angeles, he called the trucking outfit, whose owners he knew very well, and told them to get in touch with their client and move him out of the District area pronto and, furthermore, to inform the District office where he located. This settled the matter. The still moved to where the slops were disposed of through the Los Angeles City sewers apparently without trouble. There was a temptation to inform the Internal Revenue, or other officers of the situation, but it seemed useless inasmuch as there appeared to be little, if any, effort on the part of anyone to conceal the operation.

From the outset, the Districts were urged by the County Civil Service Manager to adopt Civil service in the employment of staff members and other employees. Many other County employees also thought the same way. The matter was given consideration on a number of occasions, but no one ever came up with a workable plan. Sanitation Districts were both City and County; it was expected that they would expand and that their territorial composition would change from time to time. New Districts were forming and the question always reached a stalemate upon who was to

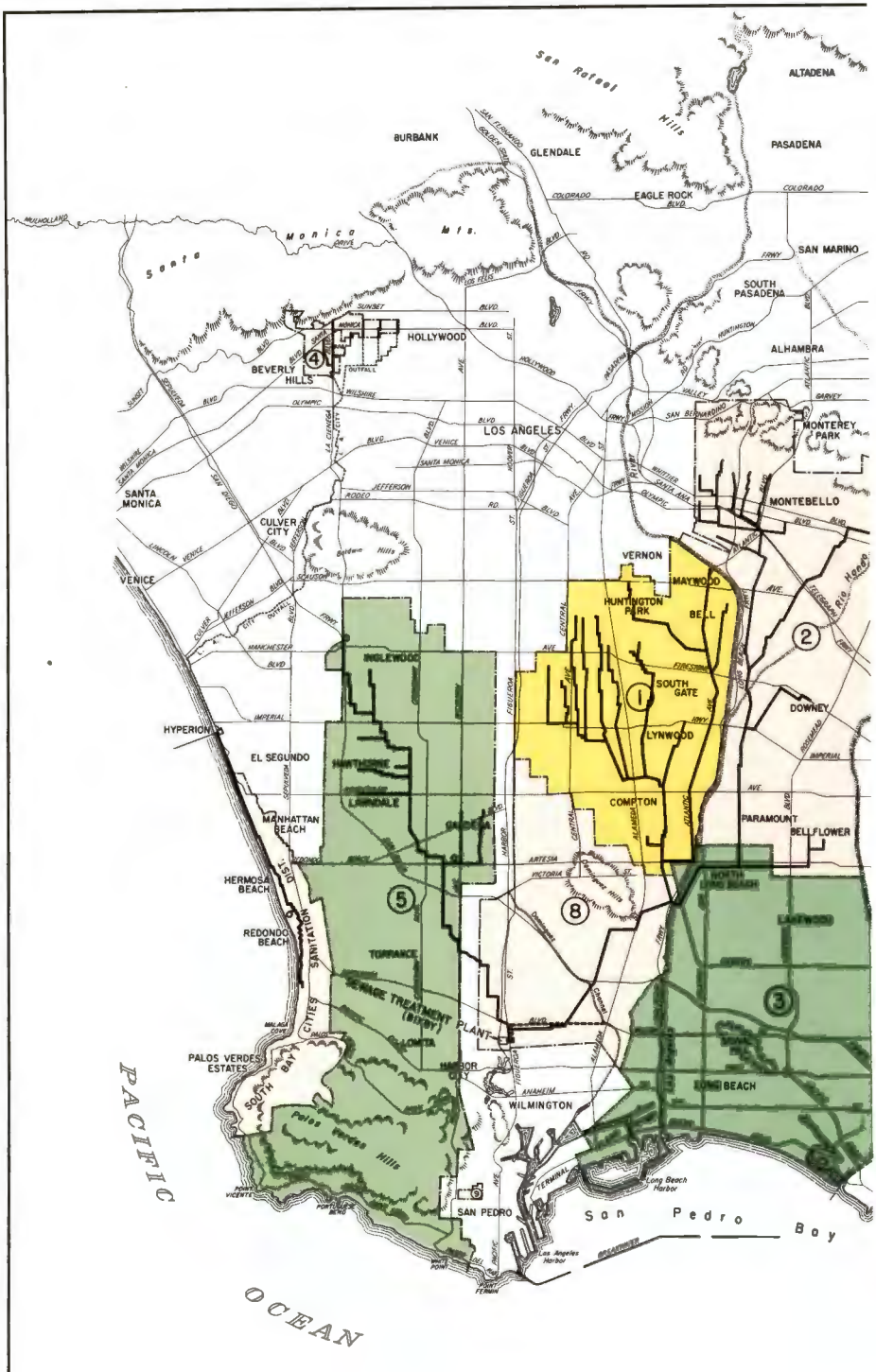
comprise the Civil Service Commission and to whom they would be responsible. Actually, civil service has never been invoked to control District employment. This has been entirely satisfactory to and for the Districts. Few efforts have been made by any persons or organizations to exercise undue influence upon District employment, and what attempts have been made have quickly failed. The very composition of the District government precludes the possibility of a concerted raid on its personnel or activities. As to its employees, the Districts have found local people, technical and otherwise, well-suited for their purposes, have had no influence exerted to employ specific individuals, and have consistently maintained salaries and wages in line with those determined for Los Angeles County employees of similar attainments. Relations with labor unions are friendly and the Districts are indebted to the unions for great assistance in prosecution of their work of construction.

The Districts were recipients of help from the various federal agencies interested in stirring up work during the depression of the late 1930's. In particular, Warren went to Washington in 1934 and, assisted by Supervisor John Quinn, wangled a splendid grant of a million dollars from Public Works Administration for use on the White's Point tunnel and ocean outfall. Federal funds were forthcoming on many occasions between 1932 and the mid '40's. They were most welcome and furthered greatly the Districts' work and accomplishments. The Districts did not find the grant conditions and limitations unduly restrictive or inconvenient, in fact, they were helpful to the extent of requiring the contractors to employ local labor and particularly what was available from the District area. Inspectors furnished by Public Works Administration to enforce federal rules were knowledgeable men of considerable experience and were helpful in ironing out the sometimes complex relations with the government. Unfortunately, Cooper, the federal inspector on construction of the ocean outfall, was killed while inspecting some trestle work at White's Point. Settlement of the matter does not seem to be of record.

Federal funds were applied on many jobs. One of interest was in Crenshaw Boulevard south of Inglewood. For this job, the Works Progress Administration agreed to provide all labor and

equipment to complete the construction of a trunk sewer. The District was to provide the material, pipe, brick, etc., and furnish a foreman for the work. March, 1936, when the job got underway, was a cold blustery month, and the ill-clad men who reported for work were neither warm nor experienced, consequently incapable of much work or effort. The soil was hard, dry gravel and clay-loam. A pick in the hands of a man, inexperienced in such labor, was totally ineffective in loosening up the material to be excavated from the trench. After the job had been in "progress" for some days, it was concluded that the wages of the foreman, which the District was paying, would amount to more before the job was finished than the cost of hiring a trenching machine to do the hard work of excavation, leaving the relatively easier job of backfilling and pipe laying to the Works Progress Administration laborers. After much argument, the Works Progress Administration officials agreed, not because the arrangement would save the District money, but rather because the road had to be kept closed during construction to protect the workers and no one could predict when the job would be finished, or indeed, if it would ever be completed under the circumstances.

In complete contrast with the Crenshaw job was one for which Works Progress Administration supplied the labor, built on Wilmington Avenue near Dominguez Slough. This was a concrete arch type of structure, poured in place, and lined with vitrified clay plates with the joints between plates filled with sand and molten sulphur mixed. The plates were first laid on the interior forms for the arch, the joints between plates filled, and then the whole thing, forms and plates, was set up in place so that when the concrete was poured in place, the plates presented an interior face which, it was hoped, would prevent the destruction of the interior conduit surface. Its effectiveness is related elsewhere. The point of this is that the Works Progress Administration Workers found themselves on a job unrelated to the business end of a pick or shovel and doing something useful, new, and interesting. Their attitude toward the job was completely different from that on Crenshaw Boulevard. The men worked eagerly and well and were reluctant to leave the job. There seems to be a lesson of some sort in this comparison and contrast. The memory of it tends to wipe


San Rafael Hills
ALTADENA
PASADENA
BURBANK
GLENDALE
EAGLE ROCK
COLORADO
SAN MARINO
SOUTH PASADENA
ALHAMBRA
Santa Monica Mts.
HOLLYWOOD
BEVERLY HILLS
LOS ANGELES
MONTEREY PARK
MONTEBELLO
SANTA MONICA
CULVER CITY
VENICE
VERNON
MAYWOOD
HUNTINGTON PARK
BELL
INGLEWOOD
SOUTH GATE
DOWNEY
LYNWOOD
HYPERION
EL SEGUNDO
LAWNDALE
COMPTON
PARAMOUNT
BELLFLOWER
MANHATTAN BEACH
HERMOSA BEACH
REDONDO BEACH
TORRANCE
SEWAGE TREATMENT (Bldg.) PLANT
LOMITA
PALOS VERDES ESTATES
HARBOR CITY
WILMINGTON
LONG BEACH
SAN PEDRO
Palos Verdes Hills
Long Beach Harbor
Los Angeles Harbor
San Pedro Bay
PACIFIC OCEAN
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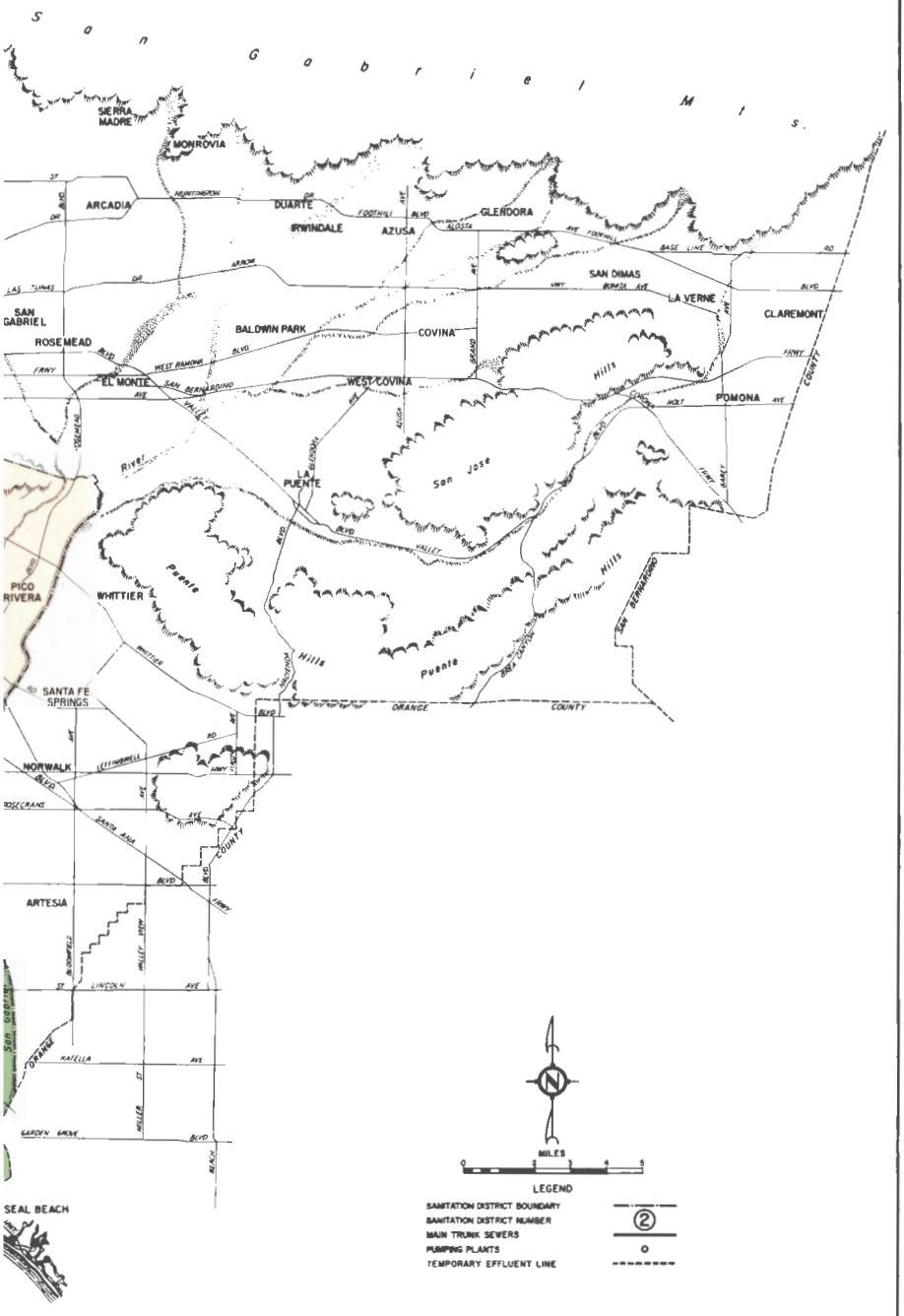
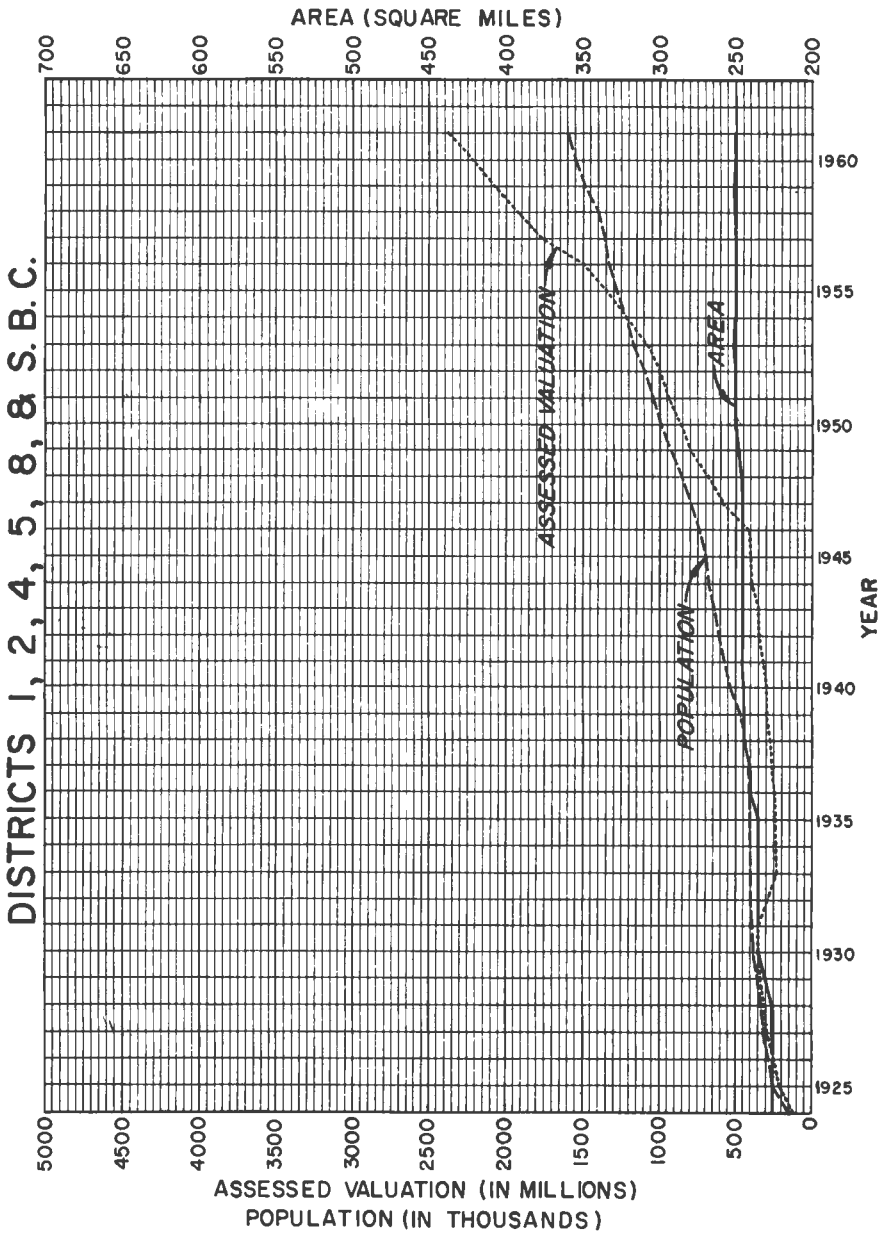


COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY, CALIF.

SANITATION DISTRICTS SEWERAGE SYSTEM (1928)


DISTRICTS 1, 2, 4, 5, 8, & S.B.C.
AREA (SQUARE MILES)
700
650
600
550
500
450
400
350
300
250
200
ASSESSED VALUATION
AREA
POPULATION
1960
1955
1950
1945
1940
1935
1930
1925
YEAR
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
ASSESSED VALUATION (IN MILLIONS)
POPULATION (IN THOUSANDS)

CONSTRUCTION UNIT NO. 1, DISPOSAL PLANT — Construction of the Joint Disposal Plant Unit No. 1 was begun in 1927 and completed in February, 1928. Taken in 1927, this picture looks toward the southwest across the low lying land in the slough. Weston (now Lomita) Street is in the middle distance.

out some of the numerous recollections of other experiences with management of Works Progress Administration and the indifference with which its benefits were accepted by recipients.

As of 1928, the Districts tributary to the Joint Disposal Plant (Bixby) and, in the case of South Bay cities and District 4, to the Los Angeles City system, comprised an area of 227.5 square miles; had constructed 114 miles of trunk sewers, including the joint trunk from District 2 to Bixby; served 275 miles of lateral sewers which had been built by others than the Districts; had constructed a three million gallon per day capacity plant at Bixby and an effluent waste line from the Bixby plant to Dominguez Slough. Two sewage pumping plants had been constructed in South Bay Cities. Population of the Districts was 299,000 and the assessed valuation $315,000,000. Flow at the Joint Disposal Plant (Bixby) was a little less than four million gallons per day.

Chapter 5

FIRST DECADE OF OPERATION

The history of the temporary plant in its activated sludge role is not without interest. As is noted elsewhere, sewage was turned into it on February 4, 1928. The flow, 2 mgd at that time, consisted of that from a primary plant at Compton plus what ground water leakage was entering the lines tributary to the system. No trouble was experienced getting the plant into operation on the initial flow. Everything worked well and the plant was speedily producing an effluent that rivaled well water in appearance. The contract for construction of the plant was number 104, which indicates its numerical position among the contracts already executed by the Districts, for work to be done and material and equipment to be furnished. Actually, there were forty trunk sewers completed, or under construction, at the time bids were taken for the plant. Use of the trunks, however, had to await, in most cases, construction of local sewers.

Flow of sewage into the treatment plant increased from two million gallons per day (2mgd) to about 10 mgd in two years, (1930) and then, by gradual increments, to 22 mgd by 1937.

That portion of the plant which had been built for the activated sludge process was constructed in three sections, or units, each with a designed capacity of three million gallons per day.

TILE-LINED CONDUIT — Typical conduit section: 10′ 6″ reinforced concrete, basket section, vitrified clay liner plates in sides and crown. Looking toward entrance to joint disposal plant. December, 1927. Rawn (left), newspaper representative (right).

Under conditions imposed at Dominguez Slough, this could be readily stretched to 4½ mgd each or some 14 mgd for the entire works without undue detriment to the process. The 14 mgd flow rate was reached by 1933. From then until October, 1937, it was touch-and-go to keep out of trouble and produce an effluent that was suitable for discharge to the inner harbor at West Basin via Dominguez Slough. To be sure, more plant facilities could have been built, but this was resisted for a number of reasons. One, that the facilities already built, when converted to the process needed for discharge to the ocean at White's Point, were adequate for many years as such; secondly, a mediocre effluent could be discharged to West Basin without undue damage or inconvenience, and thirdly, the Districts faced an action by the owners of the activated sludge process for patent infringement, based on use of the process and calculated on the design capacity of the plant.

By 1930 the flow of sewage into the plant exceeded 9 mgd and included some strong industrial wastes. About this same time, all three units of the temporary activated sludge plant were also complete, but unit 3 was being pressed into service for sludge

TEMPORARY ACTIVATED SLUDGE PLANT, 1930 — By 1930, three units of the temporary activated sludge plant had been completed. Until August, 1931, Units 1 and 2 (the nearest ten long tanks and the nearest four with housing) were used in sewage treatment. The six long and two housed tanks were used for sludge digestion. Underdrained sludge beds in lower right corner.

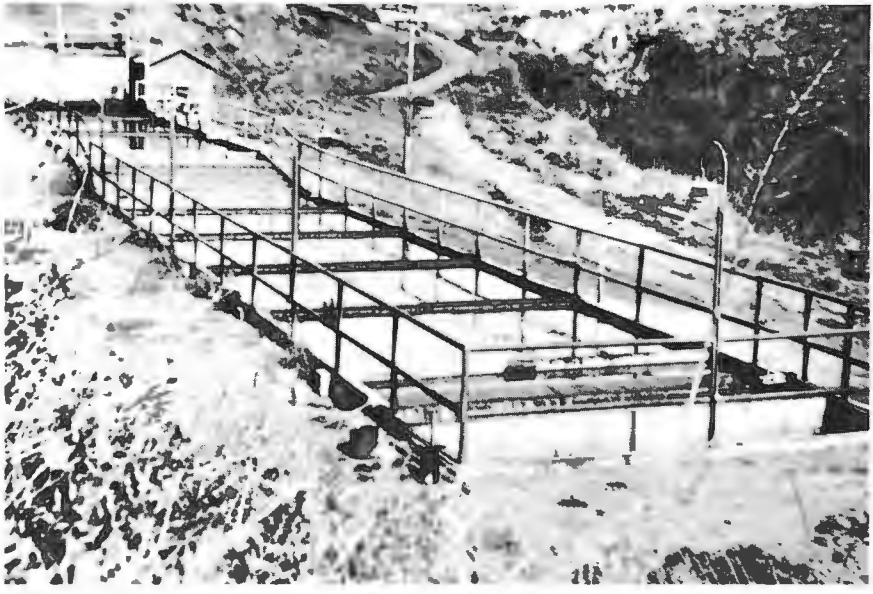
digestion. The resultant overload on units 1 and 2 was such that it became necessary to cut down on the amount of sewage going to these units if the results in treatment were to resemble what was expected of an activated sludge process. Accordingly, the flow to each of units 1 and 2 was cut back to 3 mgd, a total of 6 mgd treated. The rest was bypassed to the effluent wet well from the pre-sedimentation tanks. The mixture was chlorinated at a rate of 50 pounds per million gallons and discharged to Dominguez Slough. The results were pretty good so long as units 1 and 2 were required to treat no more than 6 mgd total, but when this amount was increased by no more than 1 mgd, the process deteriorated rapidly.

With completion of the multi-stage digestion tanks in July, 1932, all three units were used in the activated sludge process. The plant handled 10 mgd readily and, as lines were cleaned more regularly, the treatment was extended to 12 and 14 mgd without undue trouble. All over this amount was bypassed from the pre-

FUEL OIL SKIMMING AT BIXBY — Fuel oil, released at the Columbia Steel Mills at Torrance, nearly paralyzed the Bixby plant. Weeks were required to get the plant back into fair running order.

sedimentation tanks to the effluent wet well, as previously, or bypassed directly into Dominguez Slough untreated. Industrial waste discharges were not being carefully monitored at the time and frequent upsets followed at the plant. The illicit still slops, more particularly described elsewhere in this narrative, were such as to completely upset the process for days until disconnected. A fuel oil discharge from the Columbia Steel Mills in Torrance was such as to require weeks of work to get the plant and equipment into good operating order again. Threatened with complete disconnection from all lines leading to the plant, Columbia paid the cost of the cleaning process.

The area drained by the Districts' system was the locale of many oil fields and operating wells. It was originally ruled by District officials that oil brine from the wells was not to be considered an industrial waste and hence not entitled to service in the District lines except under the terms of separate agreements to be negotiated between the District and the well, or wells, owner. Terms of such an agreement were, in brief, that the owner was to pay the District $35, plus all pumping charges incurred by the



OIL BRINE SEPARATOR AND CLARIFIER — Before discharging oil well brines into the District sewers, it was required that specifications relating to oil content, suspended solids and hydrogen sulfide be met.

District, for each million gallons of brine disposed of through the District sewers, and to prepare the waste to meet certain specified requirements before it was admitted to the sewer. Between 1927 and 1950 a great many such agreements were consummated and much of the oil brine was carried to disposal through the District system.

The obvious reason for classifying oil brine as something other than industrial waste was to control the amount of brine flow reaching the sewers as the fields aged and the ratio of brine to oil increased. It was equally obvious that the oil well owners felt that they were being unjustly treated, having to pay their proportionate ad valorem share of the cost of sewerage and then being denied the right to use the facilities without paying an additional fee. In 1950, the matter was settled to the satisfaction of all concerned by allocation to the use of those who were producing oil brines a proportion of system capacity equal to the proportion of the annual assessment paid by oil properties for all District purposes. Thus, upon complying with conditions imposed upon all industrial waste dischargers, a producing field was entitled to

service for a limited waste water disposal without further cost. Each field was considered separately and a spokesman selected by the contributors to deal with the District on a year-to-year basis. Unless otherwise requested by the owner to keep previous contracts in force, all such were abandoned and the new policy substituted.

It is undoubtedly true that exclusion of oil brines from the District sewers during the life of the activated sludge plant, except under the terms of separate limiting contracts, was helpful in plant operation. When the ocean disposal means was available in 1937, it lost most of its value and late in the 1940's, the Directors wisely rescinded the initial action while still controlling the quantity of flow.

Disposal of sewage sludge, both primary and activated, was not nearly so well understood in the era of the plant in question as later on. Two municipal activated sludge plants had been constructed in California and at both, undigested sludge was discharged to undrained drying beds or buried. The Districts' original design followed this pattern and it was proposed that initially, crude activated and primary sludge would be drained and dried on beds without underdrains. It was almost immediately apparent that such a course of procedure was totally inadequate.

For three years after the plant was put into operation, the matter of sludge disposal was critical. By July, 1928, ten underdrained sand beds had been built and were in operation. By the following December, ten additional beds were added. Until mid-1929, raw, undigested and primary and activated sludge was spread on these beds to dry. The results were moderately successful so far as drying the sludge was concerned, but the modus operandi resulted in noxious odors and the breeding of countless millions of the common house fly (musca domestica). The fly population became so great and the propagation so intense that it became necessary to destroy the larvae at the sludge surface with a portable weed burner flame.

By mid-1929, unit 3 of the plant had been constructed and from then until permanent digestion tanks were completed in July, 1931, unit 3 was used to digest sludge generated in the plant as well as to confirm data on stage digestion. Use of the tanks for

MULTISTAGE DIGESTION TANKS — View of the east wall of Battery B of the sludge digestion tanks completed at Joint Disposal Plant in 1930. Protruding reinforcing rods are for connecting Battery C later.

digestion was supplemented from time to time by discharging to neighboring grape, citrus and bean fields.

Obviously, sludge digestion was the essential key to open air bed drying, but as stated, digestion was not well understood at the time and the three years of trial and error, during which the underdrained beds were made to serve, the Districts developed a process of stage digestion of sewage solids which not only greatly lessened the cost of digestion, but decreased the digestion period to less than half of that in current use. The process developed by the Districts for this operation was termed "Multi-Stage Sewage Sludge Digestion" and it set the stage for improvements in this important sewerage operation that has been of great benefit to all engaged in municipal sewerage. The Districts directed additional attention to it with construction works based on the principle and placed in operation in July, 1931.

One of the reasons, if not indeed the principal one, why there had been little drying of digested activated sludge on open beds, was that it was considered impracticable to economically digest activated sludge by the processes, and with the equipment and methods employed in the digestion of primary sewage solids. While

this seems incomprehensible now, it was current in the 1920's and resulted in either activated sludge filtration and drying as at some eastern plants and later at Pasadena, or disposal by drying the crude product after it had been run onto drying beds as practiced at Lodi, California, and later followed for a time at the District plant. The development of the Multi-Stage Process by the Districts was accompanied by an improved heating and seeding operation that was readily adapted to activated sludge as well as to primary. The impact on sludge disposal elsewhere is evidenced by the comment and commendation of Floyd Mohlman, Chicago Sanitation District, (one of the greats in sewerage practice,) to the effect that the method was new, unique and satisfactory.

On November 19, 1928, the Districts entered into a contract with H. C. Kellogg and G. W. Preston for the sale to Kellogg and Preston of all the dried sludge to be produced at the Bixby plant during 1928, 1929, and 1930. The purchasers were to remove the dried sludge from the drying beds and were to regulate their activities so as not to hinder the District use to maximum capacity of the drying beds. The contractors were to pay the Districts $1.50 per dry ton for all sludge delivered in liquid state to them by the Districts. Two years later, Preston retired from the contracting firm, but Kellogg continued on, on a year to year basis until 1945 at which date he entered into a contract for purchase of the sludge until 1950. At this point, he again contracted for the sludge until 1955, and again until 1957. In 1958, Kellogg contracted for the purchase on Bixby sludge for a ten-year period at a purchase price per ton equal to one-seventh of his bulk sale price, f.o.b. truck at his plant in Bixby.

Since 1928, Kellogg has bought from the Districts about three quarters of a million tons of dried sludge for which he has paid the Districts in round numbers some seven hundred thousand dollars. As the output of digested sludge increased at Bixby, he bought a tract of land adjacent to the Bixby site upon which the Districts built a number of shallow lagoons for drying digested sludge. After a number of years, Kellogg agreed to transfer the land to District ownership in payment for sludge. It is recollected that Kellogg bought the land when property in the area was selling for about $1,250 per acre. The Districts paid him $1,250 per acre for it.

Today the land is worth, or rather would sell for, many times that much. To whatever Kellogg has paid the Districts in money or property, must be added the very significant savings to the Districts in not having to remove the dried sludge from the beds and transport it to suitable disposal sites, or otherwise dispose of it. Kellogg's association with the Districts has been of significant value to both; Kellogg's perseverance and the Districts' confidence in him have paid off. At one time in 1955, Kellogg owed the Districts more than $130,000. In increments he paid this obligation by 1961 and currently has a well-financed fertilizer business, marketing a well-recognized product that has vastly increased public acceptance of sewage-based fertilizers.

On a number of occasions after Kellogg had established his business and was reasonably prosperous, others interested in the fertilizer business attempted to outbid him for the District sludge. Recognizing that Kellogg owned the trade names which he had made popular and had an established market for his product, the Districts were loathe to encourage any other than Kellogg to attempt processing and sale of the sludge. Based on experience with the long hard pull which had been required to establish a sewage sludge in the form of "Sludgeon," "Nitrohumus," "Triple Big Six" and others, which Kellogg had established and named, the District staff did not encourage a change in management of the sludge disposal sale business. Fortunately, Kellogg's bid for the contract always appeared most satisfactory.

By January, 1931, the Districts had installed sludge digestion facilities designed following research and experiment over a two-year period. The new tanks (multi-stage) took over the process of digestion of both primary and activated sludge in such a manner as to produce a non-odorous, fast-drying product which could be processed by disposal to shallow lagoons and, thereafter, allowing the natural forces of sunlight and air movement to complete the job. The twenty underdrained beds, which had served for the undigested mass, were continued in service for a time, but soon became auxiliary to the shallow lagoons and were then abandoned. There was probably no known process of sludge digestion and drying that had not been tried, at least experimentally, at the plant during the raw sludge drying period. None seemed as adequate as

DIGESTED SLUDGE PUMPED TO SHALLOW LAGOONS — Liquid sludge delivered to shallow lagoons contained some 95% liquid. A large part of this separated from the sludge and drained away. The rest was removed through evaporation.

that which was finally adopted.

As noted elsewhere, effluent from the temporary plant at Bixby was pumped some 4½ miles to Dominguez Slough for disposal. Until May, 1935, power for the pump was furnished by the Southern California Edison Company. By May 1, 1935, the sludge digestion tanks were furnishing enough gas to guarantee a supply sufficient to operate an internal combustion engine to take over this job. Correspondingly, on May 1, a Clark Brothers gas engine was attached directly to the effluent pump and placed in operation using sludge gas for fuel. In June, 1938, a power unit comprising an eight-cylinder Clark Brothers gas engine hooked to a Fairbanks-Morse fifty-cycle generator was installed in a newly constructed power house; the Clark engine driving the effluent pump was moved into the power house to drive a similar generator. These two power units furnished all power and light requirements for the plant at that time. In addition to the two units noted, a standby power unit, using gasoline for fuel, was installed in the power house to provide emergency service. The latter unit had been previously installed at the Gardena Pump Plant in District 5

EARTHQUAKE (MARCH 10, 1933) DAMAGE, COMPTON — Most of the Districts' structures, being underground, suffered little damage in a quake that was intense enough to severely damage many surface structures.

at a time when the Edison circuits were not so complete. Edison Company power was used as standby for a few months in 1938 following installation of the power units and was then disconnected entirely.

On the afternoon of March 10, 1933, Los Angeles experienced a sharp earthquake. It is said to have registered 6.3 on the Richter scale. Fortunately, the quake came at such a time (about 5:00 p.m.) as to spare life and injury to many. The more important facts and statistics regarding this disturbance have been recorded elsewhere. Following are a few comments on its effect upon the Districts' sewerage system as observed and recorded.

The quake was so violent as to splash water (sewage) out of tanks at the Bixby plant. Normal freeboard is about a foot. At the effluent wet well in the plant, 2″ x 12″ planks, spanning the 6 foot wide tanks and resting in recesses in the walls, were sprung out of place and thrown from the tank as though the tank had been squeezed together at the top. Bricks in the foundation for a boiler were badly displaced. None of the equipment at any of the pumping stations below ground was disturbed.

MUD BOIL OVER OUTFALL FOLLOWING EARTHQUAKE — Following the earthquake of March 10, 1933, a number of mud boils, as shown, appeared. Backfill over the trunk sewer had been in place for five years without showing settlement. The structure was not affected in any way.

Flow in the sewer more than doubled for a short period following the primary quake, but subsided to normal in a few days. One occurrence which could have resulted in great damage to Bixby and might have resulted in injury or death to District employees and others was escape into the sewers of so-called "casing-head" gasoline from a ruptured high pressure line. Floating through the joint outfall trunk from about North Long Beach to the plant, it created an explosive atmosphere in the line for about six miles. The condition went unnoticed until the morning following the quake. When detected, all prime movers in the plant were shut down, by-pass gates to Dominguez Slough were opened and the entire flow diverted thereto. The oil refinery, thought to be responsible, was notified of the condition and immediately dispatched Foamite trucks and tank pumpers to Bixby where they took over. District employees were instructed to open each manhole between the plant and the general location of the gasoline origin and to post a guard at each until the atmosphere in the line became non-explosive. The Bixby plant resumed operation only

when all trace of the gasoline had been removed from the incoming sewage. Foamite trucks stood by for the following three or four days.

As each manhole cover was removed along the joint outfall, presence of gasoline vapor was readily apparent in the rising column of escaping air because of its "vapor wave" appearance. Fortunately, no one attempted to test its explosive characteristics except with appropriate equipment. Incidentally, a thirty-inch, reinforced concrete pressure pipe, laid without collars, and through which effluent from Bixby was pumped to Dominguez Slough, came through the quake unscathed. This would not have been considered unusual had the line been equipped with connecting collars. The line in question runs from west to east in its section of greatest hydraulic pressure. An interesting observation following the quake was that gasoline seeped rapidly through brick manhole walls. Gasoline lines nearby some of the sewers were ruptured at the time and saturated the surrounding soil. It continued to seep into the sewers for days. Later, in 1941, in digging the gasoline-saturated soil adjacent to one of the larger refineries, it became necessary to repeatedly burn the gasoline out of the soil, encountered in excavation, in order to prevent dangerous combustion from sparks made by workmen's tools. Five men were rather seriously burned during this operation.

It came as something of a shock to the plant operators that the early schedule of peak flow of sewage into the plant reversed what might ordinarily be expected in a sewer. The District trunks were all, or nearly all, pipes of large diameter, designed to take full advantage of the natural slope of the terrain they were to service. As a rule, the minimum slope of such trunks were such as to produce a velocity of not less than two feet per second when flowing at half depth, but obviously a much lower velocity when at the depth of the very early flows. The results were, to say the least, disconcerting. Length of the lines and low velocity caused the diurnal variation in flow to be at flood from about noon to midnight and at low flow from then until noon again. Unfortunately, the low flow was so low that suspended solids in the sewage dropped out and stranded in the sewers and were not moved on to the plant until the following high flow. The result was that the

high flow was not only of much greater strength per unit than the low, but was rankly septic with an immediate oxygen demand calculated to discount the beneficial effects of the activated sludge with which it was innoculated. The consequences were not so apparent, while the daily flows were not over 3 or 4 mgd per plant unit, but were very troublesome at times above that.

Chapter 6

PERMANENT DISPOSAL WORKS

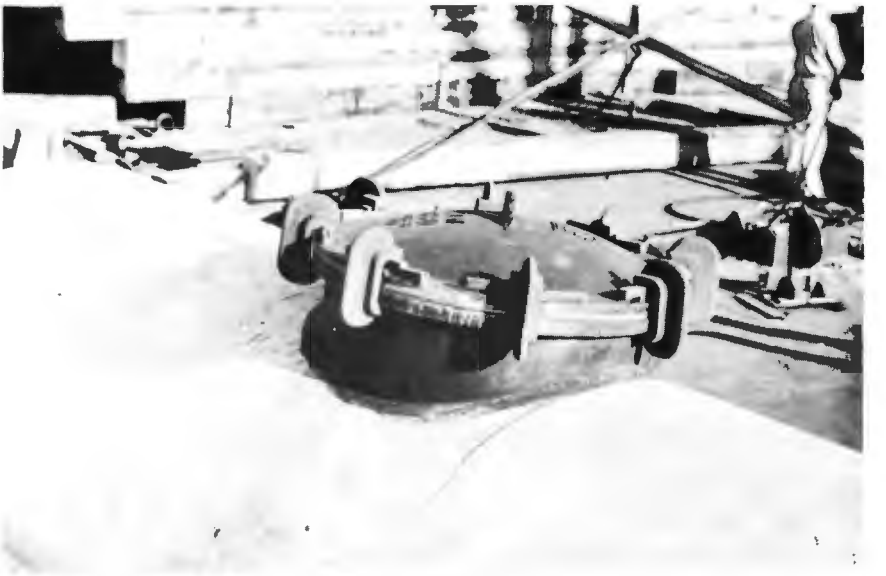
The ten year operation of the disposal plant as an activated sludge process afforded ample time for investigation of the proposed White's Point tunnel and ocean outfall as well as final design and construction of these two important structures. In 1933, prior to final decision regarding the use of a tunnel to reach the Point, borings were taken along the proposed route. While the boring showed vividly the heterogeneous composition of the Palos Verdes pile, they disclosed nothing which would lead to the abandonment of the idea of tunneling or the route selected. The rock floor of the ocean outfall site was drilled where rock was disclosed and wash borings were taken in the sand bottom beyond the rock. All physical factors seemed to be most appropriate for the construction desired. There was little experience to guide one in the design of the ocean outfall, particularly since it was to be built directly in a busy ship roadstead. District engineers, pipe manufacturers, and metallurgists put together their best ideas and adjusted them to those of experienced marine contractors which resulted in a pretty useful and sound structure. The tunnel presented no unusual features.

Certain design criteria appeared essential to the safety, security, and appropriate operation of the White's Point tunnel and the ocean outfall. The tunnel would obviously need be lined with reinforced concrete. To protect the lining from destruction by

CORE DRILLING WHITE'S POINT TUNNEL, 1933 — Where possible, cores were taken of the material to be encountered in excavating the tunnel. A record of all holes at tunnel level was preserved and shown to prospective bidders.

oxidized hydrogen sulfide gas, the tunnel would be required to flow full at all times, regardless of the quantity of sewage flow or the position of the tide. Thus, the invert of the 8-foot nominal diameter lining was established at minus twelve feet U.S.G.S. datum which, with a salt water density equivalent of 2.5 feet over the ocean outlet, would meet this requirement. Grade of the tunnel was level from the plant to the sea. Entrained air escape vents were built into the structure near the inlet end to permit release of air intrained by entrance turbulence.

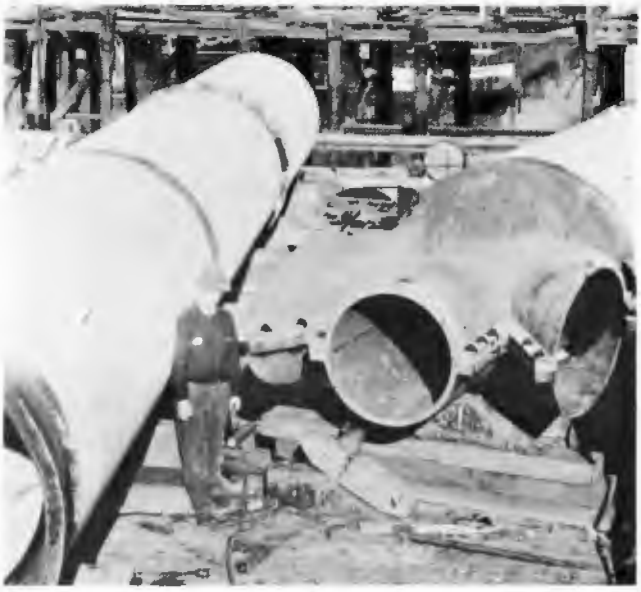
Boards of Directors of County Sanitation Districts Nos. 1, 2, 5 & 8
and the Contractors – White Point Outfall Sewer
Inspection Trip – November 12, 1935.



MANHOLE ENTRANCE ON OCEAN OUTFALL — Cast iron manhole frame was welded to the concrete pipe reinforcing prior to pouring concrete. Manholes placed at 500 foot intervals. Covers were clamped in place. Note wedges for tightening clamps.

The ocean pipes were designed of reinforced concrete; they were 60 inches in diameter and of 7-inch shell thickness. Alternate pipe sections were joined together with universal metal ball-and-socket joints, completed topside. The couples were joined under water with a short moderately flexible joint. Joining rings were made of Meehenite cast iron, to which it was possible to weld securely the pipe reinforcing steel and which otherwise had the corrosion resistance properties of gray cast iron. Cast iron manholes were built into the pipe at 500-foot intervals throughout its length, and the outlet end of the pipe was equipped with a three-jet, cast iron diffusion structure designed to encourage mixing with sea water and discourage spread of the sewage field at the ocean surface.

The outfall was double-barrelled past the breaker line. A trench was blasted through the rock and both pipe completely embedded in concrete therein. Past the breaker line, the east pipe was directed easterly for its short remaining distance and closed with a timbered bulkhead which could be readily removed when it became necessary to extend the line. As a safety measure, the east



OUTLET STRUCTURE FOR FIRST OCEAN OUTFALL — Breaking the flow of effluent into three jets promoted more rapid mixing with sea water, greater dispersion and, consequently, faster breakdown of the field of contamination.

trench was carried 150 feet farther seaward to obviate blasting close to the west line in place. The west line continued seaward in trench through rock, gradually emerging to the ocean floor. From about 2000 feet offshore and at 50± foot depth of water, pipe was laid directly on the ocean floor and continued in this manner to the end. The diffuser structure was elevated slightly above the floor to prevent aspirator action of the emerging jets of sewage effluent and ocean currents from causing under-cutting of the pipe. Each pipe was crossed with a 60-inch cast iron gate valve at the tunnel outlet.

The job was completed by the Merritt, Chapman, Scott Company for a bid price of $528,000. Subsequent experience with the line in operation indicated necessity for placing gravel alongside the pipe where it was laid on the ocean floor on sand to prevent scour occasioned by ocean currents. This work was done by District forces about 3± years after the line was placed in service.

It cannot be said that this ocean outfall was entirely successful. Of the structural materials, the iron showed marked electro-

GATE VALVES—TUNNEL TO OCEAN OUTFALL — Sixty-inch diameter gate valves were placed at the shore ends of the two ocean submarine pipes at White's Point. They have been in frequent use in revision and extension of the lines.

lytic effect within twenty years and at the rate of destruction noted at that time, would have been destroyed in some fifty years unless protected. Corrosion of the pipe end rings, where embedded in the pipe concrete, was sufficient to fracture the concrete at some of the joints, as was particularly noted when obsolete ammunition was detonated along side the pipe by military personnel who were fishing with explosives in the area. Concrete in the pipe walls was unaffected by salt water as was evidenced by cores taken from the

DISTRICT DIRECTORS AT WHITE'S POINT — The directors made frequent trips of inspection. This one, made on November 12, 1935, occurred during construction of the White's Point tunnel and ocean outfall.

shell after twenty years of immersion. Concrete embedment appeared unaffected by use of sea water in mixing concrete for this purpose.

After investigation of the proposed Palos Verdes tunnel route including test borings of the entire line, the engineering staff concluded upon a horseshoe section, reinforced concrete lined, tunnel section, 8-foot nominal diameter. The proposals for construction were presented to bidders in three schedules, No. 1 (south) 9,072′; No. 2 (middle) 14,050′; No. 3 (north) 9,102′. The division into three schedules was dictated by soil conditions and location. Schedule 1, the ocean end, would quite obviously be excavated from the outlet portal, Schedule 2, the center stretch, would probably be excavated and completed using a shaft for access; Schedule 3, at the upper end, would be attacked from the inlet end or portal. In addition, Schedules 1 and 2 would probably be largely in rock and most likely wet, while Schedule 3 was indicated by borings as being sand and dry. Contract was awarded to Shoeffner and Gordon for Sections 1 and 2 and to United Concrete Pipe Company for No. 3.

DIRECTOR JOHN QUINN AT WHITE'S POINT — Chairman of the Board of Supervisors John Quinn took an active part in Sanitation District affairs. He was particularly helpful in negotiations with Washington, both before and after World War II.

The United job proceeded with promptness and dispatch. No water was encountered. The excavation method employed was crown spiling over 4-inch or 5-inch "I" beam ribs and side lagging where necessary. The maximum day's excavation was almost exactly 100 feet. The average was considerably less. Excavation equipment was excellent for the ground encountered. A small power shovel operated in the heading, loading directly into a belt which discharged onto an endless belt supported on a frame. The frame, slightly longer than a train of muck cars, was mounted on trucks which ran on rails with a gauge wider than the muck cars. The frame-supported belt discharged into muck cars which were spotted under the discharge end as excavation progressed. Men on the job were given incentive pay and the job, both excavation and lining, proceeded well. Nearly all of the men employed on this job by the contractor were of Slavic ethnic origin, as were the contractors themselves. In compliance with rules of P.W.A., all were from the District area.

CONSTRUCTION OF WHITE'S POINT TUNNEL — The north schedule of the White's Point tunnel passed through sand. It was dry and, for the most part, stood well in the heading. Timbering was held in place with four and five inch I beams. The crown was held with spiling (later cut back) and side lagging.

The middle and south sections were attacked, respectively, from an access shaft and the outlet portal. The ground encountered was variable and, for a considerable part, moderately wet. The bore traversed a wide variety of sedimentary rocks, folded and distorted to the extent that little valid prediction could be made as to what would be encountered in the next 50 feet. A great deal of trouble was experienced with squeezing ground. Excavated to required section, the perimeter of the hole would gradually contract until it would be necessary to re-excavate to pass equipment into the heading. The squeezing continued in certain areas to a

HEAVING GROUND IN TUNNEL CONSTRUCTION — In particularly heavy and squeezing ground in the White's Point tunnel construction, heavy bracing was required. Steel ribs were difficult to obtain at all times; hence, some tunnel support with timber.

degree that required re-excavation twice before placing concrete lining. It appeared that the ground contracted into the hole about like the lens opening of a camera closes and, as it did so, gradually built up its own resistance to further movement. When the ordinary tunnel bracing would support against further movement, the job was considered safe for permanent lining. Asphaltum was encountered in certain areas and at times flowed slowly into the hole, clogging drain pipes and ditches. The tunnel, being uniformly without slope, relied on pumping throughout for dewatering.

A near disaster occurred in the center section of the tunnel when, after the north end had been completed, drainage water began to accumulate around the upper end of the finished job. Shoeffner and Gordon installed a bulkhead at the upper end of the finished line to protect their work, but continued rain raised the level of the ponded water to the extent that the bulkhead failed and the middle and north section were flooded. Fortunately, all men working in the tunnel at the time got safely out at the shaft. Damage to the uncompleted work was quite serious and the fin-

WHITE'S POINT TUNNEL CONSTRUCTION — Pressures underground forced the wall and floor into the excavated bore. Shown here, in background, is earlier excavation which had same end area as newly re-excavated part in foreground. Section was re-excavated until it ceased movement, then lined with reinforced concrete.

ished section was filled with a couple of feet of mud and sand. No lives were lost.

As might be expected, the tunnel crossed many faults in the tortuous mass which comprises the Palos Verdes Hills. Only one of

POSSIBLE FAULT CRACK IN TUNNEL CONCRETE — Shortly after the White's Point tunnel lining was placed, and before the structure was in operation, a crack developed at Station 257 + 19.6. The crack was continuously observed and explored until operation began. Again examined when the tunnel was emptied in 1955, no further movement had occurred.

the faults showed any signs of activity during construction. At Station 257 + 19′ near the contact of the sandy material and the rock, a transverse crack developed shortly after that section was lined. It was carefully observed while the tunnel was still open. During this interval, it showed no further movement. Seventeen years later when the tunnel was dewatered, it was again observed still showing no further movement. Quakes since 1937 have ap-

EIGHT FOOT DIAMETER, CONCRETE-LINED TUNNEL — Final cleanup of White's Point 8′ diameter, reinforced concrete-lined tunnel. Protrusion down from tunnel crown occasioned by concrete placing spout.

parently had no effect upon the structure.

Early in 1937, after completion of Schedule 3 of the tunnel, a contract was let for the remaining short section connecting the completed schedule with the treatment plant and for the entrance works. This section had been delayed, pending completion of Schedule 3, in order to allow for ample construction room at the north portal. The delay had a further advantage in that there was no interference with operation at 'Bixby until the entire outfall works were ready to go. The connection was completed without much difficulty or inconvenience to the plant or the contractor. Use of the works was delayed a few days pending some negotiations regarding payment for extras and delays. Federal W.P.A. labor was supplied to assist in making the minor modifications in the plant structures to accommodate them to primary sedimentation operation.

FINAL INSPECTION OF PALOS VERDES TUNNEL — The White's Point tunnel was placed in operation in October, 1927. Final inspection prior to use was made by (l. to r.) Hugh Gordon, District Counsel; A. K. Warren, Chief Engineer; A M Rawn, Asst. Chief Engineer; an unknown man; Floyd Shoefner, tunnel contractor; an unknown man; and Charles T. Leeds, Consulting Engineer, Los Angeles.

Chapter 7

THE WAR YEARS

With the completion and acceptance of the White's Point tunnel and ocean outfall in September, 1937 and the facilities installed in the treatment plant to permit its conversion from activated sludge to a primary plant, sewage effluent was turned into the tunnel on Thursday, October 14, 1937, at 9:20 p.m. The change-over was complete. The by-pass at Dominguez Slough was closed; the effluent pumps which had pumped plant effluent to Dominguez Slough for years were stopped permanently; the air compressors were shut down and the plant left in an unaccustomed quiet. Only the inlet sewage pumps continued in operation. The plant had served its purpose for a little less than ten years. When the process of treatment was changed from activated sludge to primary sedimentation, the same structures which served for the one were adapted to the other and with a built-in capacity many times greater for the new process than for the former.

The period 1937 to 1945 is memorable for many reasons: District 14, in the Lancaster Valley, was formed on August 31, 1938, voted bonds in the amount of $36,000 in October of that year, and sold them in August 1940; A. K. Warren died on August 28, 1940. President Roosevelt declared war on Germany, Japan et al on December 7, 1941, following the attack on Pearl Harbor by

the Japanese fleet, and a whole new crop of so-called, alphabet organizations, mainly federal, sprang up. World War II ended in late 1945.

Warren's death was a great loss to the Districts and to the staff. He had been a good and inspiring leader, had overcome many obstacles in his path to success and had welded together a group whose admiration and affection he held. Starting from scratch, he had accomplished a task that was new, unique and of great value to those he served. Warren was a man of action. With the completion of the system which he had envisioned, his interest waned and, although he still ran the show, some of the old vigor was gone. This may have been due to ill health, but since he was not one to complain about anything, quien sabe? His death was caused by a malignancy. His memory will be bright with all who worked with and for him in his greatest engineering experience. The writer visited him a day or so before his death and well remembers that even though barely conscious at the time, Warren commented with satisfaction on the successful sale of bonds in District 14. At an emergency meeting on the day following his death, Rawn was appointed Acting Chief Engineer, a post to which he was later assigned permanently and held until December 1, 1958.

Concurrent with the appointment of Rawn as Chief Engineer, C. R. Compton was appointed to the post of Assistant Chief Engineer and, by the Board of Directors, authorized to act in the capacity of Chief Engineer in event of the absence or disability of the Chief Engineer. Such provision had never been made during Warren's tenure in office, which omission was the occasion for the immediate meeting of the Board following his death. H. K. Palmer, an employee of the Districts for many years assumed Compton's former duties as Office Engineer. F. D. Bowlus was placed in charge of all field engineering and of District Operation and Maintenance.

Since what follows in this narrative, at least the part of it from 1940 to 1958, occurred during the years when the author was Chief Engineer and General Manager of the Districts of Los Angeles County, he (Rawn) will write from here on at times in the first person.

By 1938 the Districts had built or otherwise acquired some 176 miles of District trunk sewers, ranging in size from fifteen inches in diameter to ten feet, six inches nominal diameter; 19 miles of joint outfall sewers; seven pumping stations; an activated sludge sewage treatment plant, later converted into a sedimentation plant; a six and a half mile tunnel under the Palos Verdes Hills and a mile long ocean outfall. Some 650 miles of lateral sewers drained into the trunks to serve a population of about 400,000, not all of whom were availing themselves of sewerage service. The laterals were built and maintained by agencies other than the Districts. The four large districts, (1, 2, 5 and 8) had expended a little more than eleven million dollars in construction and from all appearances it looked as though the twenty-year capacity life of the system would materialize. Flow at the disposal works as of '38 was twenty-three million gallons a day. Assessed valuation of the active Districts at the time was 284 million dollars. Drop in the assessed valuation was occasioned by a drastic reduction in such values by County Assessor John Quinn as he took office in the early 1930's. Not until 1943, or thereabout, did the assessed valuation again reach that of 1932-33.

The works in the South Bay Cities District and in District 4 were completed and such sewers as had been projected for the oil companies in District 11 were substantially finished and draining to the Los Angeles City North Outfall. As heretofore noted, both S.B.C. and District 4 drained to Los Angeles City sewers, as did small parts of Districts 2 and 5.

District 14 was to be a W.P.A. job, which accounts for the very modest bond issue authorized ($36,000) for its construction. I had argued a little with Warren about providing sewage treatment through an Imhoff Tank, feeling that in this pasture country a milk processing plant was not only possible but probable after the sewerage facilities were installed. The issue, however, had been voted on the basis of an Imhoff Tank and it was so built. I had a feeling that, with separate sludge digestion, some of the refractory wastes, as from milk and poultry processing plants, might be more readily adapted to expansion or extended treatment. Actually it made very little difference. The town of Lancaster, which the District was designed to serve, outgrew the plant and its own limits

PRIMARY PLANT AT LANCASTER — First plant at Lancaster, District 14. Imhoff tank. Disposal of effluent to neighboring slough area.

during the war years and those which followed, and the whole works had to be abandoned in favor of a much more elaborate plant in a more remote area. The poultry wastes did materialize but did little harm after certain regulations were imposed, and enforced, on the operating personnel at the processing plant.

District 14 was completed with promptness and dispatch. With all of the works involved it cost the District no more than the bond issue. Federal funds paid most of the cost, and the District profited greatly on the deal. The money for this job had been pledged by the federal government before war was declared, the advent of which latter, made no difference in its forthcoming.

District 3 was participating in the joint outfall effort to some extent. The experience with District 3 regarding the North Long Beach pumping plant served as a good guide line in subsequent negotiations for service to areas outside the owner District boundaries.

Situated near the inlet to the original siphon structure under the Flood Control Channel at about Long Beach Boulevard, Long Beach had constructed a sewage pumping station designed to lift the sewage of North Long Beach into the Districts Joint Outfall.

PORTABLE ONE-TON CHLORINATION STATION, 1931 — Chlorination stations were constructed (1931) so as to be easily moved from one location to another. All stations were designed for one-ton containers. Fred Bowlus, Construction Engineer, in picture.

Long Beach had contracted with the Districts for disposal of the sewage. Long Beach was to pay $35 per million gallons for this service. Rate of flow averaged 0.7 mgd. The local lines leading to the plant were on very flat grade and soon after beginning of use were extremely dirty and generating H_2S at a great rate.

The Districts had determined that control of H_2S must be such as to produce sewage at the inlet to the Bixby plant with not over about a half part per million H_2S, as a protection to concrete in the joint outfall. It was further determined that, on the average, there was consumed in the system about 20 pounds of Cl to each pound of H_2S in order to effect such control. It was further evident that the sewage from the North Long Beach plant was the source of 35 pounds of H_2S each day, for which the Districts were required to apply 700 pounds of Cl to the flow. Thus for a daily receipt of about $25 the Districts were spending some $30 a day for chlorine besides applying it to the sewage, treating the sewage at the Joint Disposal Plant after conveying it many miles to that structure and finally disposing of it. After a few months of

TRASH AND CLAY LINERS REMOVED FROM BULLIS ROAD TRUNK — Action of hydrogen sulfide gas, oxidized on the sewer walls, penetrated through the vitrified clay liners and forced the liners free from their bond to the concrete.

experience with the contract, the Districts insisted that the North Long Beach sewers be kept clean by the owners and that sufficient chlorine be applied to assure a residual of chlorine in all sewage delivered to the District lines. Subsequent contracts for similar service reflected this experience.

Elsewhere in this narrative attention has been called to the failure of the tile liners to permanently protect the inner face of the concrete pipe and conduits. This became increasingly evident after the system had been in operation for ten years or so. By 1939 so many liners had fallen from the sides and top of the joint outfall south of District 1 that it became imperative that the debris be removed from the lines. Work on this was commenced in December of 1939. Flow of sewage at that time was some 27 mgd at Bixby. While the maintenance crew was working on this task on December 27, 1939, a sharp earthquake occurred. The foreman of the gang reported that he could hear many liners fall from the top and sides as a result of the shock.

The six final clarifiers were still doing the job of sewage clarification at Bixby in December, 1939, when systematic clean-

ing of the joint outfall was undertaken. The method of cleaning was devised in the field. A timber "pusher" which fitted the invert of the structure and extended up the sides a foot or so, was assembled in the sewer and loaded so as not to float but enough to overcome buoyancy. As it moved downstream it pushed and washed the debris ahead to where it was being removed at the next manhole down. The method worked all right and tons of broken liners, sand and other settleable material were removed, but unfortunately a great deal escaped past the point of removal and went on into the plant, to the complete disruption of the six clarifiers which quit forthwith, and many days were spent getting them back in order.

During December 1939 and January, 1940, the ocean outfall at White's Point was inspected by the District's diving inspector who reported it to be in excellent condition, showing no signs of failure at any point. At this time the contractor, Merritt, Chapman and Scott Company, was relieved of responsibility, for sufficiency of the work of construction, and released. M. C. S. Co. had been required to furnish bond guaranteeing the sufficiency of the work. The guarantee was to run for two years and then released if no defects in the work appeared. Since the work was all done in strict accordance with District plans and specifications, under close and adequate District inspection and with materials furnished or prescribed and inspected by the Districts, it is difficult to see that the guarantee had any real value. The outfall was well built, however, and still remains (1964) in workable condition.

In 1940 and 1941 the District owners of Bixby plant sold their remaining bonds, few in number but sufficient with some money saved from the O & M levy to finance the District's share of the cost of certain plant features, including modification of some of the longitudinal tanks and construction of the third battery of sludge digestion tanks. It is interesting to note that bonds which sold for par and premium at 5¼% in 1925, sold for 1½% to 2½% in 1940. Same bonds; same security; different times.

All of the work undertaken as construction following and including the White's Point tunnel and outfall until 1945-46 was done with federal assistance. This includes everything, so far as I can recollect. A good deal has been written and expressed about

the alphabetical agency assistance, before, during and just after World War II, some of it not very complimentary. While the District employees had some differences of opinion with their opposite numbers in federal service, mostly in administrative positions, relations were generally good and the Districts profited greatly from the association. It was sometimes difficult to exercise the proper diplomacy and restraint when dealing with those in administrative positions who were obviously in over their heads, but the effort paid off, and the balance in benefit was vastly in the Districts' favor. Fortunately the District Director for W.P.A. and many other federal assistance programs in the Southern California area, was a warm hearted man of understanding and intelligence. He, Wright Felt, will be long remembered for his helpfulness in solving the sometimes perplexing federal requirements.

During the years 1937 to 1945, altho new construction was limited to what could be financed, in major part, by agencies of the federal government, the staff was not entirely idle. A great many of the older field employees left the Districts to work for the military establishments. This was particularly true of the treatment plant operators who were in demand because of the experience with the Districts. The incentive was more money. Not many men went into the military service. Most of the employees had been recruited from men who had served in World War I and were well over the age of continued military service. A. P. Banta of the Engineering staff served as a lieutenant colonel in the Sanitary Corps. At the request of Fred Fowler, Civil Engineer Consultant to the Constructing Q. M. General Somerville, I took over the job of recommending sewerage, drainage and incineration installations in the larger cantonments.

Two contracts of some significance were entered into by the Districts during 1940 and 41. One, the disposal of sewage from a Japanese detention camp at the Santa Anita Turf Club grounds in Arcadia, the other, an agreement to take and dispose of the waste brines from the Metropolitan Water District Plant at La Verne.

At the Santa Anita Turf Club reliance for the disposal of sewage had been placed on cesspools and spreading beds. With the advent of many Japanese and the troops necessary to guard them, the facilities quickly demonstrated their inadequacy, whereupon a

DIRECTORS IN FRONT OF J.D.P. POWERHOUSE — At the time of this inspection (9/10/41) there were 29 Directors on the Boards of the Sanitation Districts, representing 24 incorporated cities and the county. Twenty-three of them appear in this picture. Without identifying each Director, the 29 were as follows: Darby, Binder, Bogart, Jessup, Cox, Grieb, Gentry, Fletcher, Fike, Ford, Hauge, Kennedy, Levet, McDonough, McGuire, Poole, Randall, Roessler, Smith, Meyer, Blech, Jones, Dowell, Hawkins, Kieselhorst, Van der Oef, Leonis, Bennett, Tarleton. Five District employees are in the group.

local cesspool pumper was called upon to keep them emptied. He, the cesspool pumper, naturally concluded that he would be able to dispose of his pumpage into the nearest District sewer, which was north of Montebello in District 2. I refused to allow him access to the District lines with the sewage because it originated outside of the District boundaries, as they then existed. We came to terms on payment, by the pumper, of fifty cents a thousand gallons for disposal. This was to be split between the City of San Gabriel and the Districts, since the sewage had first to flow through the City lines to reach the District trunk. This contract ran from August, 1942 to April, 1943.

Obviously, the City of Arcadia had to make better provision for sewerage than cesspools, etc., and therefore hired a local Engineer to advise them on a proper course of procedure. Quite naturally the Engineer came up with a recommendation to build a complete treatment plant which would serve the Turf Club detention camp and, later, the City of Arcadia. It was also proposed that the Army build the plant. I countered with a plan for a line from the Turf Club grounds to connect with a District line in North Montebello and, on behalf of the Districts, to take and dispose of the camp sewage free if the United States would give the line to the Districts when it was no longer of service to them, otherwise $35 a million gallons. To be brief; the line connecting was built, the Army kept title to the line, the government paid the thirty-five dollars a million gallons while using it, as did the Turf Club until war was over. When the line was no longer of use to the Federal Government it was offered to the Districts at cost, but in the meantime District 15, including Arcadia had been formed and financed and the connecting line had lost its importance. The Districts offered the United States a dollar for it, which the U.S. accepted. The line from the Turf Club to Montebello was designed much too large (about 24″ diam.). We took the flow without trouble in a 15″ diameter District trunk serving Montebello.

Brines from the water treatment plant of the Metropolitan Water District presented a disposal problem to that agency. It was solved by contracting with the Sanitation Districts for a connection with the latter's trunk system at about the north boundary of District 2. M.W.D. paid the Sanitation Districts $30 per million

gallons for disposal from the point of connection, on. Later, the line, from La Verne to the District connection at Whittier Narrows, assumed considerable importance and the Sanitation Districts were allowed joint use of the line with M.W.D. The Water District contracted to pay the Sanitation Districts some $640,000 in forty annual installments for use of the Sanitation Districts' lines from the Whittier Narrows to final disposal, plus $1.50 per mg service charge.

The war marked the advent of thousands of war workers and their families to Southern California where war industries were concentrating. It soon became apparent that these were not, in any sense, migrant workers, but once here were here to stay. This could be quite readily determined by the manner in which they "bedded down" in their new homes and became Californians. As the tide of fortunes turned in favor of the Allies and end of war seemed someplace on the horizon, it became apparent that a great deal more sewerage planning was imminent. By the end of 1945, when the war ended, the need for prompt expansion of all public utilities was obvious.

By 1945 the Districts had built, or otherwise acquired, a total of 198 miles of District trunk sewers; 19 miles of Joint Outfall sewers; 12 pumping stations; the Joint Disposal Plant at Bixby; an Imhoff Tank plant in District 14 at Lancaster; the six and one-half mile tunnel under the Palos Verdes Hills and mile long ocean outfall at White's Point. Thirteen hundred and eighty-seven miles of lateral sewers, built by agencies other than the Sanitation Districts, drained into the trunks, ready to serve a population of 701,000. Flow of sewage at Bixby averaged 51.6 million gallons per day in 1945. At South Bay Cities it was 1.5 mgd and in District 14 less than one million. By comparison with the work accomplished between 1925 and 1937 it is obvious that the years from 1937 to 1945 were not those of great accomplishment. No new cities were incorporated, in the District area, during this period. As of 1945 the District had 59 permanent employees.

Assessed valuation of the active Sanitation Districts in Los Angeles County in 1937 was, in round numbers, 284 million dollars. In 1945 the assessed valuation of substantially the same area was 420 million.

Although the District system was not greatly expanded during the period mentioned above, its existence was vital to the development of the area, particularly in view of the concentration of war industries in Los Angeles County, and the impressive increase in population. In fact, it is difficult to imagine just what would have been the role of the area in the war effort if the District sewerage system had been lacking. Not only was the system able to furnish disposal facilities for the many war industries, hospitals and housing projects in the Districts, but were able to reach well beyond the District boundaries to serve plants, the wastes of which would have otherwise presented serious and difficult problems, if not, indeed, to the extent of preventing location of some of the plants in environments best suited to their objectives. Although sometimes the War Department Procurement group were inclined to be quite arbitrary in their demands, we got along pretty well with their representatives, even though they threatened, once to waste poison gas, in solution, into our lines. We got a little arbitrary about that ourselves.

Chapter 8

POST WAR ACCELERATION

By 1946, the Sanitation District procedure, as a solution for the sewerage problems in Los Angeles County, was well recognized as controlling for most of the area outside of the City of Los Angeles, except the North Santa Monica Bay Cities and the San Fernando Valley. District 3, which had tried in vain to finance District works in 1925 and '30, voted bonds in the amount of $4 million in February 1946, while Districts 15, 16 and 17, covering part of the area of original District 7 (dissolved) voted bonds in 1946-47, in the amount, collectively, of $6,529,000 after joining with the other active Districts in joint agreements for construction, operation and administration. This action set the stage for some immediate, and very much needed, new or extended, facilities.

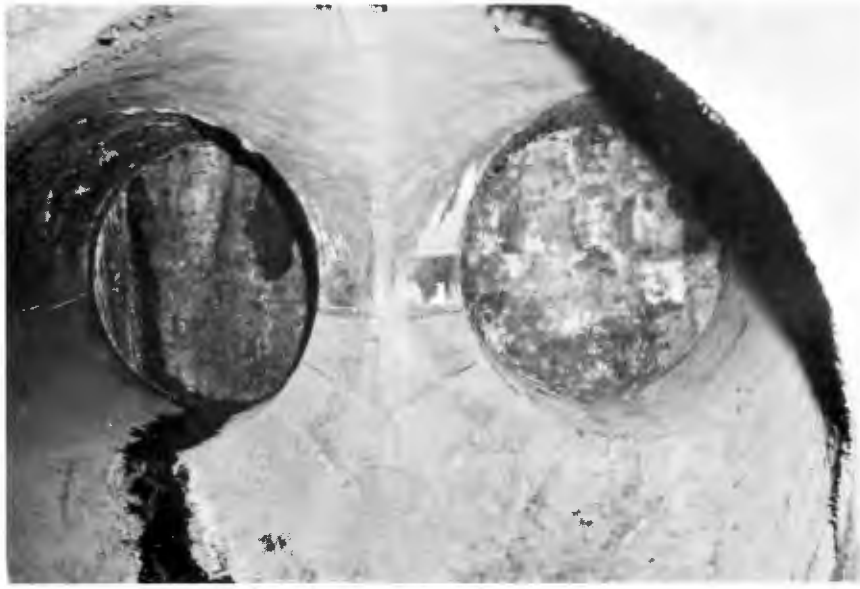
Terms of joint ownership in existing, and new, structures were construed to mean that, irrespective of ownership rights in any structure, all districts participating had acquired the right to use the facility until the limit of the facility's capacity had been reached. Thus, capacities could be adjusted among Districts as needed by buying or selling capacity ownership, or by leasing. When the limit of facility capacity had been reached, or was imminent, additional jointly owned structures were financed and

built and the new construction cost properly assigned. All facilities were bought and sold at cost, exclusive of interest on the investment or depreciation and did not include in any transaction the value of any gift or subsidy of any kind. The Districts early adopted, and have consistently followed, the unwritten policy that adequate sewerage is the business of all the citizens and public bodies in the County. Many new District investigations, preliminary plans, costs of promotion, advertising and bond election have been financed from the funds of existing, operating Districts until the tax money allowed after District formation could be made available. Also, if expedient, one District may transfer some of its capacity rights in certain facilities to another for sufficient funds to tide it over a brief period, and then buy it back. A sort of District Facility Hock Shop.

As heretofore noted, the ocean outfall at White's Point was originally planned to be a double barrel line reaching seaward about a mile. As built, the double barrel was laid through the breaker zone and to a point off-shore, from which the second line could be constructed from barges without the necessity for near-shore trestle facilities during construction. Friction losses in the eight-foot Palos Verdes tunnel and the single sixty-inch diameter outfall pipe, limited the gravity capacity of the couple to a discharge rate of about 52 million gallons per day at mean tide. This average daily flow, having been reached in 1946, it was desirable to expand the bottle-neck in the outfall works by building the second leg of the outfall. By so doing the tunnel and outfall capacity could be increased to a rate of some 70 million gallons a day at mean sea level.

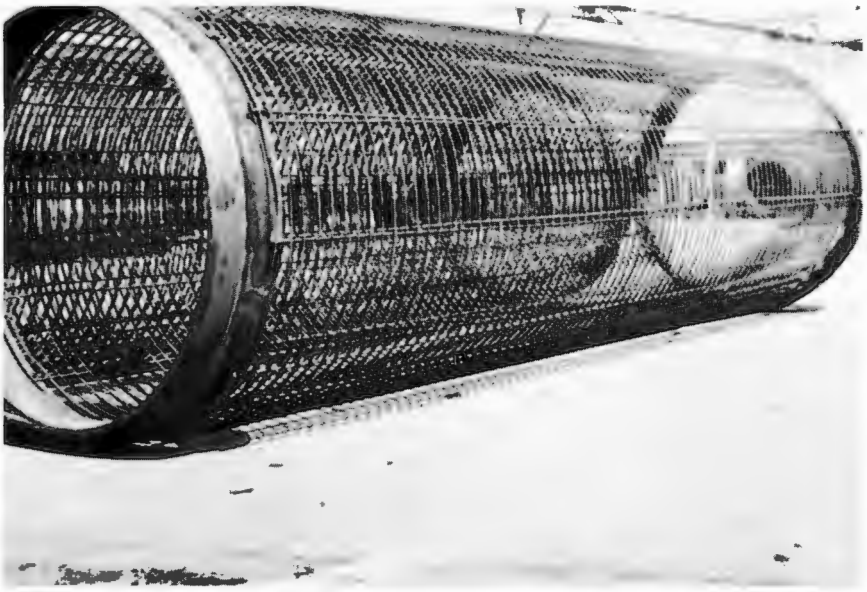
The stub line to which the second ocean pipe was to be connected, was 60 inches internal diameter; it extended seaward about two hundred feet and was there blanked off with a timber bulkhead. The extension, however, was designed as a 72″ internal diameter pipe in order to cut down head losses and increase capacity. It seemed desirable to have the district forces do the job of extending the pipe for both this reason, and, because limited funds rendered entering into a fixed contract inadvisable. It was so ordered.

The outfall construction in 1937 had, fortunately, required



ORIGINAL VALVES FROM 8-FOOT TUNNEL TO 60-INCH OUTFALL — Connection, 8-foot tunnel to ocean outfall pipes: 60-inch gate valves. Picture taken after 21 years in service. Valves in excellent condition.

that the rock trench in which the second outfall pipe was to be laid, should be excavated a couple of hundred feet seaward and at an angle to the east, so that further shooting in the foundation, when the second leg was built, would be far enough away from the existing line to avoid damaging shock in further blasting in trench excavation. As a further precaution against possible rupture of the existing pipe, all further required blasting for the new trench was done with four pound bombs, instead of twenty pound bombs such as were used in the original construction. This latter provision was extremely fortunate. As is pointed out in the legal discussion, the Districts brought suit against the Federal Government for damages sustained to their outfall as a result of exploding obsolete ammunition over and near the outfall as a means of securing fish. In the pre-trial discussions, it was evident that the Federal Investigators were under the impression that twenty pound bombs had been used in blasting the latter trench, causing the damage for which the District was blaming the Army personnel. When the facts were

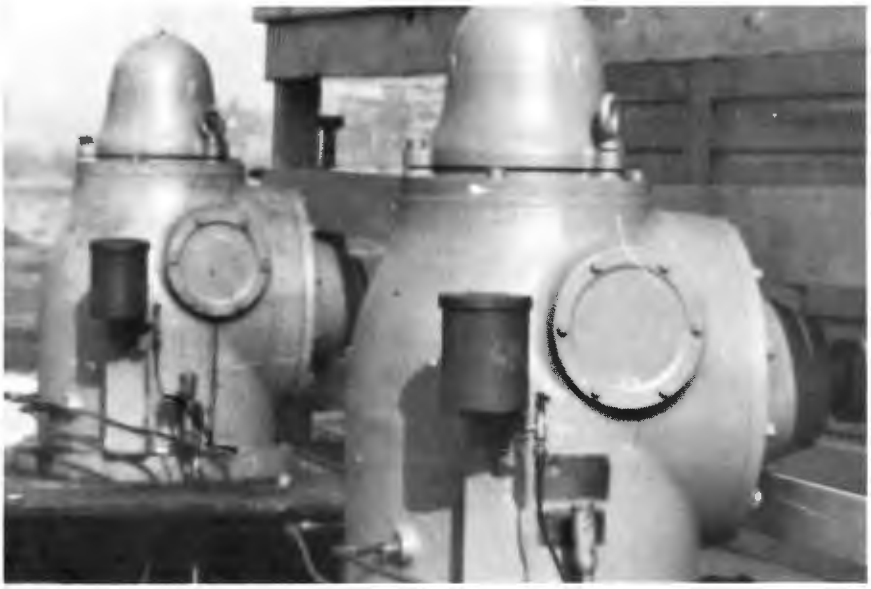


REINFORCING CAGE FOR 72-INCH OCEAN OUTFALL PIPE — Pipe construction in the 72-inch outfall at White's Point was modified after using 8-foot lengths to about 850 feet offshore. At this point construction proceeded using 24-foot lengths. Double reinforcing and special cast iron end rings for 24-foot length.

discovered the Government offered a settlement which, although short of the actual damage sustained, was accepted on advice of Counsel.

Extension of the second outfall pipe was commenced using 72″ diameter spun concrete pipes, 8-feet in length. Two pipes were joined on deck and lowered into place attached to a strongback. The pipe in rock trench were embedded in concrete, wholly or in part, as required and the annular space between adjacent end rings and pipe caulked with lead wool. All pipe were equipped with end rings, attached at the plant of manufacture. At about 900-feet seaward the construction procedure was changed; pipe was cast in twenty-four foot lengths and equipped with mechanite iron end rings which could be caulked from the pipe interior, under water. This length greatly facilitated construction and, additionally, provided a moderate amount of flexibility in the line. Beyond the rock bottom shelf, pipe were laid directly on the undisturbed sand bottom.

Although the second outfall pipe was an obvious need, it was



EFFLUENT PUMPS AT BIXBY — By December, 1942, the flow of sewage into the Bixby plant (52 M.G.D. peak rate) had increased sufficiently to warrant pump installation for use during simultaneous occurrence of high flow and high tide, as well as during severe rains. The two pumps were direct-connected to sludge gas-driven engines.

not a solution. The flow of sewage from the new District 16, comprising the cities of Pasadena, South Pasadena, Alhambra and San Marino, as measured at the Tri-Cities Plant west of San Gabriel, was known to be twelve million gallons a day. Districts 15 and 17 could be readily determined to contribute ten million between them as soon as lateral sewers were built, while the flow from District 3, not already taken into the District system, was estimated to be some 8 million gallons per day. Thus, it was apparent that upon completion of the second ocean pipe, or shortly thereafter, an average daily flow exceeding 82 million gallons per day, plus the normal increase in the connected Districts, impended.

It may be well at this point to state that the average daily flow was not the factor controlling the quantity of flow which could be treated, and disposed of, at Bixby, neither was the gravity capacity of the tunnel and ocean outfalls. As early as 1942, the Districts found it necessary to provide equipment, for high flow pumping into the outfall. Two Climax gas engines, operating on sludge gas,

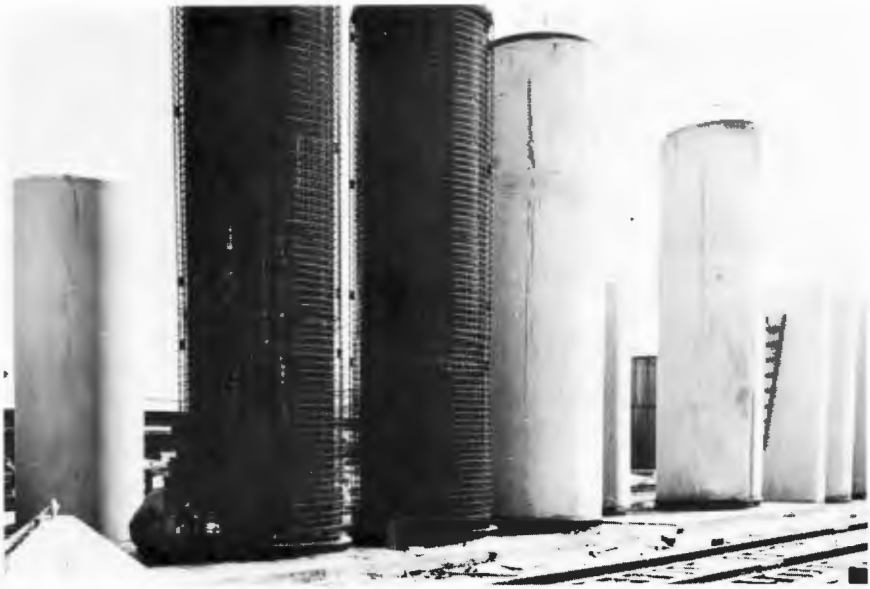
direct connected to 30″ Peerless Cent. Pumps, were installed at Bixby. These pumps, secured with the cooperation of the War Production Board as essential to public health, were used to move the flow into the outfall during periods when high tide and high flow coincided, or otherwise as required. Adequate pumping facilities have consistently been a characteristic of Bixby, but, by economic limitations, are appropriate for use only to supplement an otherwise adequate gravity disposal. The District effort has consistently been to provide gravity flow through the outfall for average daily flow of sewage at mean water level.

With the second ocean pipe in place, providing some seventy mgd capacity, the next bottle neck would occur in the eight-foot diameter tunnel and it was apparent that, as acceptance of the District idea gained momentum, the next enlargement would need to be on a rather impressive scale in order to continue operating on the basis of ocean disposal of primary effluent. This indicated greater access to White's Point and obviously much greater tunnel capacity. The latter implied a parallel tunnel larger than the existing one. A twelve-foot diameter tunnel was indicated. Experience with the eight-foot tunnel and single 60″ diameter ocean outfall pipe was used to determine that the gravity flow through the combination of 12 and 8-foot diameter tunnels in parallel, thence to sea through 5 and 6-foot diameter pipes, would amount to 165 mgd. Furthermore, that if a seven-foot diameter ocean outfall pipe were added to the other two the gravity capacity of the combined structures would amount to 250 mgd. A pump lift of 20-feet above maximum water surface, in the tanks, at the plant, coupled with mean tide, would permit discharge to sea of about 400 mgd of plant effluent. Such a flow, it was estimated, might occur about 1970, at which time further steps would have to be taken if the same means of disposal were continued.

The new Districts, parties to the Joint Outfall Agreement, were well supplied with bond money for purchase of capacity rights in the existing works of the four original owners of Bixby and the trunk lines leading thereto and to the sea. They were likewise bonded for construction of trunk lines leading to, and into, their respective Districts. Such anticipated additional treatment and disposal works as were imminent were, of course, includ-

SEVENTY-TWO INCH OUTFALL EXTENSION WYE — The second ocean outfall was extended seaward in 1954, terminating in perforated wye branches 48" in diameter and 216 feet long. Wye section is shown on barge ready for launching.

ed. The original owners were without funds, excepting for those received from the new Districts under the Joint Outfall Agreement. I felt reasonably sure that there was enough money to finance construction of the additional 72″ diameter ocean pipe



REINFORCED CONCRETE PIPE FOR SUBMARINE OUTFALL — The second leg of the ocean outfall at White's Point was completed in 1947. Six-foot diameter pipe lengths were used to extend the stub which had been laid in 1937. Sewage flow had increased to 65 million gallons a day average flow, with maximum rates of about 90 m.g.d.

line but that it would be inappropriate to contract the work, but rather, to do it with District forces on a "pay-as-you-go" basis. The Directors authorized the work. Fred Bowlus, the Districts' construction engineer and Dan Boom, the Districts' diving inspector and consultant, organized the job. Work commenced in August 1946 and the structure was completed to 110′ depth at 5000′ seaward and in operation in November 1947. This pipe was extended seaward in 1954 far enough to reach a depth of about 165 feet some 7,000 feet from shore.

There was no doubt about the necessity for building a second outfall tunnel at this time, and the indications were that it had better be one of ample size and capacity. The four Districts (1, 2, 5 and 8), were without construction funds for such a costly undertaking but all signs pointed to an impressive increase in assessed valuation throughout the entire County in the immediate future, sufficient to provide funds for the tunnel construction if it were carried out over a few years. This gave rise to the plan of building the tunnel in four increments, beginning at the inlet end and

TWELVE-FOOT DIAMETER TUNNEL UNDER CONSTRUCTION — Cross section of 12-foot tunnel lining. Note how the tunnel support is embedded in concrete. Picture taken at connection point of finished tunnel with Section 4.

constructing a cross over to the original eight-foot line at the quarter points. Such a plan would increase the gravity capacity of the outlet works in increments of about 20 mgd for each quarter of tunnel completed.

Work on the 12-foot tunnel commenced in July 1948. The four increments were completed by District forces and placed in operation respectively in April 1949; December 1950; March 1954, and April, 1958.

Concurrently with the construction of the 12-foot diameter tunnel, the Districts built a third ocean outfall at White's Point. This one, a 90-inch internal diameter reinforced concrete pipe extended to a water depth of 200 feet and embodied advanced principles of sewage diffusion in sea water, investigated, and described in Technical Journals by District engineers. The additional data were based largely on the initial work of Palmer and Rawn. The practical application as well as an extension of the principles involved were developed more fully in the second paper which was authored by Bowerman (Engr. Dists.), Brooks (Professor, Cal-Tech) and Rawn. It is gratifying to be able to note that the

PRECAST WYE 90-INCH OCEAN OUTFALL — The 90 by 60 by 60 inch wye placed in ocean outfall at connection to wye diffusion structure. White's Point.

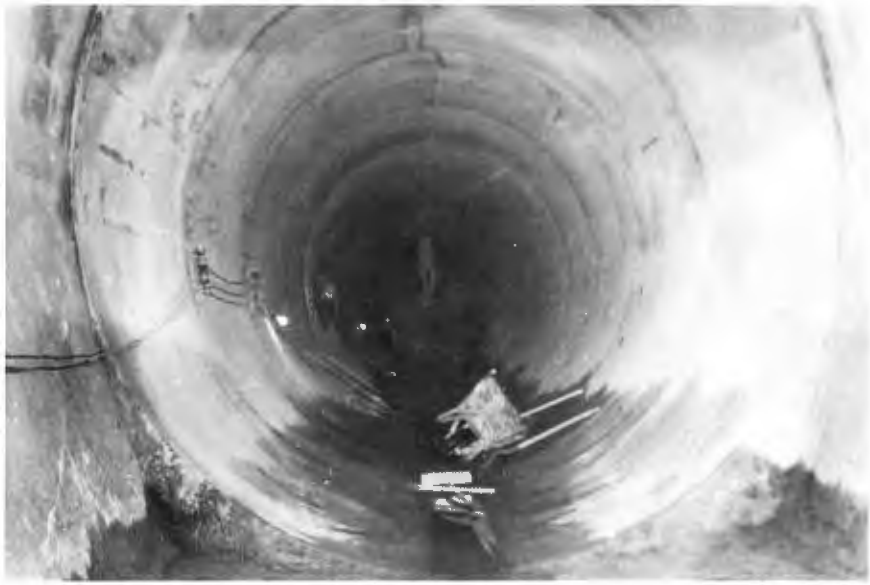
prototype structure was most efficient in action and, in addition to promoting prompt diffusion of the sewage effluent and hence its oxidation, practically eliminated the view of the surface field, and therefore much of the criticism, from shore observers. This pipe line was built by District employees.

The prediction that the assessed valuation of the County would increase materially in the years immediately following the close of World War II, proved to be a valid one. In the Districts which had built their initial works in the first quarter of the century, the assessed valuation more than doubled from 1946 to 1948. From the latter year to 1958 it more than doubled again.

CONSTRUCTION OF NINETY INCH DIAMETER OUTFALL — District construction barge in foreground; construction trestle through surf, White's Point. 1955. The outfall tunnels terminate at cliff. Palos Verdes hills in background.

CROSSOVER 12-FOOT TO 8-FOOT TUNNEL — Crossing from twelve to eight foot tunnel for bypass from completed sections of 12-foot sections to 8-foot operating line.

Assessed valuation of those Districts which were organized in the mid-'40's increased in about the same order. It began to appear that, by careful planning and programing of required new works, further construction could be carried forward without the necessity for additional bonding, save in Districts separate from the jointly owned sewerage works. A member of the engineering staff was designated to program all new works for extension and expansion of the system, including those for which original bond money was not available, which would be needed in the succeeding five-year period. In addition the program was to include an estimate of the assessed valuation for each of the five years ahead



TWELVE FOOT DIAMETER REINFORCED CONCRETE PIPE IN OUTFALL
Upper end of 12-foot diameter line from Bixby to White's Point was constructed of precast R. C. pipe. View shows junction with 12-foot nominal diameter tunnel section at about Vermont Avenue.

and, under none but the most extraordinary circumstances, was the estimated cost of the work to be accomplished in any one year to produce an increase in the previous year's tax rate, but, preferably, reduce it. This was to be a continuing programing, so that the District would know at all times what the needs for the next five-year period would be. The plan contained flexibility only to the extent of substituting some jobs for others. It did not include any increase in the tax rate over the previous year. The District Boards approved of the plan and it was followed thereafter.

In order to finance the proposed method of extension and expansion, it was necessary to increase the current O & M tax rate in Districts 1, 2, 5 and 8. The average O & M tax rate for the four Districts was 17 cents per hundred A.V. This was increased to an average of 30 cents in 1946 and by 1958 had been reduced to 14 cents per hundred. Tax rates for all other Districts participating in the jointly owned works were held at rates sufficient to defray cost of extensions and expansions in the system over and above those contemplated in the original bond issue of each, subject to the

APPEAL FOR ECONOMY — Most of the tunnel labor came from the District area. An appeal was made to their sense of economy in the use of construction lumber, since they were taxpayers who would have to pay the bill.

same conditions, in re-increasing the rates, as applied to the older Districts. In 1951 the rates were actually increased over the previous year but for a reason not connected with the disposal of sewage. The two cent increase in 1951 in many of the Districts had to do with fulfilling new provisions in the law requiring the Districts to dispose of rubbish. The matter will be discussed later in this narrative. Furthermore, the foregoing discussion of financing extension and expansion of facilities does not apply to Districts 4, 9, 11, 14 or 20, none of which were parties to the Joint Outfall Agreement. In some measure they apply to South Bay Cities, which District abandoned its connection to the Los Angeles City Plant at

DEEP TRENCHING; DISTRICT 14 — Rosamond Outfall Sewer, District 14. Deep trench partially excavated with dragline; later with trencher to grade.

Hyperion, in 1950 and constructed a connection to one of the mains in District 5; thence to the Bixby disposal works. S.B.C., thereafter, became a party to the Joint Outfall Contract.

The history of District 4, during the period 1946 to 1958, is quite uneventful. Los Angeles City annexed part of it, creating some question about payment of services in the Los Angeles system, finally settled by having the Improvement Maintenance District act in certain matters for the Sanitation District. It is a somewhat confused District at best. A small part of the sewage originates in what is now Beverly Hills; much of the District is in Los Angeles; the rest is unincorporated. Sewage from the City of

EARLY MULTISTAGE TANKS — First of the multistage digestion tanks at Bixby. These tanks were later supplemented by other similar tanks; and still later (1960 or so) were discontinued in operation in favor of others of greater efficiency.

Los Angeles flows into the District lines along the north boundary of the District and then flows again into the Los Angeles lines south of the District. The District pays for what originates within the District but that from the City has to be measured at the north boundary and deducted. The matter is further complicated by annexations to Los Angeles from the southern part of District 4 where much the same confusion reigns, only more so, because in this case the annexed area sports a large hospital which overloads the District lines. Add to this the fact that Los Angeles City and Los Angeles County building laws are not the same and both are different from those of Beverly Hills and that the unincorporated area is developing into a high-priced, high-rise district and that Los Angeles is somewhat loath to extend service to such a formidable competitor; and District 4 is the result. From a sleepy little village before the last war it has developed into a roaring development of high-priced, high-rise apartments and office buildings. Sunset Boulevard bisects it the long way.

District 9 is a residential area of County, completely surrounded by Los Angeles, in the San Pedro annexation to that city.

Its history is that of a static area, improving in price as the surrounding land increases in value. It had no bonded indebtedness and pays an annual fee to Los Angeles for the disposal of its collected sewage through a Los Angeles sewerage plant on Terminal Island. District 11, organized for the purpose of contracting with Los Angeles for disposal of oil well brines, is gradually being absorbed into, or served by, District 5 as it develops residentially.

District 14 has a history dating from 1940, when it sold bonds to build a small system in and about Lancaster. It was a W.P.A. job and cost the property owners in the District very little.

Lancaster was, and is, unincorporated and its Chamber of Commerce successfully undertook to guide the local destiny of the District. The Hon. Roger Jessup was County Supervisor of the area and for many years was Chairman of the Board of Supervisors. The Board of Supervisors, by law, constituted the Board of Directors of the District. Its initial district system served very well until 1952, at which time the District area was expanded from about ⅔ of a square mile to five, and two years later to seven square miles. During those two years the District used $340,000 of a $440,000 bond issue voted in 1952 for new facilities and cancelled the remainder of the issue. In 1956 the District expanded its boundaries to include thirty-five square miles and voted bonds in the amount of $2,853,000. Revenue from the sale of these latter bonds was used to extend and increase the trunk sewer and pumping system and to build a rather large and impressive oxidation treatment plant well North of Lancaster and its rapidly developing environs.

All efforts to dispose of the very acceptable irrigation water resulting from treatment of sewage at the District 14 plant have been unavailing. There is no outlet from the Dry Lake area, to which the plant flow is tributary, leaving the final disposal of the plant effluent to evaporation. This requires extensive pond areas which are not readily available because of the desire of military forces in the locality to use the dry lake bottom for military purposes. The treatment process employed at the plant is eminently successful and well adapted to an area, where there is a great deal of arid land in the immediate environs. Were it not that the highest and best use of the ancient Dry Lake area is for military

purposes, at least in the opinion of Federal personnel, the existing works in District 14 would end sewerage problems there, but disposal of the effluent from the plant still remains to be permanently resolved.

District 20 is in the same general location as District 14. Organized in 1951, bonds in the amount of $140,000 were approved in January 1952 and the proceeds used to build a modest system to serve some 2 square miles in the immediate Palmdale area. In 1957 additional bonds, in the amount of $2,400,000 were successfully floated and, in the same year $1,540,000 were sold to finance construction of additional works to serve an area of 28 square miles. Trunk sewers were extended to serve the entire area as it developed and a process of sewage treatment installed similar to that at Lancaster. District 20 has arranged with a nearby property owner for use of the sewage plant effluent in irrigation of hay.

In both Districts 14 and 20, the reason for the rather impressive expansion of sewered area was the advent of large air transportation industry. Since 1957, population of both districts has greatly increased, and growth is continuing although at a steadier and more conservative rate. It is stated that lots in the Lancaster area, now commanding very high prices were, in the early part of the century, given away with subscriptions to the Los Angeles Times and, perhaps, other newspapers.

The foregoing brief explanation of activities in some Districts, is related to indicate that the problems in Districts 4, 9, 11, 14 and 20, were quite different from the much more impressive difficulties confronting the Districts which were parties to the Joint Outfall Agreement, and facing the necessity, in the older Districts, of financing many millions of dollars' worth of improvements and extensions. It is easy to say, now, that the problems attendant upon successful consummation of necessary works were resolved and the record of accomplishment is in public view, leaving to the narrator, the enjoyable, if somewhat nostalgic, task of filling in some of the unrecorded experiences.

Money began to accrue to all of the active Joint Outfall Districts in 1946. Sale of bonds and purchase, by the new Districts, of capacity rights in structures and facilities built ten to twenty

years before, spread the money around sufficiently so that some construction, very much needed, could be gotten under way. I was informed, at the time, that the Auditor would not recognize a contract executed by the Districts unless there was sufficient money in the Treasurer's possession to cover the entire cost to each participating District. By Auditor and Treasurer, I mean the County of Los Angeles Officials who served in this capacity for the Districts. This factor was one of those which prompted us to go forward with the second ocean outfall pipe construction with District forces rather than by contract. Another reason, and a very potent one, was that the available contractors at the time, had been engaged in Federal, or Federal financed, construction and had grown accustomed to being paid for their efforts in a manner and amount which only the Federal agencies could readily afford. Bids received by the Districts for minor jobs were straws in the wind, but when the Districts offered the first quarter of the 12-foot tunnel section for tenders it became apparent that either the Districts would have to revise their estimates upward in a hurry or, get into construction operations on a large scale with their own forces.

The disparity between District estimates of cost for proposed work, and the contractors' ideas of what price tag should be put on them, compelled the Districts to undertake building with District forces early in 1947. The decision put the Districts in the market for a considerable amount of construction equipment. Most of what existed was in war surplus stocks in the various cantonments, including, at Hueneme, some which would be very useful to the Districts. I tried to reach the proper contact locally, but was shunted around and finally told that the surplus was sold only to veterans who wanted to use it for their own purposes, and was otherwise not for sale. This was so far fetched that I decided to try to reach the right parties by going to Washington, where I had served on many occasions during the war as a dollar a year consultant on sewerage matters. It looked rather hopeless, upon arrival, because most of those I knew were back at their regular jobs all over the country. While nosing around I was informed that the allocations board had, on it, as a member, the National Commander of the American Legion and that he was the big wheel on

the Board. I called past National Commander, John R. Quinn, at Los Angeles, and explained the dilemma to him. He knew the current National Commander, gave him a ring and, immediately, the Districts received a priority right to purchase, at heavy discount, machinery from the surplus military stock. This put the Districts in position to bid against the contractors on any job, thanks again to John Quinn.

It is well to explain that, whenever a low bid was within five to ten percent of our engineering estimate of what the submission should be, I recommended to the appropriate Board that the contract be awarded. If it exceeded that difference I offered to do the work with District forces. Between 1947 and 1958, the Districts were saved more than three and one-half million dollars in this manner. The record of District operation was public, and any qualified contractor or other individual could investigate it. All were urged to do so.

The permanently employed construction force of the Districts was always a very small one. There were four good, well qualified construction men in the employ of the Districts during the era when it seemed necessary to undertake a considerable amount of construction with District forces. Two of these men were professional engineers, while two were better identified as practical construction superintendents. District practice was to employ the entire working crew on each job from the Union Labor Halls, if men with the required knowledge and experience could be so obtained. The Districts are greatly indebted to the Unions for help and assistance, particularly at times of critical stress. All labor employed on construction jobs by the Districts, whether union or otherwise, was paid union wages. When no new construction work was in progress, the limited construction force was absorbed into the operation and maintenance supervisory groups.

The Associated General Contractors became quite critical of the Districts activity in doing their own construction work and sought to, and eventually did, amend the enabling legislation in an effort to prevent it. To this, the Districts put up little resistance, since the Directors, or a large majority of them, were enthusiastic proponents of free enterprise and had no desire to build with District forces without ample reason for doing so. The times and

circumstances appeared to warrant what steps were taken, following the war, and the District welcomed the amendment setting out in detail the steps preliminary to, so-called, "force account" work.

The Joint Disposal Plant was greatly expanded during the period (1947-58) but the work of expansion was done only as required and as money became available. There was probably no time during the twelve-year interval when new or extended construction was not being carried forward. All elements had to be expanded, changed or modified as conditions dictated. Experimental work was continuous.

Between 1947 and 1958, the average daily flow of sewage at Bixby increased some 435 percent or at an average yearly increase of 15 mgd. Flow in 1958 was 225 mgd average daily. The average daily high flow for the same year was 235 mg. Capacity of the outfall complex, at mean tide was estimated to be in excess of 250 mgd possibly 260. Sludge disposal, power development, pumping facilities, and land requirements, increased correspondingly. The Joint Outfall Operation, by 1958, was serving more than the territory envisioned by Warren in his original concept.

Six, multiple stage, sludge digestion tanks had been constructed and were in use at Bixby by 1947. Experiments completed by that time indicated a change in future construction and the desirability of supplementing the existing tanks. By 1958 sludge digestion facilities had been expanded to more than three times the capacity of 1947 and the process of digestion improved to the extent of doubling the efficiency of the process. Briefly — the original multi-stage digestion tanks were capable of digesting sludge at a rate of about seven pounds per cubic foot of tank capacity per month instead of the four pound capacity per cubic foot in tanks previously in general use; the tanks constructed later in the 1947-58 period digest at the rate of 12 to 15 pounds per cubic foot per month.

From the very modest start in 1938, when an 8-cylinder internal combustion engine, using sludge gas as fuel, was used to drive a generator at Bixby, power generation at the plant has kept pace with other requirements. A power house had been constructed, at Bixby in 1936 and in anticipation of future needs had been designed to accommodate four power units. In 1946 an Ingersol

BIXBY POWER PLANT — The first Chief Engineer's preference for brick construction is demonstrated in the original power plant at Bixby. Built in 1936, the building was converted to concrete exterior finish later to bring it into harmony with other structures.

Rand, V-Type, eight-cylinder, 880 H.P., internal combustion engine, driving a 760 K.V.A. generator was installed in the power house. It operated on sludge gas. It was followed by three similar units installed, one each, in 1948, 1953 and 1954. The power house, which had been designed in 1936, with more compact units in mind, had to be enlarged to accommodate the fourth unit.

Power generation, using sludge gas for fuel, had paid off very well at Bixby. Purchased power, in this area and in the quantities needed at Bixby, costs about 1.7 times as much as power generated at the plant using sludge gas for fuel. The record discloses that since installation of the first gas engine generator at Bixby in 1938, a saving in power costs of $350,000 has resulted from generation and use of 14 million K.W.H. Excess sludge gas is currently being sold at Bixby for ten cents per thousand cubic feet. In its earlier history it had little value, if any, commercially.

Effluent pumping facilities kept pace with increased flows of sewage. Beginning with the two gas engine driven pumps installed in 1942, pumping facilities were supplemented with two motor driven pumps in 1947. In late 1948 a second effluent pumping

FOUR GAS ENGINE PUMPS, 1948 — Effluent pumps at Bixby. Four of these units were installed. Power furnished by sludge gas, internal combustion engines connected through angle gears. Gas engines originally purchased were unsatisfactory and were rejected and replaced by others.

plant was constructed. In this structure were to be installed four sludge gas engines, each directly connected to a pump of 28,000 g.p.m. capacity at 35-ft. pumping head. The engines and pumps were installed and placed in operation during the first quarter of 1949. The engines proved to be entirely unsatisfactory and the Districts refused to pay wholly for them until obvious deficiencies were corrected. The manufacturer's representatives worked with the District personnel for nearly two years trying to justify the sale, during which time the plant superintendent kept accurate records of the equipment, performance and deficiencies.

By late 1951 it was obvious that the equipment was totally unsatisfactory and the vendor was instructed to remove the engines and release the Districts from payment. It must be understood that, despite their shortcomings, the deficient engines had to be kept on the line and a very careful schedule for their removal timed with replacement by others. The vendor threatened suit, which the Districts welcomed but, after pre-trial conferences he decided against legal action. Merely being relieved from paying the

INTERIOR OF TWELVE-FOOT DIAMETER REINFORCED CONCRETE PIPE — A joint outfall trunk sewer built in 1955. Contractor Vido Artukovich, on right; John Parkhurst, Engineer, C.S.D. (later Chief Engineer and General Manager of C.S.D.).

purchase price of the engines did not repay the Districts for the trouble, inconvenience or expense caused by the defective equipment but we decided against trying for recovery in view of the delays and confusion which such trials cause in an otherwise very busy organization.

Plant area, with particular attention to sludge drying and disposal, became critical after the war years. In 1947, the Districts owned 29.57 acres at the Bixby site, most of which was occupied, or reserved, for sewage purification structures. The sludge purchasing contractor had acquired a tract of land adjacent to the Bixby site which the Districts were using as a drying area and upon which

they had constructed extensive sludge drying beds. It was obvious that more land was, or shortly would be needed, for plant expansion and to provide a buffer strip around the works. Commencing in 1950 the Districts started acquiring property in the area and by 1958 had increased their holdings at Bixby to 234.24 acres. The average cost per acre to 1958 was a little over $3,300. Land in the area today is selling for upwards of $20,000 an acre.

Despite the expanded sludge disposal facilities, sludge was beginning to be a most formidable problem again. Digestion in the multi-stage tanks was good as a rule with only occasional departure from requirements, but notwithstanding a rather extensive area devoted to sludge beds, drying lagged to the extent that the beds had to be filled to a depth which aggravated the situation by retarding removal. There seemed but one alternative, at the time, to wit; disposal of digested sludge through the outfall to sea. In preparation for such an unusual (announced) departure, the Bixby chemist, Joe Candell, and Rawn, conducted an investigation upon the possible pollutional effects which might accrue if some, or all, of the digested sludge were to be wasted with the plant effluent, to the sea.

It was surprising to learn that little, if any, additional contamination would be added to the flow, however it did appear that certain components of the sludge which came through the digestion process unscathed, would cause an unsightly nuisance along shore. Results of the study and investigation are published in Transactions of the American Society of Civil Engineers 1950. They have had quite an influence on sludge disposal. Research, by the District staff members, and its application to screens and shakers, has successfully solved the matter of retaining, at the plant, the undesirable sludge solids while wasting the bulk of the sludge, without difficulty, to sea. The same investigations have enabled separation of solids from liquid components in digested sludge to a degree which permits vastly greater, and more efficient, use of the sludge bed areas. Much of the improvement in the sludge operations has been accomplished since 1958 but is tied in to it to a degree that seems to require mentioning here.

Construction with District forces, rather than by contract, was not limited to Bixby and the outfall works leading to the sea.

INSPECTION OF TWELVE-FOOT DIAMETER OUTFALL TUNNEL — Directors inspect tunnel, September, 1950. L. to R.: Paniccione; Haug, Korsmeier; Cox; Jones; Waugh; Bowen; Butler; Greenwood: Rawn: Chase: Witham; McNamee; T. C. Smith; R. H. Smith; Jackson.

Bids were rejected on a score of jobs upon which tenders were considered higher than the work warranted. Such work was undertaken by District forces. The record of results seems ample justifi-

INSPECTION OF TWELVE-FOOT DIAMETER TUNNEL — Directors on tunnel inspection, September, 1950. L. to R.: 1, Witham; 2, Gilman; 3, McNamee; 4, R. H. Smith; 5, Rawn; 6, T. C. Smith; 7, Greenwood; 8, Bowen; 9, Butler; 10, Haug, Construction Engineer; 11, Jones; 12, Panaccione; 13, Chace; 14, Jackson.

cation for this departure from customary free enterprise. Actually, the Districts have contracted for many times as much work of construction as has been undertaken by District forces.

Chapter 9

EXPANDING DISTRICTS

There were many interesting, and some amusing, experiences connected with progress during the 1946-58 era. Some of them, bearing on the history of the Districts are worth recording. While the Districts were already pretty well entrenched in the economy of the County, there still remained many to be convinced of the merit of sewerage as a regional activity. Elsewhere also, the regional plan was arousing interest. I was requested to serve on investigating engineering boards in a number of places throughout Western America and overseas. I introduced the Sanitation District idea into the recommendations for Orange and San Diego Counties, where they have taken firm foothold. In the East San Francisco Bay Cities the general idea was incorporated, as it was in New Zealand and Vancouver, B.C. Acting on my advice the engineering board investigating the San Jose-Santa Clara County sewerage expansion, incorporated the regional district idea. Portland leaned strongly toward the regional and Seattle is now even further along than most in regional undertakings.

District 3 presented a series of interesting facets before finally determining to take advantage of the opportunity to move all sewerage works out of the City of Long Beach and its harbor.

EXCAVATING "BACKBONE" SECTION THREE — Excavation in heading of tunnel under Eleventh Street, Long Beach. Excavation continued in three shifts daily. Three men to a shift at night, and enough during day shift to remove excavated material from access shafts and furnish night shifts with lining and well point material and equipment.

District 3 was formed May, 19, 1924. A report submitted to the Board of Directors (McClellen, Cogswell and Buffum) by the Chief Engineer was approved and the date of March 3, 1925 set for voting on a bond issue of $3,540,000 to finance construction of the works. Action on the bond election was rescinded however, and the matter postponed. Subsequently, an election to dissolve the District failed and a second bond date set for April 22, 1930. The election failed, but a majority voted for the $3,400,000 in issue and the District remained inactive until 1946, although it was party to the joint agreements binding the active districts together

DISTRICT THREE "BACKBONE" TRUNK SEWER — The "backbone" line in District Three, under Eleventh Street, was excavated in sand, supported by steel ribs under corrugated iron. Section of 60-inch diameter R.C. pipe being laid. Space between pipe and lining, grouted.

at the time. In late 1945, or early 1946, the Long Beach City Administrator (Manager) requested the firm of Metcalf and Eddy, of Boston, Mass., to survey the sewerage situation for Long Beach, which City was, to all intents and purposes, District 3. Thoroughly sold on the idea of regional sewage disposal for the area, particularly when the cost was less than for local disposal and additionally removed the sewage, and sewerage works, out of Long Beach and its harbor, I had little doubt but that M. and E. would report favorably on the District plan. I was mistaken. Their report proposed a plant within the City, near the harbor, with discharge of plant effluent to the inner harbor waters. It was a good plan and would have deserved support had there not been a much better and

SEWAGE PUMPING STATION — Long Beach Main Pumping Station, District 3. Current capacity about 35 M.G.D.

less troublesome alternative.

The City considered the matter first at a bond election based on the estimate and plans of the Boston engineers, which election failed to carry, and then upon the District submission, which did. Four million dollars was voted for the District plan on February 5, 1946. The election carried nearly 5 to 1. The difficulty in getting the bonds voted in Long Beach was due in large part, to the existence of sewers in the City and its screening plant near the inner harbor mouth. The plant, while quite inadequate in the modern concept of such facilities, was getting rid of the sewage, in a manner of speaking, although dilution was most inadequate over the outfall and a considerable quantity of sewage, floating on the surface of the salt water, was carried into the inner harbor. Conditions were slightly improved before sewering to the Districts' system by installing over the vertical riser at the outlet end of the short outfall, a diffuser structure, which came to be known, facetiously, as a Rawn Sewage Carburetor. It didn't help much.

The "backbone" of the District 3 system was to be a very deep line under 11th Street in Long Beach. The immediate need for this line was not as pressing as other construction, and work on it was delayed as long as possible. Other than the fact that its construction was not immediately necessary, was that an area of

some 14 square miles, not in any District and unincorporated, lay between the east boundary of District 3 and the east boundary of Los Angeles County. This largely undeveloped land was mostly in large ownerships and its immediate future something of a question. It was relatively low lying and if it were organized as a District and sewered into the joint system, would have quite an effect on the grade and capacity of the trunk under 11th Street. For this, and other reasons, the "backbone" structure was postponed as long as possible. By 1950, marked development had taken place in this eastern area. Long Beach had annexed a large part of it and there was talk of incorporation in the small settlements in the north portion. As a consequence, District 19, covering this area, was formed March 28, 1950 and, since its influence on the design of the District 3 structures was now predictable, work commenced on the "backbone" line.

The line was designed to be built in three sections, and at the lower end of each, to temporarily cross over to a Long Beach line on Anaheim Boulevard. This procedure gave promise of quick action on relief to the new District 19. It also allowed for construction of the upper Joint Outfall "C" and relief of the Artesia pumping station in District 2. The initial "backbone" construction contemplated some 1200 feet of the upper end of the tunnel, and I requested, and received, permission to proceed with this portion of the job with District forces. This was a sort of trial balloon, for a job which would ultimately assume considerable proportions. Contractors were invited to inspect the work. Accurate costs of each phase were kept and furnished to contractors on request. Lester Haug and Harry Panacionne were in charge for the Districts, having just completed extensive construction work in the South Bay Cities District.

The work on the section proceeded smoothly enough and upon its completion the second, of three, section was advertised. The Districts were tendered a price which looked a little low for the bidder's reputation but he insisted on taking it. He changed methods of doing the work, operated at a loss and when finished had to be forgiven a debt that the District could probably have collected, if the contractor had any more resources than he had put into the job.

This experience and the fact that money was in rather short supply at this point persuaded the Districts to build the final unit (the third) with District forces, utilizing its credit in purchasing some of the materials which went into the work. On this job we ran foul of the Union requirement that we pay into their retirement and health fund. At the same time, we were advised that, under the law, the Districts could not pay the demands. We offered to raise wages by the amount required but to no avail. The Union Secretary said that if we paid it to the workmen the Union would not get much of it. After refusing receipt of payment on what seemed the only possible way of complying, the Union later relented and also demanded back pay, for their members, for the period during which they had originally refused to accept the compromise. The matter was finally settled within the law.

There has been a material subsidence of land in the Long Beach Harbor area. Subsidence centered at the east end of Terminal Island. At the lower end of the "backbone" trunk sewer the ground lowered some two feet after the line had been constructed. The sewer drains to the Long Beach pumping station which also settled two feet. The net result was to increase the capacity of the sewer. In the harbor area west of the Flood Control Channel and south of Anaheim, settlement was such as to require extensive repairs and replacements to two District 3 trunks. Over the years the land at Bixby has lowered some two feet also, increasing to a degree the pumping requirements but with a net result of little consequence since it is reflected almost entirely in fuel requirements.

Sewage from Districts 3 and 19 drains to the Long Beach Pumping Plant west of the Flood Control Channel and about midway between Anaheim Boulevard and Pacific Coast Highway. At the time the plant was designed there was some doubt about the advisability of pumping the flow through a force main some two and half miles long to reach a trunk sewer west of Dominguez Slough leading to the Joint Disposal Plant. Reason for the uncertainty was that there could be an impressive generation of H_2S in the sewage enroute because of depletion of available oxygen. It was feared that an abundance of hydrogen sulfide at the outlet end of the force main would speedily destroy the receiving trunk sewer as well as create disagreeable odors. Chemical treatment at the pumps

could be used to cure the situation, but the cost would be great and, as it developed, was unnecessary. The problem was solved by pumping enough air into the force main with the sewage to supply the oxygen deficiency which would otherwise exist. With some refinements to improve the efficiency of the process, the method is still in use. In all fairness it should be stated that I borrowed the idea from Ewald Lemke, an operator in Orange County, who was using it with good results on a small sewage force main in his area.

In developing Lakewood, later incorporated, the Montana Land Company (Lakewood owners) faced the necessity of providing sewerage for its project. Lakewood is in District 3 as is the City of Long Beach, which latter had not yet decided to support the District works. It was doubted by the Company that Long Beach would permit connection to its existing sewerage system unless the Lakewood area annexed to Long Beach. The Company opposed annexation. Meeting with the owners, I explained to them that their only out, so far as I could determine, was to extend a pump line to the north and discharge into the District 2 trunk sewer south of Bellflower. They were further advised that consent of the Board of Directors of District 3 to such connection was a requirement and that the Board comprised two representatives from the Long Beach City Council and the Chairman of the County Board of Supervisors. They were also advised that pumping would be required to reach the trunk sewer and that a long force main would not be permitted but rather that the discharge line would be broken into four lifts, involving four pumping plants with the sewer between plants flowing north against the general slope of the land which was to the south.

It sounds a little complex when written out but it was accomplished in the manner proposed. It is recorded here for posterity and the record in the event the north flowing sewers, long since abandoned, are ever uncovered and cause wonderment in the minds of engineers at that time as well as some skepticism regarding the professional integrity of the designer.

Sanitation District 15 was formed January 2, 1945. At formation the District comprised, generally, the area lying south of Arcadia, west of Baldwin Park, north of Whittier Narrows and east of Monterey and San Gabriel. Prior to the District bond

election on April 23, 1946, it had expanded its territorial limits to include Arcadia, Monrovia, Sierra Madre and La Puente. This annexation was not completed until February 26, 1946 after considerable argument in Arcadia because of the recommendation of a private engineering firm that Arcadia stay out of the District and build its own treatment facilities. Following the issuance of bonds for construction of the enlarged District, the Baldwin Park area annexed on April 28, 1947, and El Monte followed suit November 13, 1948. Since then and up to 1962 there have been 61 annexations to this District.

Following the bond election in District 15 and with the assurance of sewage disposal, Arcadia embarked upon a city-wide plan for construction of lateral sewers, under the 1911 Improvement Act. The private engineering firm responsible for encouraging the City to build its own treatment works was employed to engineer the job. The system of sewers was well designed, but the engineers estimate was way off, with the result that when bids were received many of the citizens were disinclined to proceed further. The City asked the District engineering staff to review the bids and recommend a course of action. We did so and at a tempestuous meeting in the Arcadia City Hall, I recommended that the contract be awarded to the lowest responsible bidder, whose submission I considered appropriate. The advice was followed. Monrovia, probably less in need of additional sewerage than Arcadia or Sierra Madre, its neighboring cities, was an enthusiastic proponent of the District enterprise from the start. Sierra Madre was content, for some time, with a District trunk sewering its main business center.

District 16 encompassed the four cities served by the Tri-Cities Sewage Treatment Plant, by all odds the best and most modern of the early works in the County. As to the District itself, the Mayors of the four District cities decided that they did not want a member of the County Board of Supervisors on the Board of Directors of the District and hence, limited the territorial area of the District to that in the four incorporated cities, Pasadena, South Pasadena, Alhambra and San Marino. This limitation of area has caused some confusion in certain areas tributary to the District's trunk sewers, particularly one of rather large proportions which is completely surrounded by Pasadena and which, in

resisting incorporation into Pasadena, excluded itself from participation in District benefits. Cesspool sewerage still serves this and other small areas along the east border of Pasadena.

During the war years the flow of sewage at the Tri-Cities Plant increased to the extent that the plant was unable to successfully cope with it. In particular, sludge disposal was troublesome. Activated sludge was filtered and heat dried at the plant. Results, with overloaded facilities, were not satisfactory and complaints were many and insistent, particularly from San Gabriel City, on whose western border the plant was located. The plant owners employed Dr. Charles Gilman Hyde, Dean Emeritus of Sanitary Engineering, University of California, to investigate the situation and make recommendations. Dr. Hyde found for the District system and on January 2, 1945 the District was formed without protest. On April 16, 1946, the District voted bonds in the amount of $2,186,000 for District construction. Delay of more than a year from formation to bond election was occasioned by lack of action in neighboring District 15, where the extent of that District was not adequately determined until the annexation of the three important northern cities.

Following the bond election in District 16, the District Board of Directors negotiated a contract with owners of the Joint Outfall System permitting the wasting of liquid activated sludge into a sewer in Monterey Park in District 2 for disposal to the Bixby plant. This operation settled the matter of odors from sludge drying at the Tri-Cities Plant but inspired some criticism from Monterey Park residents and required sealing many manholes and other measures of correction. On February 27, 1948, at 2:00 p.m., sewage was diverted from the Tri-Cities Plant to a District 16 trunk and the plant drained and later, demolished. I tried, unsuccessfully, to preserve the plant for use as a water reclamation facility for which, with some minor modifications, it would have served admirably.

District 17 has had an uneventful and satisfactory existence. It formed at the same time as District 16 and comprised the unincorporated residential area known as Altadena. The entire area was unsewered, but lying along the gentle lower slopes of the Sierra Madre mountains, local sewers were readily constructed,

although quite expensive. Later in the history of the Districts, Altadena (District 17), was seriously disturbed over the possible location of a refuse disposal site on its northern border. The concern was manifested because of the presence of rodents carrying ticks infested with endemic typhus. The rodents bred in the forests north of the town and District and the fear was that the refuse would attract them in greater numbers. The matter was settled to the satisfaction of the area citizens and was the inspiration for the provisions described in paragraph 3 of title 4741 of the Sanitation District Act.

District 18, formed December 22, 1948, comprised all of the territory in original District 6 lying north of Artesia Boulevard. It comprises the area from Whittier south to Artesia Boulevard and from District 2 on the west to the County line on the east. District 6 had been formed in 1925 but was dissolved in 1929. The remaining area originally included in District 6, lying south of Artesia, was formed into District 19 on March 31, 1950. When formed District 18 included but one incorporated city, Whittier. The Board of Directors, as a consequence had but three members; two from Whittier and but one from the Board of Supervisors, as a result of the division of District population between the city population and that of the unincorporated area. The ratio changed rapidly after 1950. By 1958 there were eight incorporated cities wholly or in part in the District.

The City of Whittier had a sewage treatment plant south of the City from which a number of farmers and cattle ranchers still further south derived a considerable amount of water for irrigation of pasture and hay. The water had cost them nothing. When the District works were completed and in use, I attempted to negotiate with the same land owners for sale of water from the plant at a price sufficient to pay for production of usable water with delivery at such times and seasons as were required by the water users. The users were unwilling to pay anything. The plant was razed and the outfall leading to it was purchased by the District and incorporated in the District system.

As originally formed District 21 comprised the cities of Claremont, La Verne and Pomona as well as a small area of unincorporated territory. The District was formed November 13, 1951, but not without some difficulty. A well designed activated

sludge plant served to dispose of the sewage of the three cities. The plant, originally designed by the Kansas City firm of Black and Veatch, was awarded the first honorable mention plaque from the California Sewage Works Association for design and operation. Water reclaimed from the sewage was sold to two large ranches in San Jose Creek valley. Had conditions remained static in the three cities the sewerage works might have sufficed for many years, but, unfortunately for the well built works, they did not and the plant owners found it necessary to enlarge the plant to an extent that distorted and unbalanced it.

Pomona was the largest city in the proposed District 21. Its civic leaders had in mind the promotion of an industrial area within the city but were quite cognizant of the fact that either the industries must be limited to those producing either no wastes or wastes which would be non-toxic to the existing sewage treatment process or crops irrigated with effluent from the process. The Sanitation District system was the obvious answer and it was agreed that, upon association with the other Districts in the ownership and use of the Districts' disposal works, District 21 would purchase the existing activated sludge plant, assume any obligations existing against it and remodel it as a water reclamation plant. Sewage used as a raw water supply was to be diverted from the main District outfall at such times and in such quantities as desired and all solids removed from the sewage, including excess activated sludge,

With the foregoing plan in mind the District was formed (November 13, 1951): a plan and estimate prepared, including a proposal to convey waste cooling water from an Edison Plant at Etiwanda, San Bernardino County, and submitted to the voters on February 5, 1952 at an election for issuance of bonds for construction. The election failed to carry although receiving a simple majority favorable vote. The issue was again submitted to the electorate November 4, 1952 and again lost. The State Legislature then approved an amendment to the Sanitation District Act authorizing the issuance of bonds, in this case, upon a favorable vote by a simple majority. The issue was again submitted on August 4, 1953 and at this election the bonds carried nearly 3 to 1. Unfortunately for District 21, the Edison Company had concluded that it could no longer wait in uncertainty and had negotiated with District 22 for disposal of its waste water. The delay in providing

funds for construction plus the loss of the Edison Company participation cost District 21 about a million dollars.

A word about the transformed activated sludge plant. Seven men had been required to operate the plant when it was serving as a sewage disposal works for Pomona, Claremont and La Verne. Equipped as a water reclamation plant only one man is required to do the job. The Districts' repair crew makes major repairs and inspections as required. Customary simple laboratory tests are made by the operator, any others requiring greater technical knowledge are worked out in the Districts' central laboratory at Bixby. Industrial wastes, harmful to the plant process or effluent, bypass the plant in a separate line. The plant operates to produce some four million gallons per day of acceptable effluent at a cost quite satisfactory to the District. Experience with this plant served to demonstrate principles which were later incorporated in the much larger and more efficient water reclamation plant built by the Districts at the Whittier Narrows.

District 22 was formed by the Board of Supervisors on September 22, 1953. Citizens in the area were indicating a desire to be included in the Sanitation District system in early 1952 but there was strong dissention to the idea in Azusa, where a small trickling filter sewage treatment had been in operation for a number of years. Opposition was particularly strong from a local paper published in Azusa and there was a pretty good chance that if the District were formed, without putting the matter of formation to the electorate first, an election would be called for under the terms of the District law anyway. I discussed the matter with the City Council members and the Editor. They agreed that, if at an election to form the District, a majority voted in favor, opposition on their part would cease. Upon this basis I recommended to the County Board of Supervisors that a formation election be held. The Board complied and the election, held September 15, 1953, carried by a majority that assured the success of a bond election.

On January 19, 1951, a bond issue amounting to $5,000,000 carried in District 22 by nearly 4 to 1. This was in time to permit joint action with District 21 in the construction of trunk sewers leading to, and through, the Whittier Narrows. One of the most active areas in District 22 in support of the bonds and the District plan was in the City of West Covina. As previously

AZUSA PLANT PERCOLATION POND — City of Azusa Sewage Treatment Plant and percolation bed. The plant is being operated as a water reclamation plant by District 15, of which Azusa is a part.

narrated, West Covina owed its primary life as an incorporated city to defense against the establishment of a sewage farm or plant in the unincorporated area later occupied by the City. As an urban community it was not impressive until sewerage was made available in the 1950's. Incorporated in 1923 the City was little more than farm land devoted mainly to citrus culture when District 22 was formed. I met with the City Council and a number of interested citizens while the District was being considered. They were certainly a forward looking group and eagerly supported the District plan as promising the future development into a large urban community. Their encouragement was most acceptable and well placed, as indicated by the growth of the City.

Azusa was served by two sewage treatment plants; one of which, a trickling filter, served the main business section of the town and disposed of the treated sewage water to percolation beds, thence to the underground pools; the other was built by the Lucky Lager Brewing Company at their Azusa plant as a condition precedent to the use of the large quantities of wash water needed in the beer making and bottling process. Plant wastes at the

brewery are piped to a high capacity trickling filter for treatment, thence to percolation beds for return to the underground from which Azusa draws a city supply. The District now operates both plants for water reclamation in much the same manner as at Pomona.

A part of Vernon had long been included in District 1. This placed the Mayor of that City on the District Board of Directors and kept the City Council well informed on District activities. The principal parts of Vernon, however, were sewered to the Los Angeles City system under a contract developed about 1924 and greatly influenced by the need for a right of way through Vernon upon which to construct the Los Angeles outfall sewer to Hyperion. The contract was very favorable to Vernon and was construed, by Vernon, to grant free access to the outfall for Vernon sewage irrespective of what Los Angeles might have to do with the sewage to properly dispose of it. When the contract was drawn, Los Angeles had under construction a new, modern sewage screening plant and ocean outfall at Hyperion. The Hyperion plant failed to live up to expectations and in the early 1940's Los Angeles was instructed to improve the disposal works. This it did some eight or ten years later by building a large and expensive activated sludge plant on the Hyperion site. Vernon refused to pay what Los Angeles considered a fair share of the new work's cost.

The Vernon representative on the District Board was fully aware that all of Vernon could readily be sewered, by gravity, through the District system to the south and Mayor Leonis of Vernon asked that an estimate of the cost of so doing be prepared. After some pretty lengthy arguments with the city, and faced with a court order to contribute to the cost of Hyperion improvements, the Board of Supervisors formed all of the City of Vernon, not in District 1, into Sanitation District 23. Bonds in the amount of $3,320,000 were voted on September 11, 1956 and all sewage diverted from the Los Angeles system a year or so later. The bond issue carried by a vote of 38 yes and 2 no. Vernon, strictly devoted to industrial development has few registered voters. Glendale, in somewhat the same position with Los Angeles as Vernon, investigated the possibility of service through the District system but was advised against attempting it.

Chapter 10

RECLAMATION AND POLLUTION CONTROL

After the war was ended in 1945, civil engineers, finished with their war endeavors, were again available. On my recommendation the District Directors revised our table of organization in order to permit employment of enough staff members to accomplish the impressive amount of work which appeared imminent if we were to keep ahead of the predicted population and industry influx. Between 1946 and 1950, fifteen graduate civil engineers were employed to supplement the limited staff held during the war period. Of these; four left to engage in private practice; one now holds the position of General Superintendent of the Chicago Sanitary District; one became City Engineer of a neighboring Orange County city; two were retired. The other seven now occupy the top administrative positions in the Districts' staff.

On the clerical side, Ariel Soule, Chief Clerk and Secretary of the Boards, retired July 31, 1946 at the age of seventy. He was succeeded by Kenneth Harding who had been his chief assistant during the years he (Soule) had been employed. Harding died June 6, 1952 and was succeeded by James Foster, who had been Harding's chief assistant while he, Harding, was Chief Clerk. Foster had been an employee of Los Angeles County in the Audit-

ing Department prior to engagement by the Districts. The experience with the County Auditor was of advantage to the Districts inasmuch as the County Auditor is, by law, the Districts' Auditor also.

The Sanitation District employees were admitted to the State Employees' Retirement System, July 1, 1946, prior to which time no provision had been made for retirement compensation. Social Security was made available to District employees, at the option of each employee in 1958.

Since the formation of the first County Sanitation District in Los Angeles County there have been more than 700 Supervisors, Mayors or their alternates who have served on the Boards of Directors of the several Districts. Subsequent to service as Directors, three City Mayors joined the Districts' staff as employees; Edwards of Watts; and Smith and Lange of San Gabriel. Harold Pomeroy served as Mayor of South Gate after he had served in the clerical department of the Districts. The Mayor of a District City, or his designated alternate, serves as a Director in each District in which any part of his city lies. The Board of County Supervisors is the Board of Directors in a District which includes no incorporated city, or part thereof. The Chairman of the Board of Supervisors represents the unincorporated territory in a District, as member of the Board of Directors.

The South Bay Cities District, for which sewerage facilities were installed in 1925, was sewered to the Los Angeles City Hyperion Plant in the manner and for the reasons heretofore narrated. Following the close of the war, during which conditions at Hyperion had steadily deteriorated, the disposal facilities at the City's plant and the resulting shore contamination in Santa Monica Bay, became so bad as to invoke quarantine by the State Department of Public Health. To his credit, the City Engineer of Los Angeles had tried vainly to secure enough priorities from the War Production Board in Washington to improve the situation. Following the war the City employed the firm of Metcalf and Eddy of Boston, to survey and investigate the Hyperion situation and make recommendations for its correction. The survey completed, the engineers recommended complete treatment of the sewage with disposal of plant effluent through a short outfall to sea.

DISTRICTS' CENTRAL OFFICE — In 1950, the Districts constructed a central office building at 2020 Beverly Boulevard, Los Angeles. These quarters were occupied in November, 1950.

Investigating the situation, as it would affect South Bay Cities District, I concluded that disposal of the District's sewage at Hyperion would no longer be economical and recommended that the District float a new bond issue based on connection with the jointly owned District system leading to Bixby. It was a somewhat awkward situation, but analysis indicated its soundness. It involved abandonment of a couple of miles of trunk sewer which had been built along the beach to flow sewage to a pumping plant on Los Angeles City property at Hyperion, as well as abandonment of the pumping plant itself. The whole system of trunk sewers in the District had been tipped to the north while the change-over required that the northerly sloping lines be intercepted some miles south of their original destination, their contents pumped over and through the sand hills and then retrace the journey, through sewers in District 5, to the Bixby plant, six or more miles south. The Board concurred in the recommendation, floated the bonds and disconnected from Hyperion.

Cost was not the only factor influencing the South Bay Cities District joint operation with the other Districts. The District felt it would be in a better position to proceed against Los Angeles City for polluting the beaches of the South Bay Cities if the District cities were not contributing to the pollution. Additionally I reached the conclusion that the proposed new works were grossly under-estimated as to cost, that the method proposed for sludge disposal would not be successful and, at the request of the Los Angeles Board of Public Works, joined with two practicing engineers in the area, in so stating. The report had no effect whatsoever on the City's plans. The plant was built as designed by the consulting firm. The cost was much greater than estimated, the sludge disposal method was a complete and expensive flop and within a few years after its completion the plant was rebuilt to conform to views expressed locally by the Los Angeles Board of Public Works engineers. Removal of the South Bay Cities sewage probably made little difference in the outcome but was greatly to the District's benefit financially.

During the decade following close of the war, interest in sewage disposal increased to the extent that the Legislature enacted a law placing the control of water pollution under the jurisdiction

of a State Water Pollution Control Board and nine similar Regional Boards. Responsible for the condition and safety of waters receiving wastes, the new Board established rules and regulations far more stringent and restrictive than were current, governing disposal of sewage plant effluent into salt waters. I served on the State Board as a charter member for eleven years, for seven years as chairman. A former employee of the County Sanitation Districts of Los Angeles County, Vinton Bacon, was its charter executive secretary.

The Pollution Control Board took cognizance of the many recreational and commercial uses to which the ocean waters, bordering the California coast, were put and based its regulations on what it considered a fair division of salt water uses. The Board concluded that, for the readily foreseeable future, certain limited areas in the littoral waters could be subjected to a moderate amount of sewage effluent pollution but that the area so polluted should be limited and continuously monitored by, and at the cost of, the discharging agency. Imposition of the restrictive regulations were not only a potent factor in hastening construction of the Sanitation Districts' third ocean outfall, at White's Point, but also inspired the installation of equipment, at Bixby, designed to remove floating particles from sewage and digested sludge and extension of chlorination equipment for use in disinfecting plant effluent at critical times. The Pollution Board's regulations probably contributed to recent changes at the Los Angeles Hyperion plant now one of the best and most modern in the State. To the credit of both the City and the Districts, it is noteworthy that each recognized the merit of the Pollution Control Board's regulations and contributed, without stint, to their enforcement.

As a matter of historical interest, it may be well to note at this point, that the State and Regional Water Pollution Control Boards were never very popular with other executive divisions of State government. This was not very surprising because two or three dozen of them had previously had some authority in pollution control. The new law made the Regional Board responsible for determining the advisability of a proposed discharge and for stating discharge requirements. Conflict with other State boards was inevitable and caused some confusion. The Regional Boards

have been expanded over the years and still function as in the past. The name of the State Board has been changed to define its duties as interested in water quality. The original State and Regional Board organization did much to correct water pollution in the State during its fifteen or so years of existence. The Regional Boards are now probably stronger and better established than before, which is good.

As has been stated a number of times in this narrative, the wasting of large amounts of water into the ocean in the form of sewage, has inspired a great deal of thought upon how to get the fresh water separated from what makes it sewage and back into unrestricted use. The Districts' philosophy has consistently been to first complete the sewerage system for the disposal of sewage, and then, when no reliance need be placed on water reclamation for adequate sewage disposal, to institute measures, if acceptable, for developing fresh water using sewage, from certain areas, as the raw water supply. Although convinced that water acceptable for practically any ordinary purpose could be developed from domestic sewage, District investigators were of the opinion that percolation of water, reclaimed from sewage, into underground water pools, from which, mingled with water from other, and perhaps more acceptable, sources, it could be withdrawn for use, would allay any misgiving as to its acceptability. Illustrating such an approach is the fact that for many years underground pools in the area have been replenished with drainage from thousands of cesspools and from inland sewage treatment plants, without trouble or discomfort.

Two reports, bearing on the matter of reclaiming water from District Sewage had been submitted to the Directors and to the County Board of Supervisors. One, prepared in 1949, and submitted to their respective principals by the Chief Engineers of the Flood Control, the Sanitation Districts and, the County Engineer, directed attention to the possibilities inherent in water reclamation from sewage, its potential in the fields of water supply in the area and, in general, its cost. The second report, to the same principals was submitted in 1958. The second report was in much greater detail and formed the basis of a plan which accelerated construction of a Water Reclamation Plant above the Whittier

Narrows, placed in operation in 1960.

Prodigality in the use of water had to be discouraged in a number of cases where eastern firms wished to establish manufacturing plants in Southern California. Without exception the Industrial Waste Department of the County Engineer's Office received excellent cooperation from the prospective locaters in the area. Illustrating the problem is an experience in which the Districts also had quite a stake. A very prominent soap manufacturing company decided on Los Angeles County as a western location. In view of the fact that the process to be employed would produce quantities of industrial wastes their advance representatives were referred to the Industrial Waste Engineer in the County Engineer's Office, Arthur Pickett. Pickett was informed that their eastern plants each required from eight to thirty million gallons of water a day, depending upon process employed, and that most of that quantity would eventually reach the sewers as industrial waste. Los Angeles County wanted the plant to locate in the area and it became Pickett's job to guide development of a plant process which would not hamper the manufacturing process but would greatly reduce water, and waste disposal requirements.

Averaging eight and thirty million gallons, one arrives at nineteen million gallons. The Districts were not officially interested in where this amount of water was to be developed but, rather, what would be involved in disposing of it as waste. Although not involved in negotiations with the Company, at the time, the Districts advised the County Engineer that 19 mgd capacity in the Districts system had a construction value of some $4,000,000. To his credit, Pickett worked out a process with the soap company which resulted in a prospective use of four hundred thousand gallons of water a day and an actual use of about half that much.

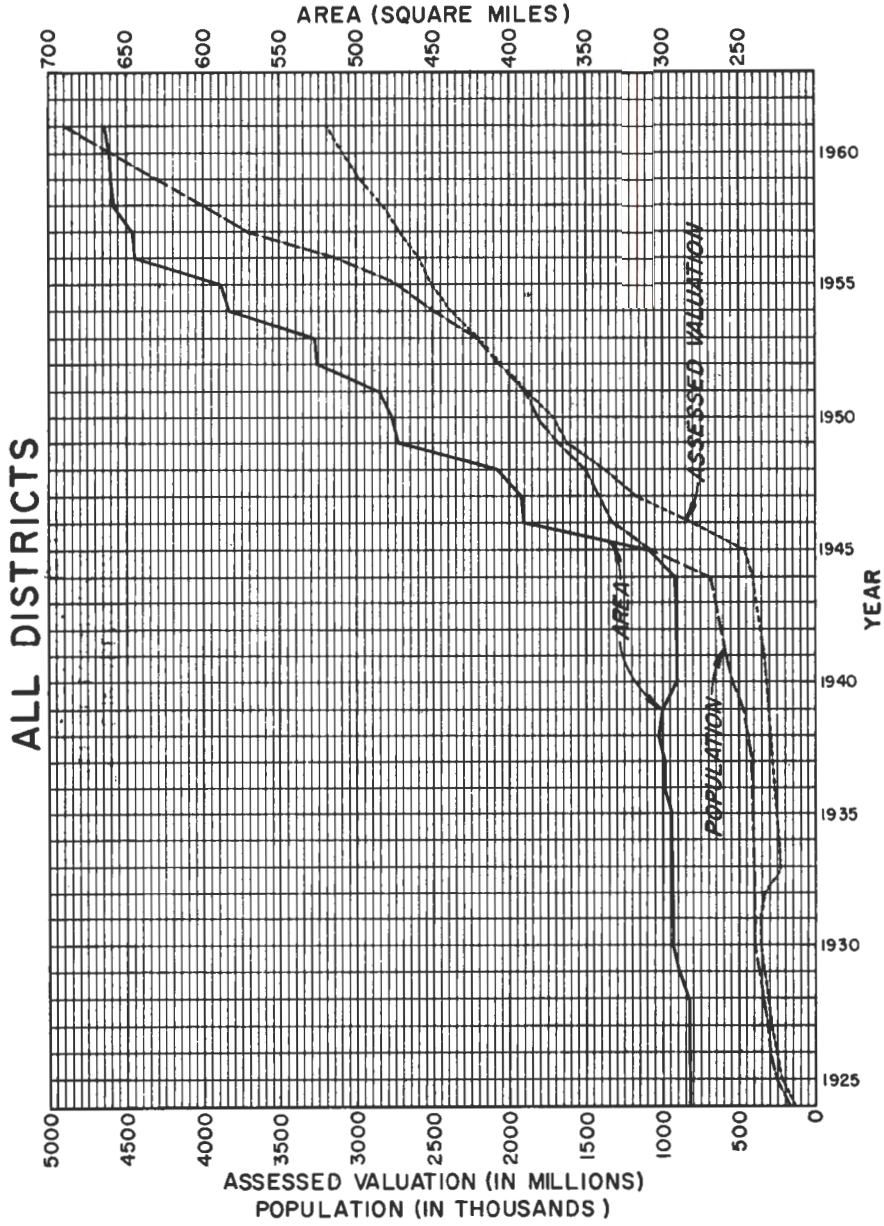
During the war years, defense authorities built an aluminum recovery plant a little way north of Torrance in District 5. Drainage of plant wastes was to be provided by the District. After much effort and many arguments, I had secured authority to buy a few thousand feet of 24-inch diameter clay pipe for construction in one of the Districts. In building the aluminum recovery facilities the federal official informed the pipe company, from which I was to get the pipe, that they (the pipe) were needed at the Torrance

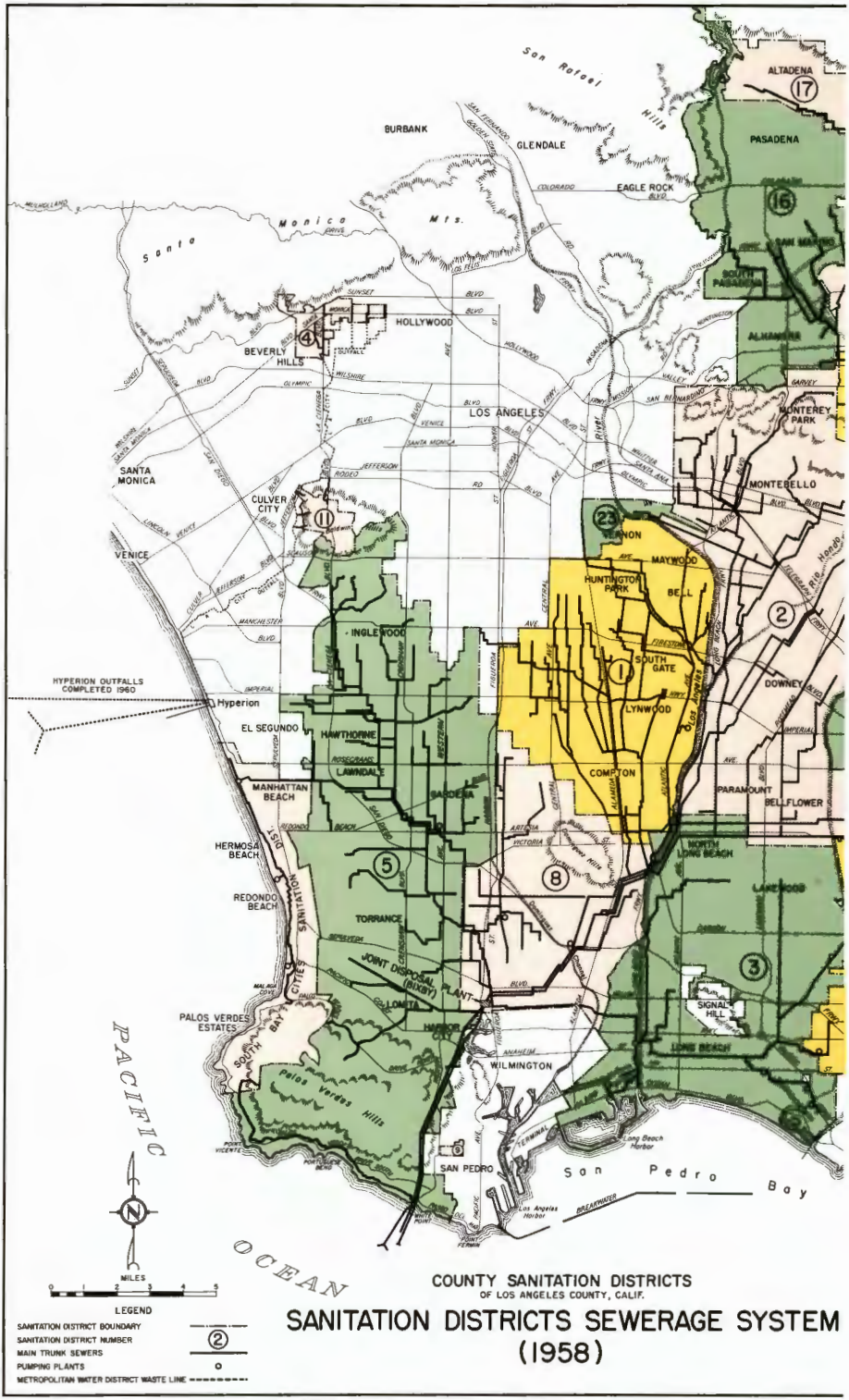
plant. No amount of argument would convince the federal authorities that a ten or twelve inch diameter pipe would suffice. They pointed out that eastern plants used pipe that large, that the plans called for it, and that it was needed here. Perhaps, where water is not at a premium such size pipe were customary. The 24-inch pipe was installed. At its lower end, where it drained into the District system the entire flow was never, at any time, over two or three inches in depth. The use of water is greatly modified when the user finds himself on the horns of a water-sewerage dilemma such as exists in Southern California.

By 1958 the Districts had built, or otherwise acquired, 530 miles of District trunk sewers; 175 miles of joint outfall sewers; 29 sewage pumping stations; the expanded separate sludge digestion plant at Bixby, including complete power generation and pumping facilities, for designed flow of 410 mgd (peak rate); two six-and-one-half mile tunnels through the Palos Verdes Hills, one of 8-foot nominal diameter, the other, 12-feet; three ocean outfall pipes of 60, 72 and 90-inch diameter respectively; three small water reclamation plants, producing some five million gallons daily of reclaimed water; two surface oxidation plants in the Antelope Valley; a central office in Los Angeles and two field offices, one in Compton, the other in West Covina. The area covered by the Districts in 1958 was 658 square miles in which had been constructed 5523 miles of laterals to serve a District population of 2,820,000. Flow at Bixby averaged 224 mgd for the year 1958. At Lancaster and Palmdale the flow averaged 3 mgd for the year. Additionally, in compliance with the 1949, et seq, amendments to the Sanitation District Act the Districts had established two refuse disposal sites in the District area, to wit, Palos Verdes and Pomona. As of December 1958 the Sanitation Districts had a capital investment of 73 million dollars.

The Districts now had, wholly within their boundaries, 53 incorporated cities and portions of four others. Assessed valuation of the real property in the Districts (upon which the District tax was levied) was $3,873,000,000.

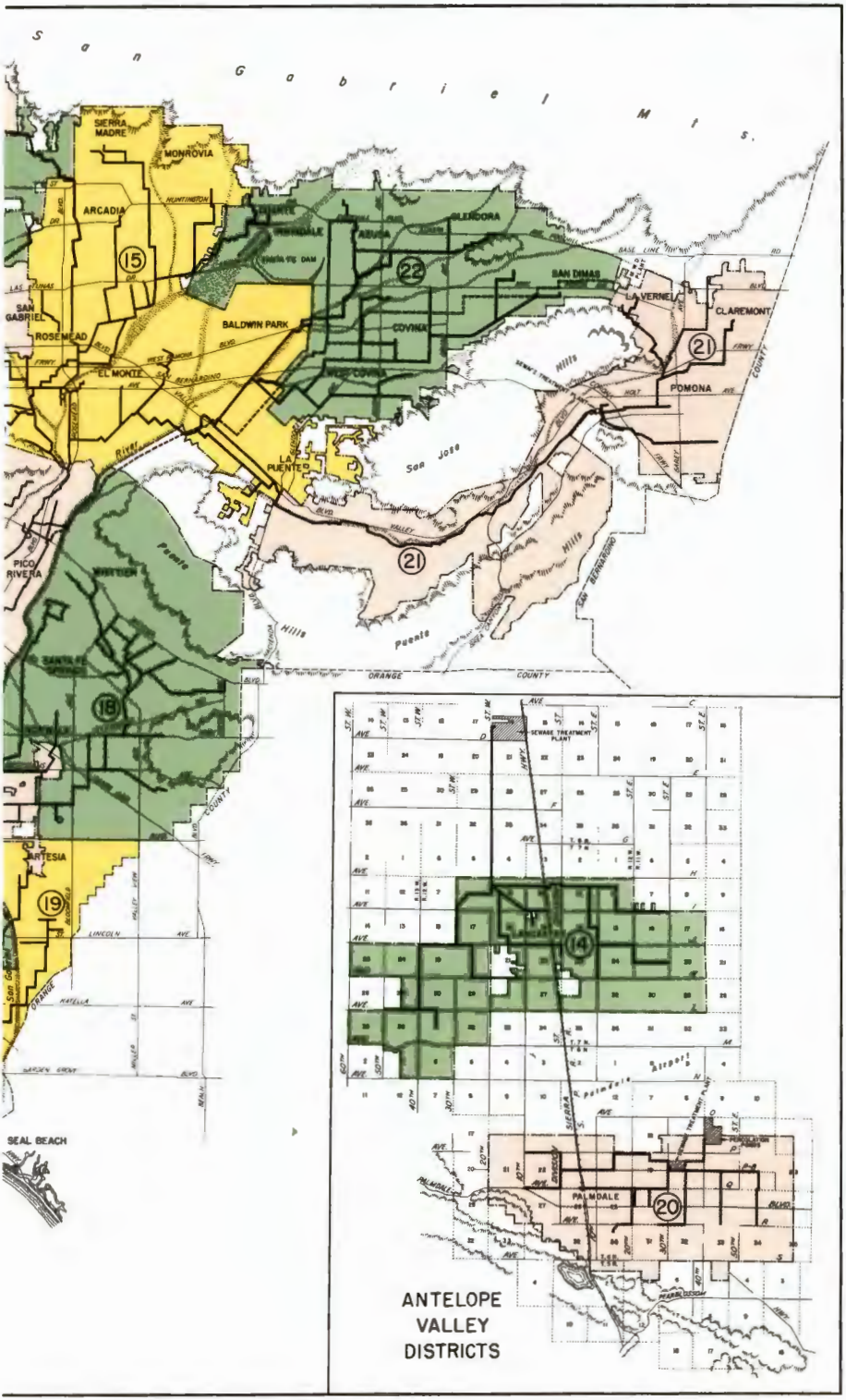
A M Rawn retired from the post of Chief Engineer and General Manager of the Sanitation Districts on November 30, 1958 to be succeeded by Charles Ross Compton. Mr. Compton was


AREA (SQUARE MILES)
700
650
600
550
500
450
400
350
300
250
ALL DISTRICTS
ASSESSED VALUATION
AREA
POPULATION
1960
1955
1950
1945
1940
1935
1930
1925
YEAR
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
ASSESSED VALUATION (IN MILLIONS)
POPULATION (IN THOUSANDS)



COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY, CALIF.

SANITATION DISTRICTS SEWERAGE SYSTEM (1958)


San Gabriel Mts.
SIERRA MADRE
MONROVIA
ARCADIA
15
SAN GABRIEL
ROSEMEAD
EL MONTE
BALDWIN PARK
GLENDORA
IRWINDALE
AZUSA
22
COVINA
WEST COVINA
SAN DIMAS
LA VERNE
CLAREMONT
21
POMONA
LA PUENTE
San Jose Hills
PICO RIVERA
WHITTIER
Puente Hills
18
ORANGE COUNTY
ARTESIA
19
SEAL BEACH
SEWAGE TREATMENT PLANT
14
PALMDALE
20
ANTELOPE VALLEY DISTRICTS

employed as the Districts' Office Engineer during Warren's term of office and as Assistant Chief Engineer during Rawn's term. Compton became an official employee of the Sanitation Districts immediately after Warren's appointment as Chief Engineer in 1925. He had been associated with the District work as a County employee since early 1924. He and one other employee, Harry Chapman, were the only two members of the original staff remaining active at the time of Compton's appointment as Chief Engineer. All others had passed on or were retired.

Chapter 11

GROWTH CONTINUES

By the date of Compton's appointment, the District operations were rather sharply divided between Sewerage on the one hand and Refuse Disposal on the other. Mr. Compton, therefore, made a sharp division in the engineering force by appointing Division Engineer John D. Parkhurst as Assistant Chief Engineer of sewerage, and Division Engineer Frank R. Bowerman as Assistant Chief Engineer of refuse disposal. Mr. Chapman was appointed to the post of Superintendent of Sewer Maintenance. At this time (1958) the Districts permanent employees numbered 250. Of these 22 were engaged wholly in Refuse Disposal activities; 162 wholly in sewerage and 66 in engineering and clerical positions at the headquarters office.

At the request of Mr. Parkhurst, presently the Chief Engineer and General Manager of the Sanitation Districts in Los Angeles County, and with the consent of Mr. Compton, who preceded Mr. Parkhurst, I will extend this narrative to include the years December 1958 to August 1961 during which Mr. Compton served, until retirement, as Chief Engineer.

In 1959 and 1960 the plan for constructing a water reclamation plant at Whittier Narrows was consummated. It involved participation by the County of Los Angeles, the Los Angeles County Flood

Control District, the Los Angeles County Sanitation Districts, and the newly created Central and West Basin Water Replenishment District. The works were not designed and built as an experiment but rather as a demonstration of what might be accomplished with known and proven methods of sewage purification, or, to put it more in keeping with what was desired, to indicate how water could be reclaimed from sewage, what it would cost and what steps were deemed necessary to prepare the reclaimed water for unrestricted use. The plant (physical structure) was designed by the Sanitation District engineering staff and built, by contract, under their supervision and direction. It has more than fulfilled expectations, particularly as to water production, and is currently operating to produce 120% of its originally designed capacity of ten million gallons a day. The plant, which is self-liquidating, indicates clearly a vast resource of good water for unrestricted use, if desirable, should other acceptable sources fail.

Refuse Disposal operations inaugurated by the Districts in 1957 at Palos Verdes and Pomona were supplemented in 1960 and 1961 at three additional locations; Mission Canyon in West Los Angeles; Scholl Canyon in Glendale and Calabasas near Agoura. No one of these three operations were of much direct benefit to the Sanitation Districts but, as later related in a more detailed narrative describing this District activity, were placed under the management of the Sanitation Districts, as self-liquidating undertakings. With the opening of the fifth refuse disposal site at Calabasas in February 1961 the District had provided capacity for disposal of about 125 million cubic yards of refuse which latter would cost about one billion dollars to collect and transport to the disposal sites and about fifty million dollars to bury, compact and cover.

During the period 1959-60-61, in addition to some 36 miles of trunk sewers, the Bixby plant was extended to include three additional digestion tanks of new design and double the efficiency of the multistage type; an additional battery of sedimentation tanks; centrifuge equipment designed to reduce sludge moisture to about 70%; a new inlet structure and a redesigned chlorinating plant.

It is interesting to note that reduction of moisture in the digested sludge from 97% to 70% by centrifuging prior to bed

drying, not only greatly reduces the drying period but discourages sludge flies and odors. Loss of nitrogen through removal of centrate removes very little of the available nitrogen in the sludge and hence its fertilizing qualities do not suffer greatly. Sludge is transported from the centrifuge machines to the drying bed by truck and after being dumped the moist pile frequently is covered with a thin scattering of wood shavings to dampen odors. Similarly wood shavings are used in the same manner when the piles of sludge are broken into in the drying process. Sludge to be wasted through the outfall is passed first over shaker screens to remove buoyant particles and objects which might float ashore at the disposal site. Additionally, monitoring of the area over the outfalls is maintained and detected floating objects of sewage origin are picked out of the water. Precautions taken at the sewage treatment plant (Bixby) have rendered this "picking up" operation almost unnecessary.

Previously described in this narrative is a process of sewage sludge digestion, developed by the Districts which, because of its method of operation, was called multi-stage digestion. Continued experimentation with the phenomenon of digestion indicated some shortcomings in the method in use and led to development of a still further refinement in the process wherein heated and seeded sewage sludge is violently agitated at stated periods by injection of large quantities of gas developed in the sludge digestion process, without entirely abandoning the multi-stage process the Districts invoked the later development in new tanks in the early 1960's.

Two additional Sanitation Districts were formed; No. 26 in the Saugus-Newhall area and No. 27 in the Sunset Mesa tract. Neither of these Districts joined in the Joint Outfall Agreement being remote from possible service in the joint outfall system. Both entered into the Joint Administration Contract with all other Sanitation Districts in the County.

As of August 1961 the Sanitation Districts had added to the 1958 list of structures 32 miles of District trunk sewers; 14 miles of joint outfall trunk sewers; 8 pumping stations; a water reclamation demonstration plant at the Whittier Narrows; the Bixby plant had been expanded commensurate with the Districts' growth and improved methods of treatment and a new wing had been added to

the Los Angeles office to accommodate the increase in the number of District Directors. The Districts, as of August 1961, had a capital investment of 80 million dollars.

From December 1958 the District area in the County had increased to 667 square miles, the population to 3,210,000 and the assessed valuation to $4,883,000,000. Twelve new cities had incorporated increasing the number of incorporated cities wholly in the District area to 65. Flow of sewage at Bixby plant had reached 268 mgd average for the year 1961. That from Districts 14 and 20 was 4.5 mgd. Outfall capacity from Bixby to the ocean remained unchanged for this period. As of August 1961, District employees numbered 330. Of these 195 were in the sewerage division, 51 in refuse disposal, and 84 in engineering and clerical positions in the central office.

Charles R. Compton retired from the post of Chief Engineer and General Manager of the Districts on August 30, 1961, and was succeeded in that position by John D. Parkhurst. Frank R. Bowerman was appointed Assistant Chief Engineer, Walter E. Garrison and Lester Haug were appointed, respectively, Deputy Assistant Chief Engineer of Sewerage and Deputy Assistant Chief Engineer of Refuse Disposal. George Posthumus remained as Office Engineer and James R. Foster as Chief Accountant and Secretary of the Boards of Directors.

Chapter 12

REFUSE DISPOSAL

Termination of the war effort in 1945 and return to the more peaceful pursuits of urban life, brought a sharp realization of the changes which the advent of the many new industries associated with modern military preparation had effected. In particular, it was noted, the atmosphere in many parts of the county was so contaminated with noxious gases as to threaten the health and comfort of a large proportion of the population. So much has been written concerning Los Angeles "Smog" and it has been so widely publicized, that a letter addressed to Smogville, California, will reach its Los Angeles address without delay. To its credit, the Los Angeles County Board of Supervisors immediately commenced an investigation into the phenomenon and encouraged enactment of a law which would give the Board wide authority in its abatement. After such law became effective the Board appointed qualified personnel to determine specific causes and cures. Much of the history of "Smog" has originated in Los Angeles County and carefully recorded and publicized. Only the effects of the "causes and cures" upon the Sanitation Districts will be touched upon in this narrative.

The entire county was designated as an Air Pollution Control District for the purpose of investigation and abatement of smog.

Those in the forefront of the work of correction promptly concluded that one "controllable" contribution to air contaminants was generated in back yard single chamber combustible rubbish incinerators. The conclusion was quite logical. Los Angeles County undoubtedly had a greater concentration of home incinerators than any other area in the United States, if not the entire world. Furthermore, atmospheric conditions in the Southern California coastal region tended to intensify concentration of air contaminants.

Studies seemed to indicate that the home incinerator, as operated by the average home owner, would continue as a constantly worsening offender in smog generation unless eliminated. The task of elimination was a formidable one and 12 years were required to accomplish it. It should probably be noted at this point that but very little of the combustible rubbish generated in the County—that could be jammed into a home incinerator—was disposed of in any manner other than by back yard incineration.

The Sanitation Districts found themselves very much involved in the change-over from the existing system of combustible rubbish disposal to a more acceptable one. The Sanitation Districts were called upon to assist in smog investigation and to concern themselves with developing for the County, in particular the District area, a comprehensive plan for collecting and disposing of combustible rubbish, with minimal air pollution and without interference with established private collectors or operators of disposal sites. The District Directors ordered the staff to take all necessary steps to keep abreast of the situation as it developed and to prepare to report upon the Districts' position in the control effort at all times.

In 1949, amendments to the County Sanitation District Act were introduced in the Legislature by Assemblyman (now Lt. Gov.) Glenn Anderson of Hawthorne. The amendments were inspired by Mayor Charles H. Wortham of Redondo Beach and were designed to put the Districts in position to both collect and dispose of refuse. The amendments were approved by the Legislature and became law. Correspondingly the Districts' engineering staff prepared and submitted to the District Directors an engineering report, dated 1950, outlining a plan for District participation.

With submission of the 1950 report it became immediately apparent that the District entrance into the refuse collection field would be totally unsatisfactory to the constituent cities in the several Districts as well as to the Garbage Disposal Districts in unincorporated communities. Assurance by the Districts that it was not intended that the Districts should engage in refuse door-to-door collection did not quiet the opposition to District activity in this field so long as the law could permit engagement in collection. The Legislature was therefore petitioned in 1951 and again in 1953 and '55 to amend the law, limiting District participation solely to transfer and disposal. These efforts failed altho supported by assemblymen representing the Sanitation District area. Reason for the failure is logically attributed to the efforts of private collectors and disposal site operators, who attributed to the law a significance that was not intended, viz.—complete elimination of the private operator. This suspicion, altho without foundation, was probably natural with those engaged, privately, in refuse and garbage collection and disposal and as a group thruout the State their influence was probably effective in legislation. My personal feeling was that every protection should be given to the Los Angeles County private refuse collector for the very significant part played in filling a vacancy otherwise existing in one of the primary functions of government.

The report and planning submitted in 1950 did accomplish an important first step in preparing the Districts for action in the refuse disposal field. The report contained a recommendation that the Districts accumulate a reserve fund, to be used only for refuse disposal, by assessing a two cent tax per $100 of assessed value, in each District for a period of five years, to be followed by a one cent tax for the same purpose for an additional five years. It was made plain that any District funds invested in refuse disposal (land or facilities) would be returned from service charges but that a considerable amount of money would be needed immediately the Districts commenced activity in the new field. Six of the Districts enacted the recommendation immediately. A number of others followed suit a few years later in time to be of assistance. Certain of the Districts would have found no profit in affirmative action and were not encouraged to subscribe.

PALOS VERDES LANDFILL — Refuse disposal site in Palos Verdes hills. Operations nearly complete east of Crenshaw Boulevard. County Arboreta Department has commenced landscaping, etc., at left end of fill. Landfill operations continuing west (right in picture) of Crenshaw Boulevard.

The Los Angeles County Board of Supervisors, in 1955 ruled and ordered that back yard incineration thruout the county should cease October 1, 1957. The order applied with equal force to open burning of refuse of any sort and to improperly operated public incinerators. The implication of this was that anything thrown away must be collected, transported to an appropriate disposal site and disposed of without producing any gases or particles that would contribute to smog. At the time the order was to be effective (1957) this implied collection and disposal of forty-five hundred tons of refuse a day in the Districts alone.

The District law still contained authority for the Districts to collect as well as dispose of refuse, and, in view of the fact that quantities of refuse were increasing almost daily while refuse disposal sites were being exhausted at a great rate, and, since the Districts were not endowed with police power to compel acceptance of District services—it became necessary, if the Districts were to be of benefit in the matter to somehow exclude themselves specifically, from any possible connection with *collection* and identify solely with transfer and disposal. This they did, to the satisfaction of all interested parties, by contracting with the city council of each interested City, and with the Board of Supervisors for each Garbage Disposal District, for each such city or district to serve as the Sanitation District's agent in the collection of all refuse of any, and all, kinds generated in the respective areas.

The contracts further specified that the method and manner of collection was the province of the local agency with which the contract was drawn, and that the District would have, or assume, no responsibility in the refuse collection activity. The consideration for acting as the District's agent would be $1.00 per year and it was the tacit understanding that all contracts entered into in the manner described would be rescinded as soon as the Legislature amended the Sanitation District law to exclude District collection of refuse.

Completion of contracts was effected with all interested parties but not until after a long and laborious effort involving the explanation of the matter to 19 District city councils and the Board of Supervisors, their managers and engineers. The District law was amended in 1957 to exclude the Districts from collection

and also to cancel out all of the individual contracts described supra.

By the close of fiscal year 1956-57, the Districts had accumulated some $1,770,000 in the refuse disposal fund resulting from the two and one cent tax levy recommended in 1950. This put them in position to implement the County's order regarding burning combustible refuse in back yard incinerators. In compliance with the contracts between the Districts and their constituent cities and towns, the latter were required to collect the refuse by any appropriate means at their disposal. On their part, the Districts acquired and implemented two refuse landfill sites and built one refuse transfer station. Both of the disposal sites were in operation prior to the effective date of the ban on burning; one in the Palos Verdes Hills in May, 1957; the other, near Pomona, in July of that year. The refuse transfer station in South Gate was equipped ready for operation on January 2, 1958.

The Palos Verdes landfill site was a deep quarry, or pit, excavated by the Great Lakes Carbon Co. in the recovery of diatomaceous earth. Considered quite unusable for any other purpose, it was admirably suited for use in waste burial and cover. The owners were not unaware of its value as a fill site nor were they inclined to relinquish title to the land after it was filled. Citizens in the area were opposed to use of the area as a waste disposal site but insisted that, if it were so used, the filled area be developed as a regional public park or golf course. Opposition to use of the pit for waste disposal was justified by the deplorable condition of most of the privately operated waste disposal facilities in the county. Elaborate preparation by the Districts, including methods of operation which would exclude flies and rodents, softened up the opposition a little and when the County Board of Supervisors agreed to join in the deal to the extent of purchasing the fee title to the land, and to establish a regional park on the land after it was filled, opposition subsided. Satisfactory terms were negotiated with the owners. So far, public relations have been excellent, much of the area is filled and finished. The County Arboreta and Botanical Gardens Dept. has taken over in some of the already filled areas and are fulfilling the county obligation anent a regional park.

A word about District administration of the refuse disposal activity;—When refuse disposal was first proposed as a District function, the staff made an intensive investigation of such operations in the United States and elsewhere. A staff member, F. R. Bowerman was sent on a trip of inspection covering sufficient ground to get a long look at every sort of refuse disposal at all adaptable to conditions in the Los Angeles area. The information which he acquired plus research in local sources formed the background for the 1950 report to the Districts. During the five years following 1950, Bowerman, as a division head, continued preparations for District engagement in refuse disposal. During this period, contact was made with all public and private agencies which might have an influence on the new District activity and the merits of District participation were told, convincingly, to private operators and to the householders who were to pay the bill. Potential disposal sites in and about Los Angeles county were investigated for adequacy and possibility of acquisition. Amendments were adopted to the District law greatly restricting location of sites. All of this drew attention to the Districts as the only group of agencies in the county with sufficient power and authority to organize, finance and operate refuse disposal on a regional basis.

Immediately after the Palos Verdes site was acquired, purchase of the Pomona site was consummated. District forces had completed work on the 12 ft. tunnel under the Palos Verdes Hills to White's Point and the 90″ diameter ocean outfall, allowing for the transfer of the Districts construction engineer, Lester Haug, and construction Superintendent, Harry Panaccione, to development of the two sites. In the meantime the refuse disposal division engineers were investigating other areas and had the transfer station at South Gate under construction. Two locations which were adequately suited to refuse disposal were carefully investigated and subsequently abandoned for reasons beyond the control of the Districts. One, in Monterey Park, now fronting on the Long Beach Freeway might have been available if the Districts had been able, under the law, to compensate Monterey Park for its use. In fact, such an approach was proposed and seemed agreeable but was later found unlawful and, in being abandoned, cancelled out the possibility of use. The other, just north of Whittier in an area well-

suited for the purpose, was so vigorously opposed by citizens of Whittier, who wished to establish a memorial park cemetery in the location, that it lost the support of public officials who were otherwise interested in having it there, and was abandoned. Incidentally; the effort to obtain the Monterey Park site was probably the most potent influence in writing into the Sanitation District law the rigid restrictions governing and limiting establishment of refuse disposal sites in or by Sanitation Districts.

Beginning with the operation of the Palos Verdes and Pomona refuse disposal facilities in 1957, the Districts were, more or less, catapulted into operation of refuse disposal for the entire county. Rules adopted for operation of District sites included some very important and beneficial terms, as follows;—(a) There was no restriction regarding who could use the facilities. They were open to all who would conform to laws regarding hauling and covering loads and who would observe District rules. (b) All loads, except those obviously minimum, were weighed and priced accordingly. (c) No refuse was accepted free at the site. All was paid for regardless of the source. (d) No salvage operations of any sort were permitted at the site. (e) Credit cards would be issued to all and sundry who would post bond and meet certain financial terms imposed, and to city and county governmental agencies. (f) The operation was to be conducted by District personnel at a financial level that would defray all costs and investments. The District Boards, very wisely, decided at the outset that no special advantage should accrue to any District as a result of use of the District's finances or credit in the original installation but rather, that refuse disposal was the objective and the Districts concern was the perpetuation of adequate facilities, properly operated, at such a level as to return to each District its investment and no more.

Refuse disposal amendments were written into the Sanitation District law in such form as to permit the Districts to operate refuse disposal sites within or without the Districts. This feature of the law plus the elaborate, but liberal, plans under which the Districts proposed to operate, coupled with a sound financial plan backed by the County Board of Supervisors, attracted attention to the Districts' effort and tended to crystallize the thought among public administrators that perhaps the Districts were the logical

agency to perform this service for all of the county not otherwise served by public or private facilities. The unique success of the Palos Verdes operation and the excellent public relations maintained at that site were quite convincing.

In the early 1950's District engineers had made an inspection of Mission Canyon in west Los Angeles, near Mulholland Dr. and Sepulveda Blvd. This canyon was completely outside of any existing or prospective District and, unless served from transfer stations could be of little value to the Districts. Nevertheless it was scouted for possible future use. Later, in company with Los Angeles officials, I visited the site again with an eye to acquiring it. The City officials agreed to its usefulness, the Board of Supervisors invested $2,353,000.00 in 362 acres of the canyon land and facilities at Mission Canyon and the Districts took over the building and operation of the site. Again, in this instance, there was strong opposition from citizens in the area and a number of groups were taken to Palos Verdes and Pomona to inspect District operations. The criticism ceased after the operation at Mission got under way and it is interesting to note that many new homes, with lots priced at $35,000 each and houses in the $125,000 class, have been built and sold along the borders of the disposal area in anticipation of the park which will be built in the filled area when its capacity for refuse has been exhausted. Mission Canyon Disposal Site was placed in operation June 1, 1960.

Undoubtedly the success with the three operating disposal works had the effect, in 1960-61, of convincing the City of Glendale, not in any Sanitation District, of the advisability of granting fill rights on some 350 acres of land in Scholl Canyon, for refuse disposal under District operation. For the use of this land, which was owned by Glendale, the city receives 25¢ per ton, or 20% of gross revenue, from the service charge for refuse disposed of at the site. Los Angeles County built a service road into the plant site and defrayed the cost of roads, facilities and equipment required to place the works on an operating basis. The County is also being reimbursed at the rate of 25¢ per ton or 20% of the gross revenue. The operation will be entirely self liquidating, as will all such operations by the Districts.

MISSION CANYON LANDFILL — Operations in portion of canyon adjacent to homes along Mulholland Drive. San Fernando Valley in background.

Since the Board of Supervisors of the County, acting in the capacity of Directors of the County-wide Air Pollution Control District, had issued the 1957 order banning the burning of combustible rubbish in single-chambered, home incinerators, and were enforcing its provisions, its members took a keen interest in the refuse disposal activities in the county, and, having at their disposal an operating agency of demonstrated ability authorized by law to transfer and dispose of refuse the Board had no hesitancy in financing a fifth refuse disposal site at Calabasas in 1961. This site is of no value to any Sanitation District, but the Districts are the operating agency of this self liquidating operation.

As of August 1961 the Sanitation Districts investment of District funds in operating landfill sites was confined to the Palos Verdes and Spadra operations. The Districts had also financed, with District funds, the South Gate Transfer Station and a small site purchased in 1953 adjacent to the Dominguez Slough in unincorporated area south of Compton. This latter site is leased to a private firm engaged in reclaiming nonferrous metals from foundry sand. The waste sand fill will provide a stable fill on which a transfer station can be constructed when necessary.

As of 1964 the Districts have invested $1,530,000 of District funds in the purchase and preparation of Palos Verdes, Spadra, Dominguez and South Gate facilities and $600,000 in operating equipment, which latter is held in a pool for use as required at any of the sites. Use is charged against operating revenue at a rate which will return the original cost during the useful life of each item of equipment.

The Districts have none of the funds derived from District taxes instituted in 1951 invested in Mission Canyon, Scholl Canyon or Calabasas Landfills. These latter disposal sites were originally financed by Los Angeles County as to land, improvements, equipment and access, for which the County is being repaid from operating revenues. Los Angeles County also financed the land for Spadra Landfill which is being repaid in the same manner. Los Angeles County financed 40% of the land cost for Palos Verdes Landfill which is not being repaid, but for which the County will own fee title after the land is filled. Los Angeles County's reimbursable investment is $4,465,000; non-reimbursable investment in

FINISHING OFF LANDFILL — Covering and grading top of landfill. Top cover not less than two feet of native material.

Palos Verdes is $446,000.

The modest tax of two and one cent per hundred dollars of assessed valuation imposed by the Districts, commencing in 1951, has proven ample to place the refuse disposal activity on a sound operating basis. Action on the part of the County Board of Supervisors, support from the County Administrative Officer and the County Engineer, and cooperation of the District Cities and of Glendale (not in the Districts) have made available three of these disposal sites of immense value which are now being operated by the Districts, under terms imposed by the District law, in which the Districts have no investment whatsoever. Returns from the several operations have been adequate to meet all obligations in the three sites in which the Districts have no financial involvement as well as in the two (Palos Verdes and Pomona) which were financed, in part, with District funds. Returns from the several sites accruing to the Districts, plus taxes collected from the two and one cent levy and not used to date, are proposed to be used to extend District activity in refuse disposal facilities and equipment. as required.

As existing sites are filled, other means of disposal may be instituted or more involved methods of transporting and disposal undertaken. Many sites of vast capacity exist in the outskirts of the metropolitan area of the county. Refuse disposal in the operating sites has more than doubled since 1961, having increased from about five thousand tons per day at that time to more than ten thousand tons per day in '64. The latter figure is considered to be about half of the refuse generated in Los Angeles County daily. Reliance may probably be placed, with assurance, on the present methods of refuse disposal for two or more decades. Disposal methods, now current, can always be adapted to the area by increasing the haul distance to the disposal site.

Discussion of the refuse disposal activity of the Sanitation Districts is carried to September 30, 1964 at the request of Mr. John Parkhurst, currently Chief Engineer and General Manager of the Los Angeles County Sanitation Districts.

Appendix I

LEGAL

The County Sanitation District Act, as originally drafted and enacted into law, had some shortcomings and prohibitions which not only limited the Districts operations to a degree which could be inconvenient, but one, in particular, which could render it inoperable. Discussion with Mr. Hugh Gordon who served as the Districts' General Counsel from 1925 until his retirement from active legal practice in 1956, has directed attention to some of the more important changes in the law which have made the Act a more workable document. It is to be noted that many of the changes in the law during its 40 years of operation have been effected at the instigation of others than the Los Angeles County Districts and have little, if any, applications to conditions in Los Angeles County.

Gordon's principal worry at the outset was a provision in the Act, that the Districts levy the tax to provide District revenues. The power to levy a property tax in a District is, by law, delegated to the County and the appropriate procedure, logically, one in which the Districts determine the amount of the tax and submit it to the County Board of Supervisors for levy. On advice of Mr. Paul Schwab of the firm of O'Melveny and Myers, bond counsel, an amendment to the Act was prepared for the legislative session of 1927 and enacted into law, clearing up the matter.

The law was further amended (a) to allow a District to include both incorporated and unincorporated area in the same District; (b) to use tax revenues not only to cover bond interest and redemption, as well as operation and maintenance, but also, to provide for "all costs incidental to the exercise of powers granted." This made possible supplementation of the funds provided from sale of bonds, which later were restricted in their use; (c) provision was made to allow a District Board to advertise its bonds

for sale at a fixed rate of interest; (d) to assure payment of bond interest and redemption by vesting authority in the County Auditor to discharge all legal obligations against the Districts, from District funds held in the County treasury; (e) placed the County Board of Supervisors under mandate to levy the necessary tax to cover bond interest and redemption in event the Sanitation District Boards failed to certify the levy to the Board of Supervisors at the time and in the manner required; (f) authorized acquisition of existing facilities from cities and other governmental agencies.

In addition to minor changes made in the Act by the Legislature in the 1929 and 1931 sessions were four of great importance; (a) payment of a fee to District Directors for attendance at meetings of the Board; (b) authority to engage in joint action among Districts; (c) authority for the Districts to conserve and put to beneficial use water or sewage effluent recovered from sewage treatment processes; (d) power to sell, lease, etc., any water, sewage effluent or fertilizer resulting from the operation of a sewage treatment plant.

Some of the amendments to the Act by legislative action at the sessions during 1933 to 1947 are of importance to the Districts in Los Angeles County. Briefly: The District Investigation Act was made inapplicable to the Sanitation District Law; an attempt by the Districts to institute reclamation of water from sewage as a supplement to imported water failed through the efforts of M.W.D.; annexation of territory in a neighboring county was authorized; authority to borrow money; authority to attend State Legislative sessions; modification of the two-thirds rule in District 21 bond election; participation by new Districts in State Retirement.

The 1949 Legislature enacted the amendments; (a) authorizing the Districts to engage in refuse collection and disposal, a matter which was further amended in 1957 to exclude the Districts from refuse collection activities. This matter is more fully discussed in the chapter on refuse transfer and disposal; (b) authority to contract with governmental agencies within or without the District for disposal of wastes. In 1955 the law was amended to permit consolidation of two or more Districts; in the late 1950's the law was amended to permit a sanitation District to be formed

within a single incorporated city as for instance, Vernon.

Litigation in District matters has been conspicuous by its relative absence. An action in condemnation was required to secure the necessary right of way for District works at White's Point resulting in the award of $14,000 to the owners who had offered settlement for $250,000. Shortly before sewage effluent was turned into the White's Point tunnel and while the Districts were still discharging activated sludge process effluent to Dominguez Slough, the California Yacht Club sought to enjoin the Districts from further discharge to the slough. The Court refused to issue the injunction relying on the Districts' intention to cease the discharge upon completion of the tunnel.

An effort was made by officials of the Los Angeles Municipal League to curtail the activities of the Sanitation Districts by making false charges about the manner and cost of District works. In defense it was shown that all of the work accomplished by the Districts up until the time when the accusations were made had been completed nearly ten percent under the engineers' estimates, that the work had all been done by contract and almost without exception was built to greater capacity than indicated in the original engineering plans. Presented to the Board of Directors of the League, this evidence resulted in the withdrawal of the charges and a reprimand to the originating officials. This disagreeable episode took place in 1926-27.

An altercation with The Cooper-Bessemer Corporation regarding the sufficiency of certain engines furnished the Districts by that company appeared headed for the courts, but upon sufficient showing, by the Districts, at pre-trial conferences, suit was avoided and the company removed the engines from District premises and repaid the Districts what had been paid on the engines at delivery date. The engines had been contracted for delivery in late 1948. They were removed and delivered to the contractor in 1951. Elsewhere in the text is an account of an action which the District threatened to take against the federal government for damage to the 60-inch ocean outfall, occasioned by military personnel exploding obsolete ammunition over the outfall in an effort to secure fish. The matter was settled to the Districts' satisfaction without trial.

A sewer in District 5, designed to serve an impending subdivision in the area owned by the Great Lakes Carbon Company of Palos Verdes, was built by the Districts under a contract with Great Lakes Carbon Company under which the company would pay the cost of construction and the District would thereafter buy the line at its cost price. Upon completion of the line a land slide occurred in the area which crushed a considerable portion of the line before it had been delivered to the District. The matter of validity of the negotiation was heard before Judge Fletcher Bowron who found for the Great Lakes Carbon Company. The Districts appealed and the appellate court confirmed Judge Bowron's decision. The District had to pay the full cost of the broken and unusable line as well as to replace it with another.

Appendix II

ACCIDENTAL DEATHS

The following memorandum was prepared for me by Harry Chapman, Superintendent of Sewer Operations. The data were prepared from memory, and notes kept by Chapman and from office records.

During the construction of the South Bay Cities Main Trunk in 1925 along the beach, a timber set failed and the sand flowed in covering the pipe layer and he had suffocated before the sand could be removed. This sewer was built by J. C. Duncan.

In 1927 the Joint Outfall "A" was constructed by Charles and George K. Thompson, north of Rocha Street on Wilmington Avenue. A crane was using a clam shell to pull timber. The clam broke loose from the machine killing the man below.

Mr. Cooper, working as an inspector for the P.W.A. was killed by falling off a pier built by Merritt Chapman and Scott Construction Company building the Ocean Outfall in 1936.

Two W.P.A. workers engaged in building a sewer line in Wilmington Avenue were killed while cleaning up a manhole. The names are unknown to the Districts as were the names of most W.P.A. workers whose employment records were kept by Federal timekeepers.

Construction crew building sewer lines in Long Beach, 1948, was making connections of existing lines to the Water Street Trunk. Aguilera and Schumacher, without jurisdiction or permission, tried to make a connection between two sewers and were overcome by gas. When found both men had expired in a manhole on Pico Avenue at Eighth Street.

William Chorovich lost his life in 1948 due to a cave-in while working for the George Miller Company on the construction of the Alameda St. Ext. Trunk sewer. H. L. Kennedy injured his head in a

fall during construction of the 12′ tunnel and later died from the accident.

Pete Grgic, working for the P & J Artukovich Construction Company building the Joint Outfall "F" in 1950, contacted a cable on a crane that was against a power line causing his death.

Martin Brkich Company constructing the Joint Outfall "C" tunnel on Eleventh Street, in Long Beach, caused the death of a man in 1951 when the timbering in a shaft failed.

William Katko lost his life in 1951 while working with District Forces cleaning the Lomita Trunk. Al Hartwig while working in a manhole lost consciousness. Katko entered the manhole and tied a rope around Hartwig who then was removed from the manhole and given first aid by men on the crew. In the meantime the fire department had arrived, removed Katko and applied first aid. The doctor who had been called to the scene pronounced Katko dead. Hartwig was revived and is still working for the Districts.

In 1955 Frank C. Kelly, working for Healy-Tibbitts Company on the inshore end of the Ocean Outfall, was killed when he fell off the pier to the rocks below.

Pipe stacked to be layed for the Base Line Trunk being constructed by the Kevry Construction Company in 1955, was the cause of the death of a child, Nancy Jean Sherer. She was crushed when the pipe shifted while playing on the stacked pipe.

A man was killed by a cave-in during the construction of the District 5 Relief Trunk by the Bosko Construction Company.

John F. Jensen was killed at Palos Verdes Landfill on July 4, 1961, when the tractor he was operating turned over and crushed him.

Harry Chapman

Appendix III

SOME SIGNIFICANT FINDINGS

On many occasions, the engineering staff of the Districts was confronted with situations which could not be resolved by application of the experience of others. Five of these occasions are notable in the life of the Districts because of the solutions presented by the Districts and which had widespread acceptance. Two of the efforts have received honors from the American Society of Civil Engineers; a third is incorporated in its Proceedings and the other two have been given wide publicity in technical journals.

The condition which had developed in the trunk sewers of Los Angeles and was apparent prior to commencement of District work, was such as to imperil the life and safety of many of the sewerage structures. Almost immediately upon completion, the screening plant at Hyperion began to show the destructive action of oxidized H_2S upon unprotected concrete. Early in 1925 the Districts requested authority to build an experimental line near the inlet to the City plant, thru which sewage would flow during high flow periods. Each four foot length of pipe in the line was protected on the inside with a lining which had been recommended for use in such construction and one which the District thought might be satisfactory. The line was placed in operation December 7, 1925 and inspected from time to time by all concerned. All of the lining materials failed excepting that proposed by the District engineers. Actually the District had merely adapted a lining previously used by the City but improved it by rendering certain joints impervious to acid attact.

This experiment dictated a course of action to the Districts which was followed for years at a good deal of expense, but it proved of temporary value only in the long run. That it did partially protect the main trunk of the districts during years of extremely limited sewage flow is the sole value it produced. For years, however, it remained the genesis of experimental work in

this direction and practically every experimenter into this matter found himself eventually at the end of the line at Hyperion. At the time it was considered a step in the right direction. Actually it was the wrong approach but the Districts' interest in the subject led to a far better solution later.

A much better precaution against the H_2S destruction problem was brought to light a number of years later when a fairly high velocity flow in the Wright Road sewer in District 1, in which sewage of required age to produce sulfide, in sufficient quantity to promote destruction of concrete pipe, did not appear to be doing so. Experiments showed that sulfide was being formed by the slimes on the submerged pipe wall, but something was happening to it before it could escape into the sewer atmosphere. It was determined that the sulfide was being oxidized as fast as formed by oxygen absorbed at the surface of the stream. Subsequent investigations, prompted by the phenomenon observed in the Wright Road experience gave rise to the Bowlus-Pomeroy formulae defining the strength - temperature - velocity conditions controlling escape of hydrogen sulfide to the atmosphere from sewage. This permitted design of sewers to prevent escape of the gas and thus protect the pipe interior. The results were published in a paper in 1946 that was awarded honors by The Sewage Works Federation, and that is now widely used in sewer design.

Prior to Sanitation District experimentation, there was very little accurate knowledge of the rate of diffusion of fresh water in salt water, consequently little was known or could be determined, in advance of actual operation, about the spread of a sewage field in sea water before its disappearance as such. In March, 1926 the District staff undertook to find out the factors which influenced the phenomenon and, to that end, installed a small experimental plant on a raft anchored in San Pedro Harbor. At the model study the effect of depth, direction and quantity of discharge, upon the spread of a field of fresh water on one of salt water was determined and applied, with great benefit, to design of the District Ocean Outfall at White's Point. The formulae derived, (Rawn-Palmer) were widely adopted and were published, with a description of the research, in proceedings of the American Society of Civil Engineers.

In 1962, after many years of experience, research and analysis, a second treatise on the subject was prepared and published in the journals of the American Society of Civil Engineers. The second paper reviewed the existing District structures at White's Point and, in addition to a further analysis of the phenomena of ocean disposal, prepared a pattern of design. The second paper was awarded honors by the Society. The second paper and treatise were authored by Bowerman, Brooks and Rawn. All were employees of the District at the time.

A radical departure from universal sewage sludge digestion practice was investigated by the District staff. Known then, and now, as stage digestion, it took advantage of the gravimetric segregation of sewage solids during the digestion process, resulting in more rapid progress of readily digested solids thru digestion tanks, less tank capacity and better control of the process. The investigation resulted in a paper descriptive of the work, authored by Banta, Pomeroy and Rawn, all employees of the District. The paper was awarded honors by the American Society of Civil Engineers and was published in its journals. Much of the progress in the perplexing problem of sewage sludge disposal was stimulated by the District effort and the development of the process has materially reduced the cost of sewage treatment to the Districts and elsewhere.

Measuring small sewage flows was a problem in sewerage practice for many years. It was one which confronted the Districts in apportioning sewage flow costs to the various districts, in the early days of operation. Incorporating the principal of critical flow in fluids, Bowlus and Palmer, both District employees, developed a simplified weir which offered no obstruction to the passage of sewage solids thru the area where normal flow was temporarily increased to critical flow. Loss of head in the sewer was greatly minimized and the weir could be moved from place to place easily. Its use has been adapted to many locations since publication of the results in technical journals. For the Districts it simplified the trimonthly task of apportioning costs of operation to flow and accurately assessing each District with its proper cost.

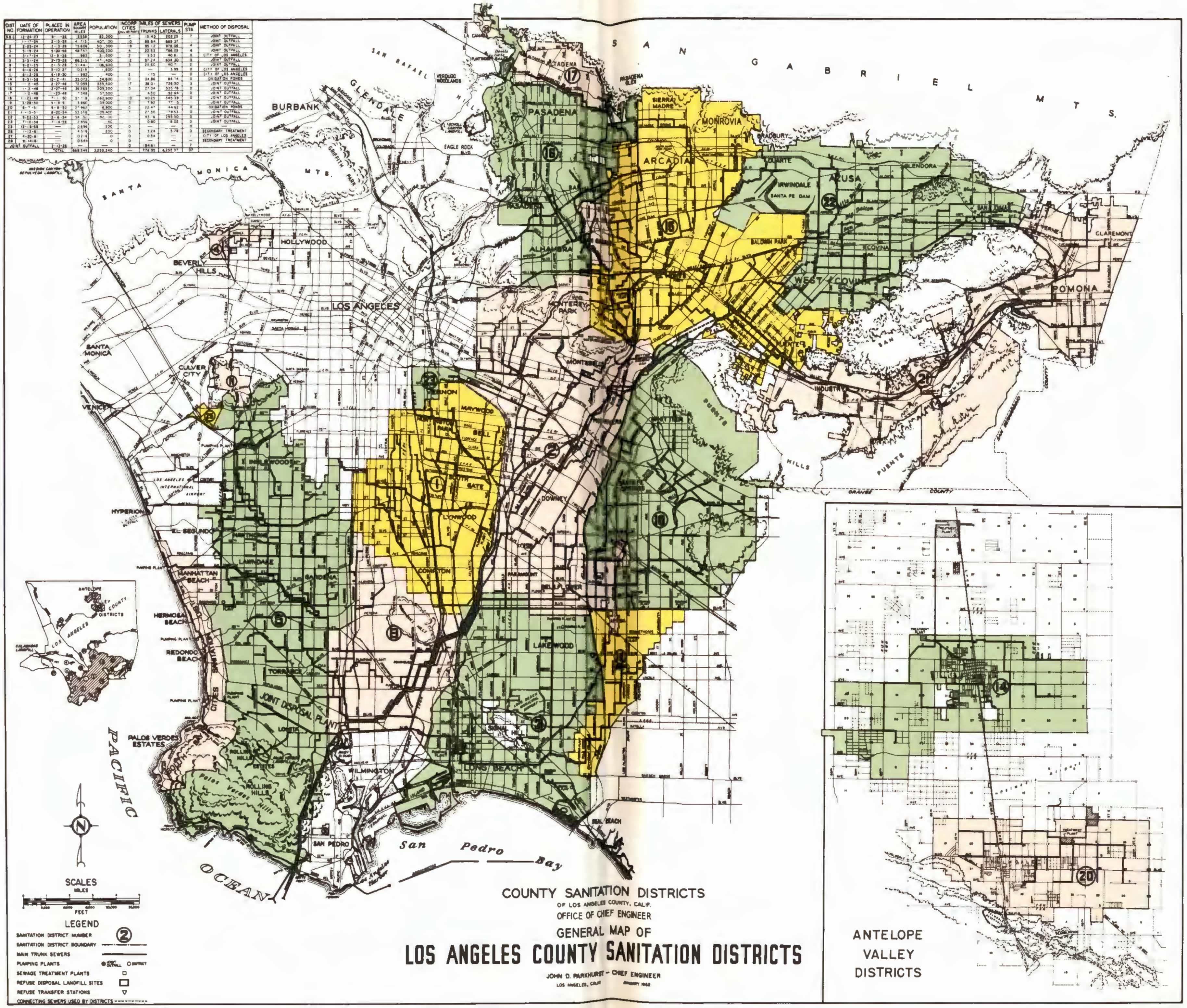
Appendix IV

Some Published Articles Written by District Personnel

Title	Author(s)	Reproduction	Year
"Pre-Determining the Extent of a Sewage Field in Sea Water"	Rawn, A M Palmer, H. K.	Transactions Vol. 94, p. 1036	1930
"Multi-Stage Sludge Digestion at Los Angeles County Sanitation Districts' Plant"	Rawn	Sewage Works Journal Vol. III, No. 4	Oct. 1931
"Adaptation of Venturi Flumes to Flow Measurements in Conduits"	Palmer, H. K. Bowlus, Fred	Transactions Vol. 101 (1936) p. 1195	1936
"Multiple-Stage Sewage Sludge Digestion"	Rawn, A M Banta, Perry Pomeroy. R.	Transactions Vol. 104 (1939) p. 93	1939
"The Utilization of Sewage Water for Agriculture"	Rawn, A M	Printed. International Sewerage Conference Dresden.	1941
"Sludge Digestion Temperature Control With Live Steam"	Rawn	Water Works & Sewerage	July 1942
"Developments of the Year in Sewerage & Industrial Wastes"	Rawn	Water Works & Sewerage Vol. 91, No. 2	Feb. 1944
"Employee Organization in the Professional Field and the Public Services"	Rawn	Journal of the American Water Works Assn. Vol. 36, No. 7	July 1944
"Report on Sulfide Control Research"	Pomeroy, R. Bowlus, Fred	Sewage Works Journal Vol. XVIII, No. 4	July 1946
"Water from Wastes: Concepts and Costs"	Rawn	Engineering News-Record	Sept. 1949
"Postwar Growth and Development of the County Sanitation Districts of Los Angeles County"	Parkhurst Gilman, III, R.	California Sewage Works Journal	1949
"Handling Radioactive Wastes in Sewers"	Parkhurst	Sewage Works Journal Vol. 22, No. 8	Aug. 1950

Title	Author(s)	Reproduction	Year
"Postwar Growth and Development of the County Sanitation Districts of Los Angeles County"	Parkhurst Gilman, III, R.	California Sewage Works Journal	1949
"Handling Radioactive Wastes in Sewers"	Parkhurst	Sewage Works Journal Vol. 22, No. 8	Aug. 1950
"Some Effects of Anaerobic Digestion on Sewage Sludge"	Rawn Candell, E. J.	Transactions Vol. 115 (1950) p. 181	1950
"Some Effects of Home Garbage Grinding Upon Domestic Sewage"	Rawn	The American City	Mar. 1951
"Central Garbage Grinder Stations"	Rawn	The American City	Apr. 1951
"Sewage Reclamation by Spreading Basin Infiltration"	Stone, Ralph Garber, W.	Transactions Vol. 117 (1952) p. 1189	1952
"Application of Molecular Filter Membranes to Specific Problems in Water Analyses"	Goetz Gilman Rawn	Journal of the American Water Works Assn. Vol. 44, No. 6	June 1952
"Integrating Reclamation and Disposal of Waste Water"	Rawn Bowerman Stone	Journal of the American Water Works Assn. Vol. 45, No. 5	May 1953
"Influence of Water-Borne Sewage"	Rawn	Centennial Transactions Vol. CT (1953) p. 649	1953
"Disposal of Digested Sludge by Dilution"	Rawn Bowerman	Sewage & Industrial Wastes Vol. 26, No. 11	Nov. 1954
"Incineration and Alternative Refuse Disposal Processes"	Stone Bowerman	Proceedings Vol. 80 Separate No. 471	Aug. 1954
"Philosophy of Water Pollution Control in California"	Rawn Bacon	Sewage & Industrial Wastes Vol. 27, No. 11	Nov. 1955
"New Methods for Sand Tunneling"	Haug	Western Construction pp. 25-27	Apr. 1956
"Planned Refuse Disposal for Los Angeles County"	Rawn	Civil Engineering Vol. 26, No. 4	Apr. 1956

Title	Author(s)	Reproduction	Year
"Planned Water Reclamation"	Rawn Bowerman	Sewage & Industrial Wastes Vol. 29, No. 10	Oct. 1957
"Refuse Collection and Disposal in 194 Western Cities"	Updegraff Bowerman	Western City	May, June, July 1958
"Bacterial Monitoring Guards Coastal Recreational Waters"	Rawn	Wastes Engineering Vol. 30, No. 4	Apr. 1959
"The Why, When, and How of Sewer Maintenance"	Parkhurst	Sewage & Industrial Wastes	Dec. 1959
"Non-Clog Pumping and Dewatering"	Compton	Wastes Engineering	Oct. 1959
"A Density Meter to Control Sludge Pumping"	Garrison Nagel	Sewage & Industrial Wastes	Nov. 1959
"Sewerage & Waste Disposal Practices of Sanitation Districts of Los Angeles County"	Parkhurst	Journal - Water Pollution Control Federation (reprints)	Oct. 1960
"Diffusers for Disposal of Sewage in Sea Water"	Rawn Bowerman Brooks	ASCE Transactions Paper 3179 Proceedings Paper 2424	Mar.
"Composting Operation in Los Angeles County"	Compton Bowerman	Compost Science Vol. 1, No. 4	Winter 1961
"Effect of Wind, Tide, and Weather on Nearshore Ocean Conditions"	Parkhurst Garrison Whitt	Reprints from Pergamon Press Int. Conf. on Water Pollution Research, London	Sept. 1962
"Garbage, Detergents, and Sewers"	Bowerman Dryden	Journal - Water Pollution Control Federation	May 1962
"Water Reclamation at Whittier Narrows"	Parkhurst Garrison	Journal - WPCF Vol 35, No. 9	Sept. 1963
"High Rate Digester Design and Operation" (titled in magazine "Gas Recirculation-Natural, Artificial")	Parkhurst Garrison Nagel	Published in Wastes Engineering pp. 58-63 Vol 1., No 2. (typed)	Feb. 1964
"Reclaiming Used Water"	Parkhurst	The American City	Oct. 1963
"Water Reclamation in Southern California" (titled "Water - Reuse May be the Key to a Vital New Water Resource" in Magazine)	Parkhurst	The Tax Digest Vol. 42. No. 2	Second Quarter 1964



DIST NO	DATE OF FORMATION	PLACED IN OPERATION	AREA SQUARE MILES	POPULATION	INCORP CITIES (ALL OR PART)	MILES OF SEWERS TRUNKS	MILES OF SEWERS LATERALS	PUMP STA	METHOD OF DISPOSAL
S.B.C.	12-24-23	8-[illegible]-26	33.38	82,300	7	19.43	203.25	7	JOINT OUTFALL
[illegible]	1-17-24	2-13-28	4[illegible]13	407,[illegible]00	0	88.64	862.37		JOINT OUTFALL
2	2-23-24	2-3-28	75.606	50[illegible]300	9	95.12	978.06	4	JOINT OUTFALL
3	5-19-24	5-20-46	48.757	400,200	4	22.92	766.25	6	JOINT OUTFALL
4	3-17-24	12-9-26	.983	3[illegible]500	2	5.53	40.61	0	CITY OF LOS ANGELES
5	3-31-24	2-13-28	86.315	4[illegible]400	2	57.24	834.30	5	JOINT OUTFALL
8	9-21-25	2-3-28	31.44	[illegible]08,600	3	25.60	40.7	2	JOINT OUTFALL
9	8-16-26	5-10-27	0.219	1,800		—	3.99	0	CITY OF LOS ANGELES
11	8-12-29	6-18-30	1.997	400	2	1.75	—	0	CITY OF LOS ANGELES
14	8-31-38	12-2-41	35.073	34,600	0	34.86	84.74	0	OXIDATION PONDS
15	[illegible]-2-45	2-27-48	72.059	335,400	17	38.01	736.50	3	JOINT OUTFALL
16	1-2-46	2-27-48	36.568	209,200	5	27.04	535.78	0	JOINT OUTFALL
17	[illegible]-2-46	[illegible]-23-48	7.348	37,500		4.50	92.64	0	JOINT OUTFALL
18	1-23-48	7-1-50	37.[illegible]9	262,600	0	40.25	545.39	0	JOINT OUTFALL
19	3-28-50	5-9-5[illegible]	3.860	39,000	3	7.92	[illegible]		JOINT OUTFALL
20	8-[illegible]-5[illegible]	9-8-52	27.962	8,900	0	22.47	44.62	0	OXIDATION PONDS
21	1-3-51	8-20-54	53.318	[illegible]09,400	7	27.30	79.53	0	JOINT OUTFALL
22	9-22-53	2-6-54	54.[illegible]	92,[illegible]00		43.[illegible]6	295.50	0	JOINT OUTFALL
23	7-10-58	7-14-59	2.956	40		0.80	8.02	0	JOINT OUTFALL
25	12-18-58	—	0.696	500	0	—	—	0	—
26	1-12-61	—	4.316	200	0	3.24	5.78	0	SECONDARY TREATMENT
27	4-20-61	—	0.216	0	0	0.34	—	1	CITY OF LOS ANGELES
28	9-14-61	—	0.544	0	0	—	—	—	SECONDARY TREATMENT
JOINT OUTFALL		2-13-28	—	—	0	194.61	—	7	
		TOTAL	668.349	3,252,340	—	774.95	6,252.37	37	

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY, CALIF.
OFFICE OF CHIEF ENGINEER

GENERAL MAP OF

LOS ANGELES COUNTY SANITATION DISTRICTS

JOHN D. PARKHURST – CHIEF ENGINEER
LOS ANGELES, CALIF. JANUARY 1962

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