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Sewage Disposal and Drainage in the Portland Metropolitan Area

City Club of Portland (Portland, Or.)

REPORT

ON

SEWAGE DISPOSAL AND DRAINAGE IN THE PORTLAND METROPOLITAN AREA

TO THE BOARD OF GOVERNORS
THE CITY CLUB OF PORTLAND:

COMMITTEE ASSIGNMENT

Your committee was assigned to review and appraise the sewage disposal and drainage problems of the Portland Metropolitan area. It was suggested that the committee examine the history and present problems of sewage disposal and drainage in the City of Portland as well as the surrounding areas, together with a review of the duties and responsibilities of the various government agencies and authorities charged with this problem. It was further suggested that attention be given to present planning for sewage disposal, both immediate and long-range, legal problems encountered and possible legislative changes, financial problems and limitations on such programs.

SCOPE OF INVESTIGATION

The committee met with the following authorities on various aspects of its study: Harold Wendel, chairman of the State Sanitary Authority; Dr. Harold Erickson, State Health Officer and member of the State Sanitary Authority; Curtiss Everts, Jr., State Sanitary Engineer; Kenneth H. Spies, Assistant Chief Sanitary Engineer; Multnomah County Commissioner James L. Gleason; F. Sydney Hansen, M.D., County Health Officer; City Commissioner William L. Bowes; Charles L. Newberry, M.D., Washington County Health Officer; Glen W. Snyder, Washington County Supervising Sanitarian; J. O. Johnson, Tigard Sanitary District; Marvin W. Runyan, Partner in the engineering firm of Stevens and Thompson; Robert M. Hall, vice-president of Blyth & Co., investment firm, and Howard A. Rankin, attorney with Shuler, Sayre, Winfree and Rankin, bond counsel.

INTRODUCTION

The Portland Metropolitan Area, for the purposes of this study, has been considered as including the City of Portland, the western half of Multnomah County outside the city, the northwestern corner of Clackamas County, and the eastern third of Washington County. The borders of this area are, roughly: the Columbia River on the North; the Troutdale, Fairview, Gresham area on the East; the northern borders of Gladstone and West Linn on the South, and Washington County to Hillsboro on the West.

SEWAGE DISPOSAL SYSTEMS

Sewage disposal is accomplished in several ways. An individual building may be served by a septic tank or cesspool or a combination of both. A septic tank system consists of a large receiving tank into which the sewage is first discharged, and held for a period of several hours to permit attack by anaerobic bacteria so that it disintegrates, liquifies and gives off gases. A sludge is formed and settles to the bottom of the tank, necessitating periodic removal,

while the liquid is discharged into a drainage field which basically is a network of field tile laid a foot or eighteen inches underground on a gravel bed. Liquids are dispersed through this field to be absorbed by the ground. In theory, this liquid, if properly distributed and absorbed, is harmless. A cesspool is a cistern built or dug to receive sewage. The solids settle to the bottom and the liquids soak or leach through the sides and bottom into the surrounding soil. Cesspools must also be emptied of all solids frequently.

Larger groups of buildings may be served by a septic tank, but the size of the tank necessary and the resulting large area for drainage fields soon makes this system uneconomical, even if it can be proven safe from a health standpoint. Consequently, with large volumes of sewage to be handled it becomes necessary to collect all of the sewage for treatment and disposal at a central location by means of a sewage system and sewage treatment plant.

A sewage system consists of a multiplicity of house sewers, lateral sewers, trunk sewers and interceptor sewers. An individual house or building is connected to a lateral sewer, a relatively small line serving property directly, which is in turn connected to a trunk or main sewer. Trunk sewers receive sewage from a number of lateral sewers, which serve a particular drainage area, and conduct it to the interceptor sewer. Interceptor sewers are the major conduits which receive sewage from a number of trunk sewers and transport it to the point of disposal. Today this is generally a treatment plant, although formerly sewage was discharged directly into the nearest river. For obvious reasons, a sewer which takes advantage of gravity and follows a natural drainage course is more economical than one requiring pumps to lift the flow over a hill or rise in the terrain and is also not subject to power or mechanical failures.

In a treatment plant sewage is treated in one of two ways and the resulting effluent disposed of in a stream or other water course. The volume of sewage effluent and rate of flow of the water course determines the method of sewage treatment. When the receiving body of water is large in proportion to the flow of sewage and slight contamination is not objectionable, primary treatment consisting essentially of removing floating and readily settleable solids followed by disinfection may be sufficient prior to disposal. Primary treatment may be expected to remove only 60 to 70 per cent of the suspended solids and BOD (biochemical oxygen demand—a measure of the organic matter in sewage) removal is limited to about 35 per cent.

Facilities generally incorporated in a primary plant provide for (1) screening or comminution, (2) grit removal, (3) sedimentation, (4) sludge digestion, (5) sludge drying, and (6) chlorine application.

For a primary plant, rags and large solids are first screened out or shredded by comminution devices and returned to the sewage flow. Sand and other heavy inorganic material is then removed and the sewage is held in sedimentation tanks, sometimes called clarifiers, to permit the lighter suspended organic material to settle out. The remaining liquid is chlorinated and discharged from the plant. Sludge from the sedimentation tanks is pumped to digester tanks where anaerobic bacteria convert it to an inert substance. Digested sludge is not putrescible but contains approximately 93 to 95 per cent moisture so it must be dewatered if it cannot be disposed of in liquid form. Dried sludge, although suitable as a humus material, has little value as a fertilizer unless certain chemicals are added. If it is used as either humus or fertilizer it should not be used in gardens where vegetables are grown which are to be eaten raw.

The degree of treatment provided by primary treatment facilities alone is often not sufficient to meet the requirements established for a receiving stream. This occurs when the volume of flow in the stream is small with respect to the sewage plant effluent or when the organic load is sufficiently large to impose an oxygen demand upon the stream that reduces the available oxygen in the stream below the safe limits for fish life. Where additional treatment is required, facilities must be provided which will remove the organic matter in solution. This additional treatment is called secondary or biological treatment and consists essentially in treating the liquids, resulting from primary treatment, to effect oxidation of the organic matter in solution and thus reduce the BOD of the plant effluent. Rock filters are commonly used for this purpose and are essentially a bed of coarse rocks or special media from three to six feet in depth over which the sewage is distributed by a series of pipe arms with nozzles or specially designed openings. A growth of biological organisms forms on the rocks and is sustained by the organic matter in the sewage. Usually a part of the

filter effluent is returned by recirculation pumps for another passage through the filter to improve its efficiency in removing BOD. Rock filters may be designed to remove in excess of 90 per cent of the BOD.

Where a higher degree of treatment, removing up to 95 per cent of the BOD is indicated, the activated sludge process is usually employed. This process accelerates the action by supplying large amounts of low pressure air (5-10 psi) and adding biologically active sludge to the wastes.

HEALTH CONDITIONS

This study was prompted in part by a concern for the future health of the area and dictates consideration of ways and means of protecting the well-being of the individual and the public at large.

The history of sanitation affords numerous instances of epidemics caused by re-ingestion of waste products. As populations have continued to concentrate, the dangers of cross-infection have increased. Typhoid fever and the dysenteries, for example, are among the water-borne diseases. Infectious hepatitis and poliomyelitis are also suspected to be water-carried. Throughout Oregon, including the Portland Metropolitan area, there have been continuing instances of infectious hepatitis that have given grave concern to health officers.

Generally, complaints of "nuisance" are based on "smell." While this shows that something is probably wrong, one should go deeper than the superficial aesthetics. Raw and untreated sewage running in open ditches and streams become a temptation for small children. It is also a serious hazard where pets are concerned, as germs accumulating on their fur are transferred to the hands and may find their way to the handler's mouth.

The Willamette River today, in spite of the work that has been done to alleviate the discharge of raw sewage and wastes into its waters, is still unsafe for aquatic sports, and during certain periods of the year, anadromous fish cannot pass through the Portland Harbor area because of the water's low oxygen content.

SOIL CONDITIONS

Over much of the area west of the Willamette River, soil conditions are such that effluent from septic tanks is not readily absorbed in the soil. In most areas the top soil is underlaid by heavy clay. The effluent often reaches the clay and runs along it to come to the surface in a road, ditch, or an opening on a neighbor's property. Cesspools are out of the question for disposal of effluent, as they would be full of water a large part of the year, nor are septic tanks entirely satisfactory. Often, they are not properly maintained, drainage pipes are broken or filled up with earth or plugged by roots. In some cases the effluent goes almost unretarded into road ditches, natural drainage, or small creeks. Septic tanks are completely ineffective in areas where the water table is at or very near the surface.

Some septic tank installations, however, are quite effective. This is especially true where the area around the house is large, and the installation properly designed and maintained. They are also effective where the heavy clay sub-soil is well below the surface, and the ground water well down. These conditions are not frequent in the West side area.

Many of the areas on the West side are served by sewers running to disposal plants. Some of these plants are effective, and some are not. In all cases the effluent from disposal plants must reach the natural drainage. The creeks of the region have a very small flow in summer, and cannot receive effluent from disposal plants without being badly polluted.

Conditions on the East side of the river are quite different from the West side. Most of the area in the southeast part of the city and to the East is underlaid with coarse gravel, and here effluent from septic tanks or raw sewage can run into cesspools with good success. It may be many years before any sewage problem occurs in much of this area. South of Milwaukie and around Oak Grove, some problems have arisen. Over some of this area, conditions are the same as on the West side, and some of the area is underlaid with a lava flow.

The slough bottoms along the Columbia River and the area immediately to the south thereof present variable conditions for septic tanks. The area to the South of the bottom lands consists of either coarse gravel or sand. Here no sewage problem exists. Some of the

area, however, contain heavy clay. In the bottoms, the ridges are sandy, and septic tanks would be successful, but in the old lake beds the water table is too high. South of Blue Lake the ridge is of sandstone, and little of the effluent from septic tanks can be absorbed, but runs into Blue Lake and Fairview Lake.

POPULATION GROWTH

During the past twenty-five years, the entire Portland Metropolitan Area has increased over 54% in population. Local and federal census reports for Portland and an area within a 15-mile radius of the city show an increase from 390,000 to 600,000 from 1930 to 1950. (The area outside of Portland increased from 89,000 to 220,000 or an increase of 147%, while Portland increased from 302,000 to 373,600—only 24%.) It was estimated in 1955 that since 1950, while Portland increased its population only 8% to 402,900, the urban area increased 20% to 263,400. Conservative forecasts for 1975 predict a population of 505,800 in Portland and 449,600 outside the city, or an over-all population of 955,400 for the entire area. As can be seen from these figures, the largest growth will be outside of the present city boundaries where there are now inadequate sewage facilities.

The southwestern portion of the area under study has enjoyed a building boom during the last ten years, only recently slowed by drastic restrictions due to poor sewage facilities.

Occupancy now varies from 3 to 6 persons per acre. Within a few years this will average at least 8 persons per acre. The southern area has shown an increase in population of up to 50% and this is being accelerated by the development of freeways and expressways.

The area East of Portland extending from the city boundaries almost to Gresham is showing the greatest actual increase in population. The level ground, development of access highways and the gravel strata, which, as mentioned earlier, has to date proven most satisfactory for waste disposal, have all contributed to the construction of moderately priced housing on relatively small parcels of land.

City of Portland

In the last decade, Portland has made great strides in revamping its sewer system and curing evils which had long existed. The principal advance was in the construction of the interceptor system and treatment plant which brought to an end in large part the dumping of raw sewage into the Willamette River. However, raw sewage is still discharged into the Willamette, some parts of the city still rely solely on cesspools and septic tanks for disposal of wastes, and many portions of the existing sewer system are overloaded while others are badly in need of overhaul for which funds are not presently available.

The interceptor system, made possible by the $14,500,000 bond issues approved in 1944 and 1952, collects and carries sewage to a primary treatment plant located north of St. Johns, and from which the effluent is discharged into the Columbia River.

The funds obtained from those bond issues will be virtually exhausted upon completion of the interceptor to collect sewage in the Guilds Lake area, a contract for which was just recently awarded. At present, sewage from Guilds Lake area is dumped untreated into the Willamette.

Raw sewage is also passed into the Willamette from the existing sewers in the Linnton area. While preliminary studies have been made, no definite plans exist to cure this condition.

The principal unsewered areas of the city lie diametrically opposite in the far northeast and southwest corners. The former area for the most part overlies extensive gravel beds and cesspools have proved adequate in most instances. However, soil conditions in localized areas are not suitable for cesspools or septic tanks and in a number of instances considerable difficulty has been occasioned in trying to install an adequate disposal system. The city has no present plans to install sewers in the general area except upon petition by residents of the area.

In the southwest corner of the city, soil conditions are not suitable for cesspools or septic tanks and a definite health hazard exists in the area. As a result, city officials are developing sewers throughout that area.

Of more serious consequence to the city as a whole is the inadequacy and state of disrepair of many portions of the existing system. The inadequacy was dramatically illustrated in the Brooklyn area in August 1956 when heavy rainfall caused sewers to back up into homes and businesses and the main trunk collapsed at one point.

It should be mentioned that almost all of the sewer system built heretofore is a combined sanitary and storm system. It is not feasible to use a combined system when sewage is treated and, consequently, it is the plan to install separate storm and sanitary systems in new areas.

It has been estimated by the city engineer that $20,000,000 would be necessary to refurbish Portland's sewers. Unfortunately, only about $400,000 a year from general funds is available for general maintenance work and this is sufficient only for situations of dire emergency.

Portland has no arrangement for accumulating money for maintenance or replacement work on sewers. Money raised by the present sewer service charge assessed at the rate of one-third of the water bill is, by the Charter amendment which authorized it, restricted solely to payment of interest on and retirement of the bonds issued for the interceptor system or to the building of interceptors, pumping stations or treatment plants. Consequently, money collected by the sewer service charge cannot be used to repair or replace other portions of the sewer system.

As a result, the City Council in 1956 proposed a ballot measure to levy, for five consecutive years, a special tax of one and one-half mills on each dollar of assessed valuation of all property in the City of Portland, or a total of one million dollars per year, whichever is the lesser, the proceeds to be placed in a special fund called "City of Portland Trunk Sewer Fund." This money was to be expended "as the Council may find necessary, appropriate or expedient" for the "replacement of existing trunk sewers to be found in need of reconstruction, construction of additional relief sewers primarily designed to relieve existing overloaded trunk sewers, enlargement of existing sewers and construction of trunk sewer interconnections." This measure was defeated, but it is planned to resubmit a substantially similar proposal to the voters at the next general election. It will be observed that the five million dollars which would thus be raised is only about one-fourth of the amount estimated to be necessary to put the Portland sewer system in a satisfactory condition.

Portland Suburban Area

There are twenty sewerage systems in use and another nine either proposed or under construction in the Portland Metropolitan Area.* Nine of the twenty have only primary treatment while the balance have secondary treatment. Primary treatment plants at Portland and Gresham discharge into the Columbia River, while Oswego, Milwaukie, Lewis and Clark College, Willamette View Manor, Marylhurst College, Oregon City-Gladstone and West Linn discharge into the Willamette River. Secondary treatment plants at Beaverton, Cedar Mill, Cedar Hills and Broadmoor discharge into Beaverton Creek; plants at Markham School, Tualatin Hills, Southwood Park, Brookford Sanitary District, Columbia Sanitary District and Tigard Sanitary District all discharge into Fanno Creek. Wood Village discharges into Fairview Lake.

Beaverton Creek rises in eastern Washington County and flows west past the City of Beaverton towards Hillsboro, joining Rock Creek, and eventually emptying into Tualatin River. The major flow in Beaverton Creek during the summer time is the sewage effluent from the plants mentioned above.

Fanno Creek rises in the West Hills of Portland and flows west almost to the City of Beaverton and then south to Tualatin River. This stream also has a very small natural flow during the summer months.

Four of the systems either proposed or under construction will discharge into Fanno Creek, two will discharge into Beaverton Creek and the balance will connect to existing treatment plants.

* Results of comprehensive engineering studies by the firm of Stevens and Thompson, and information gathered over the years by the State Sanitary Authority have been made available to your committee.

While these plants serve the major existing developed areas, there are still large areas which rely on septic tanks and cesspools. After considerable delay in west-side development, local areas and individual developers are utilizing any system of treatment facilities that will meet the State Sanitary Authority's and the affected County Health Officer's enforced regulations.

OREGON STATE SANITARY AUTHORITY

The Oregon State Sanitary Authority is a division of the State Board of Health. It has legal responsibility for enforcing all state laws pertaining to water pollution. It is empowered to develop and conduct a state-wide program for the prevention and reduction of water pollution, to make rules and regulations pertaining thereto, to establish standards of purity for the various waters of the state, to review and approve plans and specifications for all new, revised or enlarged sewer systems, sewage treatment plants, and industrial waste disposal works to be constructed in the state, and to conduct studies, investigations, research and surveys pertaining to the control of water pollution.

A review of biennial reports by the Authority clearly shows that it has been functioning in accordance with the law, and that its staff has been active in promoting the installation of adequate public sewerage systems in cities, sanitary districts and unincorporated urban areas. It should be recognized that the Authority's function does not cover actual plumbing in a building—this is controlled by the State Plumbing code—but commences only when a waterway is affected. The staff of the Authority reviews all new sewage and waste disposal projects prior to approval or rejection by the Authority. It inspects and conducts efficiency studies of existing treatment works, and advises owners and operators regarding operation and maintenance. The Authority has difficulty in getting proper construction and operation of disposal systems and is hampered by a lack of sufficient personnel to make adequate continuing inspections.

TRI-COUNTY PLAN

At the 1955 legislative session, the Tri-County Health and Sanitation Committee was instrumental in the passage of HB 502. This statute authorizes the county courts or commissioners to prepare and adopt a co-ordinated master plan for the collection, transportation and treatment of sewage from unincorporated areas of the county. Subsequently, Multnomah, Clackamas and Washington Counties entered into a joint contract with Stevens & Thompson for engineering services relative to a master plan for a sanitary sewer system in the tri-county areas. This plan is concerned only with engineering aspects and does not indicate financing methods.

The master plan, commonly called "Tri-County Plan," embraces Clackamas County north of Gladstone and West Linn, and to the east of Gresham; all of Multnomah County west of Sandy River except the cities of Portland and Gresham, and Washington County east of Hillsboro. Briefly, the tri-county plan envisions the following basic concepts:

1. A major sewage treatment plant on the Willamette River near Oswego with an ultimate capacity suitable for a population of 587,000.
2. A basin-wide system of interceptor and main trunk sewers to serve a population of 309,000 in an area of 65 square miles lying west of the Willamette River. Sewage therefrom would flow by gravity to the treatment plant at Oswego.
3. A basin-wide system of interceptor and main trunk sewers to serve 278,000 in an area of 85 square miles lying eastward of the Willamette River.
4. A major sewage pumping station having an ultimate capacity of 85 million gallons per day, to be located on the east bank of the Willamette River near Oak Grove, the purpose being to pump sewage across the river.

A major portion of the tri-county plan would be constructed within a ten-year period, with total completion projected over a fifty-year period. The cost for the entire interceptor and trunk sewer system is estimated to be $27,500,000. This does not include the cost of lateral sewers to serve individual homes which will eventually equal and probably exceed

this figure. In addition sewage treatment facilities at Oswego will have an initial cost of $3,000,000 and will afford primary treatment only. Ultimate completion of the Oswego plant will cost approximately $10,000,000 and will include complete secondary treatment.

Several treatment plants now serve the tri-county area with ten additional systems either proposed or under construction. The eventual completion of the tri-county system would eliminate the need for all treatment plants, including the recently completed Tigard plant, and the proposed West Slope plant. The tri-county plan proposes that any treatment plant constructed in the future be of a temporary nature, lasting only until the tri-county system reaches the affected area. Inexpensive temporary or portable treatment plants used in other states do not meet the requirements of the State Sanitary Authority, and to date only expensive permanent plants are being built.

The principal scope of the tri-county plan embraces five main interceptor sewers with related trunk sewers. The area west of the river would be served by the Fanno Creek and Tryon Creek interceptors, and the area east of the river would be served by the Johnson Creek, Kellogg Creek, and Willamette interceptors.

The Fanno Creek interceptor would serve an ultimate population of approximately 270,000. The areas served would be as follows:

1. The Oswego Lake area.
2. All of Fanno Creek basin north of Durham.
3. The entire west slope of West Hills, including part of Portland adjacent to Vermont Hills, Cambridge Village, Maplewood and the recently annexed Bridlemile area.
4. The area lying between Skyline Boulevard and a proposed trunk which is to extend to a point three miles north of Beaverton.
5. City of Beaverton and environs.
6. An area of five square miles northwest of Beaverton including Cedar Mills, and an area of five square miles west of Beaverton including most of Aloha and Huber.

Total cost of the Fanno Creek interceptor would be $5,343,000 and all necessary trunk sewers and pumping stations would cost an additional $3,525,000. Probably the most unique feature of the Fanno Creek interceptor is the underwater crossing of Oswego Lake. The interceptor would traverse the entire length, being submerged approximately thirty feet at the lower end and about eight feet at the upper end, known as West Bay. Branch mains will enter the main interceptor to be connected to lateral sewers serving the shore areas.

Tryon Creek interceptor would serve an ultimate population of 35,000 and would be relatively minor as to construction costs. The interceptor would cost $238,000 and the accompanying trunk sewers would cost $104,000. Included would be all the area naturally tributary to Tryon Creek basin, including some lands within Portland city limits now obtaining sewer service by pumping at Carson Heights pumping station. Lewis and Clark College is also included as well as the major part of Dunthorpe which, while naturally tributary to the Willamette River, can be diverted to Tryon Creek basin by gravity. A relatively small area in the eastern part of Dunthorpe on the lower slopes and a strip of land adjacent to the Willamette River will need to be pumped into the Tryon Creek interceptor.

The area to be served by the Johnson Creek interceptor is approximately fifty-three square miles lying along both sides of Johnson Creek basin. The ultimate population tributary to this sewer is estimated at 161,000. The interceptor would connect to the Willamette interceptor at a point just south of Milwaukie and traverses a total distance of 22 miles to a point 8 miles east of Gresham. Total cost for the interceptor is estimated at $3,385,000 with an additional $155,000 for a trunk sewer and $35,000 for a pumping station. Neither the City of Gresham, which has an adequate treatment plant, nor the so-called "gravel belt" east of Portland is covered by this interceptor.

The Kellogg Creek interceptor is designed to serve an estimated ultimate population of 97,500 in an area of approximately 15 square miles, including the drainage area of Kellogg Lake, Kellogg Creek, Mount Scott Creek and several smaller creeks extending into the

Happy Valley area. This includes the entire sewage from the City of Milwaukie, portions of the Oak Grove area, areas about Mount Scott, and areas about the town of Clackamas. Total cost for the interceptor is estimated a $636,000 with an additional $704,000 for the trunk sewers.

A short interceptor, the Willamette interceptor, would connect the Johnson Creek and Kellogg Creek interceptors to the proposed Oak Grove pumping station. The Oak Grove pumping station and the Willamette River crossing are considered a part of the Willamette interceptor system as is the trunk sewer system connecting directly to the pumping station and serving an area adjacent to the river below the pumping station including a portion of the Oak Grove and Upper River area. Cost of the interceptor and trunks would be approximately $1,850,000 and the river crossing would be an additional $320,000. Pumping stations, including the Oak Grove station, would be approximately $690,000.

General Financing

There are seven principal financing methods available to cities, counties and sanitary districts, namely:

1. Special benefit assessment.
2. Service charges or sewer rental.
3. Tax revenue bonds.
4. Special tax levy.
5. Private enterprise.
6. Federal and state assistance.
7. Combination plan.

(1) *Special Benefit Assessment.* Practically all lateral and trunk sewers in Oregon have been financed in this manner. The Multnomah Boulevard storm and sanitary sewer system is a good example of a special benefit assessment district financing an entire system. Assessment is based on 50 by 100 lot areas with a full assessment for sanitary, trunk and storm sewers or a partial assessment for trunk and storm sewers. Underdeveloped areas and those with sewers previously installed are assessed only for trunk and storm sewers. The property owner may pay the assessment in full or in 36 monthly installments, or he may pay his assessment under the Bancroft Bonding Act in which event he has ten years to pay the assessment with no additional cost other than interest. Litigation has established that Bancroft bonds are of a general obligation nature, facilitating their marketing. Cities and districts have usually availed themselves of the Bancroft Act, but apparently a question has arisen as to the legality of Bancroft Bonds in the counties. The passage in the last legislature of a bill creating a county bonding authority is hoped to erase this question and give validity to the bonds.

(2) *Service Charges.* In general, service charges are for maintenance purposes after a system is completed or for sewage disposal plant and interceptor construction. These charges are a means only of paying bonds or supplemental security. Usually the charge is a flat rate determined by the water consumption at the premises, with adjustments for users with private water systems or other unusual conditions. A small sanitary district sometimes has difficulty in the collection of service charges because the affected water district will not assume responsibility for this collection. Portland has financed construction of its primary treatment plant and miscellaneous interceptor sewers by means of sewer charges.

(3) *Tax Revenue Bonds.* The West Slope water district is probably the only system in recent years to construct lateral and trunk sewers by means of revenue bonds. After much study the district board proposed financing the entire project by general obligation bonds and eliminating direct assessment. Earlier attempts to finance the system using both general obligation tax revenue bonds and Bancroft Bonds had been rejected by the voters. This final proposal was approved by the voters.

The tax levy at the outset will be between 15 and 17 mills with a gradual decrease as assessed valuation increases. Those first connecting to the sewer system will pay a connection charge of approximately $190 and a service charge of about $2.75 per month. A part of these charges will go toward bond retirement and reduction of the tax levy.

(4) *Special Tax Levy.* Reference has already been made to the ballot measure submitted to Portland voters in November, 1956, to provide funds for the repair or replacement of existing trunk sewers. Since it requires substantial sums even to commence construction of an entire sewage system, such special tax levies for pay-as-you-go plans are of little use.

(5) *Private Enterprise.* Occasionally private capital is used in the construction of sewage works. Sewage disposal systems in the Cedar Hills, Marlene Village and Vermont Hills areas were installed by private developers. Of these projects, only the Cedar Hills system has been free of complaint as to operation. The Marlene Village system has recently been taken over by a sanitary district and the Vermont Hills system has been absorbed by the City of Portland through annexation. Property owners pay a monthly charge from one to two dollars for system maintenance.

(6) *Federal and State Assistance.* The U. S. Public Health Service, acting through the Oregon Sanitary Authority, has recently allocated a total of $647,000 on a community-matching basis for the construction or improvement of sewage treatment plants. Ten cities have been selected with three alternates in case the original ten cities do not qualify. The Authority used a point system to select the most worthy projects in the state. In general, cities which had passed bond issues or had them on the ballot for the improvement of their sewage disposal plants were eligible. State loan funds are available for the purchase of city and district bonds, and the joint legislative interim committee recommends that the legislature supplement existing loan funds and liberalize present requirements as to maturities and interest rates.

(7) *Combination Plan.* The trend toward complex treatment plants has necessitated multiple financing methods in an endeavor to spread the tax base over a wide area. Combination or multiple financing is well represented by the Tigard sewage system. That system was designed to serve approximately 2500 people and was constructed to inter-tie with the Fanno Creek interceptor of the Tri-County Plan. Financing costs are being met by means of $150,000 tax revenue general obligation bond issue, direct assessment and a sewer charge. Tigard has also been recommended for a federal grant of $27,437. The direct assessment is 20 cents per square foot for the first 100 feet from the sewer line, plus a lesser charge for all additional areas behind the 100-foot line that can be feasibly served. Property that cannot be served, such as basements and creek property, are not being directly assessed. Presently, the sewer charges per month are $2.00 for residence and between $3.00 and $25.00 for business users. This sewer charge is subject to review as conditions change.

City of Portland Financing

Prior to the construction of the Portland primary sewage plant, almost all financing had been by means of benefit assessment. The sewage construction then being limited to lateral and trunk sewers with direct discharge into the Willamette River. During the 1930's the Public Works Administration was quite active in the sewer construction field, and the city originally contemplated financing construction by means of a PWA grant. A grant of $2,240,000 was made contingent on the sale of a $6,000,000 sewer charge revenue bond issue. When the voters refused to give this bond issue general obligation status, the PWA withdrew the grant. In 1944 a $12,000,000 general obligation bond issue was approved and in 1952, an additional $2,500,000 issue was authorized, both to be repaid from sewer charge revenues.

In Oregon, sewer contractors are usually paid by means of improvement warrants. Normally, a contractor has no recourse to the city or district for a default on these improvement warrants, and the contractor must file liens against the delinquent property, hoping to collect the benefit assessment. The City of Portland has a redemption fund to pay all delinquent improvement warrants. This permits a sewer contractor to bid lower on City of Portland construction, since the contractor is relieved of the delinquency factor.

Special District Financing

Information on city financing is fairly easy to obtain, but difficulty is experienced in ascertaining the financial structure of existing and proposed sanitary districts. The only central source of information is the State Treasurer, to whom ORS 294.420 requires that copies of district budgets be sent. However only those districts levying property taxes are covered by this requirement and even these districts comply less than 100%. Within statutory limitation the sanitary districts enjoy fiscal independence, and they can raise revenue by taxes, assessments or charges. They may issue general obligation and revenue bonds up to 13% of actual value of all taxable property. Also, there is no statutory limit for ad valorem taxes in these districts. Of the ten sanitary districts currently active in the Portland area, only one has actually built a community sewer system, but three have systems under construction. The other districts are either too recently organized to have begun operations or are inactive because of rejection of proposed bond issues.

County Financing

County activity in the sewage disposal field was first authorized by the 1955 legislature. Two types of county activity are authorized. Counties may, singly or co-operatively, prepare and enforce master plans for sewage disposal facilities. They may also build and maintain local sewage collection systems, trunks and laterals, and sewage treatment plants, which may be financed by assessments, charges, and bonds in the benefitted areas. Prior to the 1957 legislature, the county could issue bonds only for roads and bridges. Multnomah County is, so far, the only county to initiate a project for the actual construction of a local sewer system. A sanitary engineer has been added to the permanent county staff, and bids have been invited on a sewer project in the Brookford area west of Portland. County activity in the sewage field has been greatly increased, due to the sewage master plan initiated by Multnomah, Clackamas and Washington counties, referred to as the "Tri-County" plan.

Tri-County Plan Financing

A revolving fund for county sewer construction was authorized by the 1955 legislature coincidental with the authorization of the tri-county plan. The fund could be derived from a 2-mill levy on all assessed property within the unincorporated area of the county to be directly benefitted by the tri-county plan, and with a levy not to exceed 5 years, but this has never been assessed. Your committee could find very little information on this revolving fund, but apparently the tri-county metropolitan sanitary committee, the administrative agency for the tri-county plan, is not anxious to use this ready-made financing plan. At present, the tri-county committee is attempting to purchase a site for the Oswego Treatment Plant, with financing derived from the general funds of the counties.

Your committee has interviewed several financial authorities, hoping they could offer a method of financing the tri-county plan. However, the consensus seems to indicate that the tri-county plan could not be financed at the present time, by the revolving plan or any other plan. Because of greater ease in financing in the city, these authorities seemed to prefer gradual annexation to the City of Portland for the affected areas, utilizing district treatment plants in the interim. Operation of the tri-county plan as a private enterprise has also been suggested, but your committee has been unable to interview anyone with concrete knowledge as to this type of operation.

STORM DRAINAGE

Your committee did not investigate extensively the problems of storm drainage, but was informed by various persons interviewed that except for isolated locations and except where storm drainage may overload existing joint sanitary and storm drainage systems, the problems of storm drainage are not acute.

Before the advent of sewage treatment plants, it was the policy to build combined sanitary and storm drainage systems. However, if sewage is to be treated, the plant capacity

required to meet the peak demands in times of maximum storm drainage makes it unfeasible to collect and pass storm drainage together with the sewage. Accordingly, it is now the general policy to build separate storm and sanitary sewer systems.

Much of the sewage disposal system of the City of Portland was constructed before treatment plants existed, and consequently, much of the system exists as a combined sanitary and storm drainage system. Portland's disposal plant is unable to handle the peak load occasioned by a heavy rainfall and provision is made to by-pass excessive amounts of sewage directly into the Willamette River.

As new sewer systems are installed in the City of Portland, the storm and sanitary systems are separated. The storm drainage may be diverted to a natural water course, if that is convenient, or may be passed to underground sumps to be dispersed by percolation into the surrounding soil and gravel. The City of Portland has through its building codes adequate control to assure that suitable storm drainage systems will be installed in new subdivisions.

In suburban Multnomah County, no storm drainage control existed until passage recently of zoning regulations. Consequently, there are isolated areas in Multnomah County in which trouble arises during periods of heavy precipitation because of inadequate storm drainage. However, the present subdivision regulations in force in Multnomah County permit county officials to withhold building permits if adequate storm drainage is not provided in the proposed subdivision.

In Washington County, such control does not exist and building may not be restricted even though adequate storm drainage will not be provided by a subdivision developer. County officials are hopeful that this condition will be rectified in the near future with installation of suitable zoning regulations.

SUMMATION

On the basis of the information made available to your committee, several facts and conclusions become immediately obvious. Health hazards inherent in raw sewage and untreated effluent present a real danger to persons living in areas not served by adequate sewage systems. Over a large portion of the area, soil conditions preclude the absorption of sewage or waste effluents. The population of the Portland Metropolitan area over the past 25 years has nearly doubled. The installation of adequate systems to eliminate such dangers is sometimes costly, but that is the price that man must pay for being politically, socially and industrially gregarious. Nevertheless, there appears to be a great reluctance upon the part of both the elected officials and citizens of this area to pay the necessary price until forced to do so by extreme circumstances.

Considering first the City of Portland, the relatively new sewage disposal plant and interceptor system now nearing completion have gone a long way toward giving Portland an adequate sewage system. Nevertheless, enlargement and refurbishment of the sewer system has not kept pace with increasing demands. As a result, the sewer system of Portland is overloaded and in disrepair in many sections. City officials, while suggesting from time to time that repair and rebuilding is necessary, have not pressed for the necessary funds with the vigor your committee believes the situation deserves.

In the suburban areas, the handling of the sewage problem has been rather haphazard. Action to provide community sewage systems has generally been taken only under duress. Even so, the systems installed have, in some instances, proved inadequate and in others, their operation appears to be improperly controlled. The adoption of the Tri-County Plan with its potential for providing an adequate overall system is to be commended. While the Tri-County plan presents solution to the engineering problems, it must be observed that no suitable method of financing the plan has yet been found. It is to the credit of the county authorities, however, that all new systems and disposal plants in the area are required to be designed so that the systems may eventually be connected to the master collection system of the Tri-County Plan and thus eliminate discharge of waste effluents into the small streams of the area.

The State Sanitary Authority has been a forceful instrument in molding the progress made to date. Its recent orders directed to the City of Portland and various surrounding

communities to abate the pollution they still are causing are to be applauded. It is apparent, however, that the Authority does not have a sufficiently large staff to make the progress desired in abating pollution.

The sewage situation in the Portland Metropolitan Area is critical. It is therefore urgent to activate the Tri-County Plan and renovate the Portland sewage system in order to correct a present and increasing danger to health, to continue orderly growth and to protect natural watercourses in the area.

RECOMMENDATIONS

It is recommended, therefore, that:

1. The Tri-County Sanitary Committee, Multnomah, Clackamas and Washington Counties, engage competent legal and financial assistance to study and recommend methods of financing the Tri-County Plan, together with such legislation as may be necessary.
2. The City Council develop and publish a comprehensive plan for the improvement of the city sewage system, prepare a long-range program for financing such improvements, and inaugurate a strong educational program sufficiently in advance of placing a measure on the ballot to acquaint the voters of its need.

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* Deceased February 1958.