Report

District of Summerland

Waste Management Plan Stage 1

May 1988

ASSOCIATED ENGINEERING

ASSOCIATED
ENGINEERING (B.C.) LTD.

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May 3, 1988
File: VD92

The Corporation of the District
of Summerland
P.O. Box 159
SUMMERLAND, B.C.
VOH 1Z0

Attention: George Redlich
Administrator

Dear Sirs:

Re: Waste Management Plan
Stage I Report

We are pleased to submit fifteen (15) copies of our report entitled, Waste Management Plan, Stage I, May 1988. An additional ten (10) copies have been forwarded directly to Mr. P.F. Epp, P.Ag., Ministry of Environment and Parks.

We have also enclosed thirty (30) copies of the Executive Summary for distribution to interested members of the public.

It has been a pleasure working with district and ministry staff on Stage 1. We look forward to your continuing contribution on Stage II of the Waste Management Plan.

Respectfully submitted,

ASSOCIATED ENGINEERING (B.C.) LTD.

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — J. R. E. CORBETT

J.R.E. Corbett, M.A.Sc., P.Eng.
Project Manager

JREC/lp/Re.1

Enclosures

cc: P.F. Epp, P.Ag. - Ministry of Environment and Parks

EXECUTIVE SUMMARY

Wastewater management throughout the district is by on-site disposal. The present (1985) phosphorus loading to Okanagan Lake from domestic wastewater disposal is 1840 kg/yr. This represents an overall phosphorus reduction through on-site treatment of 81%. The goal of the Provincial Government is to achieve a 95% phosphorus removal rate in domestic wastewater discharges to the receiving environment. Clearly then there is need for some improvement in wastewater disposal if the overall goal of the Okanagan Basin is to be achieved.

The combination of high-density on-site disposal and agricultural fertilizer use has caused increasing nitrate levels in the groundwater in the area east of the Town Centre as documented by historical monitoring of Shaughnessy Spring in the Lower Town area. Although, nitrogen is not considered to be a limiting nutrient for algae growth in the main body of Okanagan Lake, continuing increases in the nitrate concentration of the groundwater may cause problems with the fish hatchery that utilizes the spring water.

The use of on-site disposal is limiting development in the Town Centre, Lower Trout Creek, and Lower Town areas. Construction of a community disposal system would allow increased development densities in these areas.

The following areas have been identified as environmentally sensitive in terms of wastewater disposal due to high phosphorus transmission rates to surface waters and/or high density of development. Upgrading options for these areas will be evaluated in Stage II.

.1 Lower/Upper Trout Creek
.2 Town Centre
.3 Lower Town/Peach Orchard Road
.4 Crescent Beach
.5 Garnett Valley

The following areas, although not exhibiting problems at the present time due to the limited development, could become problem areas if development utilizing on-site wastewater disposal is not controlled:

.1 Front Bench
.2 Prairie Valley
.3 Cartwright Mountain

Recommendations will be presented in Stage II regarding development controls and densities for the above areas.

In addition to the identification of environmentally sensitive areas within the district, the Stage I of the WMP presented and evaluated wastewater collection, treatment, and disposal techniques that could be considered for wastewater disposal improvement. The techniques that will be investigated in Stage II for each of the selected areas are summarized in the following table.

SUMMARY OF WASTEWATER MANAGEMENT UPGRADING TECHNIQUES

TECHNIQUE	SELECTED FOR FURTHER INVESTIGATION IN STAGE II				
	LOWER/UPPER TROUT CREEK	TOWN CENTRE	LOWER TOWN/ PEACH ORCHARD RD.	CRESCENT BEACH	GARNETT VALLEY
1.0 ON-SITE DISPOSAL					
. Modification for Enhanced Nutrient Removal	Yes	No[1]	Yes	Yes	Yes
2.0 COLLECTION					
. Conventional Gravity Sewers	Yes	Yes	Yes	Yes	No[2]
. Pressure Sewers	Yes	No[3]	Yes	Yes	No[2]
. Vacuum Sewers	No[4]	No[4]	No[4]	No[4]	No[2]
. Small Diameter Gravity Sewers	Yes	No[3]	Yes	Yes	No[2]
3.0 TREATMENT					
. Preliminary Treatment	No[5]	No[5]	No[5]	No[5]	No[2]
. Primary Treatment (Community Septic Tank)	Yes	Yes	Yes	Yes	No[2]
. Biological Treatment					
- Fixed Growth Systems	Yes	Yes	Yes	Yes	No[2]
- Suspended Growth Systems	Yes	Yes	Yes	Yes	No[2]
. Phosphorus Removal					
- Chemical Precipitation	Yes[6]	Yes[6]	Yes[6]	Yes[6]	No[2]
- Luxury Uptake, i.e., Bardenpho	Yes[6]	Yes[6]	Yes[6]	Yes[6]	No[2]
. Nitrogen Removal					
- Nitrification/ Denitrification	Yes[6]	Yes[6]	Yes[6]	Yes[6]	No[2]
- Ion-exchange	No[7]	No[7]	No[7]	No[7]	No[2]
- Air-stripping	No[7]	No[7]	No[7]	No[7]	No[2]
- Breakpoint Chlorination	No[7]	No[7]	No[7]	No[7]	No[2]
. Nutrient Removal by Polishing Ponds	No[8]	No[8]	No[8]	No[8]	No[2]
. Disinfection	Yes	Yes	Yes	Yes	No[2]
4.0 DISPOSAL					
. Subsurface Fields	Yes	No[1]	Yes	Yes	No[2]
. Rapid Infiltration	Yes	Yes	Yes	Yes	No[2]
. Effluent Irrigation	Yes	Yes	Yes	Yes	No[2]
. Overland Flow	No[9]	No[9]	No[9]	No[9]	No[2]
. Conversion to Snow	No[10]	No[10]	No[10]	No[10]	No[2]
. Okanagan Lake	Yes	Yes	Yes	Yes	No[2]
5.0 REGIONAL SEWERAGE SYSTEM	Yes	Yes	Yes	Yes	Yes

NOTES

1 Insufficient area for tile fields in commercial area.

2 Density of development is too low for a community collection, treatment, and disposal system.

3 High density of development in the commercial area favours the use of conventional gravity sewers.

4 Vacuum sewers are rejected due to high cost and complexity.

5 Does not provide a sufficient degree of treatment by itself.

6 With disposal to Okanagan Lake.

7 Rejected due to operational problems and/or high cost.

8 Rejected due to inconsistent cold weather performance.

9 Rejected due to the need for winter storage and difficulty with tailwater disposal.

10 Rejected due to inconsistent performance and lack of suitable climate/ disposal area.

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LIST OF ABBREVIATIONS

BOD	Biochemical Oxygen Demand
ha	hectare
km	kilometer
kg/yr	kilograms per year
mm	millimetre
m	metre
mg/L	milligrams per litre
P	Phosphorus
SDG	Small Diameter Gravity
STEP	Septic Tank Effluent Pumping
WMP	Waste Management Plan

ASSOCIATED ENGINEERING

1.0 INTRODUCTION

1.1 WASTEWATER MANAGEMENT PLAN OBJECTIVES

The District of Summerland, a farming and residential community of some 8,000 persons, is located in the Okanagan Valley of British Columbia (Figure 1-1).

Wastewater management throughout the district is by on-site disposal utilizing primarily septic tanks and tile fields.

The Okanagan Basin Study in the early 1970's and subsequent updates have identified residential septic tanks/tile fields as a significant phosphorus source in areas where a combination of permeable soils, shallow depth to groundwater, and close horizontal proximity to surface waters allow high phosphorus transmission rates.

The Waste Management Act, introducted in 1982 as a replacement for the Pollution Control Act, introduces the concept of the Waste Management Plan (WMP). A WMP contains provisions or requirements for collection, treatment, handling, storage, utilization and disposal of wastewater or solid waste within the whole or a specified part of a municipality or regional district. Once approved by the Ministries of Environment and Parks and Municipal Affairs, a municipality or regional district is authorized to discharge waste in accordance with the plan.

A streamlined, cooperative process has been established by the ministries to provide for efficient development, review and approval of WMP's. Technical staff of both ministries are intended to work with local officials and their consultants throughout this process. An evaluation committee of senior staff from both ministries has been established to oversee the implementation of this process.

Associated Engineering (B.C.) Ltd. has been engaged by the District of Summerland to assist in the preparation of a WMP.

The WMP will lay the groundwork for wastewater management in the District of Summerland for the next 20 to 40 years. There is a need to consider wastewater being discharged to existing "septic systems" servicing households, multi-family developments, commercial and industrial establishments, campgrounds, etc. throughout the area, and future wastewater disposal needs. The Waste Management Plan would specifically apply to the entire District of Summerland.

The objectives of the WMP are:

- To identify and review the wastewater management alternatives that are capable of adequately removing phosphorus and that are technically available to existing and potential development in Summerland and to select the technically feasible alternatives for detailed analysis.

- To develop discharge criteria for those technically feasible wastewater management options that involve discharge of sewage treatment plant effluent to surface waters or to land.

- To evaluate the capital and operating costs of these technically feasible wastewater management options, both from an overall cost point of view and on a cost per user per annum basis under alternate funding and cost-sharing formulas.

- To evaluate the environmental, social, public health, engineering, operational and financial advantages and disadvantages of technically feasible wastewater management options.

- To select the most appropriate wastewater management option or mix of options that can be economically achieved and which can be implemented in phases to meet short and long-term environmental goals.

The WMP will be prepared in three stages:

Stage I will outline possible treatment and disposal methods with rough preliminary costs, including ideas received at the first public information meetings.

Stage II will outline the various options with an implementation schedule. The various options will be costed out in detail to give some appreciation of short and long range user costs. The Stage II draft will be presented at a final public information meeting where further public input will be solicited.

Stage III will be a short overview report or executive summary which gives a recommended course of action.

1.2 WASTEWATER MANAGEMENT HISTORY

Wastewater management within the District of Summerland has historically been by on-site systems.

The town centre area (Fig. 1-2) which supports the majority of the residential and commercial development is located on a sand/gravel outwash deposit. This soil type offers a very high hydraulic conductivity allowing high density development without apparent problems. The core commercial area has been developed utilizing septic tanks and "dry" pits. Ths system requires very little surface area allowing the building to occupy virtually the entire lot area.

The lower town area, adjacent to Okanagan Lake, is a second area of historical residential development and at one time supported a significant industrial and commercial activity. Disposal in this area has been by on-site systems utilizing primarily septic tanks and tile fields or "dry" wells. Due to a range in soil types from outwash sand/gravel to lacustrine silts, on-site disposal has not always been successful. Poorly treated discharges from former fruit canning plants caused problems with lakeshore pollution (1)*. A dye study of a number of residential systems in the mid 1970's by the Ministry of Health also discovered several direct discharges to the lake (1). This situation has been improved by the reconstruction of disposal facilties and the implementation of holding tanks on some residences.

The Trout Creek area, originally primarily agricultural, was also developed using on-side disposal techniques. In the early 1970's, concern regarding increasing development in areas of high groundwater and permeable sand/gravel alluvial soils led to the commissioning of a sewerage study in 1973. The report prepared by Associated Engineering Services Ltd. compared a number of options including lake disposal, land disposal, and pumping to Penticton for both the areas of Lower Town and Trout Creek (2). The costs of the feasible schemes ranged from $1.75 million to $4.00 million in 1973 dollars. Due to the high cost, community treatment and disposal were not pursued.

The remainder of the district is primarily rural or rural residential in nature. With the exception of bedrock areas on the mountain sides and the lacustrine silt cliffs above Okanagan Lake, conditions are generally favourable for on-site wastewater disposal and have not posed an impediment to low density development.

Within the District, a number of Waste Management Branch Permits have been issued for wastewater disposal for larger high density residential, commercial, or industrial developments. These are summarized on Appendix A. With the exception of the fish hatchery in Lower Town that discharges hatchery effluent via an outfall to the lake, disposal is exclusively by small scale effluent irrigation or exfiltration using tile fields or "dry" pits.

In looking ahead over the next several decades, the question that must be addressed is whether on-site disposal with its inherent limitation on development densities and potential for transmission of phosphorus to Okanagan Lake should continue or are other wastewater management systems more appropriate.

1.3 METHODOLOGY

The methodology adopted for the preparation of the WMP is as follows:

.1 Identify areas that contribute a significant phosphorus transmission to Okanagan Lake based on Ministry of the Environment mapping or areas where current methods of wastewater disposal may cause elevated groundwater nitrate levels, environmental or health problems, or inhibit planned growth.

.2 Evaluate the impact of continued on-site wastewater disposal in the above areas in light of expected growth over the next 20 years.

.3 Determine wastewater management techniques applicable to the above area and estimate order-of-magnitude costs.

.4 Hold a technical workshop and public information meeting to solicit response from the government agencies and the public on the perception of wastewater management problems, the desire to spend funds to improve the situation if required, and input into preferred wastewater management techniques and land use changes.

.5 Prepare the Stage I report.

.6 Formulate a series of wastewater management options for the areas identified above and prepare a draft Stage II report.

.7 Hold a technical workshop and public information meeting to present the above options and obtain input from the government agencies and the public as to the preferred options.

.8 Finalize the Stage II report.

.9 Prepare the Stage III report.

1.4 PUBLIC PARTICIPATION

The key to successful waste management planning in public participation during the preparation of the WMP.

Over the next several decades, growth and the type of development within the community will depend to a large extent on waste management decisions. The continued use of on-site systems or the construction of a community system allowing higher density development will have a direct bearing on the future of the community.

Input from the public will be solicited at a number of occasions during the development of the WMP.

These include:

.1 Questionnaire to property owners in the core area of Town Centre to determine current practices and the desire for a community sewer system.

.2 Public information meeting and questionnaire during Stage I.

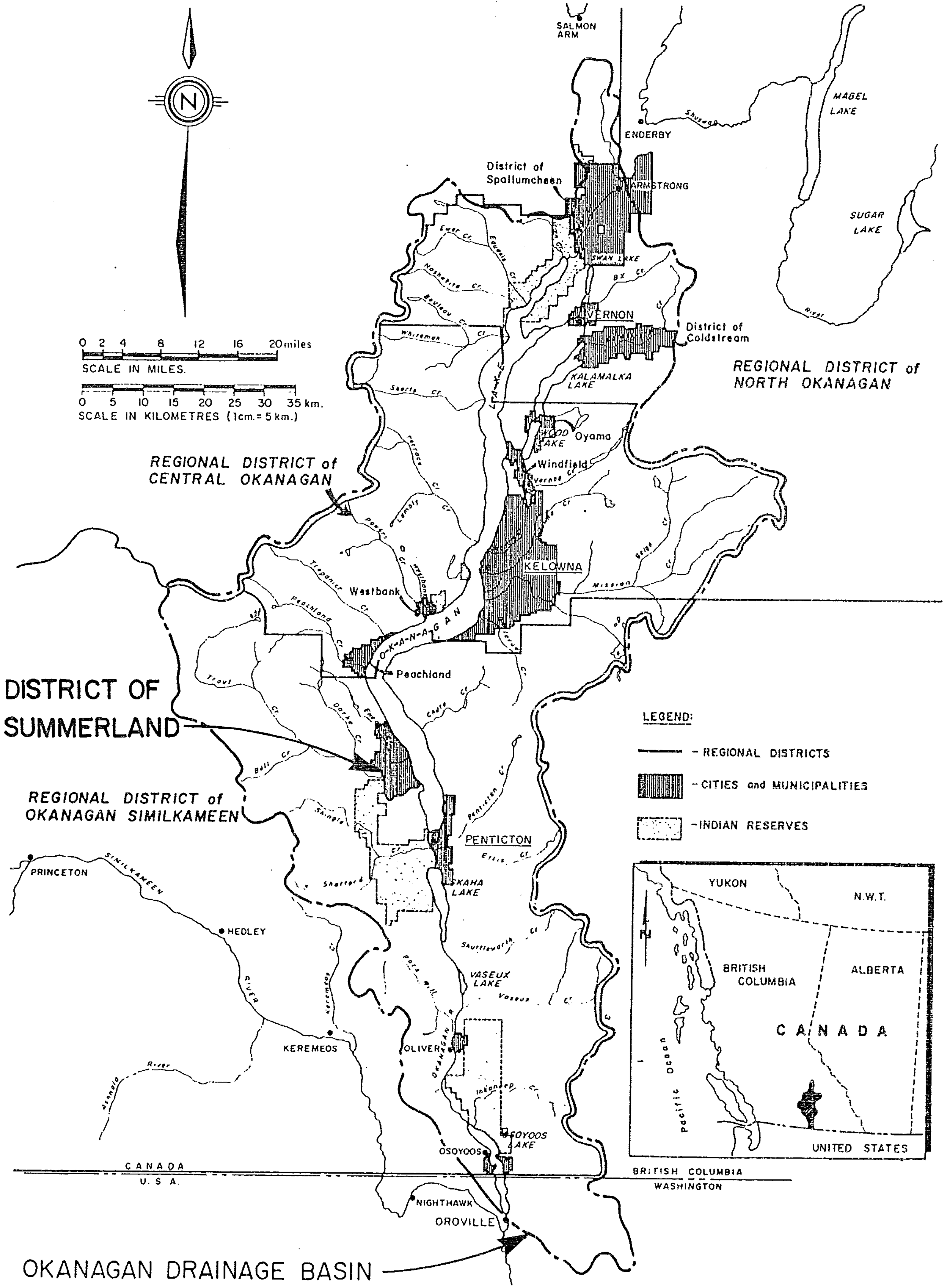
.3 Public information meeting and questionnaire during Stage II.

.4 A response to written comments submitted by the public in the Stage II report.

.5 Public availability of all final reports at each stage and the opportunity throughout the preparation of the WMP to discuss concern and approaches with District of Summerland and Ministry of the Environment personnel.

1.5 ESTIMATED COSTS

All costs presented in the WMP are based on 1988 dollars. This reflects an Engineering News Record (ENR) Index of 4500. The costs include a 25% engineering and contingency allowance unless otherwise indicated.



LOCATION PLAN

FIG. 1-1

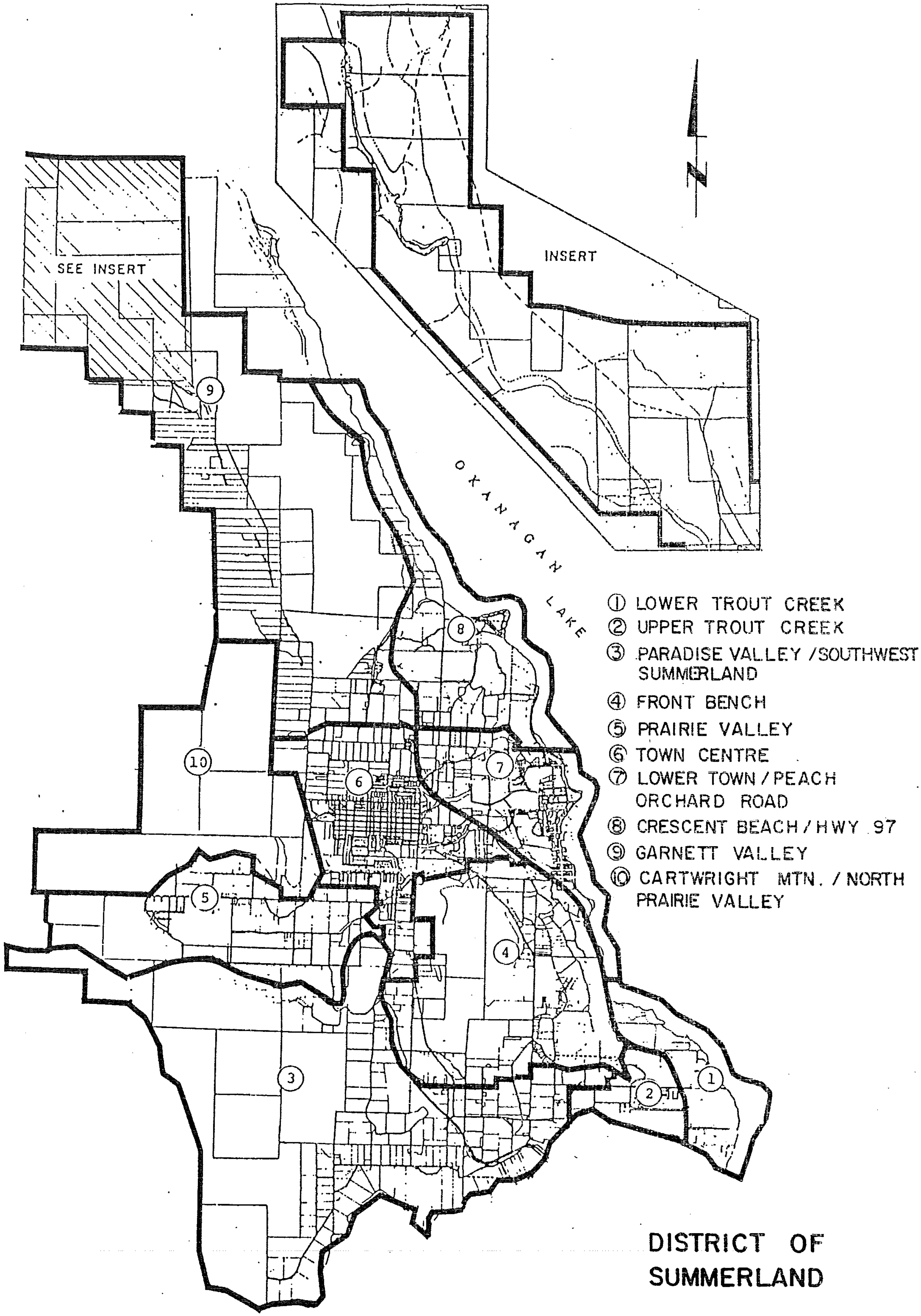

SEE INSERT
INSERT
OKANAGAN LAKE
① LOWER TROUT CREEK
② UPPER TROUT CREEK
③ PARADISE VALLEY /SOUTHWEST SUMMERLAND
④ FRONT BENCH
⑤ PRAIRIE VALLEY
⑥ TOWN CENTRE
⑦ LOWER TOWN / PEACH ORCHARD ROAD
⑧ CRESCENT BEACH / HWY 97
⑨ GARNETT VALLEY
⑩ CARTWRIGHT MTN. / NORTH PRAIRIE VALLEY
N
DISTRICT OF SUMMERLAND

FIG. 1-2

2.0 IDENTIFICATION OF ENVIRONMENTALLY SENSITIVE AREAS

2.1 GENERAL DESCRIPTION

The District of Summerland encompasses some 56 square kilometers. The community is semi-rural in nature with the historic economy based on orchard production. In recent years however, the district has experienced increased residential growth attracting retired persons from elsewhere in British Columbia and Canada and persons with employment in Penticton who prefer the more rural lifestyle.

The 1985 population of the district was about 7,770 persons. Of this total, approximately 3,600 persons live within the Town Centre area with the remainder scattered throughout the district in residential clusters or in rural residential areas.

The climate is marked by mild winters and moderately warm summers. The average January and July temperatures are -4°C and 21°C, respectively. The annual average precipitation is 300 mm.

The district is divided into two distinct topographical areas. The Lower Town and Trout Creek are located on the shore of Okanagan Lake at an elevation of between 343 m and 365 m. These areas are divided from the remainder of the district by high lacustrine silt cliffs. The Town Centre and Prairie Valley areas are located on the bench land above the lake at an elevation ranging from 425 m to 580 m. The northern and western areas of the district rise steeply to elevations of over 900 m. A large bedrock outcropping, known as the Giants Head, rises 350 m from the benchland south of the Town Centre providing a unique viewpoint for the Okanagan Lake valley.

A description of land use activity within the district is presented below.

2.1.1 Residential Development

The study area encompasses the entire District of Summerland.

For the purpose of analysis, the district is divided into the ten sectors utilized in the Community Plan (3). These areas are described briefly below and shown in Figure 1-2.

.1 Lower Trout Creek

This area is designated as a mixture of low density residential, rural residential, and farm land on the community plan. The 1985 and expected 1996 population are 555 and 601 persons.

.2 Upper Trout Creek

The majority of this area is farmland dedicated to orchard production. The population is actually forecast to decrease from 214 persons to 208 persons between 1985 and 1996.

.3 Paradise Valley/Southwest Summerland

This area, north of Trout Creek and southwest of Giant Head Park, is designated primarily an openland and farm land, with some rural residential and low density residential. Population is forecast to increase from 405 persons to 637 persons from 1985 to 1996 by development in the Victoria Road South and Canyon View/Paradise Valley areas.

.4 Front Bench

The Front Bench area, lying east of Giant Head Park and west of Highway 97 is expected to see significant development in the next decade. The population is forecast to increse from 778 persons to 1653 persons between 1985 and 1996. The majority of this increase is expected through single family (R-1) and country residential development (R-6) in the Front Bench development area.

.5 Prairie Valley

The majority of this area is farmland and rural residential. A limited growth of from 400 persons to 485 persons is projected between 1985 and 1996.

.6 Town Centre

This area west of Highway 97 and east of Cartwright Mountain supports the majority of higher density residential and commercial development. The 1985 to 1996 population is forecast to increse from 3,600 to 3,940 persons, or about 9%. The majority of this increase will be as single and multi-family residential development.

.7 Lower Town/Peach Orchard Road

The Lower Town portion of this section is located between the lacustrine silt cliffs and Okanagan Lake. The area contains a mixture of zoning including single family, country residential and tourist-commercial.

The Peach Orchard Road area above the silt cliffs and east of Highway 97 is composed of single family residential, light industrial, and farmland.

Wastewater disposal, particularly in the Lower Town, presents a contraint on future growth. Based on continued on-site disposal, the population is forecast to increase only 3.4% from 970 persons to 1003 persons between 1985 and 1996.

.8 Crescent Beach/Highway 97

This area, consisting of a mixture of farmland and residential development, is expected to see a significant increase in population between 1985 and 1996 through increased single, multi-family, and mobile home development in the Sumac-Noble Park area. The population over this period is forecast to increase from 480 persons to 682 persons.

.9 Garnett Valley

This sector is generally designated farmland and rural residential. Although long term residential development of Rattlesnake Mountain and the northern portion of Garnett Valley has been suggested, the expected growth between 1985 and 1996 is forecast to actually decrease from 345 persons to 340 persons due to an average decrease in dwelling unit occupancy.

.10 Cartwright Mountain/North Prairie Valley

Limited residential development currently exists in this area. Although future rural residential and single family development near the town Centre has been proposed, development is expected to be limited over the next decade due to high servicing costs. The expected population growth is from 23 persons to 94 persons between 1985 and 1996, occuring primarily on existing single family lots.

2.1.2 Agricultural, Commercial and Industrial Activity

Substantial agricultural land exists within the district. The primary activity is fruit and grape growing on small, irrigated parcels. Non-irrigated agricultural land at higher elevations is generally devoted to grazing.

Commercial activity is centered in the Town Centre. With the short travel distances to the larger urban areas of Penticton and Kelowna, an increse in commercial activity is not forecast and a surplus of commercially zoned land is available (3).

Industrial activity within the district is limited with the majority of the activity centered around fruit processing. At the present time, a surplus of industrial land is available. The establishment of industrial activities which produce large quantities of wastewater is hampered by the lack of a community sewer system.

2.1.3 Water Supply

The District of Summerland water system is a combined irrigation and domestic system supplying the majority of the residential within the District.

The main supply is Trout Creek with an intake located at about elev. 622. From the intake, water is transported by pipe in the winter and flume during the irrigation season to a balancing reservoir at elev. 595. At this point the water is chlorinated and distributed via a piped system. Summer time flows in the creek are augmented by the release of stored water in Headwater Lakes.

A second supply source is Garnett Lake. Water from this reservoir is piped down the Eneas Creek valley to the main distribution system.

Maximum day demand during the irrigation season is in the order of 159,000 m^3/d. Domestic use accounts for about 15% of the annual water use (4).

Concern has recently been expressed about a shortage of water under prolonged drought conditions. The alternatives of increasing Headwater Lakes storage or supplementing the current supply with Okanagan Lake water have been considered by the District with the former being favoured (5).

2.2 PHOSPHORUS TRANSMISSION

2.2.1 Okanagan Lake

Water quality in the Okanagan mainstream lakes is a major factor in terms of domestic water supply, recreation, and fisheries. The primary water quality concern is phosphorus inputs into the lakes. Phosphorus is the key nutrient controlling the amount of algae. Algae growth directly determines important aspects such as water clarity, aesthetic attractiveness, recreational suitability, the degree of domestic water treatment, and aspects of fisheries production and habitat suitability (6).

A number of comprehensive studies have been carried out on the water resources of the Okanagan (6, 7, 8). Okanagan Lake can be divided into five distinct areas due to geography and bathymetry: Armstrong Arm, Vernon Arm, North Basin, Central Basin, and South Basin. The District of Summerland is located adjacent to the South Basin, defined as the portion of lake from the Kelowna highway bridge to Penticton.

This portion of the lake is described as oligotropic with measured total phosphorus values of from 0.007 to 0.010 mg/L (6). Phosphorus is recognized to be the only limiting nutrient and an objective concentration of 0.010 mg/L has been established (6).

A summary of overall phosphorus loading to the lake is presented in Table 2-1.

2.2.2 On-Site Disposal Systems

On site wastewater disposal systems, often referred to as simply "septic tanks", contribute a significant portion of the total phosphorus to the Okanagan Valley Lakes. It is estimated that on site systems contribute 30% of the controllable phosphorus input to Okanagan Lake (6).

The 1985 Ministry of Environment report entitled, "Phosphorus in the Okanagan Valley Lakes: Sources, Water Quality, Objectives and Control Possibilities" (6), investigated phosphorus transmission from on site disposal systems whithin the Okanagan Basin. The report concluded that 73% of the existing systems achieved 95% plus phosphorus removal due to their favourable location and soil type. Of the remaining 27% of the total systems, 25% were estimated to achieve only between 0 and 55% phosphorus removal efficiency.

In the above report, Summerland, including Trout Creek, were cited as significant phosphorus contributors to the lake.

2.2.3 Phosphorus Mapping

The Ministry of Environment has recently completed a series of maps showing estimated phosphorus transmission from septic tanks for various areas of the Okanagan Basin (28). The mapping has been derived from soil survey information, groundwater data, and horizontal distance to surface water. The soil characteristics evaluated in the vertical tranport model include texture, depth to water table, depth to bedrock, depth to other restricting layers, soil coarse fragment content, and pH.

Phosphorous loading calculations are based on a phosphorus contribution of 3.2 kg/yr per dwelling unit. Dwelling units based on 1985 air photos were tabulated for each soil sector and phosphorus inputs calculated based on percentage transmission classes shown in Table 2-2. Comparison of phosphorus removal performance for Summerland with the above data for the Okanagan in general is presented in Table 2-3.

This mapping represents a significant advance in the data base available for environmental impact analysis of on site wastewater management systems in the Okanagan Basin and forms the basis for determination of environmentally sensitive areas within the District of Summerland.

2.3 NITROGEN TRANSMISSION

Nitrogen is the second major nutrient required for biological production. Nitrogen can enter surface water courses from agricultural area runoff, municipal wastewater, seepage from septic tanks, stormwater flows, and natural sources. Certain aquatic organisms can also utilize nitrogen directly from the atmosphere.

The ratio of the concentration of total nitrogen to total phosphorus (N:P) can indicate which of these nutrients is the limiting factor in algae production. Ratios greater than 10 or 12:1 generally indicate a phosphorus limited system, whereas ratios of less than 5:1 indicate nitrogen limitation (6). Limnological studies have indicated that in Okanagan Lake, phosphorus is the limiting nutrient in the main body as the ratio is generally always above 12:1 (6).

Nitrogen, however, is a concern in respect to groundwater. Within the district, the two major sources of nitrogen to the groundwater are on-site disposal and agricultural fertilizer. Domestic wastewater typically contains 30 to 40 mg/L of nitrogen, of which 20 to 25 mg/L is in the form of ammonium ion and 10 to 15 mg/L is in the organic form. The nitrogen is generally initially retained in the upper soil layers. In unsaturated, coarse soils, the ammonium and organic nitrogen is almost completely nitrified to the nitrate form in a short period of time. The nitrate ion is highly mobile in the soil strata and generally reaches the groundwater with little effective removal. In finer-grained soil, ammonium is readily sorbed into clay and organic colloids in the soil, effectively increasing the nitrogen removal capacity.

Agricultural fertilizer is also initially retained in the upper soil layers where it is utilized by the crops or trees. Precipitation and excess irrigation water, however, can leach out the nitrogen from the surface soil and carry it down to the groundwater table.

The concentration of nitrate in the groundwater from the above two sources depends upon the dilution provided by groundwater flow and the qualtiy of surface water recharging the groundwater. A nitrate level of 10 mg/L as nitrogen has been set as a recommended maximum drinking water concentration for British Columbia (25).

The Ministry of Environment and Parks has previously studied the impact of nitrate levels in the groundwater in Summerland as a result of increasing nitrate levels in Shaughnessy Spring that feeds the fish hatchery (24). Nitrate levels in the spring have increased from 0.82 mg/L in 1951 to 7.1 mg/L in 1984. The increase is believed due to nitrogen from on-site disposal and fertilizer application, each contributing about 4400 kg/year. Although a nitrate criterion level of 40 mg/L has been established for the protection of freshwater aquatic life, an "alert" level of 13 mg/L has been proposed for the hatchery water. It is estimated that this level could be reached in two to three decades (24).

In summary, on-site wastewater disposal and current agricultural practices are producing elevated nitrate levels in the groundwater primarily as a result of the coarse textured soils. As a significant portion of the nitrate is estimated to come from fertilizer application, the elimination of on-site disposal alone may not result in a reduction to historic nitrate levels. Given this situation and the likelihood that agriculture will continue as a major land use, the impact of on-site disposal on the groundwater resource must be considered in light of the benefits achievable by other wastewater management alternatives.

This is discussed further in Stage II of the WMP.

2.4 EXISTING SITUATION

2.4.1 Overview

Environmental problems with on-site wastewater management within the District of Summerland can arise from three situations.

.1 Permeable soils which allow a high phosphorus transmission to surface water.

.2 Impermeable soils or bedrock which limit hydraulic conductivity.

.3 High density development which limits the area available for system installation.

The first situation is the most prevalent in the district and presents the most concern. In comparing the Summerland situation with the Okanagan in general (Table 2-3), it can be seen that the generally coarser soils in Summerland result in septic tank-tile field phosphorus removal performance falling in the middle range (50% to 95%) when compared to the more heterogeneous soils of the Okanagan.

The second situation is not a significant problem in the district due to the generally sand/gravel soils. Exceptions to this, however, include shallow bedrock areas on the mountain slopes, the lacustrine silt deposits along the bench, and alluvial floodplain soil in areas of Prairie Valley.

The third situation reflects the commercial core area of the Town Centre. In this area, the ratio of building to lot area is such that sufficient area is not available to install conventional tile fields and alternate systems have been used.

The present (1985) estimated phosphorus transmission to Okanagan Lake from the total population of the district is estimated at 1836 kg/yr. Based on a population of 7,770 persons and a phosphorus production of 1.28 kg/yr/person, the estimated phosphorus loading to the lake represents 19% of the phosphorus generated or an effective removal rate of 81%.

To put the above value in perspective, a community collection, treatment, and disposal system utilizing state of the art advanced treatment processes with an outfall to Okanagan Lake could achieve up to 95% phosphorus removal. A well operated effluent irrigation system can produce phosphorus removals of 95 to near 100%. The goal in wastewater management in the Okanagan Basin is to achieve a minimum of 95% phosphorus removal from all surface water discharges (23). It is apparent that the overall waste management situation in Summerland should be improved to achieve, as closely as possible, the overall basin goal.

The environmental impact of individual areas within the district is discussed below. The phosphorus analysis parameters used is presented in Table 2-4. Table 2-5 summarizes the WMP plan areas and presents a breakdown of estimated phosphorus transmission and constraints on on-site disposal. The phosphorus transmission for the various areas is presented in Figure 2-1.

2.4.2 Lower Trout Creek

The Lower Trout Creek area is located on the historical alluvial fan of Trout Creek. Ground elevations range from 343 m near lake level to 348 m near Highway 97. The soils vary throughout the area from sandy/gravel to sandy/silt depending upon the relation to the historical creek channels. In general, the material tends to be finer near the lake and coarser towards the head of the fan (9). In 1949 a subsurface drainage system was installed over a large part of the area to improve drainage conditions. No "as built" records of the system are available and the condition is unknown (9).

In 1972, the area experienced high groundwater conditions brought about by high lake levels and a high rate of recharge to fan caused by aggradation in the creek bed and a higher than average freshet. Groundwater levels in September 1972 ranged from 0.6 m below the ground surface near the lake to 1.8 m near Highway 97. An engineering study (9) at the time recommended creek channel improvements to reduce recharge from the creek to the fan area. The report noted that within a zone approximately 150 to 300 m fronting the lake, groundwater level is primarily governed by lake level (9). Okanagan Lake is presently controlled between elevation 341.3 m and 342.5 m.

Analysis of the phosphorus mapping indicates that this area contributes 20% of the estimated phosphorus loading to the lake from less than 7% of the population. The zone of land, approximately 60 m wide, along the lakeshore contributes an estimated 11% of the total phosphorus transmission for the district from less than 2% of the population.

In conclusion, the Lower Trout Creek at the present time contributes a significant phosphorus loading to the lake relative to the overall community. Methods to achieve a reduction in phosphorus transmission should be considered in the WMP.

2.4.3 Upper Trout Creek

The Upper Trout Creek area is located on the upper part of the Trout Creek alluvial fan. Elevations range from 348 m at

Highway 97 to 361 m at the foot of the bench. The groundwater table is typically 1.8 m below the surface near the highway to greater than 30 m near the toe of the bench, however, considerable variation in groundwater depth have been reported (23).

The area is estimated to contribute 7% of the total phosphorus loading from 3% of the district population. This high relative loading is due primarily to the coarse texture of the soils and proximity to ground and surface waters.

Although this area is less of a concern than the Lower Trout Creek area, it should be considered in conjunction with waste management alternatives for the lower area.

2.4.4 Paradise Valley/Southwest Summerland

Development within this area is primarily rural residential on soils rated in general from moderately low to low in terms of phosphorus transmission. The overall phosphorus loading to the lake is estimated at about 2% of the total from about 5% of the population.

On-site wastewater management practices appear satisfactory at the present time.

2.4.5 Front Bench

The Front Bench area is located on a variety of soil types ranging from sandy/gravel in the west to lacustrine silts in the east. In terms of phosphorus transmission, the soils vary from a rating of high through to low. Phosphorus loading is estimated at about 5% of the total from about 10% of the population.

Although the area is generally favourable for on-site disposal in terms of phosphorus removal due to the depth to groundwater, the lacustrine silt deposits require special consideration for further development due to stability concern with the silt cliffs (10). As areas of finer grain soils occur downslope of coarser materials, the possibility of hydraulic failure and/or seepage problems exist, especially with higher density development.

2.4.6 Prairie Valley

Development in this area is primarily rural and rural residential. Soil types are variable with phosphorus transmission ratings ranging from high to low. Phosphorus loading from this area is estimated at about 4% of the total from about 5% of the population.

Although some areas are less than ideal for on-site disposal due to impermeable alluvial soils and high groundwater, this area is not considered to be a significant problem area due to the low development density.

2.4.7 Town Centre

The town centre is located on primarily sandy/gravel soils with groundwater at a considerable depth. Soil transmission classifications range from medium to moderately low. The estimated phosphorus transmission is approximately 29% of the total district from about 47% of the population.

Based on the results of a questionaire to property owners and discussions with Ministry of Health staff (1), on-site systems are generally operating well in terms of hydraulic conductivity. The one exception to this is the package plant and tile field serving the Parkdale Place intermediate care home (PE-5125). This system has experienced failure of the tile field. The problem, however, may be more a result of treatment plant performance than soil type.

Although the relative phosphorus contribution per capita is lower than in other areas, the sheer magnitude of the wastewater input to the ground and the high density of development on "dry" pits puts this area in a unique category. In addition to the question of phosphorus transmission, factors such as the effect on future redevelopment and disposal system life and replacement must be addressed. This area is thus considered to be an environmentally sensitive area in the WMP analysis.

2.4.8 Lower Town/Peach Orchard Road

As discussed in Section 2.1, this sector is physically divided into two distinct areas by the silt cliffs. The Lower Town is considered to be an environmentally sensitive area due to the density of residential development on small lots near the lakeshore. Soils in this area are rated from medium to high to very high in terms of phosphorus transmission. The estimated phosphorus loading from Lower Town is 7% of the total phosphorus from 3% of the population.

The Peach Orchard Road area on the bench above the lake is less of a problem in terms of phosphorus transmission. Soils in this area are rated moderately low to low due to the more impermeable nature and greater depth to the groundwater table. Of more concern is the stability of the silt cliffs and the ability of the area to accept further hydraulic loading. Overall development is also restricted by the slide hazard from the silt cliffs.

The overall Lower Town/Peach Orchard Road area should be considered in the evaluating waste management options.

2.4.9 Crescent Beach/Highway 97

The Cresent Beach area is located on permeable soils adjacent to the lakeshore. Phosphorus inputs from this area are estimated at 6% of the total from less than 1% of the population. This area is thus considered significant from an environmental sensitivity viewpoint.

The Highway 97 area on the bench is less significant in terms of phosphorus transmission due to the less permeable soils and low density of development. Specific developments, however, must consider the hydraulic conductivity of the soils and the potential silt cliff stability.

2.4.10 Garnett Valley

The majority of development is located along the valley floor adjacent to Eneas Creek. Due to the permeable nature of the soils and the proximity of the creek, much of the soil is rated high to very high in terms of phosphorus transmission. Overall the area contributes about 9% of the phosphorus loading from 4% of the population.

This area is thus considered to be environmentally sensitive in terms of on-site wastewater disposal.

2.4.11 Cartwright Mountain/North Prairie Valley

This area is virtually unpopulated at the present time and thus does not pose a problem in terms of present wastewater management practices. Shallow soils and bedrock outcroppings may however pose problems in the Cartwright Mountain area for future development using on-site disposal.

2.5 IMPACT OF PLANNED GROWTH

The projected population growth for the district is presented in Table 2-6. The projected annual growth rate, based on the community plan, is 1.7% and 1.6% for 1986 to 1991 and for 1991 to 1996 respectively (3). For the period from 1996 to 2006, an annual rate of 1.5% is assumed.

Expected distribution of the future population to 1996 was estimated in the community plan and is described in Section 2.1 of this report. The distribution projected assumed continued on-site wastewater disposal in the district.

Beyond 1996, distribution of population and development areas will depend to a large extent on the outcome of the WMP. Continued on-site disposal will effectively limit densities and growth in a number of areas whereas construction of a community sewer system in a given area will allow or even encourage higher density development. It is thus very difficult to predict expected population distribution and even total growth rates beyond 1996 at this time.

It is possible, however, to draw several conclusions on the impact of future growth based on the existing wastewater management situation. A discussion of the future impact where significant growth is projected is discussed below.

2.5.1 Lower Trout Creek

Although only an 8.3% increase in the population is expected between 1985 and 1996 increased development densities would be feasible and perhaps necessary to afford the sewerage works if a community sewer system were to be installed. If on-site disposal is continued, development densities will be restricted by the lot size required to accommodate on-site disposal requirements.

2.5.2 Paradise Valley/Southwest Summerland

This area is not considered environmentally sensitive and development will most likely continue using on-site wastewater management. Individual future single family subdivisions should be carefully evaluated for the suitability of on-site wastewater management prior to proceeding.

2.5.3 Front Bench

The population of this area is forecast to increase by over 100% by 1996. Development is expected to proceed using on-site disposal. Individual subdivisions should be carefully evaluated from both a phosphorus transmission as well as hydraulic performance viewpoints given the sensitive nature of the lacustrine silt cliffs.

2.5.4 Town Centre

Although the population growth is expected to be limited, a significant portion will likely be in the form of redevelopment or high density multi-family development.

Individual situations should be assessed on a site specific basis to determine the suitability of on-site disposal.

If a community sewer system were to be implemented, the restriction of on-site disposal on development density would be lifted and significant higher density commercial and residential development could proceed.

2.5.5 Lower Town/Peach Orchard Road

With continued on-site disposal, a limited growth is projected between 1985 and 1996. The area, however, due to its lakeside situation and spectacular views from the bench, is prime residential property. If a community sewer system were installed, substantial, higher density growth would be possible and the Lower Town, especially, could see extensive redevelopment.

2.5.6 Other Areas

A number of mountainside areas, such as Cartwright Mountain, Rattlesnake Mountain, Garnett Valley, and North Prairie Valley have been identified as long term residential growth areas.

Several of these areas pose less than ideal on-site disposal conditions due to steep topography, shallow bedrock, and limited soil cover. Wastewater management in these areas in the future will depend upon decision made on community sewer systems versus on-site disposal. This in turn will govern the allowable development densities.

2.6 CONTROL OF AGRICULTURAL AND INDUSTRIAL WASTES

The concern regarding nitrogen contribution to the groundwater from existing agricultural fertilizer use has been discussed in Section 2.3.

Due to the coarse texture of the soils, agricultural operations that produce high nutrient loadings are not suitable for the Summerland area. Intensive operations, such as feed lots, should thus not be approved unless a site specific study indicates that the surface soils are suitable and nutrient inputs can be controlled.

At the present time, there are no significant industrial wastewater producers in the district. The lack of a community wastewater collection and disposal system has limited the type of industry that could locate in the area. Although industrial activity is recognized as beneficial from an economic viewpoint, the approval of industrial activities producing "toxic" process wastewater should be approached with care. The permeable sand-gravel soils that allow excellent hydraulic capacity also produce little in the way of effluent renovation as the effluent travels down to the groundwater table. In addition, the area between Highway 97 and the lacustrine silt clays is sensitive to water inputs. The location of an industry that produces large quantities of wastewater for subsurface disposal in this area should be thoroughly investigated on a site specific basis prior to approval.

2.7 ENVIRONMENTALLY SENSITIVE AREAS

In the preceeding sections a number of areas within the district have been identified as having on-site wastewater disposal concerns due to large phosphorus transmissions to the Okanagan Lake or high development densities.

These areas are defined as "environmentally sensitive areas" in terms of wastewater management and are proposed for further evaluation of upgrading alternatives in Stage II of the WMP.

The areas are summarized as follows:

- Lower/Upper Trout Creek
- Town Centre
- Lower Town/Peach Orchard Road
- Crescent Beach
- Garnett Valley

In addition, there are also a number of areas where, although on-site disposal is not a problem at the present time, problems could result if development is not carefully controlled. This is primarily as a result of fairly impermeable soils and/or shallow groundwater, steep topography and/or shallow soils with near surface bedrock, or the presence of finer grain and/or unstable soils down gradient from coarser soils. The areas include:

- Front Bench
- Prairie Valley
- Cartwright Mountain

Stage II of the WMP will present comments on future development and possible future development densities for these areas.

TABLE 2-1

COMPARISONS OF PAST, PRESENT AND PROJECTED BIOAVAILABLE PHOSPHORUS LOADINGS TO THE OKANAGAN MAIN VALLEY LAKES

SOURCE	LAKE BASIN - tonnes per year														
	WOOD			KALAMALKA			OKANAGAN			SKAHA			OSOYOOS		
	1970	1980	1990	1970	1980	1990	1970	1980	1990	1970	1980	1990	1970	1980	1990
CONTROLLABLE[1]															
Point Source															
Municipal[4]							37.5	17.0	8.5	13.1	2.4	3.7	2.7	0.9	
Storm Sewers							0.3	0.5	0.7	neg	neg	neg			
Industrial							0.7	1.1	1.2	neg			0.1		
Non-Point Source															
Agriculture:															
Animals	0.4	0.5	0.5	0.3	0.7	0.7	2.2	8.8	8.9	0.5	0.4	0.5	0.3	0.5	0.6
Fertilizer	0.1	0.1	0.1	neg	neg	neg	0.3	0.4	0.4	neg	neg	neg	0.4	0.5	0.5
Septic Tanks	0.4	0.8	1.8	0.4	0.3	0.4	3.8	6.6	8.3	0.6	1.8	2.3	2.8	2.0	2.5
Logging	n/a	0.5	0.5	n/a	0.1	0.1	n/a	6.0	6.0	n/a	0.9	0.9	n/a	0.9	0.9
Other Sources	0.1	0.1	0.1	neg	neg	neg	0.2	1.3	0.3	neg	neg	neg	0.1	0.1	0.1
SUB-TOTAL	1.0	2.0	3.0	0.7	1.1	1.2	45.0	41.7	34.3	14.2	5.5	7.4	6.4	4.9	4.6
NON-CONTROLLABLE[5]															
Dustfall & Precipitation[2]	0.1	0.1	0.1	0.3	0.3	0.3	8.9	8.9	8.9	0.8	0.8	0.8	0.5	0.5	0.5
Watershed Sources[3]	1.7	1.2	1.2	2.2	2.1	2.1	24.5	18.5	18.5	4.2	3.3	3.3	7.1	6.2	6.2
Mainstem Loadings[3]				0.3	0.3	0.3	0.1	0.1	0.1	3.1	3.1	3.1	8.9	8.9	8.9
SUB-TOTAL	1.8	1.3	1.3	2.8	2.7	2.7	33.5	27.5	27.5	8.1	7.2	7.2	16.5	15.6	15.6
TOTAL LOADINGS	2.8	3.3	4.3	3.5	3.8	3.8	78.5	69.2	61.8	22.3	12.7	14.6	22.9	20.5	20.2

1. Assumes that all controllable sources of phosphorus are biologically available.
2. Assumes that dustfall and precipitation sources are biologically available.
3. Biologically available loadings from watershed and mainstem sources were calculated as set out in Summary of Nitrogen and Phosphorus Loadings to the Okanagan Main Valley Lakes from Cultural and Natural Sources, by D.G. Alexander (unpublished as of July 1982).
4. Future loadings from municipal sources are uncertain due to the type of treatment to be employed and the possibility of sewering additional areas in addition to the growth for areas already sewered. Future loadings are estimated on the basis of populations growth assuming that as a minimum objective, 90% of the phosphorus will be removed.
5. Loadings from non-controllable sources are shown to be the same for all years since the data base was not sufficient to separate differences between present and previous loadings, nor to allow projections. However, changes in loadings to lakes may result in changes in loadings to downstream mainstem lakes.

n/a - Not available. Included with watershed sources for 1970 only.
neg - Negligible

(Extracted from Report on the Okanagan Basin Implementation Agreement, September 1982).

TABLE 2-2

PHOSPHORUS TRANSMISSION CLASSES

SYMBOL	DESCRIPTOR	ESTIMATED PHOSPHORUS TRANSMISSION TO RECEIVING WATER
L	Low	0 to 5%
ML	Moderately Low	5 to 15%
M	Medium	15 to 30%
MH	Moderately High	30 to 50%
H	High	50 to 75%
VH	Very High	75 to 100%

TABLE 2-3

COMPARISON OF ON-SITE SYSTEM PHOSPHORUS REMOVAL PERFORMANCE

ITEM	OKANAGAN	SUMMERLAND
Percentage of systems achieving greater than 95% P removal	73	18
Percentage of systems achieving less than 55% P removal	25	7

TABLE 2-4

PHOSPHORUS TRANSMISSION ANALYSIS PARAMETERS

ITEM	VALUE
Total Phosphorus generated per capita	1.28 kg/yr
Average persons per dwelling unit	2.5
Total Phosphorus generated per dwelling unit	3.20 kg/yr

TABLE 2-5

SUMMARY OF WMP AREAS AND CONSTRAINTS ON ON-SITE WASTEWATER DISPOSAL

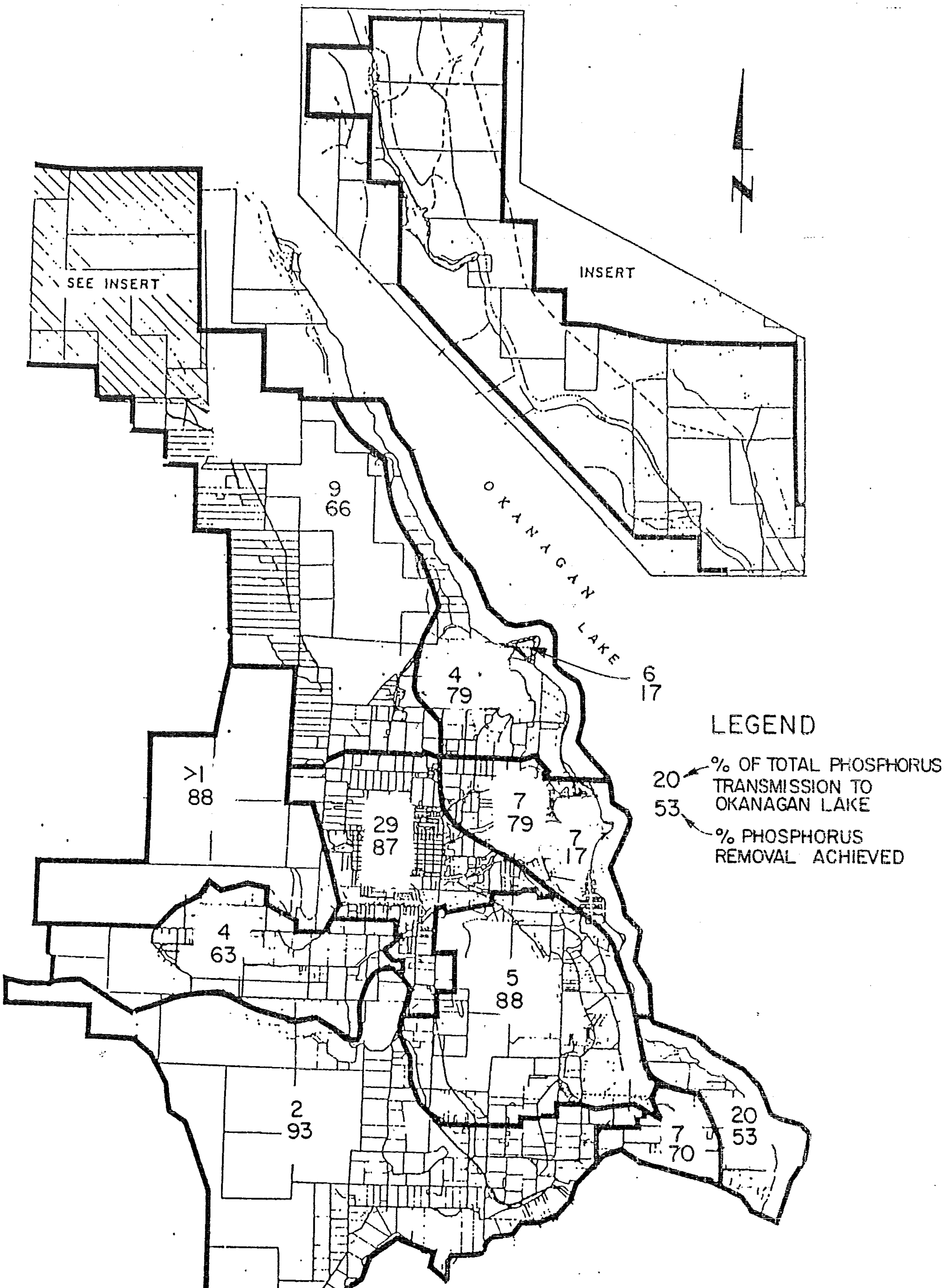
AREA	1985 POPULATION[5]	PROJECTED 1996 POPULATION[5]	PHOS-PHORUS LOADING TO LAKE[6]	PERCENTAGE OF TOTAL P TRANSMISSION TO OKANAGAN LAKE[1]	PERCENTAGE P REMOVAL ACHIEVED[1]	CONSTRAINTS ON ON-SITE DISPOSAL	POTENTIAL FOR FUTURE DEVELOPMENT[2]	ENVIRONMENTAL SENSITIVITY	
								EXISTING DEVELOPMENT	FUTURE DEVELOPMENT
Lower Trout Creek	555	601	335	20	53	High P transmission due to coarse soils and high groundwater	High	Very High	Very High
Upper Trout Creek	214	208	83	7	70	High P transmission due to coarse soils and high groundwater	Moderate	High	Very High
Paradise Valley/ Southwest Summerland	405	637	36	2	93	None	Low	Low	Low
Front Bench	778	1653	118	5	88	Fine grain soils down gradient from coarse soils; cliff stability	High	Low	High
Prairie Valley	400	485	9	4	63	Fine grain soils and high groundwater	Low	Moderate	High
Town Centre	3600	3940	550	29	87	Limited lot area for tile fields due to high density	High	High	Very High
Lower Town/Peach Orchard Rd. . Lower Town . Peach Orchard Road	970[3]	1003[3]	 126 116	 7 7	 17 19	High P transmission due to proximity to lake; cliff stability	 High High	 Very High Moderate	 Very High High
Crescent Beach/Highway 97 . Crescent Beach . Highway 97	480[4]	692[4]	 138 92	 6 4	 17 79	High P transmission due to proximity to lake; cliff stability	 Low Moderate	 Very High Low	 Very High Moderate
Garnett Valley	345	340	147	9	66	High P Transmission due to coarse soils and proximity to Eneas Creek	Low	High	High
Cartwright Mountain/ North Prairie Valley	23	94	4	<1	88	Shallow bedrock/steep topography (Cartwright Mountain)	Moderate	Low	High

1 Based on 1985 population. Overall percentage phosphorus removal achieved is 81%.
2 If wastewater disposal is no longer a constraint.
3 Total population for Lower Town and Peach Orchard Road.
4 Total population for Crescent Beach and Highway 97.
5 Total 1985 and 1996 populations are 7700 and 9643 persons, respectively.
6 Loading in kilograms per year for 1985 population. Total loading is 1836kg/year.

TABLE 2-6

POPULATION GROWTH

YEAR	POPULATION
1971	5,551
1976	6,724
1981	7,473
1986	8,187
1991	8,913
1996	9,643
2001	10,388
2006	11,191



DISTRIBUTION OF PHOSPHORUS TRANSMISSION TO OKANAGAN LAKE

FIG. 2-1

3.0 ON-SITE WASTEWATER MANAGEMENT

On-site wastewater management refers to individual wastewater treatment and disposal systems servicing single or multiple dwellings that dispose of the effluent on the property or "on-site". On-site systems are regulated under the Ministry of Health for discharges of less than 22.7 m^3/d. Discharges of greater than 22.7 m^3/d fall under the jurisdiction of the Waste Management Branch of the Ministry of Environment and Parks.

The various types of on-site systems are described in the following sections.

3.1 ON-SITE SYSTEMS

The primary function of on-site systems is to provide a sufficient degree of treatment to allow the disposal of effluent in a nuisance free manner. Phosphorus reduction is of secondary importance. Various on-site systems are described below.

3.1.1 Septic Tank-Soil Absorption System

The conventional septic tank-soil absorption system (ST-SAS), as shown in Fig. 3-1, is the preferable on-site wastewater treatment and disposal system where site conditions are satisfactory. Operation and maintenance requirements are minimal, the system can operate in a wide range of climates, and with proper design and construction in a suitable soil, the system could last for the life of the dwelling. Site conditions that limit the use of the ST-SAS are impermeable soils that retard the infiltration of septic tank effluent or excessively permeable soils that may allow significant quantities of pollutants to escape into the groundwater. High seasonal groundwater levels can also lead to rapid failure of a soil absorption system.

3.1.2 Septic Tank-Mound System

A septic tank-mound system (ST-MS), shown in Figure 3-2, can be used in some areas to overcome some of the limitations on the use of a ST-SAS mentioned above. The ST-MS is essentially a conventional septic tank with a tile distribution field constructed in an artificial mound above the natural ground level.

The mound removes suspended solids that may tend to plug impermeable soil and facilitates the entry and distribution of effluent into the ground by providing a larger infiltration area than a conventional soil absorption system. On the other hand, if the underlying soil is excessively permeable, a mound composed of a combination of coarse and fine grained soils can provide an enhanced degree of BOD, nutrient, and microorganism removal. Disadvantages of the ST-MS include the high construction cost and the possibility of having to pump the wastewater from the septic tank to the mound disposal system.

3.1.3 Septic Tank-Evapotranspiration System

The septic tank-evapotranspiration system (ST-ES), shown in figure 3-3 is a modification of the conventional ST-SAS that attempts to enhance the evapotranspiration capacity. This is accomplished by constructing a shallow coarse-grained bed with abundant surface vegetation. The bed is sized such that effluent can be stored in the bed during the low evapotranspiration season with the stored effluent being utilized during the summer months. The ST-ES can be used either in soils with low permeability or in excessively permeable soils where an impermeable liner is used beneath the bed to prevent nitrate migration into the groundwater. The disadvantages of the ST-ES are that the climate must be suitable, that is, the annual evapotranspiration must exceed the annual precipitation (assuming zero infiltration), and that salt accumulation in the bed may limit the life of the system.

3.1.4 Septic Tank Sand Filter System

The septic tank sand filter system (ST-SFS), shown in Figure 3-4, is essentially a mound system with underdrains to collect the effluent that percolates through the bed. The effluent is then discharged to a surface water course. The advantage of the ST-SFS is that the system can be used in areas where the soils are too impermeable for a conventional subsurface system or a mound system and where the climate limits the use of an evapotranspiration system. The disadvantages, however, are that a suitable receiving watercourse must be available and that construction costs and operating and maintenance costs are higher than for other systems. This system is generally only approved by regulatory agencies on very specific circumstances and is not considered applicable in the District of Summerland.

A ST-SFS which discharges the collected effluent to a conventional tile field or dry pit instead of to a water course is also utilized. This system is generally used in very permeable native soils to improve pollutent removal performance. This is discussed further in Section 3.3.3.

3.1.5 Aerobic Pretreatment

The substitution of aerobic treatment units, or "package plants", have been proposed instead of septic tanks to pretreat the wastewater before discharge to a disposal field where the available area and/or soil characteristics are restrictive. There are essentially small activated sludge plants that operate on either a continuous or batch flow basis (Figure 3-5).

Experience with these systems have been mixed (11,12). Aerobic units are more susceptible to neglect than septic tanks and, if not maintained can, in fact, product a poorer quality effluent. If tile field area has been reduced due to the use of an aerobic unit, failure to maintain the unit will often result in early field failure.

In general, the use of an aerobic unit to overcome soil problems is not a recommended approach.

3.1.6 Septic Tank Dry Pits

Septic tank dry pits (ST-DP), shown in Figure 3-6, consists of a septic tank followed by an open-jointed walled pit filled with drain rock.

ST-DP are not accepted by all regulatory agencies and are generally only suitable in very permeable soils with deep groundwater table. As the effluent is confined to a small area, nuisance odors and soil clogging can present problems (12).

3.1.7 System Life

The life of an on site wastewater management system depends on a large number of variables.

Poorly sited systems in tight textured soils can fail within a year due to hydraulic blockage. Well maintained systems in permeable soils with a low hydraulic loading can function for 20 years or more (12).

Failure in systems that have previously operated satisfactorily for some time is often a result of recent hydraulic overloading and/or lack of maintenance of the septic tank. In some cases, remedial action such as pumping the sepic tank and resting the tile field is satisfactory. In other cases, a complete rebuilding of the tile field is required.

3.1.8 Holding Tank and Wastewater Haulage Systems

This system utilizes a holding tank that collects raw wastewater from the dwelling and stores it until a transport vehicle removes the wastewater to an authorized disposal site. Holding tanks are often combined with low water use toilets to minimize the quantity of wastewater produced and thus the frequency of collection. The holding tank should incorporate an alarm device to inform the owner that the tank requires emptying.

The collected wastewater is hauled away by a tank truck. A single-axle truck can generally be equipped with a tank of up to 9100 litre capacity and a tandum rear-axle truck with a tank of up to 13,650 litre capacity. The truck capacity generally limits the size of holding tank that can be employed. A 13,650 litre capacity holding tank would require emptying every 17 days, based on a family of four producing wastewater at the normal rate of 200 litres per capita per day.

One disadvantage of holding tank haulage systems is the possible interruption of service due to heavy snowfalls, spring thaw, labour disputes, etc. Failure to empty the holding tanks results in the overflow of raw wastewater and the associated health risk.

Operating costs for the system depends upon the distance to the disposal site, the number of holding units, and the frequency of emptying. Since the primary cost of the system is the operating cost, the costs will rise with the general inflation rate through the life of the system. Typical costs in a rural area are in the order of $0.005 per litre, giving an annual operating cost for the example of a family of four sited above of $1,500 (11).

Holding tank wastewater is generally discharged at a septage disposal site. The District of Summerland is currently investigating development of a new disposal site.

3.2 BLACK WATER/GREY WATER SYSTEMS

Black water/grey water systems refer to systems that separate the toilet water from the other household wastewater such as laundry, dishwashing, sink, shower and bath wastewater. The black water is handled by a pit privy or composting, chemical, or incineration toilet. Grey water is treated and disposed of in a subsurface disposal or sand filter system.

Although separate systems have applications where a pressure water system is not available to carry the wastes or where unsuitable soil conditions for subsurface disposal exist, black water/grey water systems have not proven to be acceptable as a community wide wastewater management alternative (11) and thus have little application in the District of Summerland.

3.3 MODIFICATIONS TO ON-SITE SYSTEMS

Modified on-site systems in this report refers to in-house processes or modifications to on-site systems to achieve a greater degree of phosphorus and/or nitrogen removal. Various methods available are described below and summarized in Tables 3-1 and 3-2.

3.3.1 In-House Processes

The major sources of phosphorus in the home are laundry, dishwashing, and toilet wastes. Phosphate levels in laundry detergents were limited to 5% in 1972. The use of low or no phosphate laundry detergents could reduce overall phosphorus contributions by about 25% (23). Similarly, the use of low phosphate dishwashing detergents, which are not currently regulated, would also result in a phosphorus reduction.

Segregation of black water could reduce phosphorous levels by about 30% (12). Separate black water/grey water systems, however, are unlikely to receive wide spread community acceptance.

Any in-house measure to reduce pollutional loads requires the cooperation and commitment of the owner or tenant to achieve the desired result.

3.3.2 Chemical Precipitation

Phosphorus in wastewater may be rendered insoluble by a selected number of metal salts, including aluminum, calcium, and iron. Although the reactions are complex, the net result is the precipitation of an insoluble complex that contains phosphate. Phosphorus precipitation methods normally include the addition of a chemical, high-speed mixing, and slow agitation followed by sedimentation.

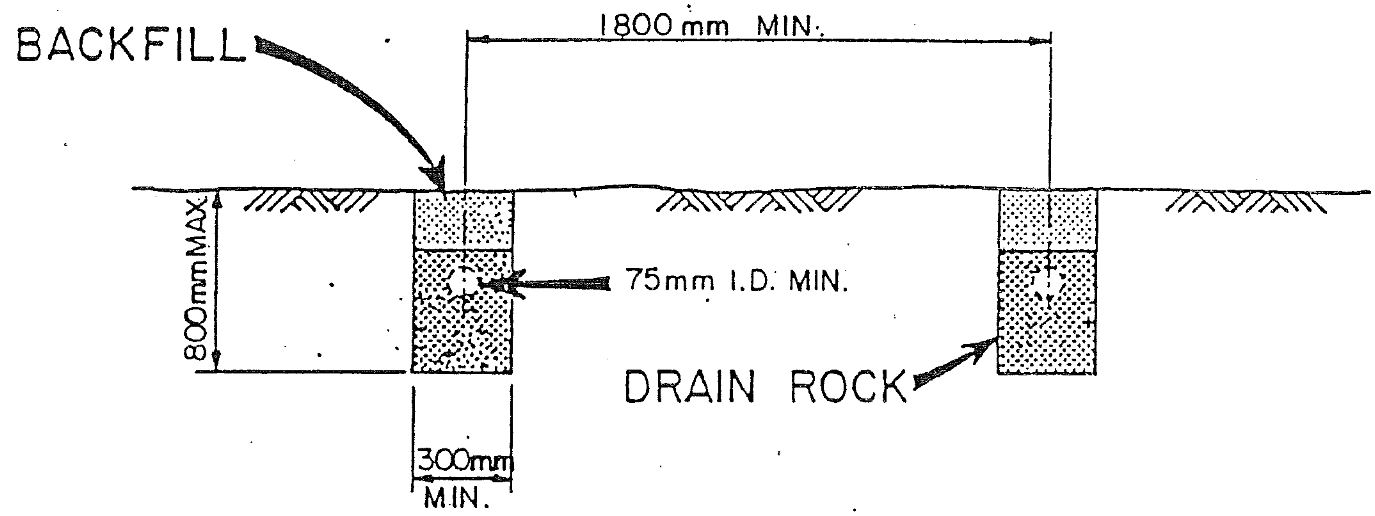
Performance is dependent on the point of chemical addition, chemical dosage, wastewater characteristics, and coagulation and sedimentation facilities. Phosphorus removals between 75 and 90% can be expected (12). Improvement in this performance may be achieved if intermittent sand filters follow the precipitation/sedimentation process. Side benefits are achieved with the addition of the precipitating chemicals. Suspended and colloidal BOD and solids will be carried down with the precipitate, producing a higher quality effluent than would otherwise be expected.

TABLE 3-2

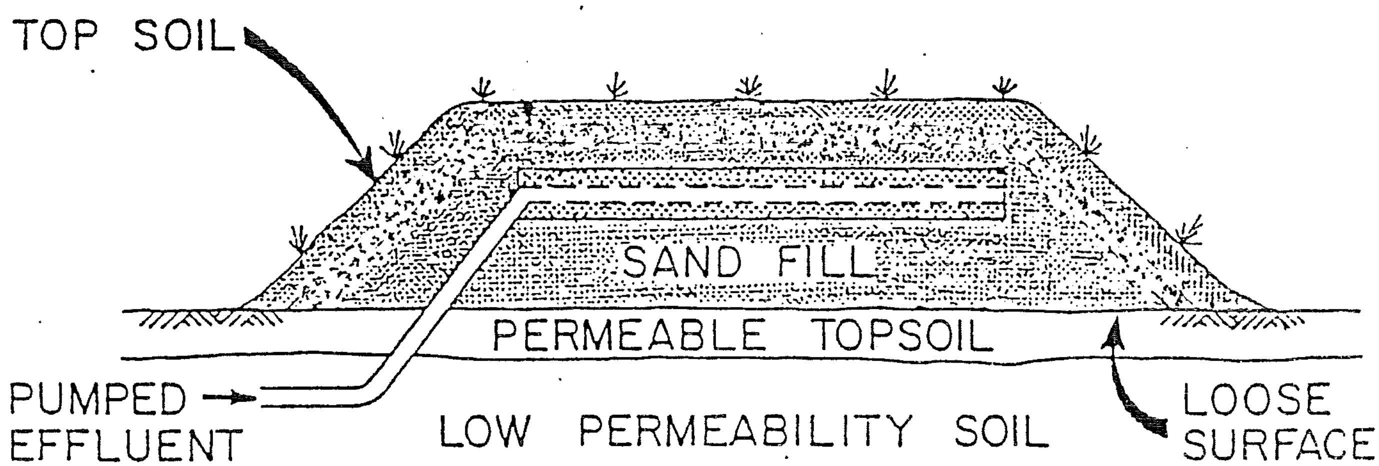
POTENTIAL ON-SITE NITROGEN REMOVAL ALTERNATIVES

OPTION	DESCRIPTION	EFFECTIVENESS	COMMENTS	ON-SITE TECHNOLOGY STATUS
In-House Segregation	Separate toilet wastes from other wastewater	78 - 90% removal of N in blackwater	Management of residue required	Good
Biological Nitrification	Granular filters	>90% conversion to nitrate	Achieves high level of BOD and solids removal	Good
	Aerobic package plants	85 - 95% conversion to nitrate	May achieve good levels of BOD and solids removal; labor/energy intensive; residue management	Good
Biological Denitrification	Anaerobic processes following nitrification	80 - 95% removal of N	Requires carbon source; labor intensive; high capital cost	Tentative
Ion Exchange	Cationic exchange-NH_4	>99% removal of NH_4 or NO_3	Very high operation costs	Tentative
	Anionic exchange-NO_3			

From Reference 12.

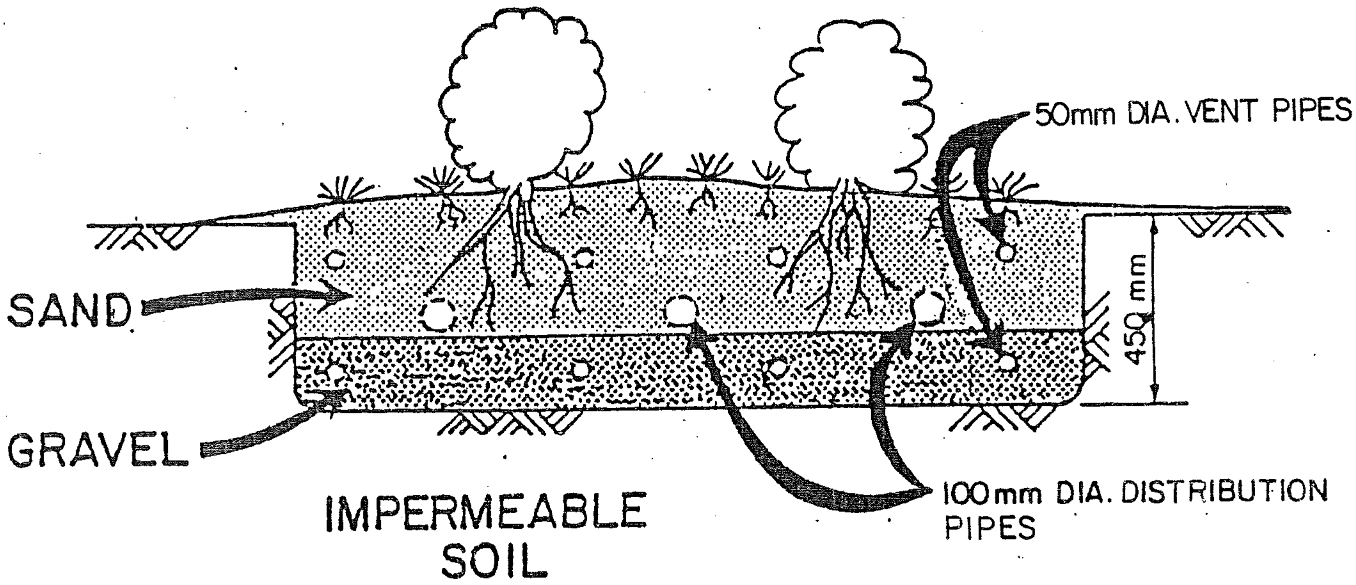


CONVENTIONAL SOIL
ABSORPTION SYSTEM

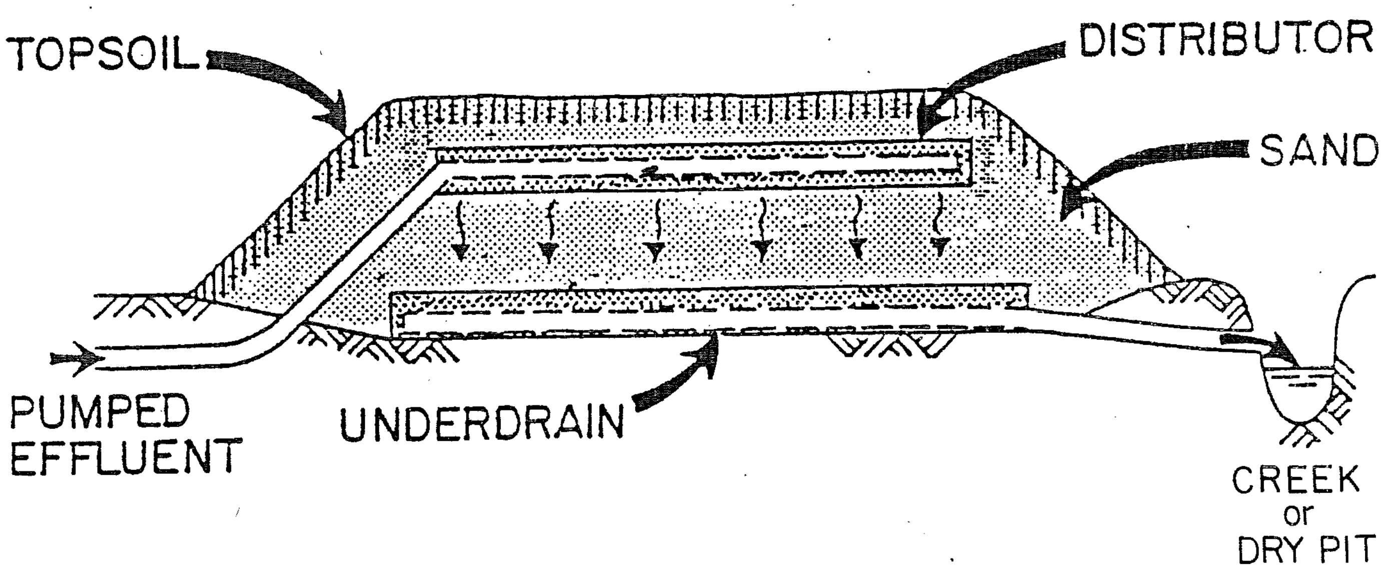


RAISED MOUND SYSTEM

FIG. 3-1.

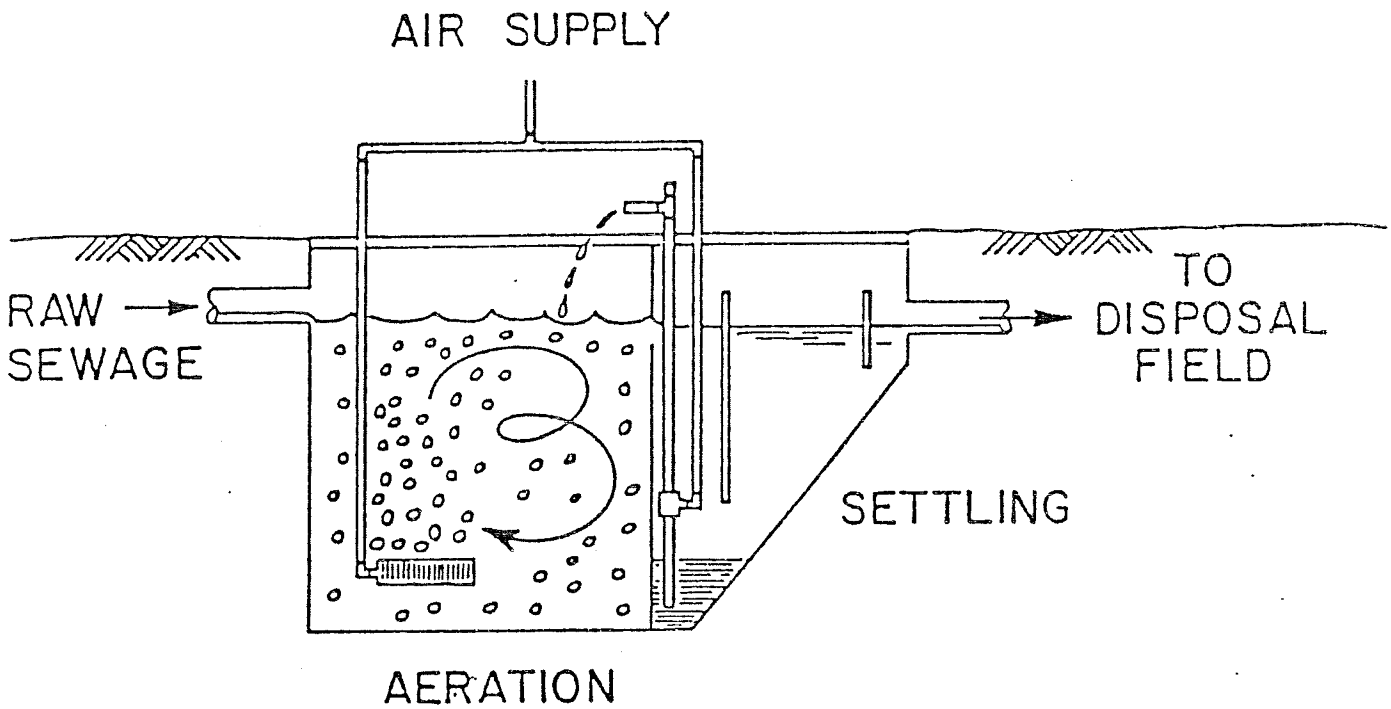


EVAPOTRANSPIRATION SYSTEM



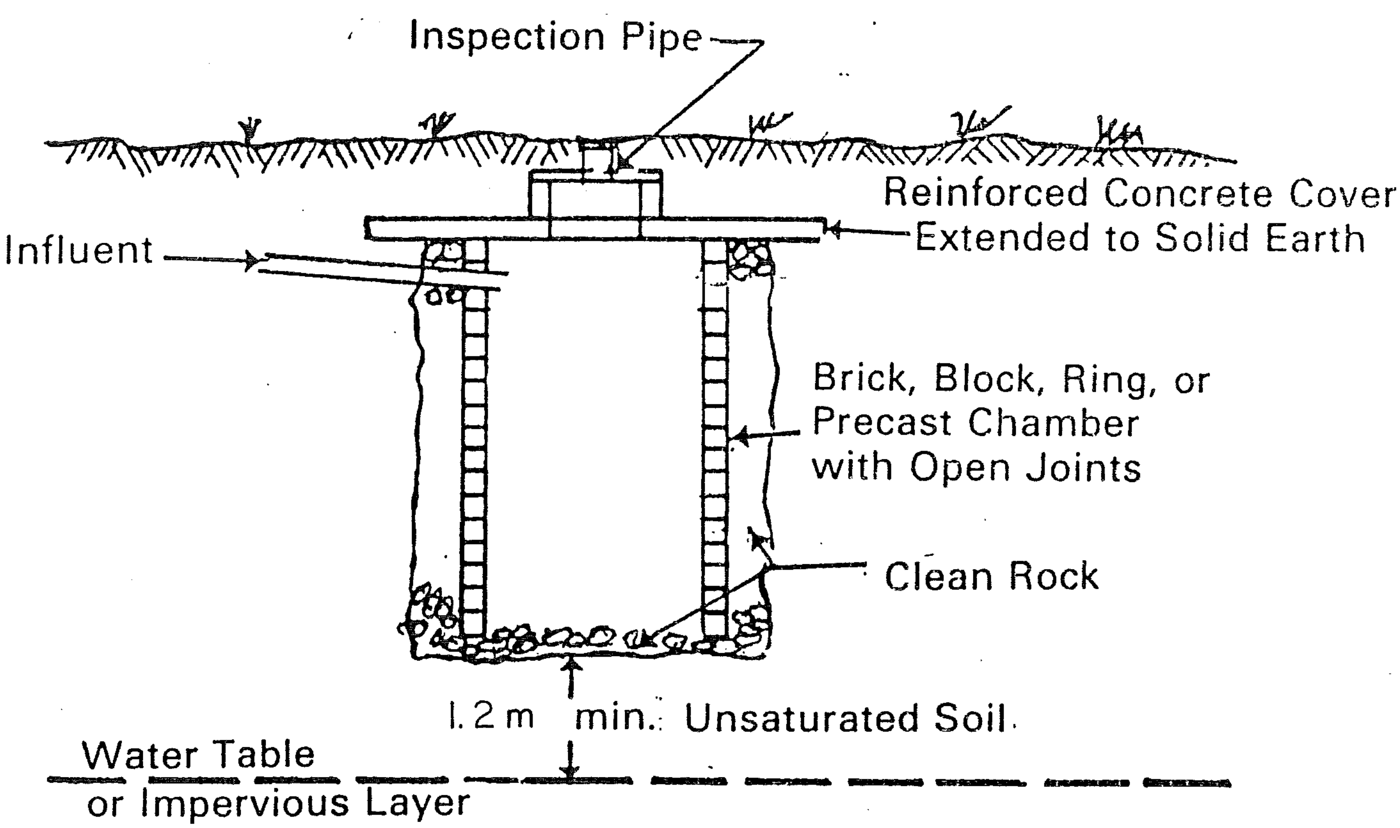
SAND FILTER SYSTEM

FIG. 3-2



AEROBIC PRETREATMENT SYSTEM

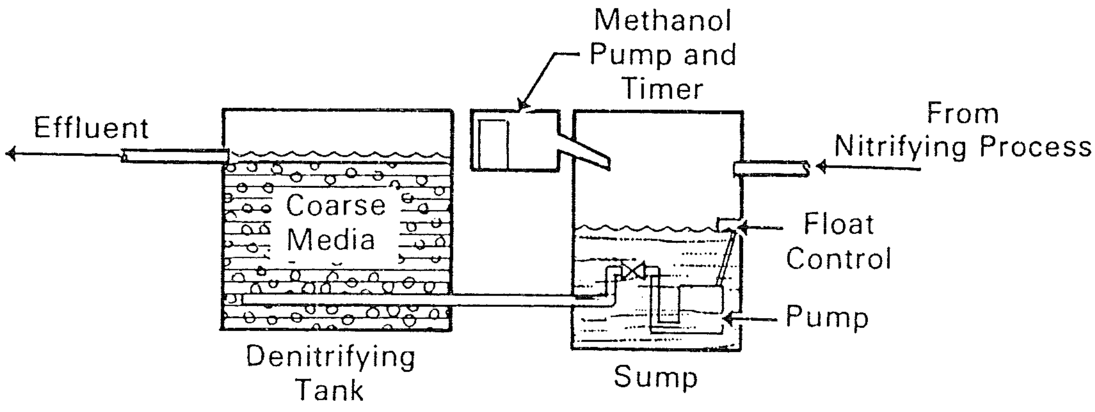
FIG. 3-3



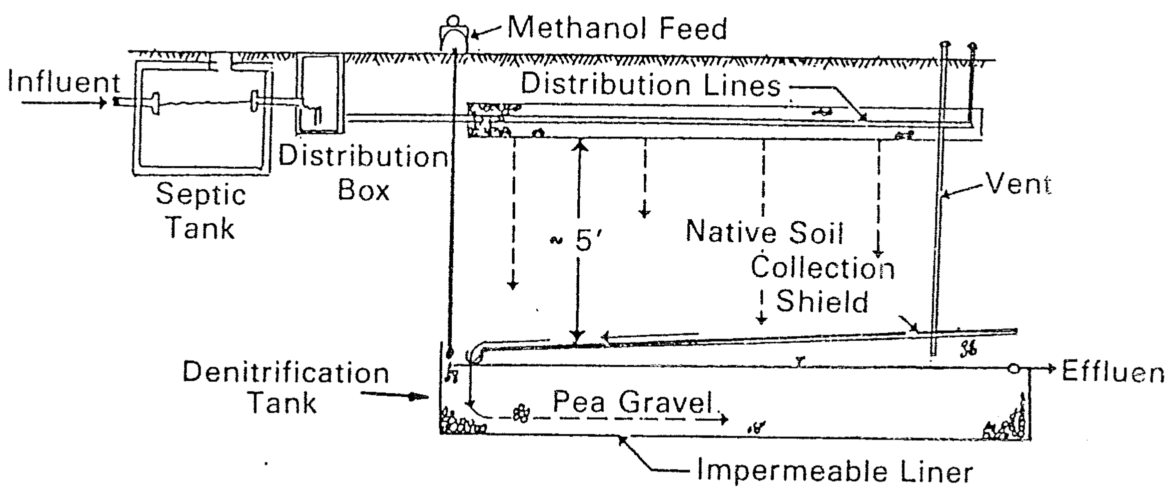
DRY PIT

FROM REFERENCE 12

FIG. 3-4



Batch Denitrification



Nitrification-Denitrification in Soil

ON-SITE NITROGEN REMOVAL

FROM REFERENCE 12

FIG. 3-5

4.0 COMMUNITY WASTEWATER MANAGEMENT

The objective of this section is to briefly describe community wastewater management techniques that are applicable to the District of Summerland, to cite advantages and disadvantages, and to present the order-of-magnitude capital costs.

The intent at this stage is NOT to formulate specific community wastewater management options for specific areas. Specific options will be presented at Stage II.

4.1 COLLECTION

4.1.1 Conventional Gravity Sewer

Conventional gravity sewers consist of a sewer main in the steet or right-of-way and service laterals to each property. All pipes are laid on a slope to allow raw wastewater to flow downhill at a velocity sufficient to maintain the suspension of solids.

Manholes are located at intervals up to 125 m. to provide access for inspection and occasional flushing. Pipe material in the sewer sizes (200 to 300 mm dia.) found in small communities is generally PVC.

Typical costs for small diameter conventional gravity sewers are between $150 to $200/m, depending upon the diameter, depth and excavation and surface restoration conditions.

If the raw wastewater cannot be conveyed to the treatment plant by continuous gravity flow, pumping stations and forcemains are required to lift the wastewater from a low point to a point where gravity flow can resume. The pumping stations are provided with duplex pumps and controls and, possibly, standby diesel power to eliminate the occurance of a raw wastewater overflow due to mechanical breakdown or electrical power failure. Pumping stations in small communities typically cost between $50,000 and $150,000 depending upon capacity, equipment and construction conditions.

A comparison of conventional sewers with alternative sewers is presented in Table 4-1.

4.1.3 Vacuum Sewers

Vacuum systems utilize a small diameter collection piping with a central vacuum source that constantly maintains 38 to 50 cm Hg vacuum (Figure 4-1). A gravity-vacuum interface valve is located at each house to separate atmospheric pressure from vacuums in the mains.

The advantages of vacuum sewers over conventional sewers are reduced capital costs because of the small diameter pipe used and reduced depth of installation, expecially where gravity systems require multiple lift stations. The advantages of vacuum systems over pressure and SDG sewers are a generally higher dissolved oxygen and oxidation state of the wastewater, centralized power utilization at the vacuum station, and reduced concern for exfiltration from the system. Disadvantages include a higher energy and opertional requirement, the need for more exact grade alignment during installation, limitations on allowable system lift caused by the vacuum limitation, greater infiltration potential, and less tolerance to flows exceeding design capacity (13).

In general vacuum systems have not found wide acceptance except in very specific circumstances.

4.1.4 Small Diameter Gravity Sewers

There are two types of SDG sewers: relatively constant gradient and variable or inflective gradient (Figure 4-1). Both types use small diameter pipe and carry septic tank effluent. Septic tanks are required at each connection to remove grease, grit, and other heavy solids so as to minimize the need for maintaining scouring velocities. The advantages of SDG sewers over conventional gravity sewers include lower capital cost because of reduced pipe and installation costs; cleanouts rather than manholes; reduced lift station costs because of pretreatment and flow attenuation by septic tanks; reduced infiltration and inflow (I/I); and potential reduction in treatment costs that results from septic tank pretreatment and reduced I/I. Disadvantages of SDG sewers include maintaining and pumping septic tanks and special design problems that relate to odor and corrosion inherent with septic tank effluent.

In comparing SDG with conventional sewers, it is necessary to examine the advantages/disadvantages of both for the site specific situation. In general, where conditions are favourable for conventional gravity sewers, SDG sewers offer no advantage.

4.1.5 Estimated Costs

The various alternative collection systems will be evaluated for specific areas in Stage II.

For the purpose of illustration, however, the order of magnitude capital costs for the various environmentally sensitive areas have been estimated based on the use of conventional gravity sewers and are shown in Table 4-2. These costs are based on a typical cost per kilometer of sewer and include service laterals costs.

4.2 TREATMENT

Community wastewater treatment can be divided into the following categories depending upon the degree of treatment provided.

- Preliminary
- Primary
- Biological (Secondary)
- Advanced (Tertiary)

4.2.1 Preliminary Treatment

Preliminary treatment refers to various physical processes such as screening, comminution, grit removal, and skimming to remove coarse solids, sand debris, floatables,and grease ahead of further treatment processes.

Although occasionally used alone in open marine discharges, preliminary tretment would only form an initial treatment step for a community treatment system in Summerland.

4.2.2 Primary Treatment

The two most common primary treatment techniques are sedimentation and fine screening.

Sedimentation (Figure 4-2) removes settleable solids and scum in a mechanical clarifier. BOD and suspended solids removal of 25 to 40% and 50 to 65% respectively, are typically achieved (11).

Static fine screens result in BOD and suspended solids removal in the range of 10 to 30%.

A community septic tank, disposing to a subsurface field, is a form of primary treatment that could be considered for cluster systems in Summerland.

4.2.3 Biological Treatment

Biological or secondary treatment processes utilize a mixed population of microorganisms to convert soluble organic contaminants to new cellular material or sludge. At the same time, a portion of the organics is oxidized to carbon dioxide and water.

Biological treatment can be divided into two categories: suspended growth and attached growth systems.

.1 Suspended Growth Process

In suspended growth processes, the microbial population is kept in suspension using compressed air or mechanical methods. Treatment systems classified as suspended growth systems include activated sludge, contact stabilization, extended aeration, oxidation ditches, aerated lagoons, and conventional stabilization lagoons.

The activated sludge, contact stabiliztion, and extended aeration systems utilize steel or concrete tankage for a fairly compact plant arrangement. The oxidation ditch process uses a lined channel in a continuous oval configuration. The two lagoon systems require considerably more area, with the conventional stabilization lagoon requiring the largest land area.

Process schematics for activated sludge and its variants are shown in Figure 4-3 and Figure 4-4.

.2 Attached Growth Process

Attached growth or fixed film systems use microbial populations attached to a solid surface to remove organic components from the wastewater. The fixed film systems, unlike the suspended growth system, do not require aeration equipment to supply the oxygen and keep the biomass in suspension. The microbial population adheres to the surface of the media used and oxygen required is transferred from the air to the microorganisms.

The two most common attached growth processes are the trickling filter and rotating biological contactor processes (Figures 4-5 and 4-6).

Biological processes primarily reduce BOD and suspended solids concentrations, although some phosphorus removal and nitrification is also achieved. Table 4-3 presents the relative removals of the various processes.

In the Summerland situation, biological or secondary treatment is applicable if the final method of disposal is by land disposal. Further treatment would be required if the final method of disposal is to surface waters.

4.2.4 Advanced Treatment

Advanced or tertiary treatment refers to treatment processes beyond the biological or secondary level. The objectives of advanced treatment are typically one or more of the following:

- Phosphorus reduction
- Nitrification or nitrogen reduction
- Disinfection

Various advanced treatment processes are discussed below.

4.2.5 Phosphorus Removal

Chemical, physical, and biological treatment processes are available for phosphorus removal. Combinations of two or all three processes are generally employed to achieve the desired level of phosphorus removal. Typical phosphorus removal systems are shown in Figure 4-7.

.1 Tertiary Precipitation and Filtration

Following secondary treatment, the addition of chemicals such as alum, ferric chloride, or lime can be used to precipitate out the phosphorus. The major portion of the precipitates thus formed in post-secondary treatment can be settled out in a sedimentation tank leaving phosphorus residuals of about 1.0 mg/L to 2.0 mg/L in the effluent. Subsequent filtration is capable of removing fine floc particles, further reducing the phosphorus down to less than 1.0 mg/L in the treated flow, with 0.1 mg/L to 0.9 mg/L being reported for full-scale plant operation.

In-plant tertiary treatment is accomplished by adding chemicals ahead of the primary or secondary treatment works. Flow equalization and filtration can be added to improve effluent quality to a level that is virtually identical to that provided by post-secondary treatment. In-plant tertiary systems generally have lower capital costs that the separate, post-secondary facilities.

.2 Biochemical and Biological Methods

Processes involving biological or combined chemical-biological removal of phosphorus have generally been incorporated into proprietary systems. These include the A/O (Anerobic-Oxic), Bardenpho, and Phostrip systems.

The A/O system is essentially a high-rate (2 hour aeration) activated sludge plant preceded by a short detention (2 hour) anaerobic tank. Return activated sludge is subjected to anaerobic conditions that result in the release of phosphorus in the anaerobic stage, but on reaching the aerobic (oxic) stage, a phenomenon called "luxury" uptake occurs that results in a high phosphorus concentration in the biological sludge and a relatively low concentration in the plant effluent. Phosphorus is thus removed from the system via the waste sludge, reportedly leaving residuals of about 0.9 mg/L to 2.0 mg/L in the plant effluent.

The Bardenpho system also depends on the anaerobic conditioning of activated sludge that subsequently results in a relatively high uptake of phosphorus by the biological sludge during an aeration phase. A portion of the sludge is then intentionally and systematically wasted from the system. A number of full scale plants of this type exist in South Africa, the United States, and, of course, at Kelowna, B.C. Phosphorus concentrations in the effluent, as reported in the literature, have been quite variable, being less than 1.0 mg/L up to 2.5 mg/L, the latter being reported for a Florida plant. Combined with final filtration with alum as a coagulant, total phosphorus values as low as 0.3 mg/L have been achieved at the Kelowna plant. Operation of the plant at Kelowna, over a significantly long period of time will be useful in evaluating treatment efficiencies under local climatic conditions. Bardenpho plants are currently planned for Westbank and Penticton.

The Phostrip system for phosphorus removal uses a more or less conventional activated sludge system layout, with chemical precipitation of phosphorus for a small side stream of waste sludge from which the phosphorus has been anaerobically stripped. The overflow from the stripper tank is treated with lime to precipitate the stripped phosphorus in a separate tank. The stripper tank underflow sludge is recycled to the plant's main flow. The lime treated stripper tank overflow is about 15% of the plant effluent flow, thus resulting in relatively low chemical usage. Treatment plant effluent phosphorus concentrations of 0.6 mg/L to 0.8 mg/L have been reported.

4.2.6 Nitrogen Removal

As with phosphorus removal, nitrogen removal systems rely on physical, chemical and biological processes, and combinations of these processes.

.1 Biological Nitrification-Denitrification

The majority of full scale treatment plants, that are designed for maximizing nitrogen removal, employ biological nitrification to produce nitrates, followed by biological denitrification that results in the formation of nitrogen gas from the nitrites. Nitrification of the ammonia and organic nitrogen in wastewater is most frequently accomplished by means of an activated sludge aeration system, but other, higher cost aerobic treatment systems can be used, including rotating biological contactor (RBC) and trickling filter units. For a given wastewater flow, a high degree of conversion of nitrogenous compounds to the nitrate form occurs when a relatively large weight of organism solids are held in the aeration tanks.

The denitrification stage of a treatment system is not aerated, and in this case, oxygen is removed from the nitrates by the organisms in the activated sludge thus producing nitrogen gas which escapes from the treated wastewater flow. Denitrification is thus carried out in a mixed but unaerated tank in the case of activated sludge treatment.

The previously illustrated Bardenpho and A/O treatment systems are examples of facilities that incorporate sequential nitrification-denitrification units. The oxidation ditch and other orbital activated sludge systems, with the potential of operating with aerobic and anoxic zones in the tankage, are additional examples of systems employing biological nitrification-denitrification for nitrogen reduction. These systems are reported to have total nitrogen (all forms) removal efficiencies of about 77% to 93%, leaving total nitrogen residuals in the plant effluent of 2.5 mg/L to 8.9 mg/L.

Various other biological nitrification-denitrification system modifications are available, such as using a 30 minutes air-on and 30 minutes air-off sequential operation for the aeration tank of an activated sludge system to produce alternating aerobic and anoxic reactions in a single tank. A food source is required during the denitrification stage, and methanol has been suggested in one system modification.

.2 Miscellaneous Nitrogen Removal Systems

The natural zeolite, clinoptilolite, can be used as a selective ion-exchange media for ammonium ion removal. At least one full scale plant employs this type of nitrogen removal following a treatment plant that includes activated carbon absorption-filtration. Total nitrogen removals as high as 96% have been reported for municipal wastewater, but regeneration of the ion-exchange media and ammonia recovery from the spent regenerate, in combination with other operations of the total treatment plant, results in a relatively high overall cost when compared with biological nitrogen removal. Other disadvantages include the prefiltration requirement, a high increase in effluent dissolved solids, and the attrition of the ion-exchange media due to backwashing.

The Lake Tahoe tertiary treatment plant has employed air stripping of ammonia in a wastewater/air countercurrent flow "cooling tower" type of unit. This process follows phosphorus reduction by the addition of lime at the Lake Tahoe Plant, the conversion of ammonium ion to ammonia by raising the pH being a necessary part of the process to achieve high ammonia nitrogen removals. This process has the disadvantages of encrustation of pumps, piping, and the air stripping tower due to the lime treatment, and the nonoperability of the air stripping tower when the ambient temperature drops to freezing.

As with air stripping, chlorine can be used to remove the ammonia fraction (about two-thirds) of the total nitrogen present in raw municipal wastewater. Due to the high chlorine dosage required (about 200 mg/L), this method has not been considered a cost effective method of nitrogen removal, but it has been suggested as a final polishing step for converting ammonia, nitrates, and nitrites to nitrogen gas in effluents low in these constituents.

4.2.7 Nutrient Removal by Polishing Ponds

The use of vegatative growth ponds has been under reseach for a number of years in the southern United States (14, 18) and more recently in Canada (15, 16, 17, 19).

In selected cases, for small communities, the use of aquatic plants may be of value in polishing secondary treated effluent. In general, aquatic plant systems would form an integral part of a wastewater treatment facility in which the initial treatment would be provided by a conventional system such as a wastewater stabilization pond or a mechanical plant. In this case, the aquatic plants would be grown in ponds or channels that receive the pretreated wastewater, and the vegetative growth would biologically remove phosphorus, nitrogen, and other constituents such as heavy metals. Nutrient removal could be maximized by harvesting the aquatic plants thus grown.

An obvious drawback for the vegetative growth system in a northern climate is that the cattail and bulrush aquatic plant growth is dormant for six to seven months of the year, thus eliminating nutrient removal during the affected period. Also, obtaining the relatively large tract of land required for an aquatic plant system may not be feasible, except for small rural communities.

One type of treatment system that would see the use of vegetative growth units, would be a stabiliztion pond for preliminary secondary treatment, followed by an 8-month storage basin, followed by a channel type aquatic plant facility for effluent polishing. In this type of treatment plant, treated effluent would be drawn into the vegetated channel works on a batch basis during the annual 5 to 6 month period when the cattail or bulrush plants are actively growing. When the BOD, phosphorus, and nitrogen levels in the channel water are sufficiently low, the channel basin would be emptied and a new batch of effluent to be polished would be drawn from the storage basin. The fill and draw batch procedure would be carried out until the storage basin becomes empty towards the end of the aquatic plant active growing season.

4.2.8 Disinfection

The disinfection of effluent to reduce pathogenic microorganisms is the final step prior to discharge to surface waters or a land disposal system.

Disinfection by the addition of chlorine is the most common method although ozone, chlorine dioxide, and ultraviolet light are also used. If the final discharge is to surface waters and chlorination is utilized, dechlorination is generally required using sulphur dioxide to remove the potential toxicity to aquatic life caused by the chlorine residue.

4.2.9 Estimated Costs

The applicability and type of treatment depends upon the ultimate method of disposal. Land disposal systems generally require a biological or secondary level of treatment. Discharge to surface waters in the Okanagan Basin requires an advanced level of treatment with total phosphorus effluent concentration of 0.5 to 1.0 mg/L.

The various alternative treatment system will be evaluated in conjunction with the selected method of disposal for the specific areas in Stage II.

For the purpose of illustration, however, the order of magnitude capital costs for the secondary and advanced treatments for various populations are presented in Table 4-4. The costs are for treatment only and exclude costs for collection, pumping and disposal.

4.3 DISPOSAL

Effluent disposal from a community collection and treatment system can be divided into two broad classifications: land disposal and surface water disposal. The various methods applicable to the District of Summerland are discussed below.

4.3.1 Subsurface Disposal Fields

Subsurface disposal fields are similar to tile fields used for individual dwelling except on a larger scale.

Small diameter perforated pipes at a spacing of 1.8 to 3.0 m are used to distribute effluent to the ground (12). Due to the length of piping required, distribution of effluent into the piping is by a pump system.

The soil requirements for a community disposal field are similar to individual on-site systems. Phosphorus removals are similar to on-site systems in properly designed fields with even distribution.
The size of the field is dependent upon the soil permeability. The practical maximum capacity is generally in the order of 300 persons. This method of disposal is thus mostly applicable to small, cluster residental developments.

4.3.2 Rapid Infiltration Systems

Rapid infiltration systems (Figure 4-8) apply effluent to the soil at rates up to several orders of magnitude greater than rates associated with slow rate systems. In high rate systems, the objective is not so much to utilize the nutrients available in the effluent for plant growth, but to either recharge the groundwater aquifier or utilize the soil as a natural treatment process. Under suitable conditions, the water thus treated may be removed by pumped withdrawal or by underdrain works, or it may join the groundwater flow. Rapid infiltration generally requires the least land and the lowest amount of energy compared to slow rate application system. Phosphorus removals vary depending upon the subsurface conditions with typical values of between 50 to 95% achievable (19). Nitrification/denitrification can also be achieved through alternate flooding and resting cycles.

Preliminary evaluation of soil mapping and aerial photographs of the area indicate a potential rapid infiltration-site northwest of Prairie Valley in the vicinity of the gravel pits and municipal landfill. It must be recognized, however, that a substantial investment in test drilling and exploratory progams is required with any proposed rapid infiltration system due to the large quantity of effluent entering the ground in a limited area. At the above site, the impact of rapid infiltration on the ground water regime, the Trout Creek reservoir, the ground water table at Prairie Valley, the stability of the silt cliffs, and the potential phosphorus transmission must be evaluated in order to determine the feasibility of rapid infiltration disposal.

4.3.3 Effluent Irrigation or Slow Rate Systems

Effluent irrigation or slow rate land treatment (Figure 4-8) is the application of pretreated wastewater to vegetated soils to meet the growth requirements of the plants. Typically, approximately 70 percent of the applied effluent is lost to plant uptake and evapotranspiration with the remaining 30 percent percolating down through the soil. As the effluent moves down through the soil, the following processes can occur.

Physical Filtering: Suspended organic particles and pathogenic microorganisms are filtered out.

Biological Degradation: Filtered organic particles are broken down by bacteria to carbon dioxide and water. In addition, bacteria also convert ammonia nitrogen to nitrate nitrogen (nitrification).

Adsorption: Phosphorus and heavy metals are adsorbed by soil particles.

Nutrient Uptake: Phosphorus, nitrogen, and trace nutients are taken up through plant root systems and utilized for plant growth. Phosphorus removals of 95 to 99% are achievable.

The excess water, not utilized by the plants, helps to leach away undesirable salt accumulation from the plant root zone.

Effluent is generally applied at agricultural irrigation rates using hand moved, mechanically moved, or fixed set equipment. Slow rate systems are generally only operated during the growing season. This results in the need to either store the effluent over the non-irrigation season or to employ an alternative disposal method. In addition, if zero buffer zone irrigation is proposed, a minimum of 60 days storage must be provided at all times. Annual and seasonal fluctuations in precipitation and climate also require additional storage to provide balancing capacity from year to year. In total, experience elsewhere in the Okanagan has indicated that one to two years storage capacity is desireable to ensure the success of an effluent irrigation system where irrigation is the sole method of disposal. The cost of providing this amount of storage will often determine the economic feasibility of a slow rate system.

Vegetation performs three major functions in a land treatment system:

.1 Reduces soil erosion by decreasing surface runoff velocity.

.2 Maintains and increases soil permeability within the root zone.

.3 Acts as a nutrient extractor, removing nutrients from the wastewater and the soil and allowing the nutrients to be removed from the system by harvesting.

The selection of vegetation for a land application scheme depends upoon the type of land treatment system, the desired rate of water and nutrient uptake, the required tolerance to potentially toxic wastewater constituents and wastewater application rates, the ease of cultivation or maintenance required, and the desirebility of producing a marketable crop.

Ideally, slow rate systems are associated with a marketable crop having a high nutrient uptake ability and water tolerance. Forage and fodder crops such as alfalfa, reed canary grass, perennial rye, and Bermuda grass are generally preferred as they have a high nutrient uptake ability, are tolerent to various constituents of wastewater, and require little maintenance and skill to grow. Due to the potential health hazard involved, vegetables for direct human consumption are not usually grown in effluent irrigation systems in Canada and the United States. Recent research in California, however, has indicated that with a sufficient degree of treatment unrestricted effluent irrigation of food crops may be feasible (29).

At the present time, the irrigation of orchard crops is not permitted in British Columbia. Pilot scale work, however, has recently been carried out by the Federal Agricultural Research Station at Osoyoos and it is possible that with a sufficient degree of treatment, drip irrigation of orchard crops may be approved in the future (26). Previous concerns with nitrate application late in the growing season causing greater than normal winter kill from frost have not been borne out by the above research.

Woodland irrigation, or Silvaculture, has been practised at selected locations. Conifers maintain water uptake on a year round basis, whereas deciduous species have a high water uptake during the summer months with a relatively low uptake rate in the winter. Forest crops generally have low nutrient uptake rates compared to forage or fodder crops.

Public health concerns in effluent irrigation systems are as follows:

.1 Pathogenic bacteria and viruses present in wastewater that may be transmitted directly or indirectly to higher biological species including man.

.2 Buildup of toxic constituents in crops grown for consumption.

The question of health risks resulting from the use of land application schemes is a complex one, and sufficient data are not available to show whether or not land treatment systems present a greater or lesser risk than conventional wastewater treatment and disposal systems. It should be emphasized, however, that no incidence of disease has been documented from planned and properly operated land treatment systems (20). This does not mean, however, that there is no health risk, and precautions should be taken in the design and use of land application systems to minimize potential health hazards.

One of the critical issues is effluent irrigation in land control and ownership. Control of the land by the municipality or authority operating the system through ownership or long term lease assures continued availability in the long term, albeit, with increased responsibility and cost to the municipality. Private ownership and the sale of effluent to the farmer as a resource increases the long term risk due to changes in land use and agriculture production. As the municipality loses direct control over the amount of effluent applied, it is generally necessary to have a second method of effluent disposal, such to surface water or to rapid infiltration, in order to dispose of any surplus effluent.

In Summerland, it is feasible that a large scale effluent irrigation system could be established on privately owned land presently used for orchard production if the regulations are altered and if sufficient storage and/or alternate method of disposal can be implemented. The second potential irrigation scheme would be a forest irrigation system north and west of

Prairie Valley. For a population of 10,000 persons and assuming an annual average irrigation rate of 600 mm, the net area of irrigable land required for a disposal system utilizing effluent irrigation exclusively would be 275 ha.

4.3.4 Overland Flow Systems

Overland flow systems differ from effluent irrigation systems in that the tail water is collected for ultimate disposal.

Overland flow systems (Figure 4-9) apply wastewater to a smooth, vegetated slope. Approximately 50 to 60 percent of the applied water is collected as runoff at the bottom of the slope, 30 percent is lost by evaporation, and 10 to 20 percent percolates down through the soil. The major mechanisms of treatment are biological degradation of organic materials, physical settling or filtration of suspended solids, nitrification, adsorption of phosphorus on soil particles, and uptake of nutrients by the vegetation. The collected runoff or tail water is either discharged to surface water courses, or reapplied to the land by means of a slow rate or rapid infiltration system.

Overland flow systems have gained little acceptance in the Okanagan due to the problem of ultimate disposal of the tail water and the need for winter storage.

4.3.5 Conversion to Snow

The concept of disposal of wastewater by conversion to snow is relatively new, although some preliminary research was carried out in the 1970's in Colorado (21). More recently, a study program, to be spread over several years, was initiated in Ontario and an interim report has been published (22). Research is currently also underway at Kamloops.

The basic concept of snow conversion has to do with the conversion of secondary treatment effluent to artificial snow using a pumping system to supply effluent to a snowmaking gun that is furnished with compressed air from air compressors. Pressurized effluent is mixed with compressed air and then blown into the atmosphere by the snowmaking gun. Expansion of the compressed air aids in cooling the water, thus enabling ice crystals (artificial snow) to form. Snow thus formed is blown over the disposal area to a depth of a few meters.

Due to the natural heat production of the ground, the temperature of the snow-soil interface will sooner or later be high enough to melt the now, possibly over a prolonged period of time, depending on the ambient temperature and the depth of snow. The snow pack application site characteristics should be selected so as to ensure that the soil will accept the snow melt water. Snow pack areas would need to be reasonably flat to provide snow storage over the winter without surface runoff. Possibly some sites that do not have deep natural drainage could be provided with underdrains to ensure controlled collection of the renovated groundwater percolate. In this case, a suitable ultimate disposal method must be available, such as disposal to a creek or lake.

The process of treatment and removal of pollutants from the wastewater snow is not fully understood but can be understood in part from known phenomenon. When water freezes, the ice crystals that form tend to exclude any impurities. It is believed that the impurities are trapped between the ice crystals and that during the melting of the snow the melt water carries the impurities from throughout the snow pack to the soil below. Thus, through physical action and through biological destruction both conservative and degradable pollutants can be reduced within the snow pack and/or may be transferred to the soil percolate (22).

Although disposal through conversion to snow may hold some promise for future use at small winter oriented communities such as ski resorts, its feasibility is still under research and review, and it cannot be considered as a proven disposal method at the present time. In any event, its practicability for disposing of a significant amount of treated wastewater in the District of Summerland context appears to be quite limited.

4.3.6 Disposal to Surface Waters

Disposal of treated effluent to surface waters is a common method of effluent disposal.

In the Summerland situation, disposal to the various small creeks is not feasible due to the low flows and the discharge into the shallow lake shore area. Disposal of effluent into Okanagan Lake by a deep outfall would thus be required.

Effluent discharged to a lake via a deep outfall is diluted and dispersed by the jet action of the effluent leaving the diffuser ports and the thermal density difference between the warmer effluent and colder lake water.

Effluent discharged to the lake would require a high degree of treatment. Total phosphorus removal of 95% or about 0.5 mg/L effluent concentration would be necessary, requiring advanced wastewater treatment and filtration.

As with land disposal, disposal of wastewater effluent to surface water is not without potential risks. Infectious agents such as bacteria, viruses, and parasites are present in raw wastewater. In addition, toxic inorganic and organic chemicals may be present from both industrial and household activities. Although, advanced wastewater treatment removes a very high percentage of the above constituents, it is acknowledged that direct reuse for human consumption poses an unacceptable degree of risk. Surface water disposal thus relies on further dilution, and in the some cases die-away or chemical degradation in the receiving water, to reduce the constituents to near background levels.

In comparing the health risks of land disposal to surface water disposal, it can be stated that both alternatives when well designed, maintained, and operated provide a large measure of safety for public health (27). Land disposal systems utilizing effluent irrigation in general offers greater protection against parasites and viruses, trace metals, nitrate, trace organics, and halogenated organics based on the assessment of dose response and probable risk.

4.4 REGIONAL MANAGEMENT

Regional wastewater management, in this situation, refers to the collection of raw wastewater from the District of Summerland and pumping it to the City of Penticton sewerage system.

The City of Penticton employs an advanced wastewater treatment process with ultimate discharge to the channel between Okanagan and Skaha Lakes. The plant is currently being upgraded to employ both phosphorus and nitrogen removal and long term plans call for disposal of a portion of the effluent by irrigation.

Regional wastewater management offers a number of advantages:

.1 A single treatment facility offers economy of scale. Both the capital and operating cost per litre of wastewater treated is reduced relative to the use of two separate plants.

.2 The discharge of effluent to either the lake or to the land in the Summerland area would be eliminated. This is attractive in reducing the phosphorus loading to Okanagan Lake.

Disadvantages of a regional system includes:

.1 An increased quantity of effluent would be discharged to the Okanagan River channel north of Skaha Lake increasing the nutrient load to the lake.

.2 Components of the City of Penticton sewerage system may require upgrading in capacity to handle the increased flow.

In summary, regional wastewater management merits consideration. The economics, including cost sharing of capital improvements and operation with the city, appears to be of a similar order of magnitude to a community system serving Summerland alone. Precedents have been set elsewhere in the Okanagan for acceptance of wastewater from outside municipal boundaries. Further evaluation is proposed in Stage II.

TABLE 4-1

RELATIVE CHARACTERISTICS OF ALTERNATIVE SEWERS

SEWER TYPE	IDEAL TOPOGRAPHY	CONSTRUCTION COST IN ROCKY HIGH GROUND WATER SITES	SULFIDE POTENTIAL	MINIMUM SLOPE OR VELOCITY REQUIRED	O/M REQUIRE-MENTS	IDEAL POWER REQUIREMENTS
SDG	downhill	moderate	high	no	low-mod	none
STEP	uphill	low	high	no	mod-high	low
GP	uphill	low	mod-high	yes	mod-high	moderate
Vacuum	flat	low	low	yes	high	high
Conven-tional	downhill	high	moderate	yes	moderate	none
SDG-STEP	undulating	low-mod	high	no	moderate	low
Conv-GP	undulating	mod-high	moderate	yes	mod-high	low-mod
Conv -Vac	undulating	mod-high	low-mod	yes	high	mod-high

SDG - Small Diameter Gravity.
STEP - Septic Tank Effluent Pumping.
GP - Grinder Pump.
Conv-GP - Conventional-Grinder Pump Combined.
Conv-Vac - Conventional-Vacuum Combined.

TABLE 4-2

TYPICAL COLLECTION SYSTEM COSTS

AREA	ESTIMATED LENGTH OF SEWERS (km)	ORDER-OF-MAGNITUDE COST* ($)
Lower Trout Creek	7.5	2,000,000
Town Centre	25.0	5,000,000
Lower Town	4.0	1,200,000

* Costs are for collection only. Costs for pumping to a treatment plant site, the treatment plant, and the disposal system are not included.

TABLE 4-3

ESTIMATED EFFLUENT QUALITY FOR VARIOUS TREATMENT PROCESSES*

PROCESS	BOD_5 (mg/L)**	SUSPENDED SOLIDS (mg/L)	PHOSPHORUS (mg/L)	NITROGEN (mg/L)
Conventional Activated Sludge	10 - 20	10 - 20	8 - 10	25 - 30
Extended Aeration	10 - 20	10 - 50	8 - 10	25 - 30
Oxidation Ditch	10 - 20	10 - 50	8 - 10	25 - 30
Contact Stabilization	10 - 20	10 - 20	8 - 10	25 - 30
Trickling Filter				
Low Rate	30 - 50	30 - 50	8 - 10	25 - 30
High Rate	40 - 70	30 - 70	8 - 10	25 - 30
Rotating Biological Contactor	10 - 20	20 - 30	8 - 10	25 - 30
Aerated Lagoon	20 - 60	30 - 170	8 - 10	25 - 30
Waste Stabilization Pond				
Facultative	20 - 60 (filtered)	20 - 100	8 - 10	25 - 30
Anaerobic	40 - 120 (filtered)	80 - 160	8 - 10	25 - 30
Activated Sludge with In-plant Chemical Addition	5 - 15	5 - 15	1 - 2	25 - 30
Bardenpho	5 - 15	5 - 15	1 - 2	2 - 5
Bardenpho with Filtration	<5	<5	0.3 - 0.5	2 - 5

* Based on a domestic waste of 200 mg/L BOD_5, 200 mg/L suspended solids, 10 mg/L phosphorus, 30 mg/L total mitrogen.

** Unless specified otherwise refers to non-filtered BOD_5.

From Reference 11.

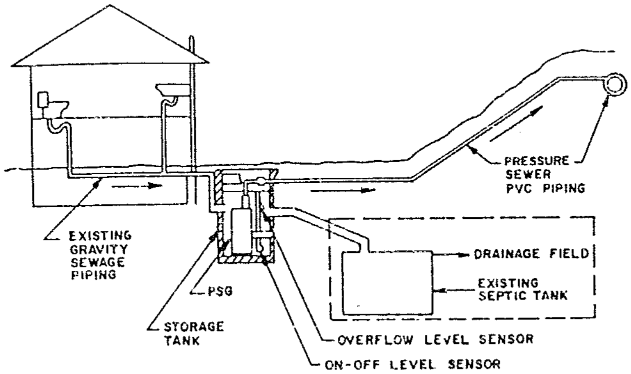
TABLE 4-4

TYPICAL COSTS FOR WASTEWATER TREATMENT

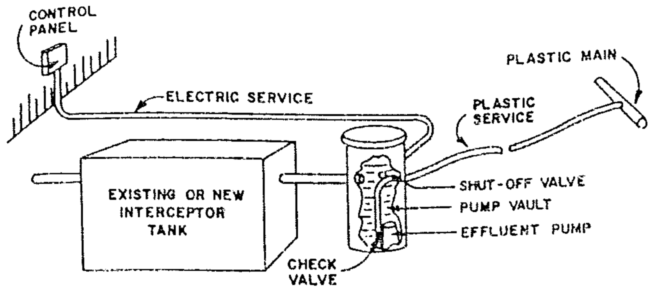
TYPE OF TREATMENT	CAPITAL COST*	
	Design Capacity: 1,000 persons	Design Capacity: 10,000 persons
Advanced Wastewater Treatment including 95% P Reduction	800,000	5,000,000
Activated Sludge Treatment	500,000**	3,000,000
Rotating Biological Contactor	500,000	3,500,000

* ENR = 4500; Costs incl. 25% engineering and contingency allowance.

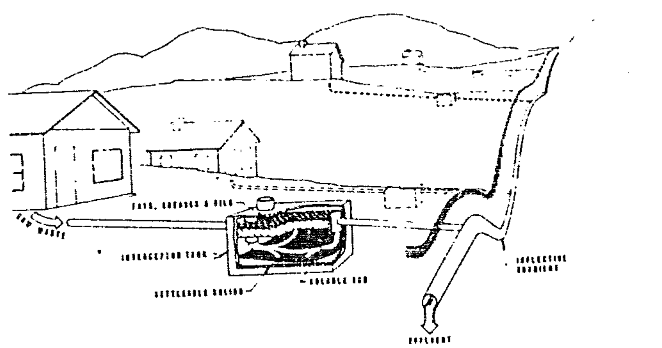
** Extended aeration process.



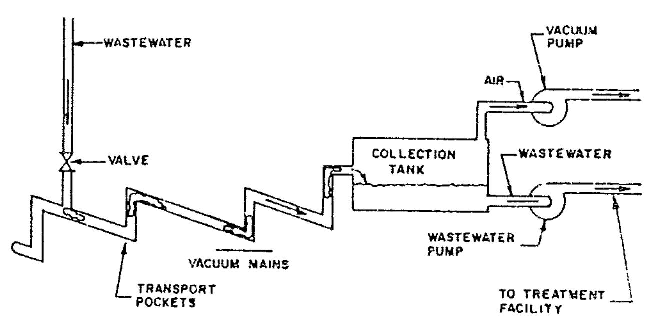
Typical grinder pump installations.



Typical STEP system.



Schematic of small-diameter gravity system.

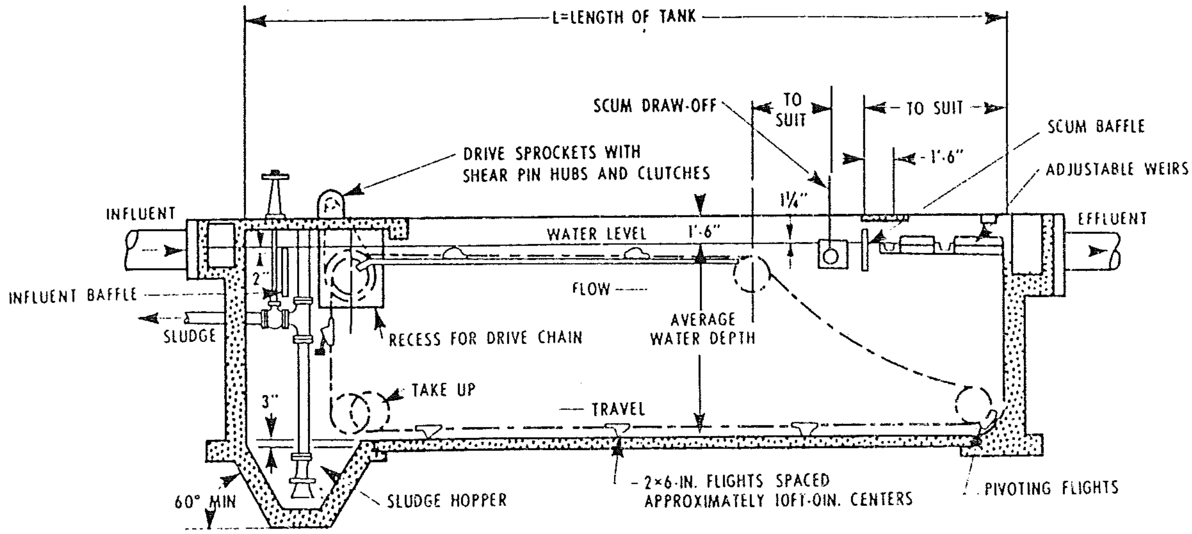


Elements of a vacuum sewer system.

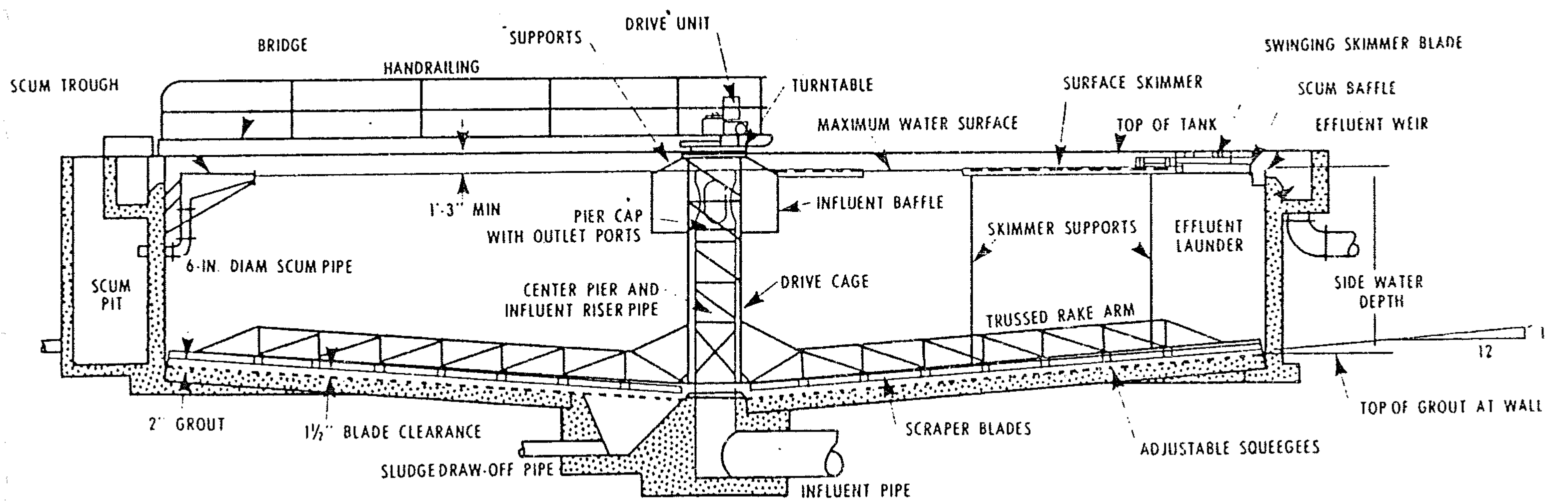
ALTERNATIVE COLLECTION SYSTEMS

FROM REFERENCE 13

FIG. 4-1



TYPICAL RECTANGULAR PRIMARY SEDIMENTATION TANK

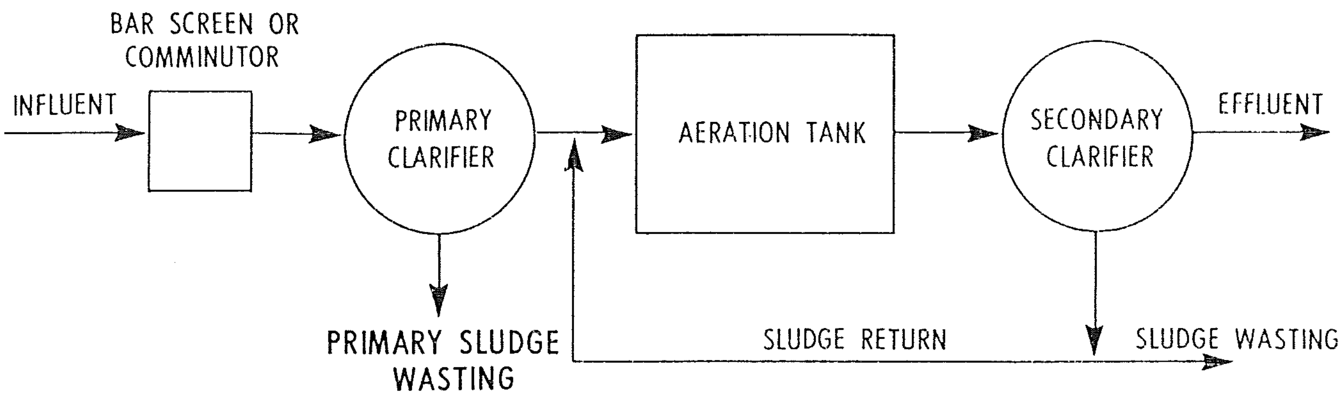


TYPICAL CIRCULAR PRIMARY SEDIMENTATION TANK

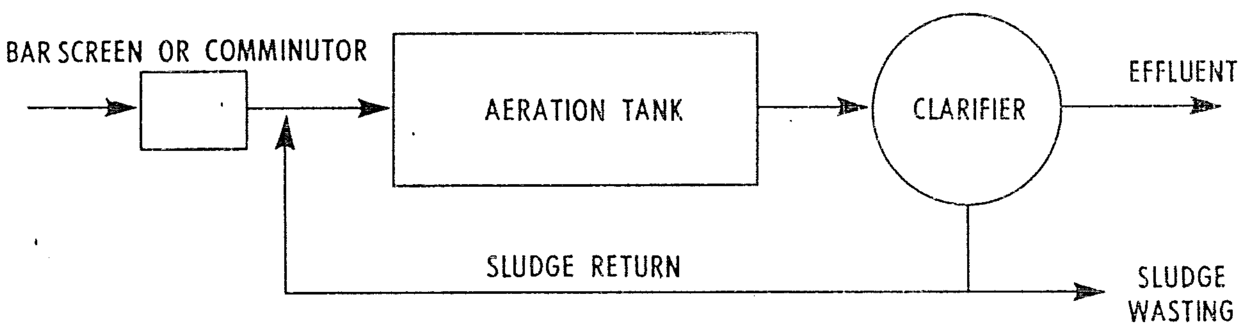
FROM REFERENCE II

PRIMARY TREATMENT

FIG. 4-2



FLOW DIAGRAM OF A CONVENTIONAL ACTIVATED SLUDGE TREATMENT PLANT

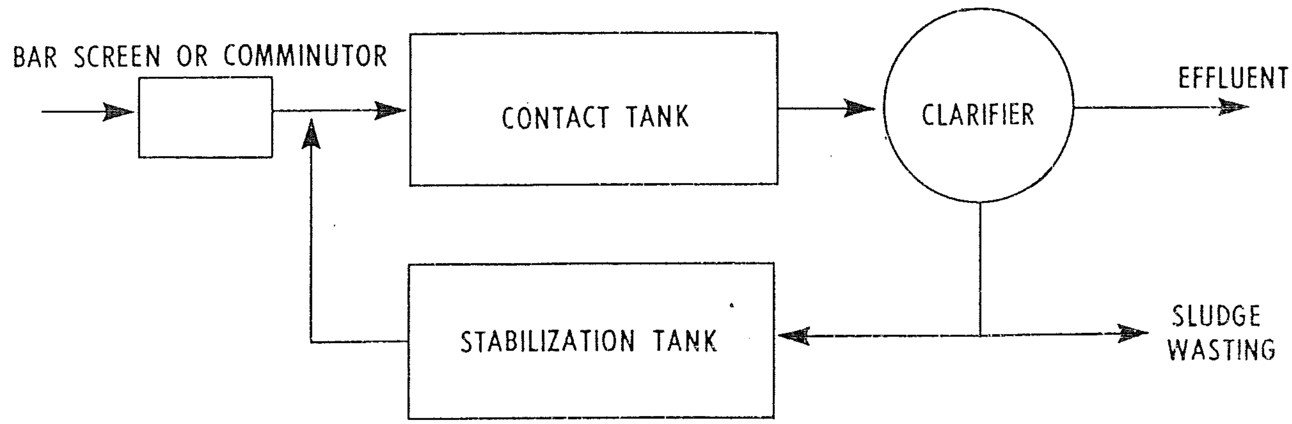


EXTENDED AERATION PROCESS FLOW DIAGRAM

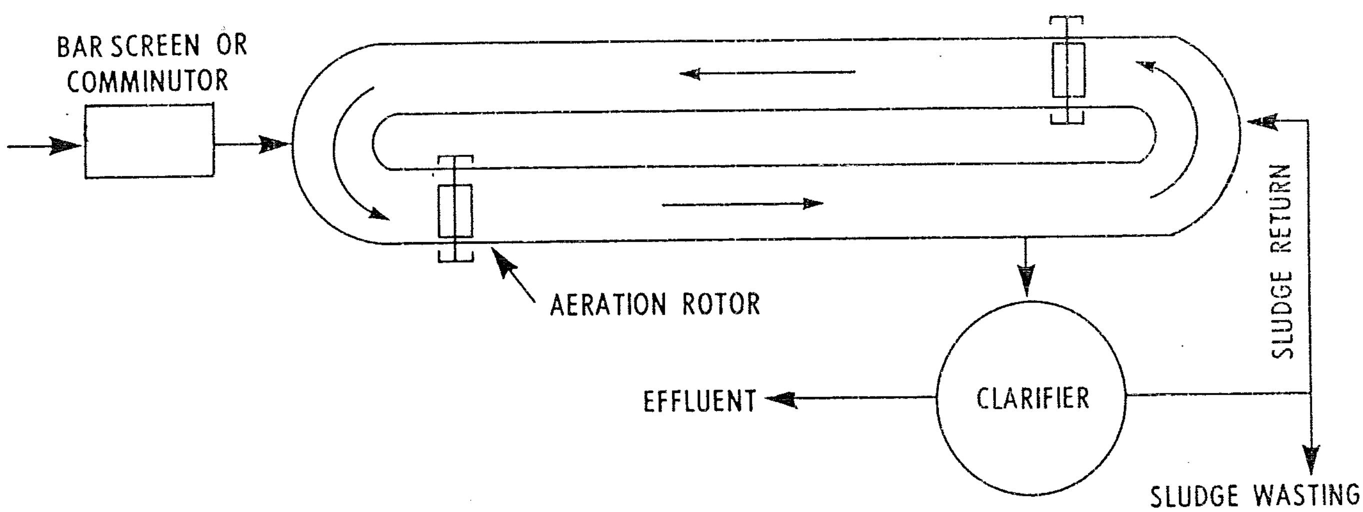
FROM REFERENCES II

BIOLOGICAL TREATMENT PROCESSES

FIG. 4-3



CONTACT STABILIZATION PROCESS FLOW DIAGRAM



OXIDATION DITCH FLOW DIAGRAM

BIOLOGICAL TREATMENT PROCESSES

FROM REFERENCE II

FIG. 4-4

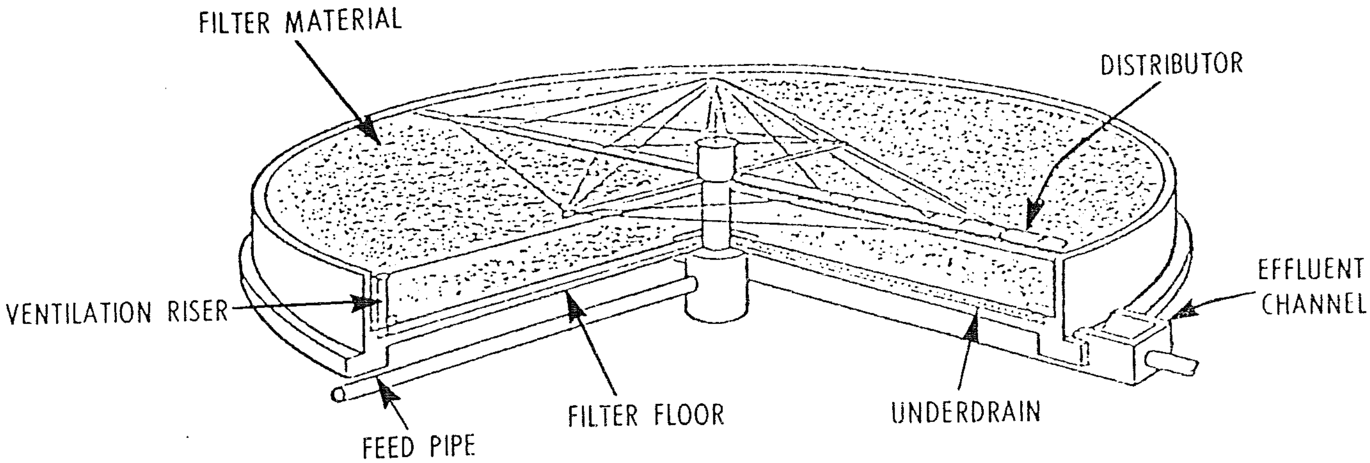
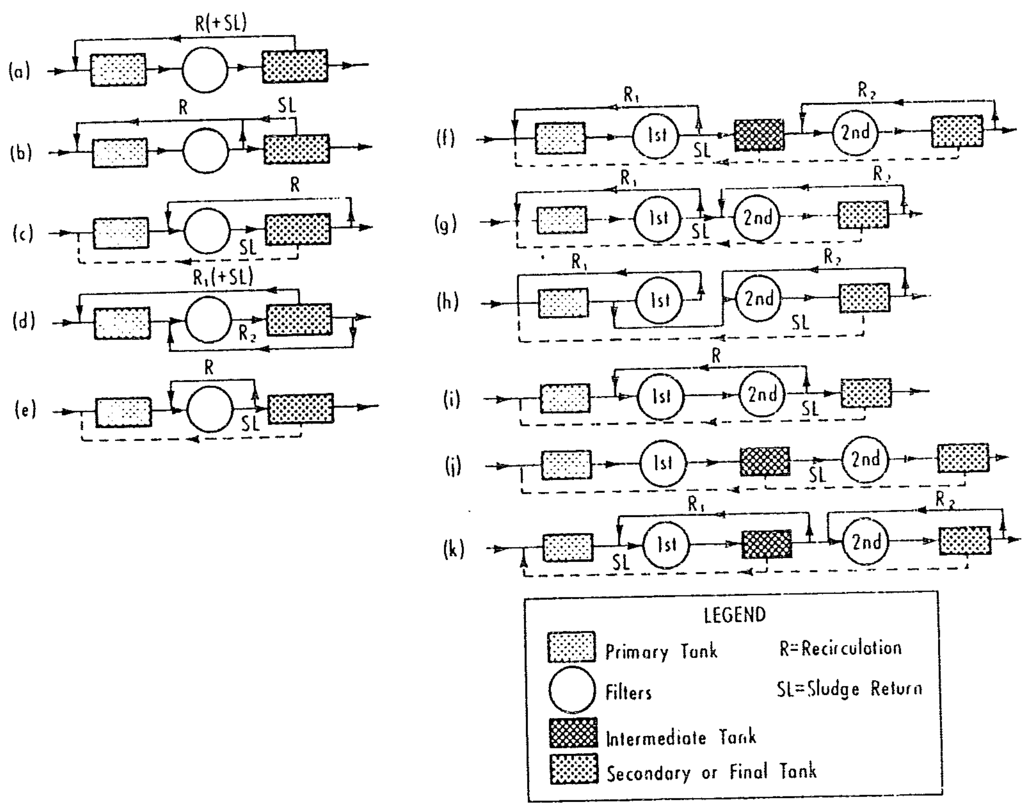


FIGURE 47 TRICKLING FILTER CROSS SECTION

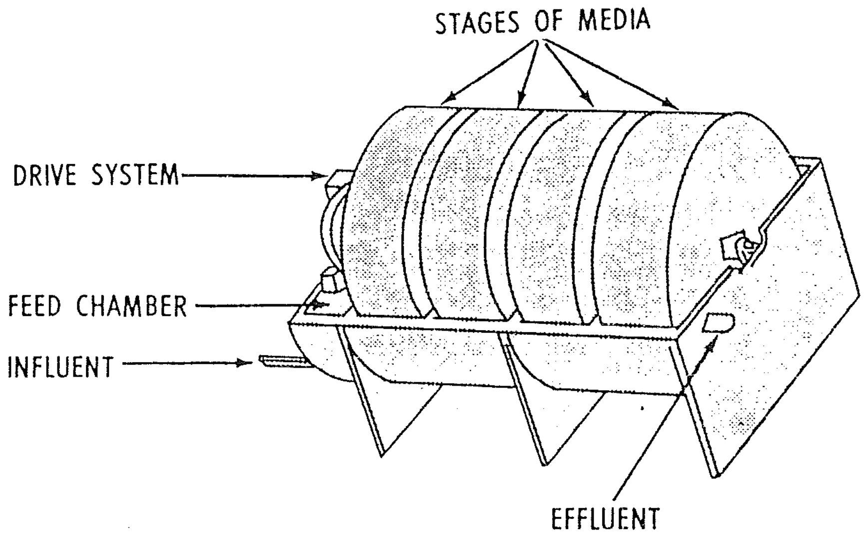


FLOW DIAGRAMS OF SINGLE AND TWO-STAGE TRICKLING FILTER PLANTS

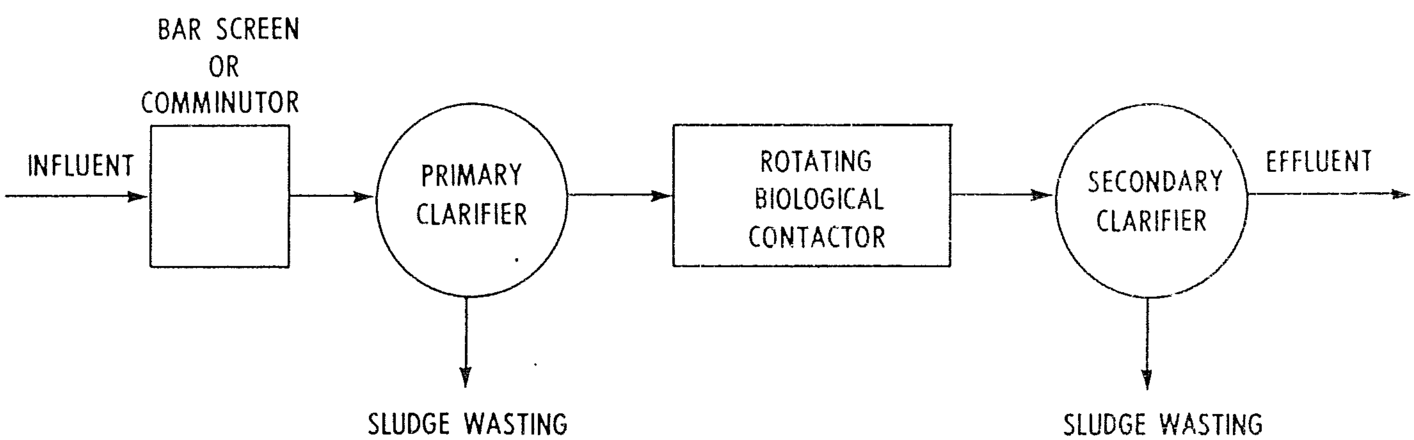
TRICKLING FILTER

FROM REFERENCE II

FIG. 4-5



FOUR-STAGE ROTATING BIOLOGICAL CONTACTOR

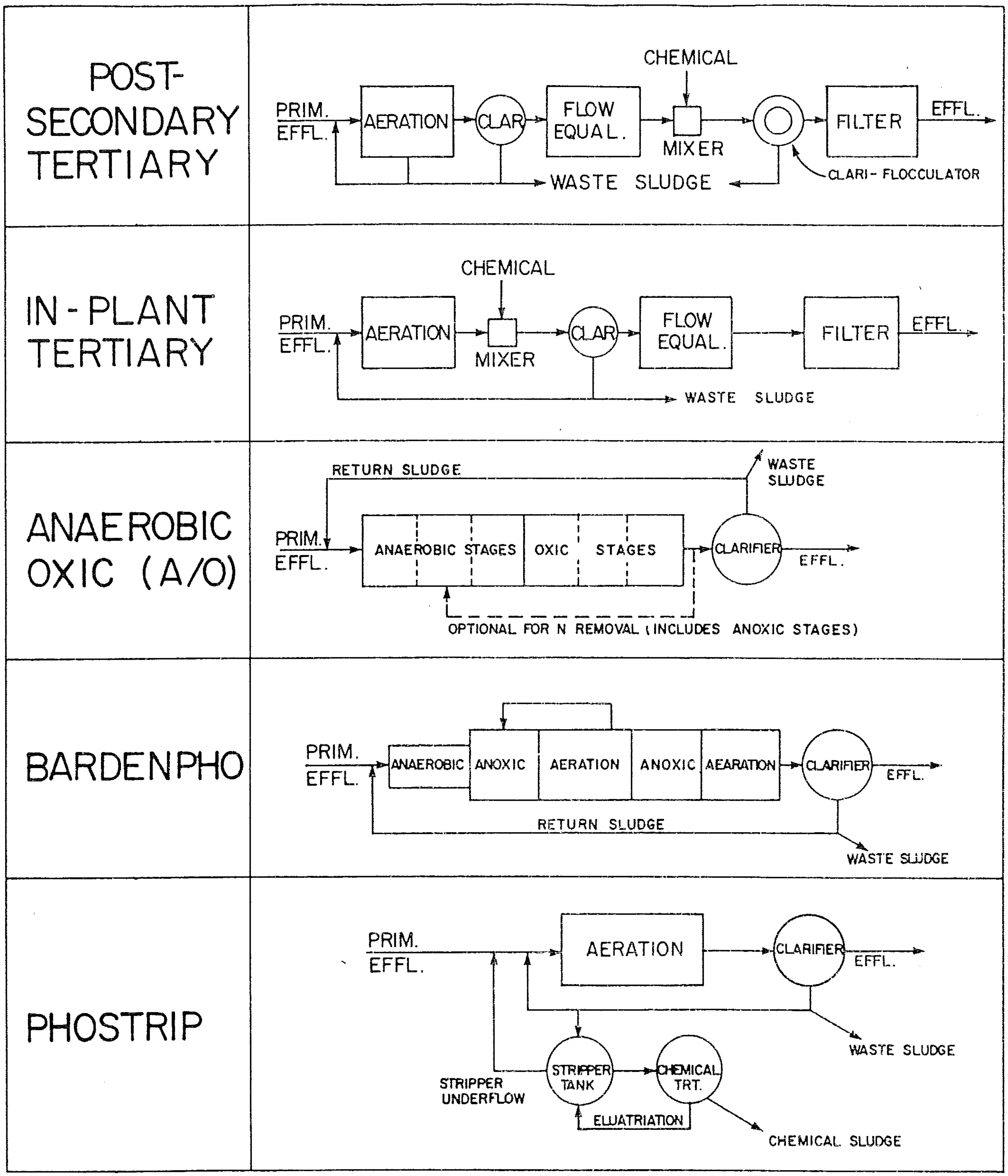


FLOW DIAGRAM OF AN RBC PLANT

BIOLOGICAL TREATMENT CONTACTOR

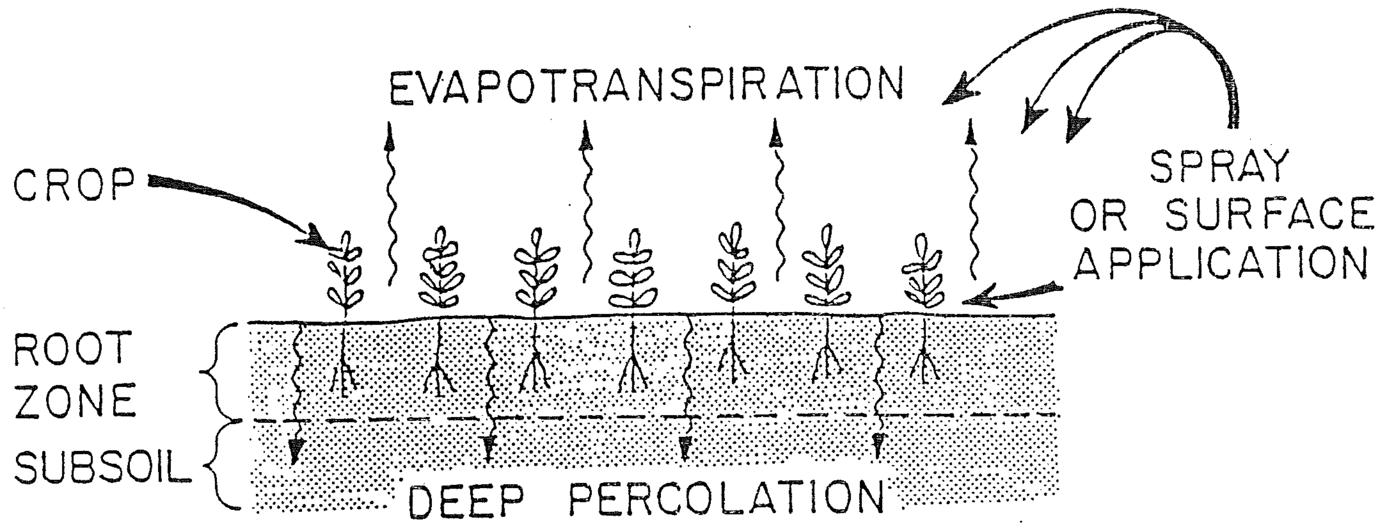
FROM REFERENCE 11

FIG. 4-6

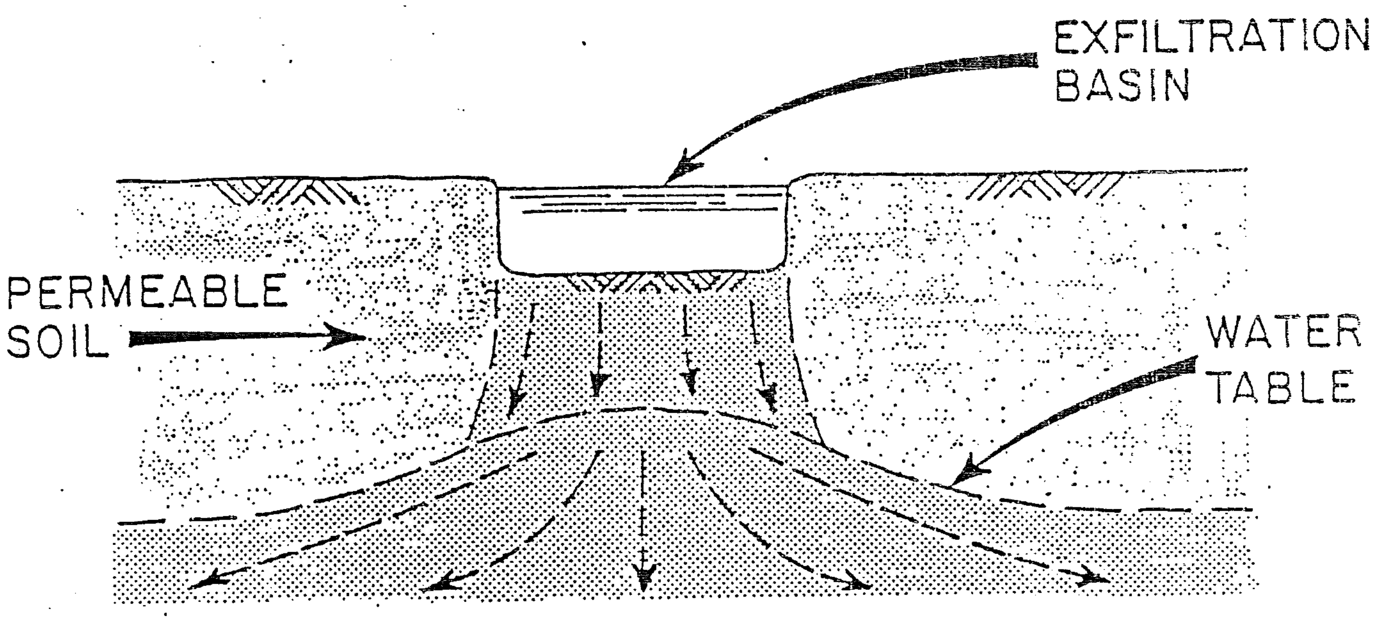


PHOSPHORUS REMOVAL SYSTEMS

FIG. 4-7

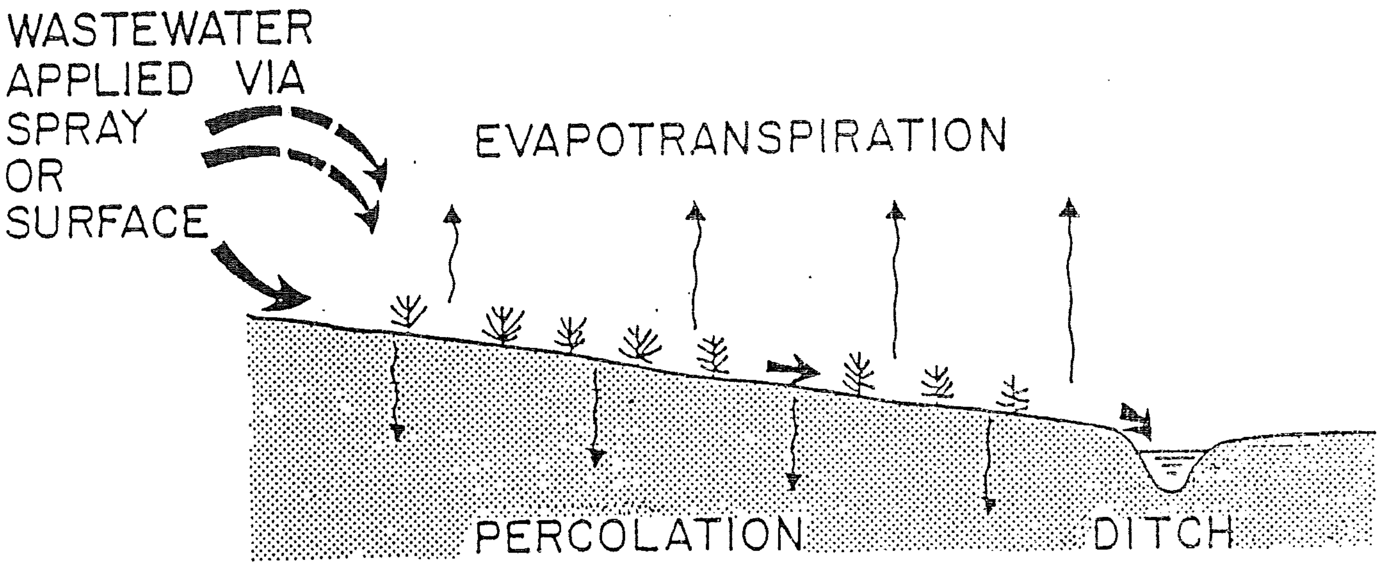


SLOW RATE SYSTEM



RAPID INFILTRATION SYSTEM

FIG. 4-8



OVERLAND FLOW SYSTEM

FIG. 4-9

5.0 PUBLIC INPUT

5.1 PUBLIC INFORMATION MEETING

A public information meeting was held in mid-March 1988 to present the findings to date of the WMP and to solicit input from the public.

The format of the meeting was a one hour presentation followed by a question and answer period and open house.

The meeting was attended by approximately 120 persons.

5.2 QUESTIONAIRE RESULTS

Two questionaires were prepared and distributed during Stage 1. Copies of each questionaire and the results are presented in Appendix B.

The first questionaire was distributed in February 1988 by mail to 78 property owners in the commercial area of the Town Centre. An exceptionally high return rate of 44% was achieved. All of the respondants indicated that their on-site disposal system was performing satisfactorily. In response to the question on the preference for a community sewerage system, 59% indicated that they would like a community system while 32% indicated that they did not want a community system. The remainder (9%) did not answer their question.

A second questionaire was available at the public meeting. A total of 41 forms were returned. Of the persons responding, 46% indicated that they would prefer a community system and 50% said that they would like to see an expansion of the town centre. Virtually all of the respondants (95%) indicated that their on-site system was operating satisfactorily but 46% said they were not happy with the current method of wastewater disposal in Summerland.

6.0 SUMMARY

Wastewater management throughout the district is by on-site disposal. The present (1985) phosphorus loading to Okanagan Lake from domestic wastewater disposal is 1840 kg/yr. This represents an overall phosphorus reduction through on-site treatment of 81%. The goal of the Provincial Government is to achieve a 95% phosphorus removal rate in domestic wastewater discharges to the receiving environment. Clearly then there is need for some improvement in wastewater disposal if the overall goal of the Okanagan Basin is to be achieved.

The combination of high-density on-site disposal and agricultural fertilizer use has caused increasing nitrate levels in the groundwater in the area east of the Town Centre as documented by historical monitoring of Shaughnessy Spring in the Lower Town area. Although, nitrogen is not considered to be a limiting nutrient for algae growth in the main body of Okanagan Lake, continuing increases in the nitrate concentration of the groundwater may cause problems with the fish hatchery that utilizes the spring water.

The use of on-site disposal is limiting development in the Town Centre, Lower Trout Creek, and Lower Town areas. Construction of a community disposal system would allow increased development densities in these areas.

The following areas have been identified as environmentally sensitive in terms of wastewater disposal due to high phosphorus transmission rates to surface waters and/or high density of development. Upgrading options for these areas will be evaluated in Stage II.

.1 Lower/Upper Trout Creek
.2 Town Centre
.3 Lower Town/Peach Orchard Road
.4 Crescent Beach
.5 Garnett Valley

The following areas, although not exhibiting problems at the present time due to the limited development, could become problem areas if development utilizing on-site wastewater disposal is not controlled:

.1 Front Bench
.2 Prairie Valley
.3 Cartwright Mountain

Recommendations will be presented in Stage II regarding development controls and densities for the above areas.

In addition to the identification of environmentally sensitive areas within the district, the Stage I of the WMP presented and evaluated wastewater collection, treatment, and disposal techniques that could be considered for wastewater disposal improvement. The techniques that will be investigated in Stage II for each of the selected areas are summarized in the following table.

TABLE 6-1

SUMMARY OF WASTEWATER MANAGEMENT UPGRADING TECHNIQUES

TECHNIQUE	SELECTED FOR FURTHER INVESTIGATION IN STAGE II				
	LOWER/UPPER TROUT CREEK	TOWN CENTRE	LOWER TOWN/ PEACH ORCHARD RD.	CRESCENT BEACH	GARNETT VALLEY
1.0 ON-SITE DISPOSAL					
. Modification for Enhanced Nutrient Removal	Yes	No[1]	Yes	Yes	Yes
2.0 COLLECTION					
. Conventional Gravity Sewers	Yes	Yes	Yes	Yes	No[2]
. Pressure Sewers	Yes	No[3]	Yes	Yes	No[2]
. Vacuum Sewers	No[4]	No[4]	No[4]	No[4]	No[2]
. Small Diameter Gravity Sewers	Yes	No[3]	Yes	Yes	No[2]
3.0 TREATMENT					
. Preliminary Treatment	No[5]	No[5]	No[5]	No[5]	No[2]
. Primary Treatment (Community Septic Tank)	Yes	Yes	Yes	Yes	No[2]
. Biological Treatment					
- Fixed Growth Systems	Yes	Yes	Yes	Yes	No[2]
- Suspended Growth Systems	Yes	Yes	Yes	Yes	No[2]
. Phosphorus Removal					
- Chemical Precipitation	Yes[6]	Yes[6]	Yes[6]	Yes[6]	No[2]
- Luxury Uptake, i.e., Bardenpho	Yes[6]	Yes[6]	Yes[6]	Yes[6]	No[2]
. Nitrogen Removal					
- Nitrification/ Denitrification	Yes[6]	Yes[6]	Yes[6]	Yes[6]	No[2]
- Ion-exchange	No[7]	No[7]	No[7]	No[7]	No[2]
- Air-stripping	No[7]	No[7]	No[7]	No[7]	No[2]
- Breakpoint Chlorination	No[7]	No[7]	No[7]	No[7]	No[2]
. Nutrient Removal by Polishing Ponds	No[8]	No[8]	No[8]	No[8]	No[2]
. Disinfection	Yes	Yes	Yes	Yes	No[2]
4.0 DISPOSAL					
. Subsurface Fields	Yes	No[1]	Yes	Yes	No[2]
. Rapid Infiltration	Yes	Yes	Yes	Yes	No[2]
. Effluent Irrigation	Yes	Yes	Yes	Yes	No[2]
. Overland Flow	No[9]	No[9]	No[9]	No[9]	No[2]
. Conversion to Snow	No[10]	No[10]	No[10]	No[10]	No[2]
. Okanagan Lake	Yes	Yes	Yes	Yes	No[2]
5.0 REGIONAL SEWERAGE SYSTEM	Yes	Yes	Yes	Yes	Yes

NOTES

1 Insufficient area for tile fields in commercial area.

2 Density of development is too low for a community collection, treatment, and disposal system.

3 High density of development in the commercial area favours the use of conventional gravity sewers.

4 Vacuum sewers are rejected due to high cost and complexity.

5 Does not provide a sufficient degree of treatment by itself.

6 With disposal to Okanagan Lake.

7 Rejected due to operational problems and/or high cost.

8 Rejected due to inconsistent cold weather performance.

9 Rejected due to the need for winter storage and difficulty with tailwater disposal.

10 Rejected due to inconsistent performance and lack of suitable climate/ disposal area.

LIST OF REFERENCES

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15. Neil, J., The Harvest of Biological Production as a Means of Improving Effluent from Sewage Lagoons, Research Report No. 38, Environment Canada and Ministry of Environment, Ontario (1976).

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23. Letter dated March 8, 1988, to Associated Engineering from P.F. Epp, P.Ag., Ministry of Environment, Okanagan Water Quality Control Project.

24. Ministry of Environment, Assessment of Water Resources at the Summerland Trout Hatchery - Report and Recommendations, September 1986.

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27. United States Environmental Protection Agency, An Approach for Comparing Health Rights of Wastewater Treatment Alternatives, MCD-41, September 1979.

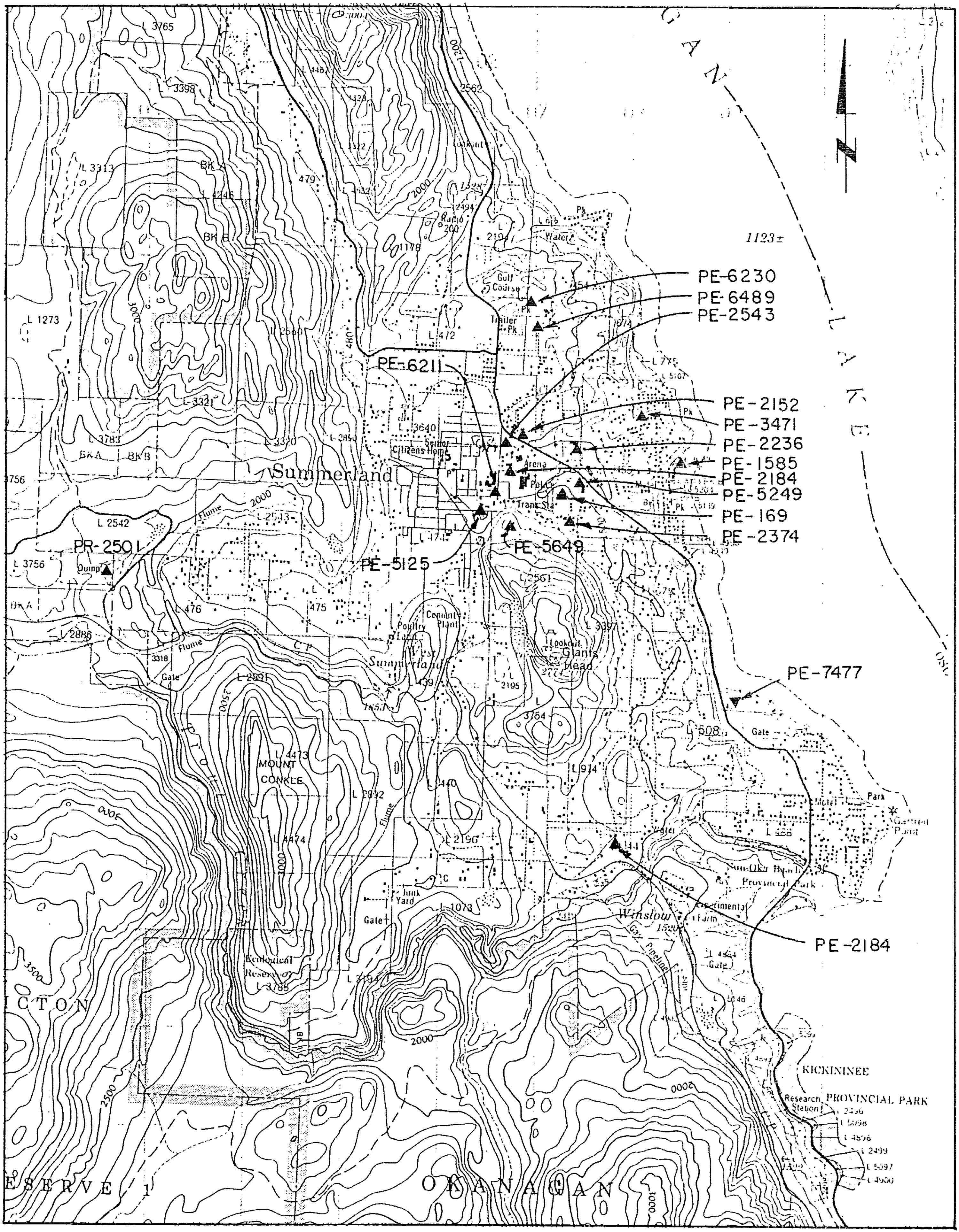
28. Epp, P.F., Composite Phosphorus Transmission Mapping, Map Sheets 82E052 and 82E062, Ministry of Environment and Parker, 1987.

29. Engineering Science Inc., Monterey Wastewater Reclamation For Agriculture, Final Report, Monterey Regional Water Pollution Control Agency, April 1987.

APPENDIX A

SUMMARY OF WASTE MANAGEMENT BRANCH PERMITS

ASSOCIATED ENGINEERING



WASTE MANAGEMENT BRANCH PERMITS

SUMMARY OF WASTE MANAGEMENT BRANCH PERMITS

PERMIT	PERMITEE	TYPE OF WASTEWATER	QUANTITY (m^3/d)	TYPE OF SYSTEM
PE-169	Summerland Hospital Society	Domestic	54.5	Package plant, sand filter, tile fields
PE-1585	B.C.B.C.	Fish hatchery	4550.0	Solids removal, outfall to Okanagan Lake
PE-2152	Smith, L.A.	Floor washing from service station	0.5	Sump, grease trap, rock pit
PE-2156	Summerland Sweets Ltd.	Process and cooling water from fruit concentrate plant	9.0	Settling tank, rock pit, exfiltration lagion
PE-2184	Lake Area Co-op Grower Association	Process and cooling water from fruit packing operation	49.2	Settling tanks, rock pits
PE-2236	J. Pattison Enterprises Ltd.	Process and cooling water from fruit and vegetable cannery	19.8	Screening, seepage pits, effluent irrigation, outfall to Eneas Creek (cooling water only)
PE-2374	J. Pattison Enterprises Ltd.	Process and cooling water from fruit and vegetable cannery	100.0	Screening, seepage pit, effluent irrigation
PR-2501	District of Summerland	Solid waste landfill and septage/holding tank disposal	N/A	Infiltration/ evaporation basin for septage disposal
PE-2543	Fischer, H.	Laundromat Wastewater	16.0	Lint trap, settling tank, seepage pit

SUMMARY OF WASTE MANAGEMENT BRANCH PERMITS (Cont'd)

PERMIT	PERMITEE	TYPE OF WASTEWATER	QUANTITY (m^3/d)	TYPE OF SYSTEM
PE-3471	District of Summerland	Domestic from trailer park and campground	68.2	Septic tank and tile fields
PE-5125	Parkdale Place Housing Society	Domestic and laundromat wastewater	55.3	Package plant/tile fields and lint trap/septic tank/ dry pit
PE-5249	Metropolitan Developments Ltd.	Laundromat wastewater	9.0	Septic tank, lint screens, tile field
PE-5649	Park Dale Resorts Inc.	Domestic from hotel, restaurant, tavern complex	37.0	Treatment water, filters, chlorination, deep well injection
PE-6211	Chinook Consulting Ltd.	Car wash effluent	1.7	Gravity oil separator, dry pits
PE-6230	Sumac Ridge Estate Winery Ltd.	Process water from winery	3.0	Septic tank, rock pit
PE-6489	Frimet, L.	Domestic from mobile home/condo complex	50.0	Septic tank, tile field
PE-7477	276970 B.C. Ltd.	Domestic from campsite	78.0	Septic tank, tile field

APPENDIX B

QUESTIONAIRE RESULTS

ASSOCIATED ENGINEERING

QUESTIONNAIRE

ON-SITE WASTEWATER DISPOSAL SYSTEMS
DISTRICT OF SUMMERLAND WASTE MANAGEMENT PLAN

The District of Summerland is currently preparing a Waste Management Plan to lay the groundwork for wastewater treatment and disposal planning for the next 20 to 40 years. The purpose of this questionnaire is to assist in gathering base data for the plan. Please return this form to the district office. Your assistance is greatly appreciated in this matter.

Street Address: ______________________________

Type of Occupancy (i.e. single-family residential, multi-family residential, commercial, other) ______________________________

If non-residential, state description of business ______________________________

Do you have one of the following?	Yes	No
Septic tank and tile field	☐	☐
Septic tank and dry pit	☐	☐
Dry pit only	☐	☐
Package treatment plant and tile field	☐	☐
Other	☐	☐

What is the age of the above system? ______Year(s)

Is it operating satisfactorily?	☐	☐
Would you prefer a community sewerage system?	☐	☐

PLEASE RETURN THIS FORM TO THE DISTRICT OF SUMMERLAND OFFICE AT 9533 MAIN STREET, SUMMERLAND, B.C., VOH 1ZO

If you would like further information, please contact:

George Redlich, District of Summerland - 494-6451
Rick Corbett, Associated Engineering (B.C.) Ltd. - 293-1411

Mo.1/VD92-QUESTNR.1

RESULTS OF QUESTIONAIRE

TOWN CENTRE COMERCIAL
PROPERTY OWNERS

	Number	Percentage
Questionaries sent out:	78	--
Questionaires returned:	34	44%
Septic tank and tile field:	14	37%
Septic tank and dry pit:	18	53%
Dry pit only:	--	--
Package treatment plant and tile field:	--	--
Other:	--	--
Do not know:	2	5%
Age of system:		
Average - 13 years		
Minimum - 6 months		
Maximum - 50 years		
Is it operating satisfactorily?		
Yes	33	97%
No	--	--
Undecided	1	--
Would you prefer a community sewerage system?		
Yes	20	59%
No	11	32%
Undecided	3	9%

QUESTIONNAIRE

DISTRICT OF SUMMERLAND
WASTE MANAGEMENT PLAN
STAGE 1

The District of Summerland is currently preparing a Waste Management Plan to lay the groundwork for wastewater treatment and disposal planning for the next 20 to 40 years. The purpose of this questionnaire is to assist in gathering base data for the plan and to allow input by the public. **PLEASE FILL OUT THIS QUESTIONNAIRE AND RETURN IT AT THE PUBLIC MEETING OR TO THE DISTRICT OFFICE.**

Location of Dwelling (i.e. Trout Creek, Town Centre, etc.) ____________________

Type of Dwelling (i.e. single family, multi-family, etc. ____________________

Do you have one of the following?	Yes	No
Septic tank and tile field	☐	☐
Septic tank and dry pit	☐	☐
Holding tank	☐	☐

Other ______________________________

What is the age of the above system? ______ Year(s)

	Yes	No
Is it operating satisfactorily?	☐	☐
Would you prefer a community system serving your property?	☐	☐
Would you like to see an expansion of the Town Centre commerical/high density residential area that would be possible with a community disposal system?	☐	☐
Would you be willing to pay for a community sewer system that:		
.1 Served your property?	☐	☐
.2 Served other areas of Summerland?	☐	☐
Are you happy with the current method of wastewater disposal in the District of Summerland?	☐	☐

Comments: ______________________________

____

____

JREC/Mo.2

RESULTS OF QUESTIONAIRE

PUBLIC MEETING NO. 1

	Number	Percentage
Number returned:	41	--
Septic tank and tile field:	35	85%
Septic tank and dry pit:	6	15%
Holding tank:	--	--
Other:	--	--
Do not know:	--	--
Age of system:		
Average - 16 years		
Minimum - 1 months		
Maximum - 60 years		
Is it operating satisfactorily?		
Yes	39	96%
No	1	2%
No response	1	2%
Would you prefer a community system serving your property?		
Yes	18	46%
No	23	54%
Would you like to see expansion of the town centre commercial/high density residential area that would be possible with a community disposal system?		
Yes	23	56%
No	15	37%
No response	3	7%

The District of Summerland, a farming and residential community of some 8,000 persons, is located in the Okanagan Valley of British Columbia (Fig.1).

Wastewater management throughout the district is by on-site disposal utilizing primarily septic tanks and tile fields.

The Okanagan Basin Study in the early 1970's and subsequent updates have identified residential septic tanks/tile fields as a significant phosphorus source in areas where a combination of permeable soils, shallow depth to groundwater, and close horizontal proximity to surface waters allow high phosphorus transmission rates.

The Waste Management Act, introduced in 1982 as a replacement for the Pollution Control Act, introduces the concept of the Waste Management Plan (WMP). A WMP contains provisions or requirements for collection, treatment, handling, storage, utilization and disposal of wastewater or solid waste within the whole or a specified part of a municipality or regional district. Once approved by the Ministries of Environment and Parks and Municipal Affairs, a municipality or regional district is authorized to discharge waste in accordance with the plan.

A streamlined, cooperative process has been established by the ministries to provide for efficient development, review and approval of WMP's. Technical staff of both ministries are intended to work with local officials and their consultants throughout this process. An evaluation committee of senior staff from both ministries has been established to oversee the implementation of this process.

Associated Engineering (B.C.) Ltd. has been engaged by the District of Summerland to assist in the preparation of a WMP.

The WMP will lay the groundwork for wastewater management in the District of Summerland for the next 20 to 40 years. There is a need to consider wastewater being discharged to existing "septic systems" servicing households, multi-family developments, commercial and industrial establishments, campgrounds, etc. throughout the area, and future wastewater disposal needs. The Waste Management Plan would specifically apply to the entire District of Summerland.

The objectives of the WMP are:

- To identify and review the wastewater management alternatives that are capable of adequately removing phosphorus and that are technically available to existing and potential development in Summerland and to select the technically feasible alternatives for detailed analysis.

- To develop discharge criteria for those technically feasible wastewater management options that involve discharge of sewage treatment plant effluent to surface or to land.

- To evaluate the capital and operating costs of these technically feasible wastewater management options, both from an overall cost point of view and on a cost per user per annum basis under alternate funding and cost-sharing formulas.

- To evaluate the environmental, social, public health, engineering, operational and financial advantages and disadvantages of technically feasible wastewater management options.

- To select the most appropriate wastewater management option or mix of options that can be economically achieved and which can be constructed in phases to meet short and long-term environmental goals.

The WMP will be prepared in three stages:

Stage I will outline possible treatment and disposal methods with rough preliminary costs, including ideas received at the first public information meetings.

Stage II will outline the various options with an implementation schedule. The various options will be costed out in detail to give some appreciation of short and long range user costs. The Stage II draft will be presented at a final public information meeting where further public input will be solicited.

Stage III will be a short overview report or executive summary which gives a recommended course of action.

The purpose of the Public Information Meeting No. 1 is to inform the public as to:

- Areas of the District that are considered environmentally sensitive due to high phosphorus transmission to the lake or due to high density development.

- Wastewater management alternatives that are being considered to improve the situation in the above areas.

- Obtain input from the public by way of a written questionnaire and a question and answer session.

The findings of the WMP to date are summarized as follows:

- The present phosphorus loading to Okanagan Lake from domestic wastewater disposal is estimated at 1840 kg/yr. This represents an overall phosphorus reduction through on-site treatment of 81%. Phosphorus transmission from various areas is presented in Table 1.

- The following areas have been identified as environmentaly sensitive in terms of the impact of wastewater disposal and are proposed for evaluation of upgrading options in Stage II.

  .1 Lower/Upper Trout Creek
  .2 Town Centre
  .3 Lower Town/Peach Orchard Road
  .4 Crescent Beach
  .5 Garnett Valley

- The use of on-site disposal is limiting development in the Town Centre, Lower Trout Creek, and Lower Town areas. Construction of a community disposal system would allow increased development densities in these areas.

- Phosphorus transmission to the lake could be reduced by constructing a community wastewater treatment plant with lake disposal or land disposal to achieve a 90 - 95% phosphorus reduction, by modifications to on-site systems to achieve enhanced phosphorus removal, or by connection to a regional sewerage system in Penticton.

The Stage II of the WMP will evaluate the performance, feasibility, and economics of various on-site, community wastewater management systems, and a regional system to achieve a reduced phosphorus transmission to Okanagan Lake.

TABLE 1

DISTRIBUTION OF PHOSPHORUS TRANSMISSION
TO
OKANAGAN LAKE

AREA	PERCENTAGE OF TOTAL P TRANSMISSION TO OKANAGAN LAKE	PERCENTAGE P REMOVAL ACHIEVED
Lower Trout Creek	20	53
Upper Trout Creek	7	70
Paradise Valley/Southwest Summerland	2	93
Front Bench	5	88
Prairie Valley	4	63
Town Centre	29	87
Lower Town/Peach Orchard Rd.		
. Lower Town	7	17
. Peach Orchard Road	7	79
Crescent Beach/Hwy 97		
. Crescent Beach	6	17
. Highway 97	4	79
Garnett Valley	9	66
Cartwright Mtn/North Prairie Valley	<1	88
TOTAL	100	81

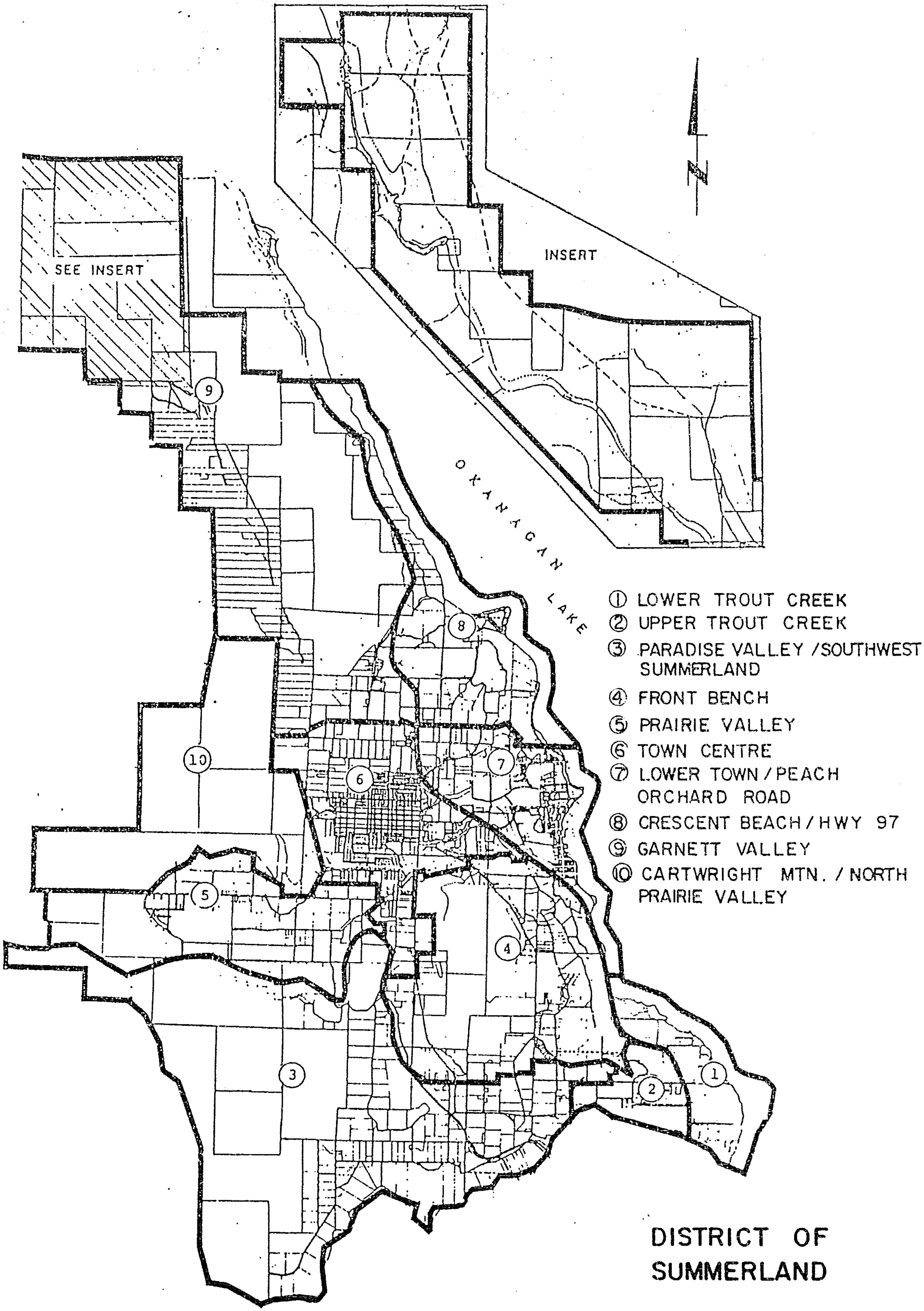

SEE INSERT
INSERT
OKANAGAN LAKE
① LOWER TROUT CREEK
② UPPER TROUT CREEK
③ PARADISE VALLEY / SOUTHWEST SUMMERLAND
④ FRONT BENCH
⑤ PRAIRIE VALLEY
⑥ TOWN CENTRE
⑦ LOWER TOWN / PEACH ORCHARD ROAD
⑧ CRESCENT BEACH / HWY 97
⑨ GARNETT VALLEY
⑩ CARTWRIGHT MTN. / NORTH PRAIRIE VALLEY
DISTRICT OF SUMMERLAND

FIG. I