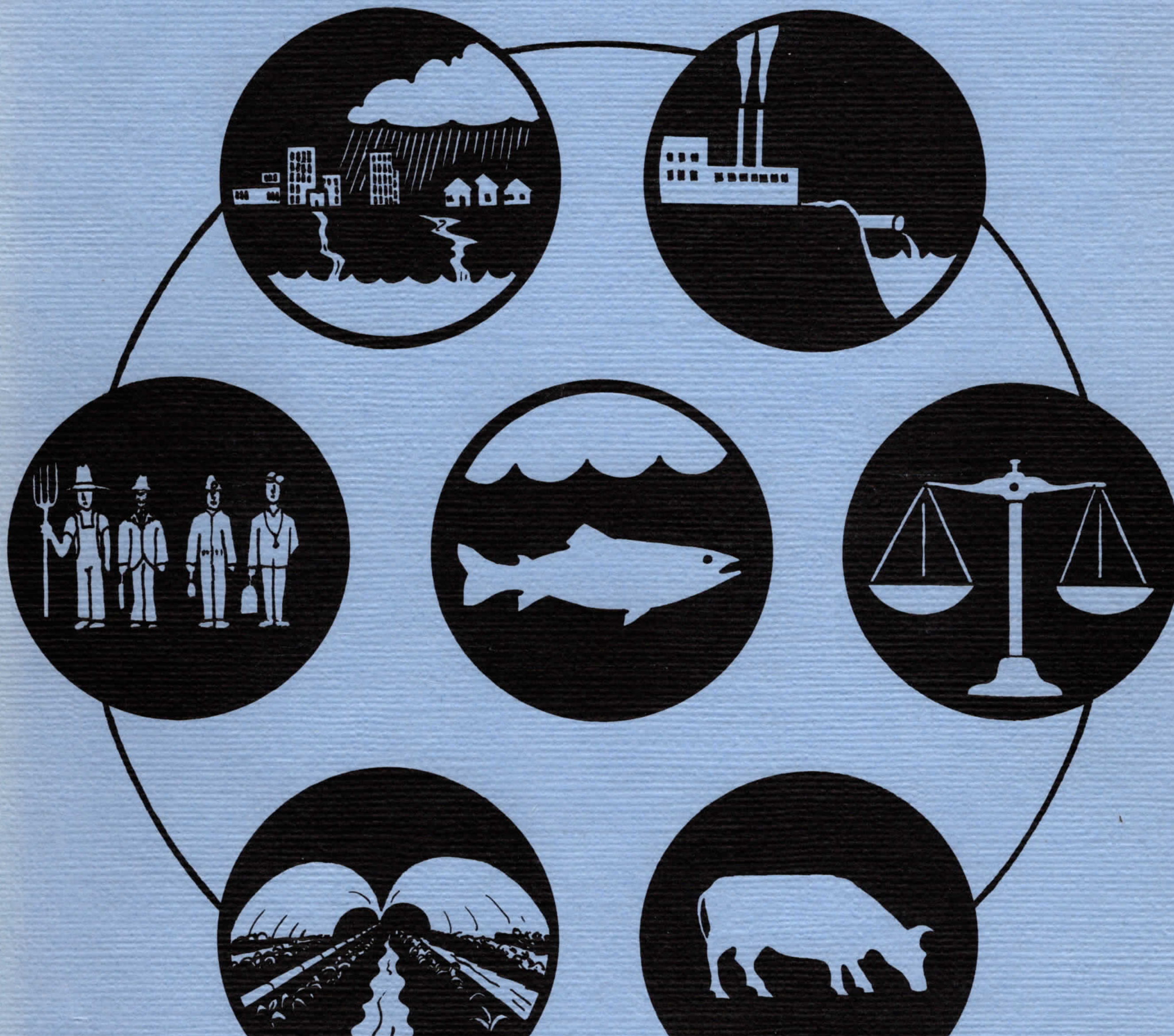
INTERIM REPORT — ENGINEERING

MUNICIPAL AND INDUSTRIAL POINT SOURCE ANALYSIS

WASTEWATER TREATMENT, OPERATION AND MAINTENANCE REQUIREMENTS



Water Quality Management Plan

LARIMER-WELD REGIONAL COUNCIL OF GOVERNMENTS
LOVELAND, COLORADO

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PREPARED BY TOUPS CORPORATION
LOVELAND, COLORADO APRIL, 1977

Larimer-Weld Regional Council of Governments

208 AREAWIDE WATER QUALITY MANAGEMENT PLAN

MUNICIPAL AND INDUSTRIAL POINT SOURCE ANALYSIS

WASTEWATER TREATMENT, OPERATION AND MAINTENANCE REQUIREMENTS

Prepared For

Larimer-Weld Regional
Council of Governments

201 East Fourth Street
Loveland, Colorado 80537

F. A. Eidsness, Jr., 208 Program Director
Terrence L. Trembly, Assistant Director

By

W. Tom Pitts, P.E., Project Director
W. R. Everest, P.E., Project Manager
D. R. Kasper, Ph.D., Project Engineer
W. H. Heller, P.E., Project Engineer

TOUPS CORPORATION

Loveland, Colorado

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

LIST OF TABLES

LIST OF TABLES (Cont.)

LIST OF FIGURES

ABSTRACT

As part of an overall 208 Water Quality Management Plan being developed for the Larimer-Weld Regional Council of Governments, Toups Corporation has completed a point source analysis for 59 separate municipal and industrial wastewater systems. The study and report begins with an analysis of existing treatment facilities in the region, determination of existing and projected wastewater characteristics, utilizing data from a comprehensive sampling program; and an analysis of infiltration/inflow in collection systems. Based upon optimum future development programs, wasteloads have been projected in terms of flow and composition. Consideration has been given to alternative disposal options, including: treatment and discharge into surface waters, land application, and reuse. Federal and State standards for waste discharge have been reviewed, with emphasis on proposed suspended solids limitations. These proposed standards recognize the need to retain stabilization pond systems for many small communities because of their inherent economical and functional advantages. The adequacy of existing facilities has been determined in terms of compliance with standards and capacity for future growth. Alternative plans for treatment have been developed, including three categories of pond systems, three optional pond upgrading processes (intermittent sand filters, rock filters, and polishing ponds), and five categories of mechanical treatment systems. Evaluation has also been made of existing wastewater system operation and maintenance conditions and problems, including: limited community budgets, insufficiently trained staff, and lack of incentive to improve effluent quality because of limited enforcement. Recommended treatment facilities for small communities include aerated stabilization ponds (compliance with proposed EPA standards), and oxidation ditch facilities, should it be necessary to meet 30:30 standards. The capital cost of projected wastewater treatment facilities in the region approximate $5 million. Based on a review of alternative programs for improved operation and maintenance, it is recommended that the concept of a cooperative, cost-sharing O&M system on a regional basis be more thoroughly explored.

For outlying communities in the Larimer-Weld region, EPA goals for Best Practicable Waste Treatment Technology (BPWTT) can be met by application of Best Waste Stabilization Pond Technology (BWSPT) for pond treatment systems, secondary treatment levels for mechanical treatment systems, and implementation of improved facility operation and maintenance programs.

1.0 EXECUTIVE SUMMARY

This planning element of the Larimer-Weld 208 Water Quality Management Plan analyzes point sources of pollution from 59 separate municipal and industrial wastewater systems in the outlying areas of the region. The study consists of: analysis of existing facilities, wastewater characteristics, infiltration/inflow problems, projected wasteloads, alternative waste disposal options, waste discharge standards, adequacy of existing facilities, treatment options, existing facility operation and maintenance conditions, and development of programs for wastewater systems upgrading and expansion, and improved operation and maintenance procedures.

Treatment facilities in the outlying areas range in capacity from the 1.65 million gallon per day (mgd) oxidation ditch facilities at Berthoud, to a 0.01 mgd activated sludge treatment plant in the Red Feather Lakes area. More than half of the plants consist of aerated and non-aerated stabilization pond systems, with the balance being mechanical plants, principally extended aeration package plants. Treatment plants in the urban triangle area (Fort Collins-Greeley-Loveland) are principally mechanical facilities (activated sludge, biofiltration), and a few aerated stabilization pond systems. The majority of wastewater collection systems in the region are not characterized by excessive infiltration/inflow (I/I). However, significant I/I problems do exist in several communities, and system rehabilitation could decrease hydraulic loads on these facilities. Wastewaters generated in the area are typically of weak or medium strength.

Population projections for each community in the study area have been made. Total population in the outlying area is expected to increase from approximately 40,000 presently to approximately 90,000 by the year 2000. Corresponding waste flows are projected from 3.8 mgd to 10.4 mgd.

Alternatives for best practicable waste treatment are considered, including: treatment and discharge into surface waters, land application and reuse. The majority of wastewaters generated in the Larimer-Weld region are discharged to surface waters. However, analysis of the water resources of the region indicates that the majority of surface waters are diverted for agricultural irrigation purposes. Therefore, the existing surface water discharge techniques utilized in the region are actually indirect forms of both land treatment and reuse. In addition, the existing waste management program results in resource recovery of nutrients by irrigation.

EPA has recently proposed a relaxation of suspended solids limitations in discharge standards of communities which utilize stabilization pond systems. The proposed standards recognize the need to retain pond systems for many smaller communities because of their inherent economical and functional advantages. Adoption of the regulations would allow the EPA Regional Administrator or state agency to grant a variance with respect to suspended solids limitations of secondary treatment requirements defined in NPDES permits. Pond systems would still be required to meet an effluent quality achievable by "Best Waste Stabilization Pond Technology" (BWSPT). BWSPT is defined as a suspended solids value which is equal to the effluent concentration achieved 90 percent of the time within a state or appropriate contiguous geographical area, by waste stabilization ponds that are achieving the levels of effluent quality established for BOD (30/45 mg/l). Adoption of the relaxed standards will result in significant cost reductions for future treatment facilities in the region.

Many of the treatment facilities in the outlying communities do not comply with waste discharge standards. This is caused by insufficient capacity and/or improper operation and maintenance. Excess capacity of outlying facilities presently exists for only about one-third of the growth projected by the year 2000. Existing O&M conditions are characterized by limited community budgets, insufficiently trained staff, and lack of incentive to improve effluent quality because of limited enforcement.

Eleven alternative treatment processes have been considered, including three categories of pond systems, three optional pond upgrading processes, and five categories of mechanical treatment systems. The recommended treatment process for small communities is aerated stabilization ponds to comply with proposed EPA standards for BWSPT. Should it be necessary to continue to comply with existing secondary treatment standards in outlying communities, mechanical treatment systems using oxidation ditches are recommended.

Based on the limitations and processes discussed above, and assuming the proposed EPA pond standards are adopted, costs have been developed for all required treatment facilities improvements for small communities in the Larimer-Weld region. A summary of the costs is presented in Table 1.0-A. As shown in the table, total capital costs amount to $4,800,000. If the proposed pond standards are not adopted, capital costs would increase to $8,043,000.

TABLE 1.0-A. PROJECTED COSTS - WASTEWATER TREATMENT FACILITIES IMPROVEMENTS - SMALL COMMUNITIES - LARIMER-WELD REGION

INDEX NO.	AGENCY	YEAR OF CONST.	RECOMMENDED PROCESS (f)	CAPITAL COST ($1000) (d)	AVG. O&M COST ($1000/YR) (e)
EXPANSION & UPGRADING					
1	Ault S.D.	1979	ASP-IRR	180	12
		1989		100	15
		Total		280	
2	Eaton	1990	OD	160	27
3	Erie W.S.D.	1977	ASP	150	11
4	Fort Lupton	1977	ASP	385	30
		--		125	6
		Total		510	
5	Hill-n-Park S.D.	1978	ASP	190	15
		1988		200	23
		Total		390	
6	Hudson S.D.	1977	ASP	160	10
7	Johnstown	1980	ASP	130	16
8	Keensburg S.D.	1977	ASP	140	1
9	Kersey S.D.	1977	OD	240	18
		1982		160	23
		Total		400	
10	LaSalle	1988	ASP	90	19
11	Lochbuie	--	ASP	140	8
12	Mead S.D.	1977	ASP	120	8
13	Milliken S.D.	1978	AS-CM	356	28
14	Pierce	1986	SP	40	12
15	Platteville	1981	ASP	91	16
16	Red Feather Lakes	1978	ASP	345 (b)	22
		1978		61 (c)	43
		Total		406	
17	Severance	1977	ASP	246 (a)	4
18	Texaco (I-25)	1977	ASP	75	7
19	Timnath	--	ASP	340 (a)	10
20	Tri-Area S.D.	1977	ASP	310	27
		1990		140	29
		Total		450	
UPGRADING ONLY					
21	Johnson's Corner	1977	ASP	40	7
22	Weld Central High School	1977	AS-EA	1	7
EXPANSION ONLY					
23	Gilcrest S.D.	1983	ASP-ND	80	9
	TOTAL			4800	

(a) Includes collection system.
(b) Treatment system.
(c) Waste hauling equipment.
(d) Excludes minor upgrading requirements.
(e) Excludes existing costs.

(f) Recommended Process Legend:
- SP = Non-Aerated Stabilization Pond
- ASP = Aerated Stabilization Pond
- OD = Oxidation Ditch
- AS-CM = Activated Sludge - complete mix mode
- AS-EA = Activated Sludge - extended aeration mode
- IRR = Effluent Reuse for Irrigation - no discharge to surface water
- ND = Non-Discharging System

Three alternatives for improving existing operation and maintenance procedures for wastewater systems in small communities have been evaluated. Options include: 1) individual community operation and maintenance as currently practiced; 2) a cost-sharing regional O&M management system; and 3) a combined regionally or sub-regionally-assisted O&M program. Several advantages of the latter two options are apparent. Highly skilled operators could be provided if the communities jointly hired a staff. Total staffing requirements could be reduced, since lesser skilled men could be directed by a chief of operations. Specialists such as chemists could also be provided. A fully equipped laboratory could be provided and the chemist could analyze sufficient in-plant and effluent samples so that good operation could be provided. Other equipment not normally owned by small communities, such as sewer line rodding equipment, could be jointly owned and operated utilizing this concept.

A combined, regionally or sub-regionally-assisted operation and maintenance program offers the benefits of a regional operation and maintenance approach, at a substantially reduced cost. Much less manpower for this cooperative approach is required, since the existing labor pool in the communities is utilized in conjunction with assistance from a regional management system. The costs of the combined approach to a regional O&M management system would be greater than continued operation by individual communities, assuming extension of the current enforcement policies. However, assuming enforcement policies are strengthened, the costs of the combined regional approach would approximate the total cost of improved O&M by individual communities. The real advantage of the combined regional approach is that it in itself will result in improved O&M, and consequently plant effluent quality.

Based on a review of alternative programs for improved operation and maintenance, it is recommended that the concept of a cooperative, cost-sharing O&M system on a regional or sub-regional basis be more thoroughly explored. Because of the many uncertainties regarding actual costs and relative benefits to communities from this concept, a specific process for developing such a program has been outlined.

For small communities in the Larimer-Weld region, EPA goals for Best Practicable Waste Treatment Technology (BPWTT) can be met by application of Best Waste Stabilization Pond Technology (BWSPT) for pond treatment systems, secondary treatment levels for mechanical treatment systems, and implementation of improved facility operation and maintenance programs.

2.0 EXISTING FACILITIES AND WASTE CHARACTERISTICS

The purpose of this chapter in the LWRCOG 208 Point Source Analysis is to describe the existing wastewater treatment and disposal facilities within the region, and the characteristics of wastewater treated at those facilities. The chapter includes discussion of collection and treatment systems, infiltration/inflow analyses, description of typical treatment facilities, and wastewater flow and quality parameters.

2.1 FACILITY LOCATIONS

Point sources of wastewater within Larimer and Weld Counties include both municipal and industrial wastewater treatment facilities. There are currently 16 industrial and 30 municipal wastewater treatment facilities which have been granted discharge permits. There are also an additional 13 municipal wastewater treatment facilities which are not required to have discharge permits because of the lack of any significant discharges.

The locations of the municipal wastewater and industrial wastewater dischargers are illustrated on Figures 2.1-A and 2.1-B, respectively. For the purposes of this study, municipal dischargers are categorized according to location--urban triangle area communities and outlying communities. The triangle area includes both large and small communities in the Greeley-Loveland-Fort Collins triangle. Major discharges in the core triangle area are discussed in detail in another section of this 208 plan. Industrial dischargers are categorized according to the potential environmental impacts which are related to the average flowrates. Industrial discharges with average flowrates less than 0.1 millions of gallons per day (mgd) are classified as minor dischargers while those with flowrates greater than or equal to 0.1 mgd are classified as major dischargers. In general, industry of the region consists of or is related to food processing. Industries discharging to municipal wastewater treatment plants are not shown on Figure 2.1-B. Industrial wastewater discharges are discussed in detail in Chapter 9.0.

2.2 WASTEWATER COLLECTION SYSTEMS

Wastewater collection systems in the Study Area vary greatly with respect to size, age, and materials of construction. Table 2.2-A presents the general characteristics of the wastewater collection systems for the communities in both the urban triangle and the outlying area.

INDEX NO.		EXISTING AVERAGE FLOW (mgd)
	MUNICIPALITY - OUTLYING AREA	
M-1	Ault S.D.	0.09
M-2	Berthoud	0.48
M-3	Cottonwood Park	0.20
M-4	Del Camino	0.02
M-5	Eaton	0.21
M-6	Erie W.S.D.	0.13
M-7	Estes Park S.D.	0.40(a)
M-8	Fort Lupton	0.64
M-9	Gilcrest S.D.	0.04
M-10	Grover	0.025
M-11	Hill-n-Park S.D.	0.07
M-12	Hudson S.D.	0.06
M-13	Johnson's Corner	0.007
M-14	Johnstown	0.22
M-15	Keenesburg S.D.	0.05
M-16	Kersey S.D.	0.05
M-17	LaSalle	0.17
M-18	Lochbuie	-
M-19	Mead S.D.	0.035
M-20	Milliken S.D.	0.10
M-21	Mountain Range Shadows	0.01
M-22	Nunn	-
M-23	Pingree Park	0.01
M-24	Pierce	0.05
M-25	Platteville	0.14
M-26	Ramada Inn (I-25)	N/A
M-27	Red Feather/Crystal Lakes	N/A
M-28	Riverglenn	N/A
M-29	Severance	-
M-30	Spring Canyon S.D.	-

INDEX NO.		EXISTING AVERAGE FLOW (mgd)
M-31	Texaco (I-25)	0.023
M-32	Timnath	-
M-33	Tri-Area S.D.	0.31
M-34	Upper Thompson S.D.	0.20(a)
M-35	Weld Central H.S.	0.01
M-36	Wellington	0.06
	MUNICIPALITY - CORE AREA	
M-37	Boxelder S.D.	0.6
M-38	Evans S.D.	0.5
M-39	Ft. Collins #1	5.0
M-40	Ft. Collins #2	5.6
M-41	Greeley	6.2
M-42	Loveland	4.0
M-43	South Ft. Collins S.D.	0.5
M-44	Windsor	0.6

N/A = Data not presently available.

(a) = Does not include seasonal flows.

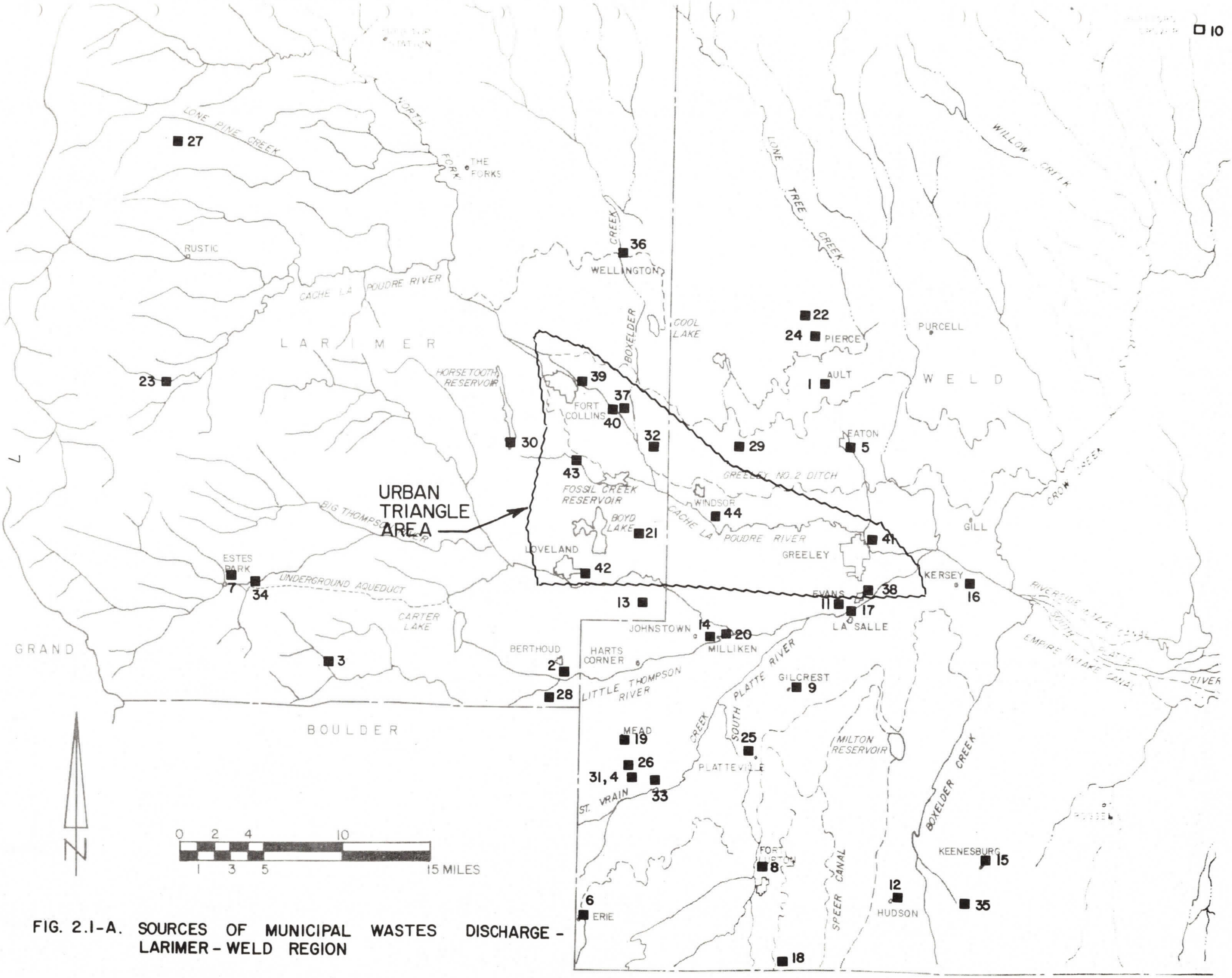


FIG. 2.1-A. SOURCES OF MUNICIPAL WASTES DISCHARGE - LARIMER - WELD REGION

The data in Table 2.2-A is based on discussions with town officials, wastewater treatment plant operators, review of Colorado Department of Health records and reports, and review of community wastewater system evaluation and planning reports prepared by various consultants.

The number of commercial and domestic taps refers to the number of separate connections to the collection system from both dwellings and commercial establishments. In most instances, a multiple family dwelling such as an apartment or duplex constitutes a single tap.

The data under the heading "Population Served" refers to number of full-time residents discharging to the system, and excludes the equivalent population based on commercial or industrial establishments. For the communities included in Table 2.2-A, the equivalent population per service ranges between 1.6 (Grover) and 4.4 (Kersey) with an average value of 3.1. In the urban triangle area, approximately 97 percent, or 160,000 people of a total estimated population of 165,000, are served by sewerage systems. Overall in Larimer and Weld Counties, approximately 85 percent of the total population discharge into sewerage systems.

The industries discharging into the community wastewater systems are tabulated in Column 4. Schools are included in the industrial category for those communities providing educational services for large numbers of students residing in surrounding areas not served by the sewerage system. A population equivalent of one person per three students is assumed for those students attending school and not residing in the sewered area.

Industrial population equivalents were calculated on both a BOD and a flowrate basis; the larger of the two equivalent populations is the value presented in Table 2.2-A. The data used for determining industrial equivalent populations was obtained from interviews with industrial representatives and from files of the Colorado Department of Health.

In several of the relatively small communities in the outlying area, the industrial loads constitute a substantial portion of the total wasteload. The Johnstown municipal wastewater system serves a milk processing plant with an equivalent hydraulic population of 1100, in addition to 1500 residents. Since the milk processing plant contributes over 40 percent of the total wastewater, both the flowrate and the composition of the wastewater will be highly dependent on the operations of the processing plant.

INDEX NO.		EXISTING AVERAGE FLOWS	
	MAJOR DIRECT INDUSTRIAL DISCHARGERS		
I- 1	Eastman Kodak Co.-KCD	1.0	
I- 2	Great Western Sugar Co. - Loveland	4.3	
I- 3	Great Western Sugar Co. - Greeley	2.0	
I- 4	Great Western Sugar Co. - Johnstown	5.4	
I- 5	Loveland Packing Co.	0.05	
I- 6	Public Service Co. - Ft. St. Vrain	1.5	
	MINOR DIRECT INDUSTRIAL DISCHARGERS		
I- 7	Cowan Concrete Products	(a)	
I- 8	Flatiron Paving Co.-Greeley	(a)	
I- 9	Flatiron Paving Co.-Windsor	(a)	
I-10	Flatiron Paving Co.-Loveland	(a)	
I-11	Flatiron Paving Co. - Greeley (West)	(a)	
I-12	Greeley Sand & Gravel	(a)	
I-13	Eldred M. Johnson	(a)	
I-14	Floyd Haag Sand & Gravel	(a)	
I-15	Mountain Aggregate - Ft. Collins	(a)	
I-16	Mountain Aggregate - (to St. Vrain)	(a)	
I-17	Norden & Son Land Leveling	(a)	
I-18	Poudre Pre-Mix	(a)	
I-19	Colo. Division of Wildlife - Bellvue	1.0	
I-20	Colo. Division of Wildlife - North Fork	3.0	
I-21	Colo. Division of Wildlife - Poudre	4.0	
I-22	Colo. Division of Wildlife - Watson Lake	12.0	
I-23	Colo. Division of Wildlife - Estes Park	3.0	
I-24	Blacky Valencia	0	
I-25	Western Fisheries Consultants	0	
I-26	Ft. Collins - Poudre Canyon Water Treatment Plant (WTP)	-	
I-27	Greeley-Bellvue WTP	-	
I-28	Greeley-Boyd Lake WTP	-	
I-29	Loveland WTP	-	
I-30	Hydraulics Unlimited Mfg. Co.	0.02	
I-31	Monfort Packing Co.	1.7	
I-32	Lone Star Steel Co.	0.03	
I-33	Terra Resources Inc.-Clarks Lake	0.009	
	MAJOR INDUSTRIAL DISCHARGERS TO MUNICIPALITIES		**DISCHARGE TO**
I-34	Hewlett-Packard Co.		Loveland
I-35	Woodward Governor		Ft. Collins
I-36	Teledyne-Water Pic		Ft. Collins
I-37	Western Food Products Inc.		Ft. Collins
I-38	Eastman Kodak Co. (optional)		Windsor
I-39	Carnation Milk Co.		Johnstown
I-40	Ft. Lupton Canning Co.		Ft. Lupton
I-41	Meadow Gold Dairy		Greeley
I-42	Monfort of Colorado		Greeley

(a) Flows highly variable.

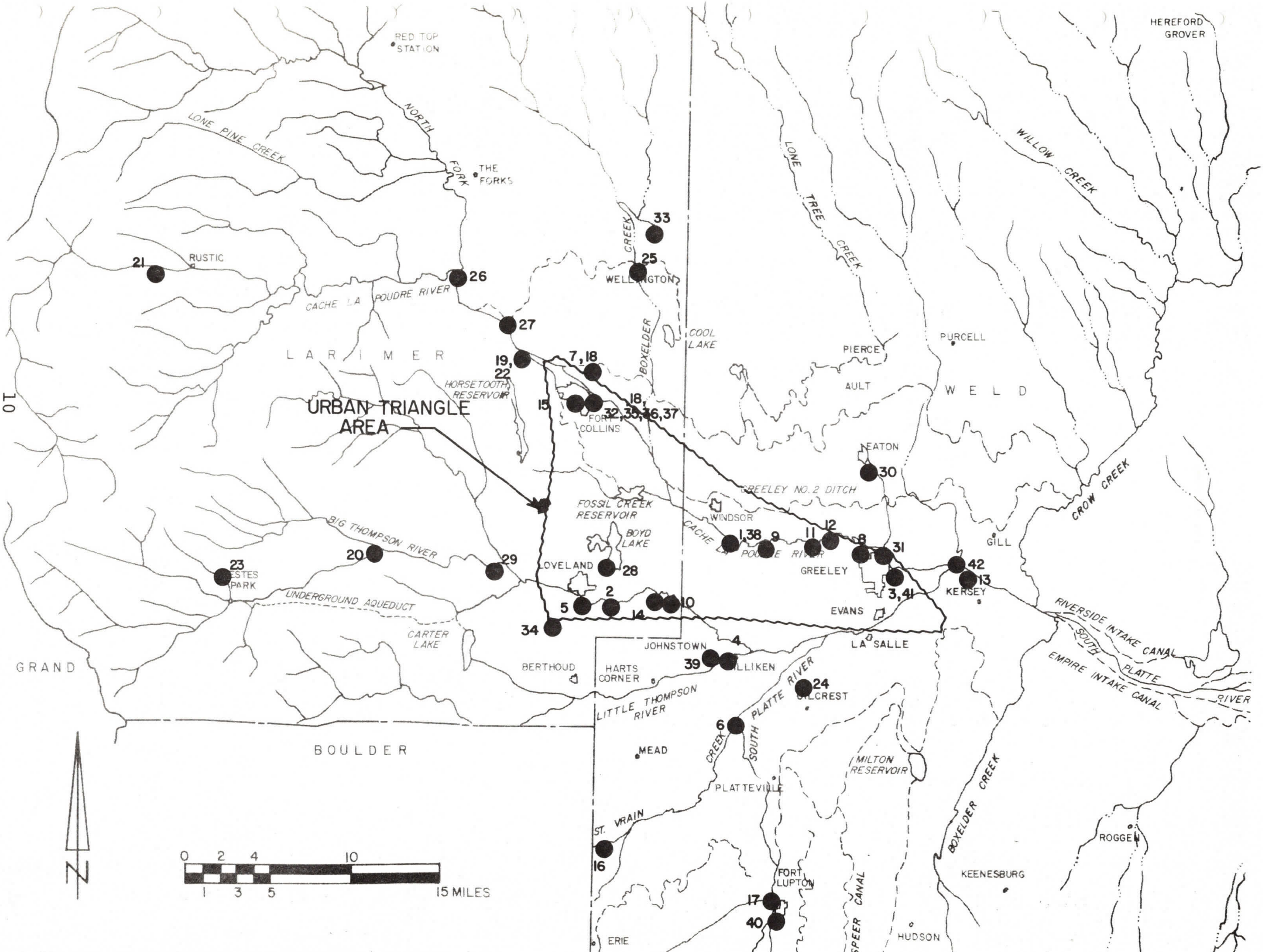


FIG. 2.1-B. SOURCES OF INDUSTRIAL WASTES DISCHARGE - LARIMER - WELD REGION

Table 2.2-A. Description of Sewerage Systems

	NUMBER OF TAPS	POPULATION SERVED	INDUSTRIES SERVED	INDUSTRIAL EQUIVALENT POPULATION	TOTAL EQUIVALENT POPULATION	SEWER SIZES	DATE SEWER INSTALLED
OUTLYING AREA							
Ault S.D.	400	950	-	-	950	8"	1952
Berthoud		2,500	-	-	2,500		
Cottonwood Park		2,000(a)	-	-	2,000(a)		
Eaton	800	2,100	Harsh Hoist	-	2,100	8"-36"	1930
Erie W.S.D.	404	1,300	-	-	1,399	8"-36"	
Estes Park S.D.		1,900(b)	-	-	1,900(b)		
Fort Lupton	900	3,300	Cannery	500	3,800	6"-12"	
Gilcrest S.D.	161	500	School (400 Students)	133	633	6"-10"	
Grover	73	120	School (150 Students)	50	170	8"	1975
Hill-n-Park S.D.	235	825	-	-	825	8"-10"	
Hudson S.D.	250	600	-	-	600	10"	1951
Johnson's Corner	2	-	Restaurant (200 Seat) + Gas Station	140	140	8"	

Table 2.2-A. Description of Sewerage Systems (Cont.)

	NUMBER OF TAPS	POPULATION SERVED	INDUSTRIES SERVED	INDUSTRIAL EQUIVALENT POPULATION	TOTAL EQUIVALENT POPULATION	SEWER SIZES	DATE SEWER INSTALLED
OUTLYING AREA (Cont.)							
Johnstown	641	1,500	Carnation Milk	1,100	2,600	8"-10"	
Keenesburg S.D.	216	525	Hatchery; Turkey Processor	N/A		8"-10:	1953
Kersey S.D.	225	1,000	Rendering Plant (100/Day)	N/A		8"-10:	
LaSalle		1,500	Packing Plant	270	1,770		
Mead S.D.	80	225	School (1650 Students)	215	440	8"-10"	
Milliken S.D.	350	1,400	-	-	1,400	8"	1930's
Mountain Range Shadows		600	-	-	600		
Pingree Park		50	-	-	50		
Pierce	290	975	School (350 Students)	80	1,060	8"	1969
Platteville	443	1,500	-	-	1,500	6"-12"	1950's
Ramada Inn	-	-	Motel & Restaurant	-	-		

Table 2.2-A. Description of Sewerage Systems (Cont.)

	NUMBER OF TAPS	POPULATION SERVED	INDUSTRIES SERVED	INDUSTRIAL EQUIVALENT POPULATION	TOTAL EQUIVALENT POPULATION	SEWER SIZES	DATE SEWER INSTALLED
<u>OUTLYING AREA (Cont.)</u>							
Red Feathers/ Crystal Lakes		200	-	-	200		
Riverglenn		50	-	-	50		
Spring Canyon S.D.		400	-	-	400		
Texaco	2	Varies	N/A	N/A		8"	
Tri-Area S.D.		3,100	-	-	3,100	12"	
Upper Thompson S.D.		5,000(b)	-	-	5,000(b)		
Weld Central H.S.	1	-	School (780 Students)	260	260	6"	
Wellington	400	1,250	-	-	1,250	12"	
<u>URBAN TRIANGLE AREA</u>							
Boxelder S.D.		4,350	-	-	4,350		
Evans S.D.		4,500			4,800		
Fort Collins No. 1		65,000(c)			114,000 (c,d)		

Table 2.2-A. Description of Sewerage Systems (Cont.)

	NUMBER OF TAPS	POPULATION SERVED	INDUSTRIES SERVED	INDUSTRIAL EQUIVALENT POPULATION	TOTAL EQUIVALENT POPULATION	SEWER SIZES	DATE SEWER INSTALLED
URBAN TRIANGLE AREA (Cont.)							
Fort Collins No. 2 & 3		65,000(c)			114,000 (c,d)		
Greeley		55,000			62,000(d)		
Loveland Plant No. 2		21,000	Hewlett-Packard	1,500	35,000(d)		
South Fort Collins S.D.		2,000			2,000		
Windsor		2,700			5,900(d)		

N/A: Data not available.

(a) Estimated.

(b) Increases with summer tourist load.

(c) Total tributary to all plants.

(d) Includes I/I.

Several of the communities serve seasonal industries related to the agriculture of the area. Seasonal variations in wastewater loads can upset biological treatment processes, since successful operation is dependent on a proper balance between wastewater load and available microorganisms. Regional schools cause relatively frequent variations in wastewater loads due to lack of use during weekends, holidays and summers. The effect of the variations in load caused by the intermittent nature of schools on the stability of the treatment processes depends on the size of the non-resident student population relative to the population of the sewer area.

Additional characteristics of the sewerage collection system such as sewer sizes and number of sewer lift stations are also presented in Table 2.2-A. Maps showing the boundaries of the existing sewer service areas for the communities in the study area will be presented in Appendix B. These service area maps were prepared from data obtained from either reports describing wastewater systems or from data obtained from city officials.

2.3 INFILTRATION/INFLOW ANALYSIS

The average sewage flowrates in many sewerage systems are greatly increased by the infiltration of subsurface water through leaking pipe joints or cracks in the pipe itself, and/or by the inflow of surface waters through illegal or unknown connections or openings into the sewers. The flow resulting from infiltration and/or inflow increases the hydraulic load on the treatment facility.

Since capital and operating costs for most sewage treatment facilities are significantly effected by the hydraulic load, the most economical treatment facilities are those treating only sanitary wastes. This economic relationship was recognized by Congress which passed a law requiring that excessive infiltration/inflow (I/I) be eliminated before granting federal money for construction of new municipal sewage treatment facilities. "Excessive" infiltration/inflow has been defined by the Environmental Protection Agency as being of such a quantity that it is more economical to eliminate it by replacing or repairing the sewer system than to construct additional plant capacity to treat the excessive water.

In the majority of the cities and towns in the 208 Study Area, surveys to determine the amount of infiltration and inflow have not been performed. An estimate of the magnitude of I/I is made by calculating the average daily flow per capita based on available measured wastewater flowrates and the populations of the sewer areas. Domestic flowrates used to calculate per capita daily flows were obtained by subtracting estimated industrial flowrates from the total wastewater flowrate. It can be seen that the per capita flowrate varies from 42 gallons per day per capita (gcd) to 208 gcd. Without I/I, the per capita flowrate of sewage is directly proportioned to the volume of water used within the household which is a function of community characteristics. The volume of water used within the household is affected by many factors, such as the climate of the area, the economic status, the corrosiveness of the water as it relates to leaking plumbing fixtures and the costs of potable water. Unit flowrates without I/I generally range between 70 and 90 gcd; wastewater treatment facilities are generally designed on a basis of 100 gcd of domestic sewage which includes some allowance for infiltration. By comparing the values presented in Table 2.8-A with 100 gcd, it is possible to draw conclusions about the magnitude of the infiltration/inflow problems for the communities of the Study Area. Inspection of the table reveals that Berthoud, Grover, Johnstown, Fort Collins, Loveland, and Windsor have a significant infiltration/inflow problem. For those communities having significant I/I problems, a flow survey should be performed to determine the location and extent of the defective sewers. A cost analysis could be performed to estimate the cost of repairing or replacing the defective sewers. Finally, to determine if repair of sewers or treatment of additional volume is more cost-effective, the costs associated with each should be evaluated.

Much of the infiltration in some of the older sewer systems is due to prior practices of construction. For example, during the 1930's the W.P.A. installed open joint sewers in the town of Milliken. These open joints are the primary cause of infiltration in those areas where the elevation of the groundwater is higher than the sewers. Likewise, such joints can also result in exfiltration or leakage of raw sewage into the groundwater in those areas where the groundwater table is lower than the sewers.

Although improved sewer construction technology exists today, it is impossible to predict the magnitude of future I/I due to the effects of changes in groundwater elevations and the uncertainties in predicting deterioration rates of older sewers in those systems where the magnitude of I/I remains constant. The relative amounts of I/I will decrease in the future as existing sewerage systems are expanded to accommodate growth of the community.

TABLE 2.3-A. Infiltration/Inflow Analyses

AGENCY	POPULATION SERVED	AVERAGE DOMESTIC FLOWRATE (mgd)	AVERAGE DOMESTIC FLOWRATE gal/(capita-day) (gcd)
OUTLYING AREA			
Ault S.D.	950	0.10	105
Berthoud	2,500	0.48	192
Fort Lupton	3,300	0.44	133
Gilcrest S.D.	500	0.04	80
Grover	120	0.025	208
Johnstown	1,500	0.22	147
Keenesburg S.D.	525	0.05	95
LaSalle	1,500	0.17	113
Mead S.D.	350	0.035	42
Milliken S.D.	1,400	0.10	71
Pierce	975	0.05	51
Platteville	1,500	0.14	93
Wellington	1,200	0.06	50
Estes Park S.D.	1,900(a)	0.51	102(b)
URBAN TRIANGLE AREA			
Boxelder S.D.	4,350	0.44	100
Evans S.D.	4,500	0.48	107
Fort Collins (c)	65,000	11.4	175
Greeley	55,000	6.2	113
Loveland	21,000	3.3	157
Windsor	2,700	0.59	218

(a) Permanent residents only; seasonal population = 5,000, and 20,000 tourists.

(b) Includes seasonal and tourist loads.

(c) Includes wastewater treatment plants #1 and #2.

It should be noted that the only communities included in Table 2.3-A were those for which existing flowrate data was available. It will be necessary for many of the communities in the Study Area to install flow meters at their wastewater treatment facilities before it is possible to make estimates of the magnitude of infiltration/inflow.

2.4 EXISTING TREATMENT FACILITIES IN OUTLYING AREAS

A great variety of treatment processes are employed by the communities of the Study Area. Table 2.4-A lists the basic types of plants and the individual processes incorporated into each. Standard process flow diagrams for the facilities which are referred to in Table 2.4-A are illustrated on Figures 2.4-A through E. The facilities are approximately equally divided between activated sludge process and stabilization pond systems. There are fifteen aerated and unaerated stabilization pond systems, three of which have rock filters for upgrading all or part of the pond effluent. Aeration equipment used includes mechanical floating aerators, cage aerators, and diffused aeration. There are thirteen activated sludge plants which can be broken down according to the following process modifications or operational modes: eight extended aeration, three oxidation ditches, one conventional and one contact aeration system. The extended aeration plants are typically package plants which are used for relatively small flowrates.

The Upper Thompson Sanitation District has the most sophisticated treatment plant which consists of secondary conventional activated sludge followed by separate nitrification, tertiary filtration, and ozonation facilities.

In several instances when facilities consisted of several stabilization ponds in series, the last pond is classified as a polishing pond in conformance with the Colorado Department of Health's (CDH) criteria for review of wastewater treatment facilities. The CDH defines a polishing pond as a pond with a minimum hydraulic detention time of two to three days. Hydraulic detention times of ponds following controlled biological processes such as trickling filters or activated sludge should have a maximum of four to five days to prevent algae growth. Polishing ponds following stabilization ponds are provided for settling of the algae and other suspended solids in the effluent of the first pond. Table 2.4-A also includes design flowrates, operator class requirements, Colorado discharge permit numbers, and effluent receiving bodies for each facility.

Table 2.4-A: Description of Existing Treatment Facilities

	SEWAGE TREATMENT PROCESSES (a)	DESIGN CAPACITY (mgd)	STANDARD PROCESS FLOW DIAGRAM NUMBER (b)	CLASS OPERATOR	COLORADO DISCHARGE PERMIT NUMBER	
Ault S.D.	ST-SP-PP	0.13	1	D	No Discharge	-
Berthoud	OD-Cl-AD	1.65	4	C	0021831	Little Thompson River
Cottonwood Park						Little Thompson or Irrigati
Del Camino	EA-Cl-PP	0.12	5	C	002934	Irrigation
Eaton	OD-Cl-AD	0.34	4	C	0023116	Cache la Poudre
Erie W.S.D.	AL-PP	0.14	3	D	0021831	Coal Creek
Estes Park S.D.	CS-CL-AD	0.70	3			
Fort Lupton	SP	0.29	2	D	0021440	South Platte River
Gilcrest S.D.	AL-SP	.05(c)	3	D	No Discharge	

NOTE: Key follows at end of table.

Table 2.4-A. Description of Existing Treatment Facilities (Cont.)

	SEWAGE TREATMENT PROCESSES (a)	DESIGN CAPACITY (mgd)	STANDARD PROCESS FLOW DIAGRAM NUMBER (b)	CLASS OPERATOR	COLORADO DISCHARGE PERMIT NUMBER	
Grover	EA-Cl	0.029	5	C		Irrigation
Hill-n-Park S.D.	SP-PP	0.12	1	D		South Platte River
Hudson S.D.	SP-PP	0.05	2	D	0029581	Beebe Seep
Johnson's Corner	ST-AL	0.05	-	D		Big Thompson River
Johnstown	AL-PP	0.25	3	D	0021156	Little Thompson River
Keenesburg S.D.	SP-PP	0.05	2	D	No Discharge	Irrigation Reuse
Kersey S.D.	OD-PP	0.01	4	C	No Discharge	
LaSalle	AL-PP-RF-CL	.36	3-RF	D	0021644	South Platte River
Lochbuie	SP		1			Beebe Seep
Mead S.D.	SP-PP		2	D	0023060	Lake Mary (dry)

Table 2.4-A. Description of Existing Treatment Facilities (Cont.)

	SEWAGE TREATMENT PROCESSES (a)	DESIGN CAPACITY (mgd)	STANDARD PROCESS FLOW DIAGRAM NUMBER (b)	CLASS OPERATOR	COLORADO DISCHARGE PERMIT NUMBER	
Milliken S.D.	EA-Cl	0.07	5	C	0026808	Little Thompson R.
Mountain Range Shadows	EA-PP	0.10	5			
Nunn	IST	-	-	-	No Discharge	
Pingree Park	EA	0.01	5	C	No Discharge	
Pierce	SP	0.17	2 + Leach Field	D	No Discharge	
Platteville	Al-SP-PP	0.20	3	D	No Discharge	
Ramada Inn	EA-PP		5	C	No Discharge	
Red Feather/ Crystal Lakes	EA	0.01	5			North Fork Cache la Poudre
Riverglenn	SP-RF	0.029	1-RF	D	No Discharge	
Severance	IST					

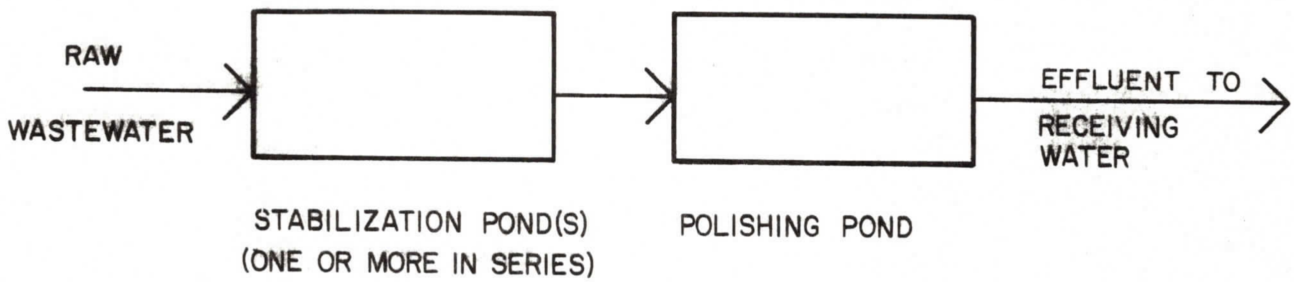
Table 2.4-A Description of Existing Treatment Facilities (Cont.)

	SEWAGE TREATMENT PROCESSES (a)	DESIGN CAPACITY (mgd)	STANDARD PROCESS FLOW DIAGRAM NUMBER (b)	CLASS OPERATOR	COLORADO DISCHARGE PERMIT NUMBER	
Texaco	EA-PP	0.018	5	C	0029343	St. Vrain Creek
Timnath	IST					
Tri-Area S.D.	AL-PP	0.52	3	D	0021580	St. Vrain Creek
Upper Thompson S.D.	CM-BF-F-O	1.50	-	A	0031844	Big Thompson R.
Weld Central H.S.	EA	0.02	5	C	0026298	Hudson Canal
Wellington	AL-PP-RF		3-RF	D	0021032	Boxelder Creek

(a) SP - Stabilization Pond
PP - Polishing Pond
OD - Oxidation Ditch
CL - Chlorination Facilities
AD - Aerobic Digestion
EA - Extended Aeration (activated sludge)
AL - Aerated Lagoon
CS - Contact Stabilization (activated sludge)
ST - Stabilization Tank (Imhoff)
RF - Rock Filter
IST - Individual Septic Tanks
CM - Complete Mix (Activated sludge)
F - Filtration (mixed-media)
BF - Biofilter
O - Ozonation Facilities

(b) See Figures 2.4-A through E.

(c) Assuming non-discharging stabilization pond; could increase to 0.15 mgd with a discharging system.



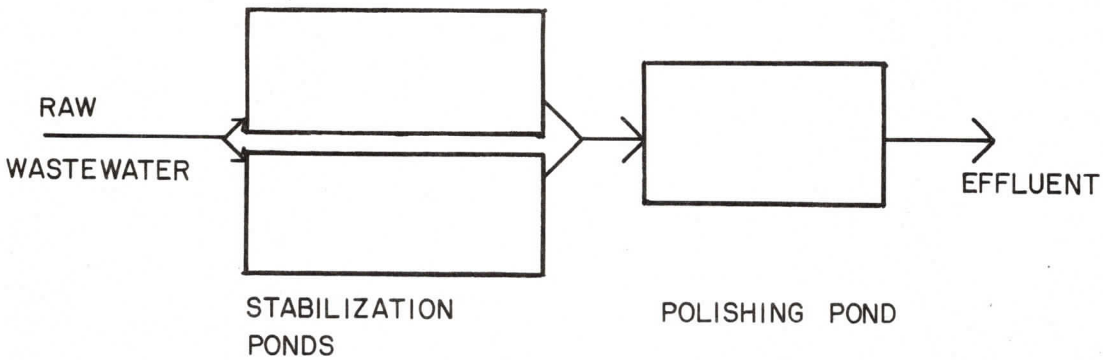
DESIGN CRITERIA
(FOR STABILIZATION POND ONLY)

MAXIMUM BOD LOADING - $\frac{18 \text{ LBS. } BOD_5}{\text{DAY - ACRE}}$

DEPTH : 3 TO 10 FEET

HYDRAULIC DETENTION TIME : 100 TO 300 DAYS

Fig. 2.4-A. Series Stabilization Pond Design Criteria



DESIGN CRITERIA

(FOR STABILIZATION PONDS)

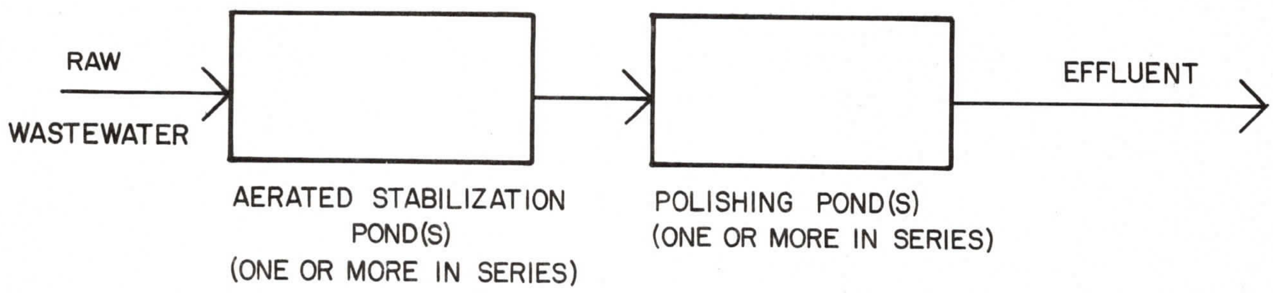
MAXIMUM BOD LOADING RATE - $\frac{18 \text{ LBS. } BOD_5}{\text{DAY - ACRE}}$

DEPTH : 3 TO 10 FEET

HYDRAULIC DETENTION TIME : 100 TO 300 DAYS

Fig. 2.4-B. Parallel Stabilization Ponds Design Criteria

AERATED STABILIZATION PONDS



DESIGN CRITERIA
(AERATED STABILIZATION POND(S) ONLY)

MAXIMUM BOD LOADING = 240 LBS/ACRE/DAY

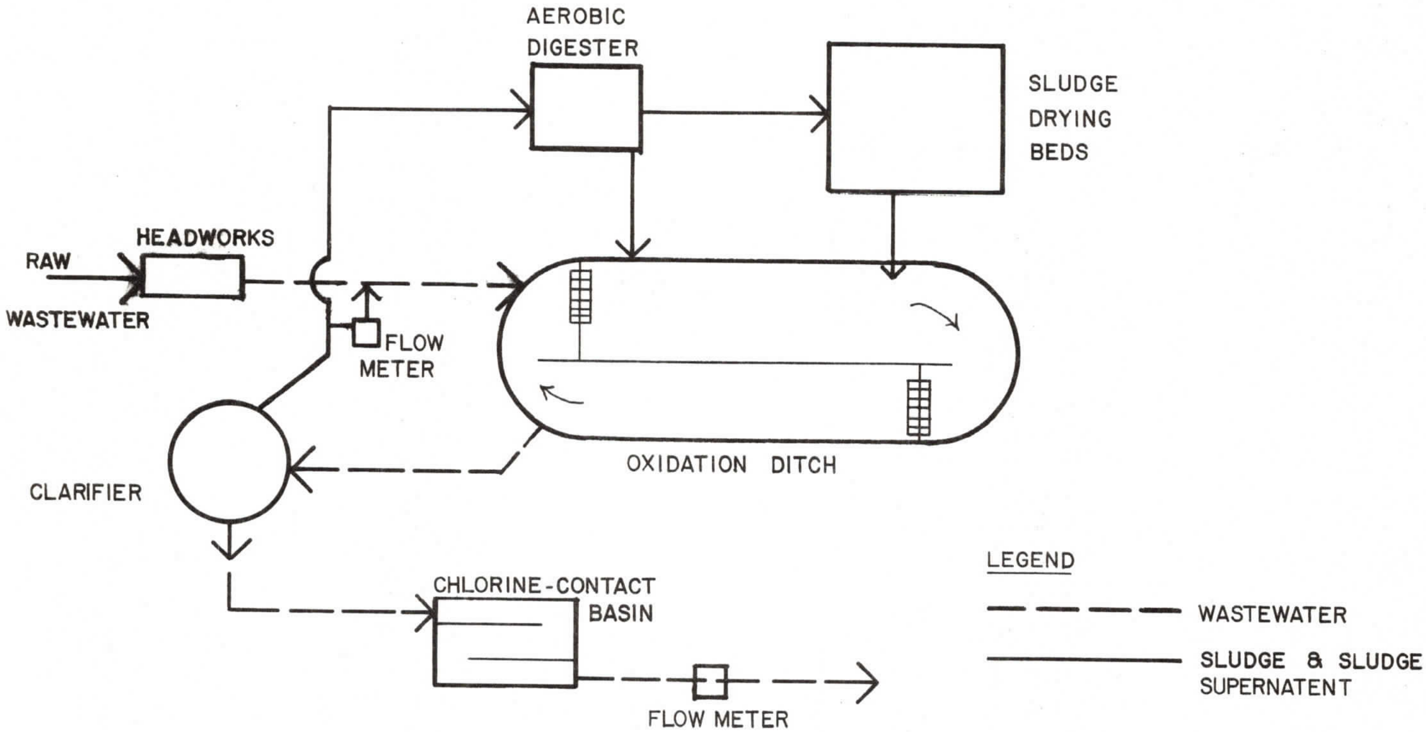
DEPTH: 7 TO 10 FEET

HYDRAULIC DETENTION TIME = 15 DAYS

POWER REQUIREMENTS: 65 HP/MGD (DOMESTIC WASTE)

OXYGEN TRANSFER RATE: 1.4 LBS. O_2/LB. BOD REMOVED

Fig. 2.4-C. Aerated Stabilization Ponds Design Criteria



Process Description and Design Criteria

- Oxidation Ditch with Cage Aerators
  Minimum 24-hours detention time @ Qavg.
  Maximum 15 lbs. BOD_5/1000 CF @ Qavg.

- Clarifier

Average Flowrate (mgd)	Max. Surface* Settling Rate (gpd/sq. ft.)	Minimum* Detention Time (hr.)
0.05	400	4.0
0.05-0.15	500	3.6
0.15	600	3.0

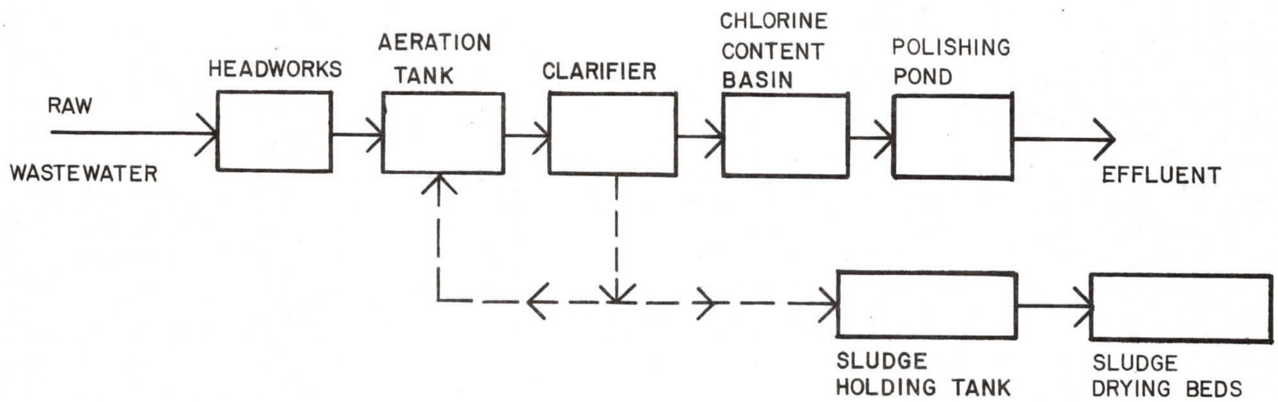
- Disinfection-Chlorine Contact Basin
  Minimum contact time = 30 minutes at peak hourly flowrate

- Aerobic Digester or Aerated Waste Sludge Holding Tank.

- Sludge Drying Bed, minimum 1 sq. ft/capita

* Based on Qavg + 100% sludge return

Fig. 2.4-D. Oxidation Ditch Design Criteria



Process Description and Design Criteria

- Aeration Tank
  Minimum 24-hours detention time @ Qavg.
  Maximum 15 lbs. BOD_5/1000 CF @ Qavg.

- Clarifier

Average Flowrate (mgd)	Max. Surface* Settling Rate (gpd/sq. ft.)	Minimum* Detention Time (hr.)
0.05	400	4.0
0.05-0.15	500	3.6
0.15	600	3.0

- Disinfection-Chlorine Contact Basin
  Minimum contact time = 30 minutes at peak hourly flowrate

- Polishing Pond (required for plants with Q<0.75 mgd).

* Based on Qavg + 100% sludge return.

Fig. 2.4-E. Extended Aeration Design Criteria

The design flowrates presented in Table 2.4-A are based on Colorado Department of Health criteria for wastewater treatment facilities. In several instances it is possible that the tabulated flowrate for a given facility is less than the original design flowrate because of the adoption of more stringent or conservative design criteria. The present design criteria are based on achieving effluent suspended solids and BOD5 values of 30 mg/l. Since these effluent standards are now in effect, the present design criteria were used to evaluate capacities of existing facilities.

2.5 WASTEWATER QUALITY CHARACTERISTICS

The characteristics of the wastewaters generated within the region were determined by reviewing existing data contained in various facility plans, regional reports, and Colorado Department of Health records and by conducting a water quality analysis program. The characteristics of the wastewater generated in the major population centers in the Study Area such as Greeley and Fort Collins are well documented since these communities employ relatively sophisticated secondary treatment facilities whose successful operation is highly dependent on the influent quality. In general, the smaller communities which are located in the outlying areas have treatment processes which are easier to operate and do not require constant monitoring of the influent wastewater quality.

Raw wastewater quality characteristics typical of the communities in the outlying area are presented in Table 2.5-A. The data presented includes information obtained from (1) the water quality analysis program conducted for this study; (2) selected facility plans and regional reports; and (3) standard wastewater references. Information from a standard reference was included for purposes of comparison and categorization. The data in Table 2.5-A indicates that most of the communities in the Study Area have a weak or medium strength wastewater. Strong or concentrated sewages in municipal systems generally result from industrial users. The majority of the communities in the outlying area have purely domestic or residential connections which produces relatively weak wastewater. Other factors influencing the strengths of wastewaters include infiltration and inflow which have a dilution effect. A consultant for the Milliken Sanitation District estimated the magnitude of I/I by comparing wastewater strengths at different points in the sewer system. This I/I survey method is based on the fact that I/I is equal to the volume of water required to achieve the observed dilutions. Table 5.2-A shows how I/I significantly reduced the effluent BOD_5 concentration to the Milliken wastewater treatment plant.

In those communities having substantial I/I, it can be expected that the wastewater strengths will increase in the future as the amounts of I/I decrease with expansion of the systems.

The majority of the analytical data presented in Table 2.5-A is for grab samples taken during regular working hours. Wastewater composition typically varies with the time of day and it is probable that composite samples would produce slightly different results. Generally values of BOD_5, suspended solids, and phosphates are greater during the daylight hours than they are at night or early morning.

Composite samples with their relatively high costs were not warranted for this investigation of wastewater composition for the Study Area in view of seasonal variations. When composite samples are taken, it is generally accepted that several samples will be obtained throughout the year to evaluate seasonal variations. Sampling at different times of the year was not possible due to the time constraints of this study. The temperature values in Table 2.5-A reflect the fact that the water quality sampling program was conducted during late summer and early fall. Lower raw wastewater temperatures do occur during the winters.

No information concerning TDS levels is presented since the wastewater TDS is directly related to the potable water TDS which varies greatly for the communities in Weld and Larimer Counties. In general, domestic use of water increases the TDS by approximately 200 to 300 mg/l.

Table 2.5-B presents the composition of a typical influent wastewater characteristic of the outlying area of the Study Area. This composition is for a domestic wastewater and does not consider industrial inputs. The presented values can be used to estimate design loads for communities which are presently unsewered or those which have inadequate historical quality data.

Table 2.5-A

Influent Wastewater Characteristics

Constituent	208 Sampling Program (a) Johnstown	Milliken S.D.	Fort Lupton	Platteville	Erie S.D.	Loveland 1973
BOD_5 (mg/l)	112	29	190	87	390	97
Suspended Solids (mg/l)	154	92	94	96	215	66
Ammonia (mg/l as N)	11.9	8.2	10.0	10.2	23	-
Phosphate (mg/l) or as P	-	-	-	-	-	2.4 0.8
pH	7.6	7.4	7.8	7.4	-	7.3
Temperature (°C)	23	19	25	23	-	-

(a) Samples collected in September, 1976.

(b) Soluble BOD_5.

Table 2.5-B

Typical Raw Wastewater Characteristics*

CONSTITUENT	RANGE	AVERAGE VALUE
BOD_5 (soluble)	112-390	151
COD	160-360	280
Suspended Solids	94-215	130
Ammonia	8.2- 23	13
pH	7.1-7.8	7.5
Temperature	19-25°C	21°C

* Values in mg/l except for pH and Temperature.

3.0 WASTELOAD PROJECTIONS

It was necessary to project future wasteloads for the communities in the study area to determine future facility requirements and the adequacy of existing facilities. These projections were made for two different years, 1983 and 2000, to determine both the short- and long-term wasteloads. Development of the projected wasteloads involves the following steps, each of which will be described separately:

- Project future population for each community;
- Project unit wasteloads per population equivalent applicable to the Larimer-Weld region;
- Calculate wasteloads by applying the appropriate unit wasteloads to the population projection.

3.1 POPULATION PROJECTIONS

Population projections for each community in the study area were prepared as part of the land use planning component of the 208 program. The various techniques employed and their characteristics will be described in detail in the population projection report.

The present population and the 1983 and 2000 year projections for the communities in the outlying areas are presented in Table 3.1-A. It should be pointed out that a relatively large degree of uncertainty exists in population projections for small communities. It is impossible to predict individual housing developments which would have a significant impact on the population of a small community. Likewise, a single industry located within or in the proximity of a small community can cause a major population influx.

No wasteload projections have been presented for individual treatment facilities which serve motels or truck centers such as the Ramada Inn or the Del Camino Center located on Interstate Highway 25. Predicting the expansions of such facilities, which are generally corporate decisions based on economic considerations, is beyond the scope of the present investigation.

Table 3.1-A

Population and Unit Flow Projections For Communities in Outlying Areas

OUTLYING COMMUNITIES		POPULATION			UNIT AVERAGE FLOW (ADWF) (gcd)	
INDEX NO.	AGENCY	PRESENT	PROJECTED 1983	PROJECTED 2000	PRESENT	PROJECTED
1	Ault S.D.	950	2000	3300	105	100
2	Berthoud	2500	4300	7000	192	100
3	Cottonwood Park				-	100
4	Del Camino				-	100
5	Eaton	2100	2900	4000	100	100
6	Erie W.S.D.	1300	1500	1800	100	100
7	Estes Park S.D.	1900(a)	2400(b)	4000(c)	102(e)	100
8	Fort Lupton	3300	5000	9000	133	145(d)
9	Gilcrest S.D.	500	700	1300	80	100
10	Grover	125	125	150	208	100
11	Hill-n-Park S.D.	700	6500		100	100
12	Hudson S.D.	600	1100	1500	100	100
13	Johnson's Corner				-	100
14	Johnstown	1500	1600	2200	220(d)	173(d)
15	Keenesburg S.D.	525	800	1300	95	100
16	Kersey S.D.	900	2100	3000	100	100
17	LaSalle	1800	3200	4500	95	100
18	Lochbuie	900	1100	1500	-	100
19	Mead S.D. (f)	400	400	700	87	100
20	Milliken S.D.	1400	2000	4000		100
21	Mountain Range Shadows	600			-	100
22	Nunn	300			-	100
23	Pingree Park	50			-	50
24	Pierce	975	1500	3000	51	100
25	Platteville	1500	2200	3600	93	100
26	Ramada Inn				-	100
27	Red Feather/ Crystal Lakes	2600(e)	4000(e)	8800(e)	-	100
28	Riverglenn				-	100
29	Severance	80	600	800	-	100

Table 3.1-A. (Cont.)

Population and Unit Flow Projections For Communities in Outlying Areas

OUTLYING COMMUNITIES		POPULATION			UNIT AVERAGE FLOW (ADWF) (gcd)	
INDEX NO.	AGENCY	PRESENT	PROJECTED 1983	PROJECTED 2000	PRESENT	PROJECTED
30	Spring Canyon S.D.	1000	2300	3500	-	100
31	Texaco				-	100
32	Timnath	270	500	750	-	100
33	Tri-Area S.D.	4100	6500	9400	100	100
34	Upper Thompson S.D.	4000	5000	7700		
35	Weld Central H.S.	100			100	100
36	Wellington	1200	2300	3700	50	75

(a) Permanent residents only; seasonal population = 5000, and 20,000 tourists.

(b) Permanent residents only; seasonal population = 6000.

(c) Permanent residents only; seasonal population = 7000.

(d) Includes industrial waste.

(e) Includes seasonal and tourist loads.

(f) Includes institutional population and flow.

3.2 UNIT WASTELOADS

In projecting future wasteloads it is necessary to consider both the composition or strength and the flowrate. The projected wastewater characteristics are based on historical data, results of a regional wastewater quality sampling program recently conducted by Toups Corporation, recommended design criteria published by the Colorado Department of Health (CDH), and standard characteristics published in the technical literature.

Table 3.2-A

Unit Constituent Loading Factors

For Domestic Wastewaters

CONSTITUENT	UNIT LOADINGS			
	PRESENT		PROJECTED	
	pcd (1)	mg/l (2)	pcd (1)	mg/l (3)
BOD_5	0.14	151	0.18	214
Suspended Solids	0.12	130	0.18	214
Ammonia as N	0.12	13	0.013	15
Phosphate				3
TDS Increase (4)	0.27	300	0.27	325

1 pcd = pounds per capita per day

2 Assumes an average per capita flow of 108 gal/day.

3 Assumes an average per capita flow of 100 ga/day.

4 Represents the increase in wastewater TDS over the water supply TDS.

3.2.1 Flow

It is assumed that future developments in the communities will be served by well-designed and constructed sewer systems. For projected flows, a unit value of 100 gallons per capita per day (gcd) is a realistic value for design purposes and will be utilized in this study. This value represents typical domestic wastes, including residential and normal commercial contributions together with infiltration/inflow (I/I) expected even from well designed and constructed sewerage systems. Unit average per capita waste flows for each of the communities in the outlying areas previously presented are also included in the Table along with the projected unit per capita flows applicable during the planning period. It is assumed that those communities currently having unit per capita flows greater than 150 gcd due to excessive I/I will correct the major existing system deficiencies. In several instances, a unit per capita flow greater than 100 gcd has been projected due to significant industrial inputs or present I/I, the elimination of which cannot be economically justified. There are several instances where the future per unit capita flow is greater than the existing value. The increased value was adopted in view of the CDH design criteria.

Sewers and conduits within a wastewater treatment plant must have sufficient capacity to handle the peak wet weather flows. Peak wet weather flows were obtained by multiplying the average dry weather flows minus the current infiltration flows by the peaking factors illustrated in Figure 3.2-A. Existing infiltration flows were then added where applicable. Figure 3.2-A is more conservative than the CDH design criteria which require a minimum peaking factor of 2.5.

3.2.2 Composition

Wastewater strength is generally characterized in terms of the suspended solids (SS) and the 5-day biochemical oxygen demand (BOD_5) which is a measure of the organic constituents requiring stabilization. Other constituents or parameters including chemical oxygen demand, ammonia, phosphates, temperature, and pH are important in particular situations where industrial wastes are involved or where nutrient removal is required due to classification of the receiving water as a water quality limited segment.

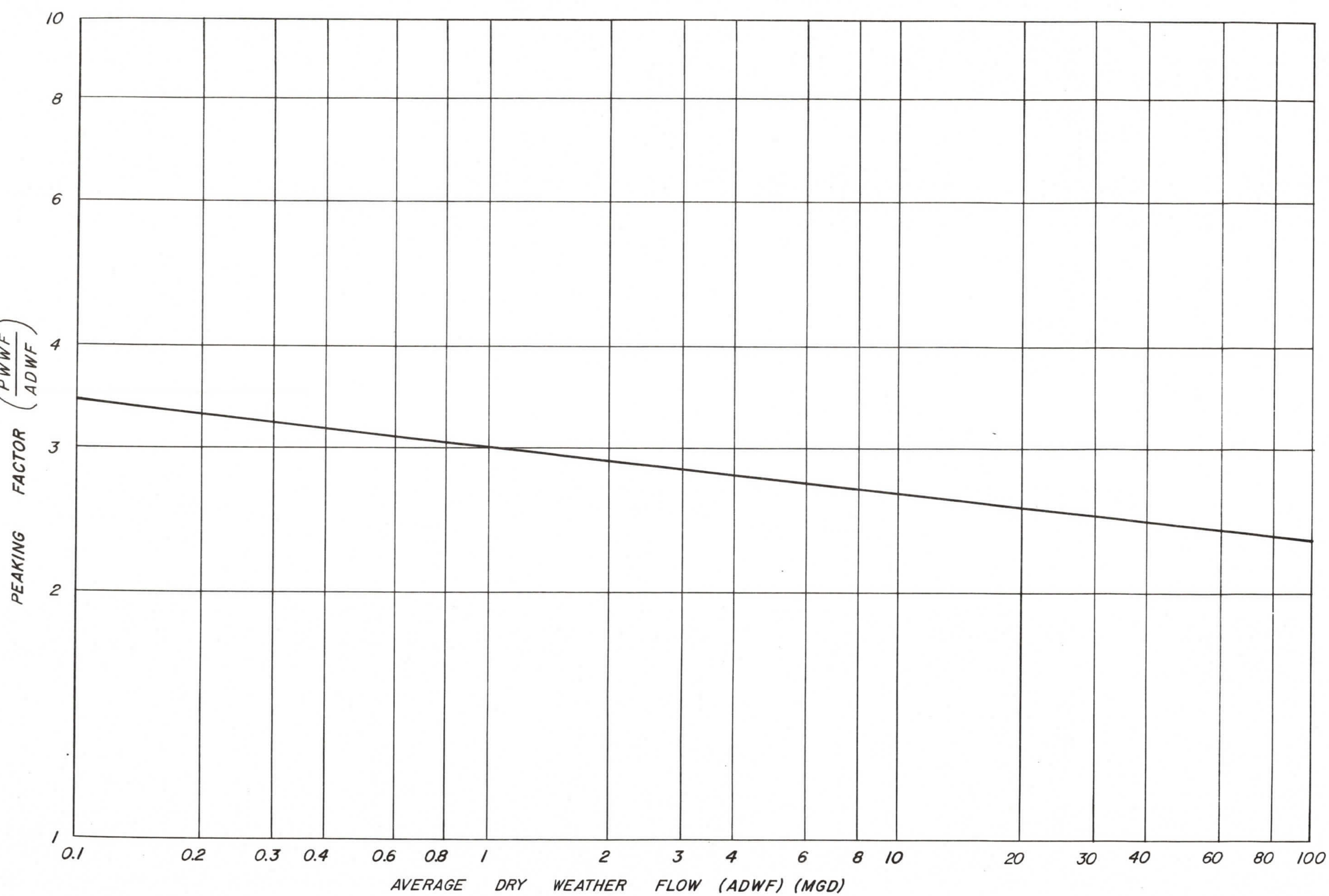


Fig. 3.2-A. Peaking Factor for Wastewater Flows

As part of a sampling program conducted in the technical planning component of the LWRCOG 208 Plan, samples of influent and effluent wastewater were collected at various wastewater treatment facilities and analyzed for a range of constituents. The results of the influent analysis together with a summary of historical, regional wastewater composition data, were presented in Tables 2.5-A and B. Based on this raw wastewater quality data and the area average flowrate, existing unit individual constituent loading factors were developed. These factors along with future projected values are presented in Table 3.2-A.

Unit loadings for the projected values of both the BOD_5 and the SS have been increased over the present values due to an anticipated greater use of garbage grinders, and the relatively weak strength of the existing wastewater. The future decrease in the relative amount of I/I also causes an increase in the projected concentration of all constituents.

Existing and anticipated values for the increase in the total dissolved solids (TDS) resulting from the domestic use of water are also included in Table 3.2-A. TDS is an important parameter when considering wastewater reuse options. The TDS of a wastewater can be projected by adding 325 mg/l to the TDS value in the water supply.

3.3 WASTELOAD PROJECTIONS

Wasteload projections have been developed by applying the unit average flows presented in Table 3.1-A and the unit constituent loading factors of Table 3.2-A to the predicted population.

Table 3.3-A presents the compilation of municipal wastewater loadings for the communities in the study area in terms of flow, BOD_5, and suspended solids for the design periods of interest. Peaking factors from Figure 3.2-A were used to calculate the peak wet weather flows from the average dry weather flows. Table 3.3-A does not include waste projections resulting from industrial developers which is more random, and its effect on water use and wastewater production presents a broad range of possibilities.

Table 3.3-A

Waste Load Projections

DESIGNATION	AGENCY	PRESENT ADWF (mgd)	1983				2000			
			ADWF (mgd) (b)	PWWF (mgd) (c)	BOD_5 (#/day)	SS (#/day)	ADWF (mgd) (b)	PWWF (mgd) (c)	BOD_5 (#/day)	SS (#/day)
1	Ault S.D.	0.09	0.20	.68	360	360	0.33	1.0	594	594
2	Berthoud	0.48	0.43	1.4	780	780	0.70	2.1	1260	1260
3	Cottonwood Park	0.20								
4	Del Camino	0.02								
5	Eaton	0.21	0.29	.95	525	525	0.40	1.3	720	720
6	Erie W.S.D.	0.13	0.15	.48	275	275	0.18	0.6	325	325
7	Estes Park S.D.	0.40	0.61 (a)	1.9	430	430	0.72 (a)	2.2	720	720
8	Fort Lupton	0.64	0.85	2.6	830	830	1.50	4.5	1200	1200
9	Gilcrest S.D.	0.04	0.07	.25	120	120	0.13		240	240
10	Grover	0.025	0.013	.05	25	25	0.015	.06	30	30
11	Hill-n-Park S.D.	0.07	NA	NA	NA	Na	0.65	2.0	1200	1200
12	Hudson S.D.	0.06	0.11	.39	200	200	0.15	.50	270	270
13	Johnson's Corner	0.007								

Table 3.3-A. (Cont.)

Waste Load Projections

DESIGNATION	AGENCY	PRESENT ADWF (mgd)	1983				2000			
			ADWF (mgd) (b)	PWWF (mgd) (c)	BOD_5 (#/day)	SS (#/day)	ADWF (mgd) (b)	PWWF (mgd) (c)	BOD_5 (#/day)	SS (#/day)
14	Johnstown	0.22	0.28	0.9	300	300	0.38	1.2	400	400
15	Keenesburg S.D.	0.05	0.08	.28	150	150	0.13	0.45	230	230
16	Kersey S.D.	0.05	0.21	.71	390	390	0.30	1.00	540	540
17	LaSalle	0.17	0.32	1.0	580	580	0.45	1.4	800	800
18	Lochbuie	-	0.11	.37	200	200	0.15	0.5	270	270
19	Mead S.D.	0.035	0.04	.15	75	75	0.07	.24	125	125
20	Milliken S.D.	0.10	0.22	.73	400	400	0.40	1.3	720	720
21	Mountain Range Shadows	0.01								
22	Nunn	-								
23	Pingree Park	0.01								
24	Pierce	0.05	0.15	.51	270	270	0.30	1.00	540	540
25	Platteville	0.14	0.22	.73	400	400	0.40	1.3	720	720
26	Ramada Inn									
27	Red Feather/ Crystal Lakes	NA	0.25	.80	750	750	0.50		1490	1490

Table 3.3-A. (Cont.)

Waste Load Projections

DESIGNATION	AGENCY	PRESENT ADWF (mgd)	1983				2000			
			ADWF (mgd) (b)	PWWF (mgd) (c)	BOD_5 (#/day)	SS (#/day)	ADWF (mgd) (b)	PWWF (mgd) (c)	BOD_5 (#/day)	SS (#/day)
28	Riverglenn									
29	Severance	-	0.03	.10	60	60	0.08	0.28	150	150
30	Spring Canyon S.D.	-	0.23	.78	425	425	0.35	1.1	630	630
31	Texaco I-25	0.023								
32	Timnath	-	0.05	.18	100	100	0.075	.28	150	150
33	Tri-Area S.D.	0.31	0.65	2.1	1200	1200	0.94	2.8	1700	1700
34	Upper Thompson S.D.	0.20 (a)	0.50 (a)	1.7	650	650	0.77 (a)	2.5	1400	1400
35	Weld Central H.S.	0.01	NA							
36	Wellington	0.06	0.17	.58	400	400	0.28	0.9	700	700

NA - Data not presently available.

(a) Does not include seasonal flows.

(b) Average dry weather flow.

(c) Peak wet weather flow.

4.0 WASTE MANAGEMENT TECHNIQUES

4.1 ALTERNATIVES FOR BEST PRACTICABLE WASTE TREATMENT

In accordance with PL 92-500, evaluation must be made of practicable techniques by which publically-owned treatment works can restore and maintain the integrity of the nation's waters. In order to achieve the 1983 goal of fishable, swimmable conditions, where attainable in the Larimer-Weld region, application of the best practicable waste treatment technology (BPWTT) will be made. Alternatives must be considered in three broad categories:

- Treatment and Discharge into Surface Waters
- Land Application
- Reuse

The general characteristics of these alternatives will be discussed in this chapter. A detailed discussion of the alternative treatment processes that can be utilized in each of these waste management techniques is presented in Section 7.2 Specific application of these techniques in the Larimer-Weld region is discussed at the end of this section.

4.1.1 Treatment and Discharge into Surface Waters

While there are many methods of treating municipal wastewaters, the only viable option for disposing of the treated effluent other than by discharge or land application is by total evaporation. Evaporation has been shown feasible only for relatively small communities located in arid climates where soil conditions are such that seepage from the evaporation lagoon is a minimum. The great majority of communities in the study area which have treatment facilities discharge effluent to surface waters. Maintenance of the water quality of these receiving waters and protection of the public health are the primary goal of wastewater treatment. These objectives, along with economic considerations, determine the degree and type of wastewater treatment necessary prior to discharge.

In Colorado, the agencies which have jurisdiction over the receiving waters and establish effluent standards are the U.S. Environmental Protection Agency (EPA), and the Colorado Water Quality Control Commission (WQCC). Surface waters of the state can be classified into two broad categories: effluent-limited segments, and water quality-limited segments. Effluent-limited segments are those reaches in which application of discharge standards for secondary treatment will result in the maintenance of stream water quality for the protection of beneficial uses. Water quality-limited segments are those reaches in which application of effluent standards more stringent than secondary treatment are required such that stream water quality will result in the protection of the highest beneficial use. Existing and future water quality standards and stream classifications are being analyzed in other components of the 208 plan.

For waters in the region which are classified principally for agricultural use, BPWTT will be defined as secondary treatment. Waters for which the highest beneficial use is the protection and maintenance of aquatic life, BPWTT will be defined as secondary treatment and if required, followed by advanced waste treatment (nitrification for ammonia reduction, plus dechlorination), land application, or reuse. Other required elements of a program to maintain fisheries by 1983, including implementation of Best Management Practices (BMP) for agricultural discharges, control of non-point sources of pollution, and provisions for maintaining year-around minimum stream flows, will be discussed in detail in the Areawide Technical Planning component of the 208 plan.

4.1.2 Land Application

There are three basic methods of land application of wastewater:

- Irrigation
- Infiltration-Percolation
- Overland Flow

Irrigation, the predominant land application method in use today, involves the application of effluent to the land for treatment and for meeting the growth needs of plants. In infiltration-percolation systems, effluent is applied to the soil at higher rates by spreading in basins or by sprinkling. Overland flow is essentially a biological treatment process in which wastewater is applied over the upper reaches of sloped terraces and allowed to flow across the vegetated surface to runoff collection ditches.

Extensive work has been done by EPA to determine the feasibility of land application systems. For more information, the reader should review the following texts:

- Evaluation of Land Application Systems, Environmental Protection Agency, Office of Water Program Operations, EPA-430/9-75-001, March, 1975;

- Costs of Wastewater Treatment by Land Application, Environmental Protection Agency, Office of Water Program Operations, EPA-430/9-75-003, June, 1975;
- Alternative Waste Management Techniques for Best Practicable Waste Treatment, Environmental Protection Agency, Office of Water Program Operations, EPA-430/9-75-013, October, 1975;
- Cost-Effective Comparison of Land Application and Advanced Wastewater Treatment, Environmental Protection Agency, Office of Water Program Operations, EPA-430/9-75-016, November, 1975;
- Land Treatment of Municipal Wastewater Effluents - Design Factors-I, Design Factors-II, Case Histories, Environmental Protection Agency, Technology Transfer, January, 1976.

Treatment of wastewater prior to land application is necessary for a variety of reasons, including: reduction of pathogens consistent with the protection of public health, particularly those transported by aerosols; avoidance of nuisance conditions, especially odors, from the storage of wastewater; maintenance of a reliable distribution system; maintenance of high infiltration rates.

In many areas, particularly Region VIII (Denver), EPA may require secondary treatment (or at least Best Waste Stabilization Pond Technology (BWSPT)) plus disinfection prior to land application, to avoid problems mentioned above. This requirement is based on experience gained particularly in California, and Florida.

4.1.3 Reuse

Four factors prerequisite to wastewater reclamation for reuse of treated wastewater are: 1) the availability of a wastewater reuser (industry or irrigation operation located in close proximity to source of reclaimed water); 2) storage facilities or alternate disposal site for wastewater during periods of non-reuse; 3) capability of producing reclaimed water of required quality; and 4) legal ownership of the wastewater by the municipality.

The degree of treatment required depends upon the characteristics of the function for which the treated wastewater is used. The common reuse of municipal wastewater today includes industrial cooling, landscape irrigation of parks and golf courses, recreation lakes providing both primary and secondary contact sports, and crop irrigation. In addition there are several minor reuses such as water closet flushing in hotels (Grand Canyon Village).

The greatest amount of wastewater reuse occurs by industry which has significantly reduced both their intake water requirements and their discharge volumes by reclaiming and recycling their process waters. Internal industrial reuse will not be considered in this analysis.

4.1.3.1 Irrigation Reuse

The State of Colorado currently does not have water quality standards for reuse of wastewater for irrigation purposes. However, because the applicable discharge standards will be no less stringent than the existing recommended Federal standards, it will be necessary for any treatment plant to produce secondary effluent prior to reuse of wastewater for irrigation. Assuming tertiary treatment is not required for surface discharge to a stream, this standard is identical with the quality requirements for discharge, and no additional treatment facilities would be required for irrigation reuse than if the water were discharged directly to a receiving water. An exception is probable higher levels of disinfection to insure the protection of public health at the reuse site. An identical discharge standard also eliminates the requirement for effluent storage, i.e., permits discharge to receiving waters, during non-irrigation periods. If it is desired to maximize the amount of wastewater reuse or to discharge all effluent to cropland, effluent storage facilities would be necessary. The volume of storage would be determined by both the variations in the irrigation requirements due to the seasonal nature of agriculture and the seasonal variations in available wastewater. Storage facilities have added as much as 25 percent to the total cost of a project.

Probably the most important consideration in evaluating the reuse potential of wastewater for irrigation is the quality requirements for the irrigation water. Quality requirements are determined by bacteriological regulations for wastewater reclamation, plus evaluation of the possible adverse effects on the irrigated crop by individual constituents contained in the water. The specification of non-injurious chemical constituent concentrations is a difficult and involved task requiring an extensive review and evaluation of available literature and other data prepared and compiled by numerous agronomists.

Additional precautions are necessary in a reuse program for the protection of public health. Such precautions have been documented as guidelines issued by the California Department of Health. Particular specific documents are of interest, including the following:

- Guidelines for Use of Reclaimed Water for Landscape Irrigation
- Guidelines for Use of Reclaimed Water for Surface Irrigation of Crops
- Guidelines for Worker Protection at Water Reclamation Use Areas

These guidelines are reproduced in their entirety in Appendix C. In addition to general guidelines concerning pipeline coding, on-site water control, and use of reclaimed wastewater, the guidelines address such factors as protection from cross-connections, prevention of unauthorized public use, identification tags, minimized exposure of drinking fountains and picnic tables, public notification of the reclamation operation, and precautionary measures concerning employee contact with reclaimed wastewater.

In considering the suitability for reusing wastewater for irrigation, it is necessary to consider the effects of the specific chemical constituents of the water and their relation with the soil and with plant metabolism. Extensive studies have been conducted by many organizations in efforts to determine specific acceptable water quality criteria for irrigation waters.

Probably the most emcompassing attempt to determine water quality criteria for agriculture has been conducted by the University of California, Cooperative Extension, Committee of Consultants. The results of their analyses have been published in "Water Quality Guidelines for Interpretation of Water Quality for Agriculture". These guidelines are intended for use in estimating the potential hazards to crop production associated with long-term use of the particular water being evaluated. Since individual constituent tolerances vary for different crops and for different soil types, the data should not be automatically applied. Potential wastewater irrigation sites should be evaluated on an individual basis where all factors can be considered. Poorer quality wastewaters have been successfully used by modification of the irrigation practices to maximize soil drainage.

4.1.4 Application of BPWTT Techniques in the Larimer-Weld Region

The three basic alternative BPWTT techniques of treatment and discharge to surface waters, land application, and reuse, are interrelated under certain circumstances. For example, the existing situation in the Larimer-Weld region is that all discharges from publicly-owned treatment works (POTW) in the triangle area, and three-quarters of the POTW's in the outlying area, are to surface waters, with the remaining applied to the land or reused. However, analysis of the water resources of the region indicates that the majority of surface waters are diverted for agricultural irrigation purposes. Therefore, the existing surface water discharge techniques utilized in the region are actually indirect forms of both land treatment and reuse. In addition, the existing waste management program results in resource recovery of nutrients by irrigation. The historic and future opportunities for land application, water reuse and resource conservation will be more thoroughly explored in the Areawide Technical Planning component of the 208 Plan.

4.2 WASTE DISCHARGE STANDARDS

4.2.1 Existing Requirements

As a minimum, planning of publically-owned wastewater treatment facilities must provide for secondary treatment by 1977 or as soon as possible thereafter, and for application of Best Practicable Waste Treatment Technology (BPWTT) prior to 1983. The levels of BPWTT and various waste management techniques available to meet those levels have been defined by EPA. Secondary treatment and BPWTT requirements apply to discharges to all surface waters of the state, and NPDES permits issued by the WQCC incorporate these standards. The Colorado Attorney General has ruled that these standards also apply to discharges to privately-owned irrigation supply waters. Current EPA secondary treatment requirements as promulgated under the Federal Water Pollution Control Act Amendments (PL 92-500), together with current standards of the Colorado WQCC, are summarized in Table 4.2.1-A.

More stringent standards apply to dischargers to water quality limited segments of the state receiving waters. The probable water quality limited segments are identified in another report prepared as part of the 208 program.

Table 4.2.1-A

Current Waste Discharge Requirements for Secondary Treatment

Parameter	Federal PL 92-500		State WQCC		
	30-day Average	7-day Average	30-day Average	7-day Average	Single Sample
BOD_5 (mg/l)	30(a)	45	ns	ns	ns
SS (mg/l)	30(a,d)	45(d)	ns	ns	ns
pH	ns	ns	ns	ns	(b)
Total Residual Chlorine (mg/l)	ns	ns	ns	ns	0.5
Fecal Coliform (MPN/100 ml)	ns	ns	6,000	12,000	ns
Oil and Grease (mg/l)	ns	ns	ns	ns	10(c)

ns = none specified

(a) Shall not exceed 15 percent of 30-day average influent concentration.

(b) Within the limits of 6.0 to 9.0 unless it can be demonstrated that: (1) inorganic chemicals are not added to the waste stream as part of the treatment process; and (2) contributions from industrial sources do not cause the pH to exceed the 6.0 to 9.0 limits (EPA requirements).

(c) Nor shall there be a visible sheen.

(d) Conditional relaxation of these standards now proposed by EPA for communities utilizing stabilization ponds systems with a design capacity of 1 mgd or less.

4.2.2 Proposed Requirements

4.2.2.1 Environmental Protection Agency

EPA has recently proposed a relaxation of suspended solids limitations in discharge standards of communities which utilize stabilization pond systems (Appendix D). The proposed standards recognize the need to retain pond systems for many smaller communities because of their inherent economical and functional advantages. Adoption of the regulations would allow the EPA Regional Administrator or state agency to grant a variance with respect to suspended solids limitations of secondary treatment requirements defined in NPDES permits, providing the community can show that: (1) waste stabilization ponds are used as the process for secondary treatment; (2) the treatment facilities have a design capacity of 1 mgd or less; and (3) performance data indicates that the facilities cannot comply with present suspended solids limitations, even if properly operated, without the addition of treatment systems not historically considered as secondary treatment (i.e., filtration systems for algae removal).

Pond systems would still be required to meet an effluent quality achievable by "Best Waste Stabilization Pond Technology" (BWSPT). BWSPT is defined as a suspended solids value which is equal to the effluent concentration achieved 90 percent of the time within a state or appropriate contiguous geographical area, by waste stabilization ponds that are achieving the levels of effluent quality established for BOD (30/45 mg/l).

It is not possible at this time to present the effluent quality standards for stabilization ponds in the study area since the numerical value of the maximum accepted suspended solid level has not been established.

4.2.2.2 Colorado Water Quality Control Commission

The Colorado WQCC is currently revising the stream classification system applicable to the entire state. When adopted, the revised stream classification system will play an important role in that it determines receiving water classification which in turn establishes water quality standards for all dischargers.

5.0 ADEQUACY OF EXISTING FACILITIES

In this section the existing facilities are evaluated in terms of their ability to comply with the currently applicable effluent discharge standards and excess capacity available for excess wastewater loads projected for the study period.

5.1 COMPLIANCE WITH EFFLUENT DISCHARGE STANDARDS

The adequacy of the existing wastewater treatment operation to produce effluent satisfying the discharge standards was investigated by analyzing the quality of the existing effluents. Effluent quality data was primarily obtained from four sources: 1) records of the CDH; 2) the 208 wastewater quality monitoring program conducted by Toups Corporation; 3) existing facility reports; and 4) results of the self-monitoring programs conducted by operators of the individual treatment plants.

In Table 5.1-A, effluent quality data and the NPDES limitations are summarized for communities in the outlying areas. In general, the tabulated values represent the average of from 2 to 15 samples obtained during the last two years. Arithmetic averages were used for the BOD_5, suspended solids, and ammonia data; logrithmetic or geometric averages were used to calculate the average concentrations for the fecal coliforms. In several instances such as Del Camino and Weld Central High School, the average values were significantly increased by a single sample with exceptionally high BOD and SS concentrations which might have been taken at a time when the plant was upset.

The NPDES limitations presented in Table 5.1-A are the values of the 30-day averages. The discharge permits also specify limitations based on the 7-day average which is 50 percent greater than the 30-day averages for the BOD_5, SS, and ammonia. In the case of fecal coliforms, geometric averages are used and the limits for the 7-day average is 100 percent greater than the limit for the 30-day average.

The discharge permits also specify that the effluent pH range be between 6.0 and 9.0, that the oil and grease concentration be less than 10 mg/l in any grab sample, and that no visible sheen occur in the effluent. Generally, facilities capable of complying with the BOD_5 and suspended solids limitations do not have any difficulty meeting the oil and grease limits. Satisfying the pH requirement is not a problem for the municipalities of the study area in view of the predominately domestic nature of the wastewater.

The effluent standards in Table 5.1-A do not reflect the Environmental Protection Agency proposal to increase the maximum suspended solids concentration allowed in effluents from stabilization pond systems treating less than 1 mgd. If this proposal is adopted, the suspended solids limitations will be somewhat greater than 30 mg/l. Communities with existing stabilization pond systems and projected wastewater flows less than 1 mgd for the year 2000 are identified by the astericks in Table 5.1-A. It is probable that these communities will be required to meet the 30 mg/l BOD_5 limitation and a suspended solids value in the range of 50 to 100 mg/l.

The results of the water quality analysis program conducted for the 208 point source investigation for wastewater effluents for selected communities in both the urban triangle and outlying areas are presented in Table 5.1-B. The water quality analysis program was conducted during the summer and early fall of 1976. Overall, the data presented in Table 5.1-B are consistent with the values obtained from the other sources and presented in Table 5.1-A. Table 5.1-B includes information on the levels of various inorganic species related to both the wastewater treatment process (nitrates and phosphates) and the chemical constituents of the water supply (sodium sulfate and alkalinity). This data on the inorganic constituents cannot be considered representative of the wastewaters of the study area because the inorganic composition of a wastewater is primarily determined by the composition of the water supply. The water supplies in the region have greatly differing inorganic compositions depending upon the source of the water. In general, the waters obtained from the mountain surface waters at or above the mouth of the canyon has TDS values less than 300 mg/l. The groundwaters of the region generally contain much higher TDS levels typically between 500 and 1500 mg/l. Greeley, Loveland, and Fort Collins all make use of the relatively good quality mountain surface waters. The majority of the smaller communities utilize groundwater which is of poorer quality. It is obvious from the data in Table 5.1-B that many of the effluents in the region fail to comply with the discharge standards. While the non-compliance can result from any one of several possible causes, the most common causes are insufficient facility capacity or improper operation and maintenance.

Many communities have experienced extensive population growths since design and construction of the treatment facilities. This results in insufficient capacity which can only be corrected by expansion or replacement of the

TABLE 5.1-A

HISTORICAL DATA - EFFLUENT WASTEWATER

AGENCY	BOD_5 (mg/l) (a)	SS (mg/l) (a)	FECAL COLIFORMS (MPN/100 ml)	NH_3 (mg/l)
Ault S.D.*	37	62	48,000	4.6
Berthoud	2	10	12	
Del Camino (I-25)	19	31	150	0.8
Eaton	11	18	2,800	12
Erie W. & S.D.*	83	105	>20,000	18
Fort Lupton*	42	69	19,900	6.6
Hill & Park S.D.*	31	76	9,600	0.4
Hudson S.D.*	31	62	4,900	
Johnson's Corner*	46	94	800	
Johnstown*	34	50	1,000	4
Keenesburg S.D.*	35	58	6,000	6.3
LaSalle*	21	43	150	6.2
Mead S.D.*	47	130	1,830	2.6
Milliken S.D.	27	66	1,400	
Pierce*	28	44	270	2.8
Platteville*	35	62	< 100	5.7
Texaco (I-25)	100	180	20,000	19
Tri-Area S.D.*	40	70		2
Weld Central High School	57	50	4,500	1.7
Wellington*	18	11	300	
Estes Park S.D.	19	18		

(a) NPDES limitations: BOD_5 = 30 mg/l;
SS = 30 mg/l.

* Future NPDES limitations may be modified to reflect Best Waste Stabilization Pond Technology (BWSPT).

Table 5.1-B

Sampling Program Results - Effluent Wastewater (a)

	Fort Collins No. 1	Fort Collins No. 2	Wind-sor	Greeley	Love-land No. 1	Love-land No. 2	Johns-town	Mill-iken S.D.	Fort Lupton	Platte-ville	Erie S.D.
BOD_5 (unfiltered)	15	42	19	37	13	22	10	8	23	26	58
BOD_5 (filtered)							9	6	19	16	31
COD								22	132	191	
Suspended Solids	22	84	124	44	21	26	86	7	92	46	80
Fecal Coliform	100	11,000	10	900	100	100	3800	20	6100	2500	3800
Oil & Grease								0.4			
Ammonia	5.3	11.0	47	7.4	8.0	12.8	4.7	8.3	1.2	1.7	6.1
Nitrate	0.16	0.54	0.78	3.6	1.2	0.84	0.02	0.23	0.01	0.01	0.14
Phosphate								2.5	2.6	2.4	
Sulfate									304	442	
Sodium								137	337	364	
Total Alkalinity								244	286	304	
TDS	528	380	1152	508	720	800	640	1040	1364	1724	740
pH							8.7	7.0	8.6	8.0	8.4
Temperature (°C)							19	20	19	21	21
D.O.							6.0	4.0	6.2	7.6	7.4
Electrical Conductivity								1150	1840	1800	550

(a) Samples collected by Toups Corporation, September, 1976.

existing facilities. It is also possible that a facility which was originally properly sized for a particular set of discharge standards will fail to meet new, more stringent requirements which require a greater degree of treatment. The adoption of discharge standards requiring nutrient removal or employment of other tertiary processes would have the same effect.

In the next section, existing capacities will be further investigated and analyzed in terms of the existing and projected wasteloads.

Facilities with sufficient design capacity will not necessarily produce acceptable effluents unless adequate operation and maintenance practices exist.

Unsatisfactory operation and maintenance can be due to lack of a qualified operator, inadequate time allocated for maintenance of facilities, or insufficient funds to permit stocking the required standby equipment or replacement parts. The State of Colorado has adopted a facility classification and operator classification system to assist communities in hiring personnel properly qualified to operate the community's treatment facility. The other two causes for unsatisfactory operation are basically budgetary problems. A detailed analysis of wastewater systems operation and maintenance is presented in Chapter 10.0.

5.2 CAPACITY FOR FUTURE GROWTH

The ability of the existing facilities to provide treatment of increased wasteloads resulting from future population growth can be investigated by comparing existing capacities with the wasteload projections. Table 5.2-A contains the existing facility capacity data from Table 2.4-A along with the present and projected wasteloads from Table 3.3-A. By comparing the existing capacity with the future projection, an estimate is made of the year in which the existing capacity will be exceeded. These estimates are also presented in Table 5.2-A.

Table 5.2-A

Treatment Plant Capacity and Projected Flows

INDEX NO.	AGENCY	DESIGN CAPACITY (mgd)	PRESENT FLOW (mgd)	1983 FLOW (mgd)	2000 FLOW (mgd)	PROJECTED YEAR WHEN FLOW EQUALS EXISTING CAPACITY
1	Ault S.D.	0.13	0.09	0.20	0.33	1979
2	Berthoud	0.90	0.48	0.43	0.70	2000+
3	Cottonwood Park	0.12	0.20			
4	Del Camino	NA	0.02			
5	Eaton	0.34	0.21	0.29	0.40	1990
6	Erie W.S.D.	0.14	0.13	0.15	0.18	1980
7	Estes Park S.D.	0.70	0.40(a)	NA	NA	NA
8	Fort Lupton	0.29	0.64	0.85	1.5	Presently
9	Gilcrest S.D.	0.05(c)	0.04	0.07	0.13	1983(c)
10	Grover	0.029	0.025	0.013	0.015	2000+
11	Hill-n-Park S.D.	0.12	0.07	NA	0.65	1978
12	Hudson S.D.	0.05	0.06	0.11	0.15	Presently
13	Johnson's Corner	0.05	0.007			
14	Johnstown	0.25	0.22	0.28	0.38	1980
15	Keenesburg S.D.	0.05	0.05	0.08	0.13	Presently
16	Kersey S.D.	0.05	0.05	0.21	0.30	Presently
17	LaSalle	0.36	0.17	0.32	0.45	1988
18	Lochbuie	0.18 (b)	-	0.11	0.15	2000+(b)
19	Mead S.D.	0.03	0.035	0.05	0.07	Presently
20	Milliken S.D.	0.12	0.10	0.22	0.40	1978
21	Mountain Range Shadows	0.10	0.01			

Table 5.2-A (Cont.)

Treatment Plant Capacity and Projected Flows

INDEX NO.	AGENCY	DESIGN CAPACITY (mgd)	PRESENT FLOW (mgd)	1983 FLOW (mgd)	2000 FLOW (mgd)	PROJECTED YEAR WHEN FLOW EQUALS EXISTING CAPACITY
22	Nunn	-	-	NA	NA	
23	Pingree Park	0.01	0.01			
24	Pierce	0.17	0.05	0.15	0.30	1986
25	Platteville	0.20	0.14	0.22	0.40	1981
26	Ramada Inn I-25	NA	NA			
27	Red Feather/ Crystal Lakes	0.01	NA	0.25	0.50	Presently
28	Riverglenn	0.029	NA			
29	Severance	-	-	0.03	0.08	Presently
30	Spring Canyon S.D.	-	-	0.23	0.35	2000
31	Texaco I-25	0.018	0.023			Presently
32	Timnath	-	-	0.05	0.075	
33	Tri-Area S.D.	0.52	0.31	0.65	0.94	1981
34	Upper Thompson S.D.	1.50	0.20 (a)	0.50 (a)	0.77 (a)	
35	Weld Central H.S.	0.02	0.01			
36	Wellington	0.31	0.06	0.17	0.28	2000

NA = Data not presently available.

(a) Does not include seasonal flows.

(b) Proposed system.

(c) Assuming a non-discharging system.

6.0 BASIS OF PROJECT DEVELOPMENT

Prior to the development of alternative plans for those communities requiring upgrading or expansion of their existing facilities, specific criteria must be established to insure the proper comparison of plans and resultant selection of the apparent best project. Information required includes design criteria for facilities, and basis of cost estimate for facility construction and operation.

The basis used in selection of the recommended processes for achieving specific discharge standards for the region are capital costs, operation and maintenance requirements and costs, process dependability, and environmental compatibility.

The effluent quality standards applicable to a specific discharge play an important role in that they determine which processes should be considered initially in the selection process. Adoption of the relaxed discharge standards for stabilization pond systems as proposed by the EPA would have a significant effect in that the number of viable alternatives would be increased. Likewise, whether discharges are into effluent quality limited segments of water quality limited segments affects the processes viable by changing the discharge standards.

In those instances where significant amounts of usable facilities exist, expansion dictates that the availability, capacity, and condition of the existing facilities be assessed, with a view to their incorporation into the various alternative plans. Existing facilities should be retained in the layout of alternative plans when their use is compatible with required functions and is economically justified. The variety of existing facilities in the study region prevents recommendation of a single expansion scheme applicable to all communities. The optimum expansion scheme for a community with an existing stabilization pond would certainly differ from the optimum expansion scheme for a community having an overloaded trickling filter.

Design criteria and cost data presented in this analysis apply to preliminary design and layout of facilities. It is not possible within the scope of this report to propose specific sites and final process layouts for expansion of existing or construction of new facilities. The facility plan or a detailed engineering study for the preparation of construction drawings and specifications will determine specific site conditions including land availability, subsurface hydrology and geology, surface topography, and surface drainage. Relocation and resizing of a portion of existing facilities would also be required as part of a detailed study.

6.1 BASIS OF COST ESTIMATES

The cost of constructing and maintaining the facilities required for each of the alternative plans considered in this report includes the capital outlay necessary for initial funding plus continued expenditures for operation throughout the lifetime of project. The data presented in the following sections will provide sufficient information for comparison of alternative plans developed later in this report.

6.1.1 Construction and Project Costs

Unit construction cost prices given in this report include contractor's overhead and profit, engineering, and construction contingencies. Land costs have been included for those processes which have significant areal requirements such as stabilization ponds or land treatment systems. Costs of land for these area intensive processes were assumed to be $1,500 per acre. While this value is less than much of the land in the study area, it represents the probable value of land in the location where a wastewater treatment facility would be suitable. Evaluation of a specific site would require a more accurate estimate of land costs. The unit prices used for comparative purposes in this report represent the average bidding conditions for many projects. Actual construction bids for a given project may not correspond to the unit prices used herein. Although additive or deductive items are applied where believed necessary to cover special conditions characteristic of a specific process, the preliminary estimates presented are not presumed to be as accurate as those prepared during final design.

Because costs of construction undergo significant changes in accordance with corresponding changes in the national economy, a cost index is usually presented to reflect the conditions for which the estimates are made. The best and most widely used index is the Engineering-News-Record (ENR) Construction Cost Index, which is computed from prices of construction materials and labor and based on a value of 100 in the year 1913. Based on conditions in the northern Colorado area expected in Fall, 1977, cost data in this report are based on an ENR Construction Cost Index of 2300. This corresponds to an EPA Treatment Plant Construction Cost Index of approximately 285. Although this value may not reflect future conditions, costs of future construction can be related to cost data presented herein by applying the ratio of the then-current ENR Construction Cost Index to 2300. The project or projects selected as optimum will be relatively unaffected by different projections in the ENR Construction Cost Index since the same index value is used in all process evaluations.

Project or capital costs include construction costs plus expenditures required to cover engineering services, contingencies for uncertainties unavoidably associated with preliminary design, and overhead items such as legal and administrative fees. Thus, to predict the total project cost of an alternative, an additional 30 percent of construction costs are added to each alternative's total cost.

6.1.2 Annual Costs

Economic evaluation of alternative projects requires consideration of annual as well as project costs. Annual costs include expenditures for capital recovery plus operation and maintenance. Operation and maintenance costs include expenditures for labor, repairs, power, chemicals, supplies, administration, and additional costs which vary from project to project. Operating costs presented herein have been assumed to increase at the same rate as construction costs and are based on an ENR Construction Cost Index of 2300.

6.1.2.1 Interest Rates

Interest rates, generally applied as a compounded percentage per year, are an expression of the time value of money. Interest rates must be assumed for purposes of computing the annual cost of capital and for estimating the total cost of prospective bond issues. Based on current data, a rate of 7.0 percent is used in this report for public works construction financing and annual cost calculations.

6.1.2.2 Depreciation and Amortization

Most bonds sold for sewerage projects have redemption periods of about 25 years. However, an estimate of the average economic life of each project is used in computing the annual cost of capital. The annual fixed cost is computed by applying a capital recovery factor to the project's capital cost. The economic life of projects and facilities will vary. Ponds, pipelines, and storage reservoirs are assumed to have a 50-year economic life. Pumping facilities and wastewater treatment facilities are assumed to have an economic life of 30-years. It is re-emphasized that selection of different interest rates or amortization periods will not affect the conclusions which are based on a comparative analysis of the various projects.

7.0 ALTERNATIVE PLANS FOR TREATMENT AND DISPOSAL

This section includes a discussion of process selection criteria and a discussion of alternative treatment processes, and the development and evaluation of alternative plans.

7.1 PROCESS SELECTION CRITERIA

The selection of the optimum process for an individual community should not be based exclusively on the economics of the individual processes capable of satisfying discharge requirements. Many technical and social factors should be considered in evaluation of viable alternatives. Community characteristics such as growth rate, land cost and availability, proximity of treatment facilities to residential or commercial areas, available operator capabilities, and treatment facility aesthetic effects (visual and odor) on the community, all have a bearing on the treatment facilities best suited for a given community.

There are a great number of alternative treatment processes capable of satisfying BOD and suspended solids (SS) discharge requirements. The alternative discussed in the following sections are those which have been found suitable for smaller communities. Processes requiring extremely sophisticated operator capabilities generally unavailable in smaller communities, such as continuous operator monitoring, are not considered in this report.

No attempt will be made to recommend an optimum process or processes for the larger communities in the urban triangle area in this report. Generally, the larger communities have conditions or factors that require analyses on an individual basis and prevent selection of regional optimum solutions. This will be accomplished in the Areawide Technical Planning component of the 208 Plan.

The three major communities in the study area each have a significant industrial wastewater input: Greeley - dairy and meat packing; Loveland - electronics; Fort Collins - food processing and metal plating. Each of the larger communities also have substantial existing facilities which require evaluation and modification for incorporation into expansion schemes. The larger communities are usually able to justify utilization of complex processes in view of the financial availability of sophisticated operators and monitoring equipment. In addition, there are the complex policies of the sanitation department or district and the community financial considerations which cannot be evaluated within the scope of this project.

There are two major treatment plant classifications: biological and physical/chemical. Both types of processes have the same objective--removal of dissolved and particulate organic material. Biological treatment processes, some of which have been used since the turn of the century, depend on microorganisms to convert putrescible substances to less noxious chemical forms which are compatible with the environment. Controlled biological processes are those such as activated sludge or biofilters in which the biological growth conditions are artificially controlled; stabilization ponds or aerated lagoons are considered uncontrolled biological processes.

Physical/chemical treatment consists of the addition of various chemicals to aggregate and to aid settling particulate matter and to oxidize organic substances. Depending on the particular effluent quality goals, physical/chemical plants may employ multimedia filtration, activated carbon adsorption, ozonation or any one of several other processes. While there are several small physical/chemical package plants currently on the market, none will be considered in view of their stringent operational requirements.

7.2 ALTERNATIVE TREATMENT PROCESSES

The treatment processes which will be considered as alternatives in this report are listed in Table 7.2-A. Each of the processes is described below. The processes being considered are capable of achieving different effluent qualities and cannot be compared solely on a cost basis. Three general classes of processes will be considered: pond systems, pond upgrading processes, and mechanical systems.

7.2.1 Pond Systems

Domestic wastewater may be effectively stabilized when stored in shallow pools by natural biological processes involving symbosis between bacteria and algae. Bacteria degrade the wastewater and produce carbon dioxide; algae utilize the carbon dioxide and produce oxygen which is required by the bacteria. This symbiotic relationship requires the presence of a healthy growth of algae which occurs when pond depths are less than 6 to 10 feet. The algae which supply oxygen for the biodegradation of the wastewater do not completely settle and are present as suspended solids in the pond effluent. In consideration of the fact that algae are inherently different from wastewater solids in composition, the Environmental Protection Agency has recently recommended that the suspended solids effluent

TABLE 7.2-A

Alternative Treatment Processes For Outlying Areas

Designation	Process
	<u>Pond Systems</u>
1	Stabilization Ponds
2	Aerated Stabilization Ponds
3	Total Evaporation Systems
	<u>Pond Upgrading Processes</u>
4	Rock Filter
5	Polishing Pond
6	Intermittent Sand Filters
	<u>Mechanical Systems</u>
7	Conventional Activated Sludge
8	Extended Aeration
9	Oxidation Ditches
10	Biofilters
11	Rotating Biological Contactor

requirement for lagoons be made more lenient. The EPA has recommended that each state set the maximum allowable suspended solids concentration for lagoon systems under their jurisdiction. This level has not been set for Colorado at the present time.

According to the EPA, 25 percent of the wastewater treatment plants in this country are lagoons [Appendix B]. Nearly 90 percent of these wastewater treatment ponds serve communities of 5,000 population or less [ibid]. The reason pond systems are so popular with small communities is because initial installation costs and operation and maintenance costs are relatively low. In addition, because of the fairly long detention times in lagoons, they are less susceptible to shock loads or breakdown than are mechanical plants.

7.2.1.1 Non-Aerated Stabilization Ponds

A non-aerated stabilization pond is basically a shallow pond (3 to 10 feet deep) in which the wastewater is stored for 30 to 120 days. In some cold climate areas where freezing of the receiving stream occurs, it has been a problem to provide for pond storage of all wastewater through the winter until the spring thaw when adequate dilution water is available in the receiving stream. However, this has not been required in Colorado. The maximum BOD loading per unit volume of pond is limited by the amount of available oxygen produced by the algae and supplied by surface reaeration. Both of these sources of oxygen are directly related to the surface area of a lagoon since algae growth in deep ponds is limited by light availability. A stabilization pond is considered an uncontrolled biological treatment process, since the amount of active biomass in the system cannot be adjusted or regulated.

In cold climates where lagoon water approaches freezing, maximum BOD loading rates are approximately 15 to 20 pounds BOD per acre per day. This is equivalent to approximately 100 people per acre.

Operation and maintenance requirements for non-aerated stabilization ponds are the lowest for any secondary treatment process. It is this O & M factor combined with low capital costs that causes the wide use of stabilization ponds by small communities. Stabilization ponds do, however, have several disadvantages including: 1) large land requirements; 2) odor problems two or three times a year when temperature inversions occur and cause the ponds to "turn over", bringing up septic, odorous liquid from the lower depths; and 3) the effluent usually contains algae, and may be unsuitable for certain reuses. The odors can be especially noticeable during the spring thaw and unless the ponds are located quite a distance from inhabited buildings, the aesthetic effects make them undesirable.

A significant advantage of waste stabilization pond systems is that no sludge is produced and all sludge handling and disposal problems are eliminated. The electrical energy and chemical requirements are also minimal.

Although it is possible that stabilization ponds will not be required to meet the 30 mg/l suspended solids discharge requirement, the 30 mg/l BOD requirement will remain in effect. It is doubtful that very many discharging ponds could meet the BOD discharge requirement during the winter months when an ice cover would develop on the pond and decrease the available oxygen supply. Based on this probability of non-compliance with the BOD discharge standard, the non-aerated stabilization pond system is not recommended.

The capital costs for non-aerated stabilization ponds as a function of capacities between .02 and 2.0 mgd are illustrated on Figure E-1 (Appendix E). Also included are costs for Alternative 2 - aerated stabilization ponds. As described in Chapter 6.0, the capital costs presented include 30 percent for engineering and construction contingencies and are based on an ENR Construction Cost Index of 2300. The costs have been presented in terms of cents per 1000 gallons of plant capacities.

Operation and maintenance (O&M) costs for stabilization ponds are shown on Figure E-2 as a function of plant capacity. Also included are total costs which include the O&M costs and capital recovery based on 7 percent and a 30-year life.

The design criteria for the non-aerated stabilization pond considered on Figures E-1 and E-2 are: BOD loading rate - 20 pounds per day per acre and hydraulic detention period - 90 days.

Other characteristics including environmental suitability, land requirements, expandability are presented in Table 7.2-B, which compares characteristics of the more viable alternatives.

TABLE 7.2-B COMPARISON OF ALTERNATIVE TREATMENT SYSTEMS

	EXTENDED AERATION	OXIDATION DITCH	NON-AERATED STABILIZATION POND	AERATED STABILI-ZATION POND	CONVENTIONAL ACTIVATED SLUDGE (a)
1. COSTS					
A) Capital (Including 30% for construction contengencies, legal & engineering)	(b)	(b)	(b)	(b)	(b)
B) Annual Operation & Maintenance					
C) Total Annual Costs					
2. ENVIRONMENTAL ACCEPTABILITY					
A) Visual aesthetics	Good	Good	Poor	Poor	Good
B) Odor generation potential (minimum)	Good	Good	Poor	Poor	Good
C) Disposal of residue sludges	Average	Average	Good	Good	Average
D) Overall plant acceptability	Good	Good	Worse	Poor	Good
3. OPERATION & MAINTENANCE					
A) Time requirements	Poor	Average	Best	Good	Poor
B) Complexity	Average	Average	Best	Good	Average
4. RELIABILITY					
A) Mechanical equipment	Average	Average	Best	Good	Average
B) Biological stability	Average	Good	Average	Good	Average
C) Effluent acceptability	Good	Good	Poor	Average	Good
D) Cold weather operation	Average	Average	Poor	Average	Average
5. ENERGY & RESOURCE UTILIZATION					
A) Power	Average	Average	Good	Average	Average
B) Chemicals	Average	Average	Average	Average	Average
C) Area Requirements	Average	Average	Poor	Poor	Good
6. FLEXIBILITY					
A) Successful operation until attainment of design flow					
B) Expansion for future growth	Good	Good	Good	Good	Good
C) Operation	Average	Average	Average	Good	Average
D) Upgrading	Average	Average	Poor	Poor	Average
	Average	Good	Poor	Average	Good

(a) Or completely-mixed activated sludge.
(b) Varies with capacity - see cost curves.

7.2.1.2 Aerated Stabilization Ponds

Increased BOD loading rates and therefore smaller land requirements are possible in a pond system if a supplemental supply of oxygen can be provided. Such systems commonly referred to as aerated lagoons, aerated stabilization ponds, aerated ponds, aerated oxidation ponds, etc., are generally provided with supplemental oxygen by either mechanical surface aerators or a diffused aeration system. Supplemental oxygen can increased maximum BOD loading rates into the range of 100 to 200 pounds BOD per acre per day depending on the temperature of the lagoon water. Even with the supplemental oxygen supply, aerated lagoons, like stabilization ponds, are considered uncontrolled biological processes.

Aerated stabilization ponds have several advantages over non-aerated stabilization ponds, including: 1) much smaller land requirements due to the greater maximum BOD loading rate; 2) lower probability of odor problems since supplemental oxygen is supplied and the pond liquid is completely mixed; and 3) production of better quality effluent during the winter months when an ice layer may develop. Aerated stabilization ponds do have slightly greater O&M requirements than stabilization ponds due to the energy requirements and maintenance associated with the aeration equipment.

Capital costs and O&M total costs for aerated stabilization ponds are presented in Figures E-1 and E-2, respectively. The capital costs for large aerated stabilization ponds are less than the costs of the unaerated stabilization ponds due to the differences in land requirements. Aeration reduces the area requirements of a pond system by an approximate six-fold factor. The capital cost data and the total cost data are based on an assumed land cost of $3,000 per acre. Higher land costs would cause the aerated stabilization pond to be economically favored over an unaerated pond at lower design flowrates.

The aeration equipment generally completely mixes the liquid of the pond and keeps a portion of the smaller solids suspended. These systems are normally designed with two or more cells in series. The first cell(s) which are aerated settle out the larger solids; the final cell, which is quiescent, allows settling of the smaller wastewater solids. The algae cells which are produced in the treatment process do not readily settle in either pond due to the small differences in the densities of the algae cells and the water. In other words, algae cells are almost completely buoyant and will settle only at extremely slow rates. This causes aerated pond effluents, like those of unaerated stabilization ponds, to contain large amounts of algae which causes the effluents to exceed the suspended solids discharge requirement of 30 mg/l.

7.2.1.3 Total Evaporation Systems

In areas where the evaporation rate exceeds the precipitation rate, it is possible to use evaporation systems. In some parts of Colorado the net evaporation rate (evaporation minus precipitation) is as great as 33 inches per year. An evaporation system must contain sufficient volume to store water from periods of low evaporation to periods of high evaporation rates.

The advantages of total evaporation systems are that since no discharge occurs, the need to satisfy effluent standards is eliminated. The Colorado Department of Health recognizes the elimination of discharge standards and no NPDES discharge permit is required.

There are several disadvantages to total evaporation systems. The land requirements of evaporation systems are greater than any other process considered. There are also possible problems with water rights and groundwater pollution. It is necessary to have the ownership rights to the wastewater before it can be evaporated into the atmosphere. Evaporation is a consumptive water use. Pollution of the groundwater by highly saline solutions is possible if evaporation ponds are not lined or not located in an area with impervious soil. As evaporation occurs, the remaining solution becomes more saline. If this saline solution percolates into the groundwater, a significant increase in TDS of the groundwater can occur in the vicinity of the evaporation pond.

In view of the disadvantage of total evaporation ponds, comparative cost data has not been developed. The environmental characteristics of an evaporation pond system would be somewhat similar to those of an unaerated stabilization pond.

7.2.2 Pond Upgrading Processes

Aerated and non-aerated stabilization pond systems effluent cannot consistently satisfy a 30 mg/l suspended solids discharge standard without employment of an effluent upgrading technique. If the 30 mg/l standard for stabilization ponds remains in effect, then all discharging ponds will have to utilize upgrading techniques or abandon their ponds and construct mechanical treatment facilities.

Many different methods for upgrading stabilization ponds system effluents have been proposed. Algae removal methods considered have included air floatation, diatomaceous earth filtration, micro-screening, preadator feeding, mechanical harvesting, rapid dual media filtration, intermittent slow sand filtration, rock filters and polishing ponds. While the majority of these methods have only been studied in the laboratory or on small pilot scale, it is apparent that most utilize expensive capital equipment and have high O&M costs. Therefore only three processes will be evaluated in this report.

Characteristics of the three lagoon upgrading processes considered are presented in Table 7.2.2-A. It should be noted that each of the processes produces an effluent of a different characteristic at a different cost. In general, the best quality effluent is the most costly to produce. The optimum upgrading process would be the one satisfying the discharge requirements at the minimum cost.

7.2.2.1 Rock Filters

A rock filter is basically a submerged permeable dike consisting of one- to two-inch rock placed directly before the final system outlet. Although several rock filters have been constructed in Colorado, they are currently under evaluation to better determine design standards and process capabilities. Preliminary results indicate that the effluent quality is highly dependent upon the influent quality. In other words, an acceptable effluent (20-30 mg/l suspended solids) can only be produced when the lagoon effluent is of relatively good quality (50-80 mg/l suspended solids). During the warm summer months, pond systems in the Larimer-Weld study region typically exceed 100 to 150 mg/l suspended solid concentrations.

No cost estimates have been prepared for rock filters in view of the lack of definite design criteria for achievement of 30-30 SS-BOD_5 discharge standards. Relative cost data for the pond upgrading processes is presented in Table 7.2.2-A.

Table 7.2.2-A

Characteristics of Stabilization Pond Effluent

Upgrading Processes

Process	Capable of Consistently Satisfying 30-30 Standard	Probable Effluent SS Level mg/l	Nitrification	Relative Capital Costs	Relative O&M Costs
Rock Filter	Possibly	20- 60	No	Low	Low
Polishing Pond	No	30-100	No	Low	Low
Intermittent Slow Sand Filter	Yes	10- 20	Yes	High	High

7.2.2.2. Polishing Pond

A polishing pond is an unaerated pond with a relatively deep depth (6 to 20 feet) and a minimum surface area which is able to improve effluent quality by acting as a quiescent settling basin. The fact that algae are photosynthetic, they require light for growth, enables reduction in the algae growth rate by designing for a minimum of light penetration. Polishing ponds cannot consistently upgrade stabilization pond effluents to comply with the 30 mg/l suspended solids standard.

There is preliminary data from studies currently being conducted in California that two or more polishing ponds in series and operated on a batch, fill and draw basis, can produce relatively good effluents. Researchers believe that the batch operation mode keeps the pond in a continuous state of biological upset which reduces algae growth. Again, insufficient data exists concerning continued, long-term usage of parallel ponds.

7.2.2.3. Intermittent Sand Filters

Intermittent slow sand filters consist of 3 to 6-foot deep beds of fine sand above underdrains. Generally an impervious membrane is installed below the underdrains to maximize recovery of filtered water. Algae laden pond effluents is spread intermittently on the beds and percolates to the underdrains. The dosing cycle is adjusted to allow the surface of the sand bed to completely dry between dosings. Algae accumulation at the sand surface gradually reduces the filtration rate and necessitates scarification of the surface of the sand bed. Eventually the upper few inches of the sand must be replaced. The rate of this gradual clogging process increases with increased dosing rates.

Algae removal rates are high using intermittent sand filters if proper operation procedures are utilized. The principal drawback of intermittent filters is their high capital and O & M costs. If certain subsurface soil conditions exist, it is possible that the impervious membranes or the membrane and the underdrain system is not required. Elimination of either of these two components greatly reduces the capital costs.

Capital costs, O & M costs and total costs for intermittent slow sand filters are illustrated on Figure E-3. The most important design parameter for an intermittent filter is the hydraulic loading rate. The filter size (capital cost) is inversely proportioned to the hydraulic loading rate for a given flowrate.

7.2.3 Mechanical Systems

As previously stated, only biological mechanical plants will be discussed. Physical/chemical plants have been eliminated due to their O & M requirements. There are other biological processes than those discussed below which may be applicable for expansion of existing facilities or construction of new facilities affected by special conditions such as site availability or the presence of significant quantities of difficult-to-treat industrial wastes.

7.2.3.1 Activated Sludge - Conventional

The conventional activated sludge process is the original process involving mixing of wastewater with an activated biomass which biodegrades objectional organic substance to less noxious forms. A flow diagram for the process is illustrated in Figure 7.2-B. Basically, raw wastewater is first settled or clarified and then aerated in a tank which has a large concentration of active microorganisms. The aeration tank can be designed so that either air or pure oxygen is used as the source of oxygen required for metabolism. The microorganisms biodegrade the wastewater substances into carbon dioxide gas and microorganism cells. The outflow from the aeration tank is then processed in a second clarifier which separates the clear, treated wastewater from the sludge or active biomass. The settled biomass can then be returned to the aeration tank to maintain high microorganisms concentrations which are required for proper treatment. The retention period in the aeration is typically six hours based on the wastewater flowrate.

The environmental characteristics of the activated sludge plants are presented in Table 7.2-B. Generally, conventional activated sludge processes are not used for flowrates less than 1 mgd due to operational difficulties caused by the relatively large flow fluctuations that occur in small plants.

Waste sludge from the process must be digested before it can be disposed of in either landfills or as a agricultural soil conditioner.

Cost data for conventional activated sludge plants with sludge digestion are presented on Figure E-4 for flowrates between 1 and 10 mgd. Costs of systems treating less than 1 mgd are not presented since conventional activated sludge is not recommended for flowrates less than 1 mgd.

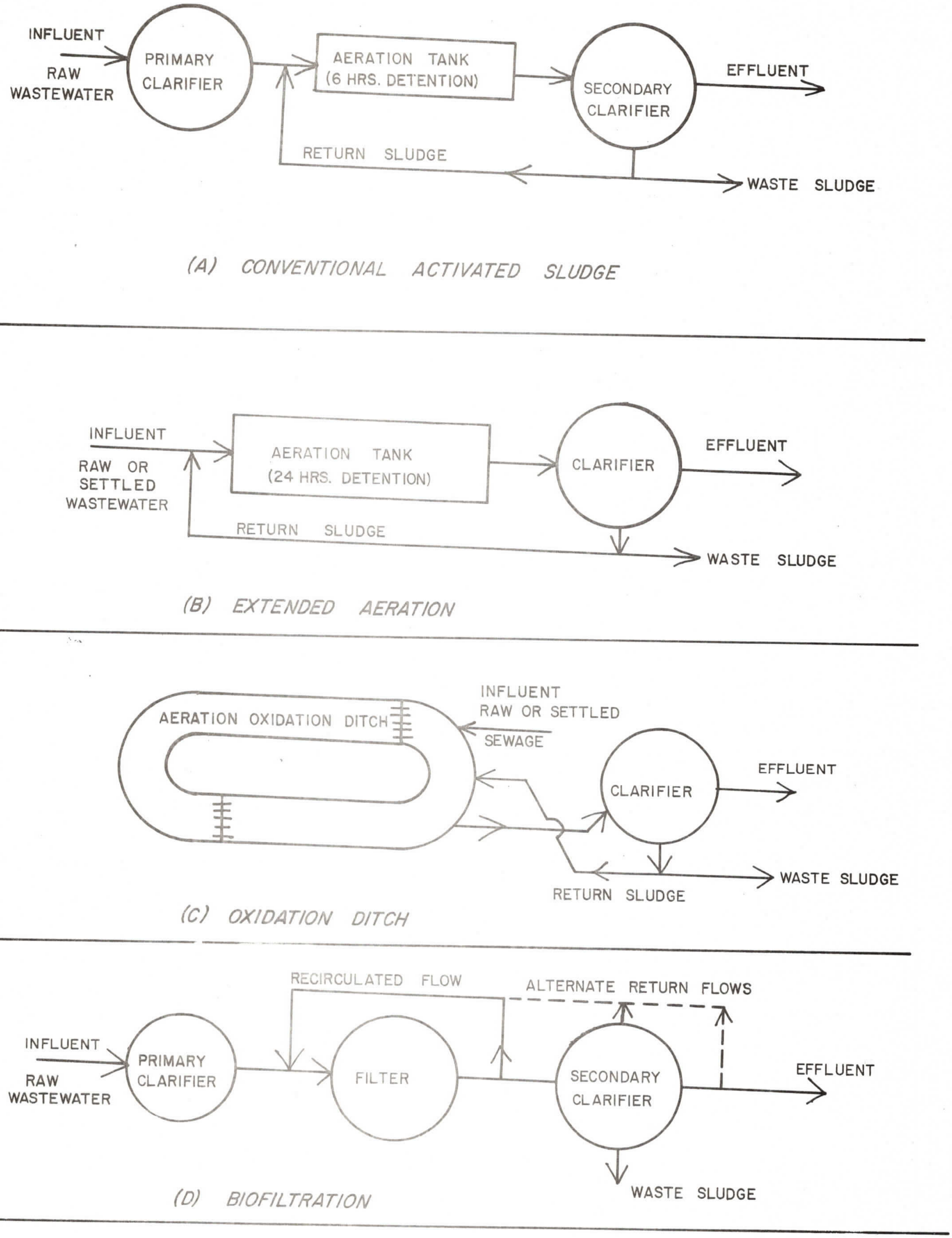


Fig. 7.2.3-A. Schematic Flow Diagrams - Alternative Mechanical Treatment Processes

7.2.3.2 Extended Aeration

Extended aeration is a modified activated sludge process suitable for use by small communities. The principal differences between conventional activated sludge and extended aeration are: (1) that the extended aeration process does not require primary sedimentation, (2) it has a 24-hour aeration period, and (3) excess sludge can be wasted on a periodic, batch basis. A schematic flow diagram is illustrated on Figure 7.2.3-A.

The major mechanical equipment required for an extended aeration plant are aerators (diffused or mechanical) and sludge return pumps. External separate sludge digestion facilities are not required since digestion occurs while the sludge is in the aeration circuit (internal digestion). A relatively small aerated sludge holding tank enabling uniform batch wasting of sludge from the aeration circuit would be required in Colorado. Depending on local conditions, sludge is generally pumped to sludge drying beds for dewatering and subsequent trucking to sanitary landfills, disposed of by land treatment, or trucked as a liquid to an appropriate disposal site.

The primary advantage of extended aeration over conventional activated sludge is that extended aeration is more stable biologically and thus requires less operation and maintenance. Proper operation will require the services of a relatively highly trained operator for several hours each day. It has generally been found that a well-operated plant does not result in any odor problem.

Additional characteristics of the extended aeration process and the other alternatives considered are presented in Table 7.2.3-A. The capital costs for an extended aeration plant along with the other mechanical plants viable for the outlying communities are presented on Figure E-5. Operation and maintenance costs, along with total costs, are presented on Figure E-6 for plants with capacities ranging from 0.02 to 2 mgd.

7.2.3.3 Oxidation Ditch

The oxidation ditch is a modification of the extended aeration-activated sludge process which utilizes a closed loop channel as an aeration chamber. The process was originally intended to be a low cost system requiring non-sophisticated construction methods and mechanical equipment.

The process flow scheme consists of aeration of raw wastewater in the loop channel followed by the sedimentation of the activated sludge in a clarifier. The activated sludge (active microorganisms) is returned from the clarifier back to the aeration tank. Brush aerators are used to supply oxygen and to retain solids in suspension in the aeration channel. A schematic flow diagram is presented on Figure 7.2.3-A.

Internal sludge digestion occurs and eliminates the requirement for external sludge digestion facilities. Depending on land availability for sludge drying beds, it may be cost-effective to provide for external sludge digestion in plants having design flowrates greater than 0.5 mgd. Sludge also can be disposed of by other methods such as land treatment or liquid sanitary landfill.

The biological stability of the oxidation ditch process causes it to have one of the lowest operation and maintenance requirements of any of the controlled biological treatment processes such as activated sludge or bio-towers. This is a significant advantage for small communities where highly-trained operators might not be readily available. Land requirements are typical of controlled biological processes. Table 7.2.3-A compares other characteristics with those of all the alternatives considered. Capital costs and operational and maintenance costs are presented in Figures E-5 and E-6, respectively.

7.2.3.4 Biofiltration

Biofiltration consists of spraying or trickling settled sewage (primary effluent) over synthetic plastic media or rocks which provide a large surface area for the growth of attached microorganisms. As the wastewater flows over the biological growth organics are biodegraded and incorporated into new biological growth which continually washes from the media. The biological growth or flocs are removed from the process effluent in a second clarifier. A schematic flow diagram for the biofilter or trickling filter process is illustrated on Figure 7.2.3-A.

Although sludges from the primary clarifiers have a greater potential for odor problems than do the secondary sludges, both sludges must be further treated before disposal. Generally the sludge problems and the operational and maintenance requirements cause biofilters to be unsuitable for small communities.

Capital costs, operation and maintenance costs, and total costs for biofilters with capacities ranging between 1 and 10 mgd are presented on Figure E-7.

A characteristic which has a major effect on the utilization of biofilters is that while the process can produce a relatively high degree of treatment, it is difficult to consistently produce biofilter effluents that meet the 30 mg/l suspended solids limitation of the secondary treatment requirement.

7.2.3.5 Rotating Biological Contactor

A rotating biological contactor is similar in operation to a trickling filter plant. It is available in package form and can therefore be installed by a small community for much less money than can a trickling filter plant. This plant uses a rotating drum on which a biological slime layer grows. This slime layer is the BOD_5 removal mechanism. Remaining solids are settled in a clarifier prior to discharge.

8.0 RECOMMENDED ALTERNATIVES

Various alternative treatment processes have been described in Section 7.0. In this section, particular alternatives will be recommended, based on cost, effluent quality, operation and maintenance requirements, and environmental compatibility.

It is impossible to recommend a single process for all communities in the study area. The large range of community sizes and the variety of existing processes necessitates recommendation of a process or processes for groups of communities categorized according to size, discharge standards, and existing facilities.

Prior to presentation of the recommended alternatives, it is important that the limitations of the techniques used to arrive at the recommendations be understood. The large number of limitations illustrates the need for an individual facility analysis for any community anticipating expansion of existing or construction of new facilities. The value of the following recommendations and this report is that they provide general information concerning probable future facilities for the region and offer data which enables communities to arrive at general costs for future expansion.

8.1 LIMITATIONS

8.1.1 Cost Analysis

A simple comparison of total process costs will not necessarily achieve the lowest cost system for a given community. There are various sources of money for capital costs of treatment facilities available from outside the communities. For example, the Federal Government through the Environmental Protection Agency funds up to 75 percent of the capital costs of facilities. This grant program is administered by the Colorado Water Quality Control Commission which prepares a priority list based on pollution potential.

Other sources of external funding are the Colorado Department of Local Affairs, Farmers Home Administration, Four Corners Regional Commission, Economic Development Administration, and the Community Development Act.

The majority of the communities in the outlying areas of the Larimer-Weld region do not pose enough of a pollution potential to be ranked in the state's priority list for Environmental Protection Agency construction grant monies.

The outlying communities in general are only able to obtain between 10 percent and 70 percent capital funding from the agencies and programs listed above.

If external sources of substantial capital funding are available, then the most economic system for a community is not necessarily the alternative with the lowest total cost. In general, if a community is only responsible for a relatively small portion of the capital costs, then the most economic alternative might be one with high capital costs and low operation and maintenance costs. In order to determine the real wastewater system costs for a community, the economic analysis process should consider the probable degree of external sources of capital. It is beyond the scope of this point source analysis to project the degree of external capital funding available to each of the study area communities. Therefore, cost comparisons are based on total capital and operation and maintenance costs.

8.1.2 Discharge Standards

Since the primary objective of any treatment facility is compliance with the discharge requirements, the requirements play a critical role in the selection of the optimum treatment system for a community.

Effluent standards more stringent than secondary treatment standards may apply to discharges into water quality-limited segments of Colorado surface waters. Standards for discharge into water quality limited segments can vary from segment to segment and stream to stream since they are dependent on the assimilation capacity of the given segment. Values for critical effluent constituents are specified.

Achievement of standards more stringent than secondary generally requires employment of one or more advanced waste treatment (AWT) processes. Since it is impossible to evaluate alternative tertiary processes without knowledge of the applicable effluent standards, no processes will be recommended in this report for facilities having discharge standards more stringent than conventional secondary requirements. AWT requirements for discharge to water quality-limited segments will be analyzed in detail in the Areawide Technical Planning component of the 208 Plan.

Alternative processes will be recommended herein for both the 30-30, SS-BOD_5 secondary standards and the proposed relaxed suspended solid standard applicable to stabilization pond systems.

8.1.3 Expansion of Existing Facilities

The costs of alternatives evaluated and presented in Section 7.0 are based on construction of completely new facilities. Any expansion of existing facilities where economy of operation and maintenance efforts is possible, or where existing facilities are actually incorporated or utilized in the expansion, would require a re-evaluation of projected costs. Therefore, the costs of alternatives and recommended projects in this report cannot recognize the detailed economics resulting from expansion of existing facilities. However, this limitation is not a major factor when considering generalized recommendations for projects.

The economy of operation and maintenance referred to above can assume a different aspect than simply one of economics. If the existing facilities utilize one process and the operators are competent in controlling this process, then switching to a different process could require re-training existing operators or employment of new operators proficient in the new process.

8.1.4 Environmental Conditions

The existence of special groundwater or other site-related problems have not been considered in evaluation of alternatives due to the specific nature of such problems. Examples of site-related problems are limited availability of land which would favor mechanical plants over stabilization pond systems, proximity to residential areas which would increase the potential problems from odors, and location of site in the flood plain.

8.2 RECOMMENDED PROJECTS

Considering the limitations described above, processes recommended for use in the Larimer-Weld study area are presented below.

8.2.1 Small Communities; 30-30 Standard

For purposes of this report, the recommended processes for communities with flowrates less than 1 mgd and discharge standards of 30 mg/l BOD_5 and 30 mg/l suspended solids is the OXIDATION DITCH alternative. This recommendation is primarily based on relative costs of processes and the superior biological stability and relative ease of operating and maintaining the process. The environmental suitability is typical for a mechanical treatment plant.

Stabilization pond systems followed by intermittent sand filtration is not recommended due to cost and operation and maintenance considerations.

A schematic flow diagram and recommended design criteria for oxidation ditch systems that comply with the Colorado Department of Health review criteria for treatment facilities is presented on Figure 2.4-D.

8.2.2 Small Communities - Proposed Standards

If the less restrictive suspended solids discharge standards currently proposed by the Environmental Protection Agency are adopted, then communities with flowrates less than 1-2 mgd could utilize stabilization pond systems. The recommended process for communities satisfying the flow restrictions is AERATED STABILIZATION PONDS. Unaerated pond systems are not recommended because of the cold weather difficulties in producing an effluent satisfying the 30 mg/l BOD_5 discharge standard.

One potential disadvantage of any stabilization pond system and the discharge standard modification as currently recommended is that the less restrictive standard only applies to systems with flowrates less than 1-2 mgd. Communities currently electing to use aerated stabilization pond systems would not be permitted to expand the systems beyond 1-2 mgd. If expected or unexpected flowrate increases occur due to population increases, expansion of the service area, industrial development, or other such factors, a community may be required to construct completely new facilities capable of complying with the 30-30 suspended solids-BOD_5 discharge standards.

A minimum of two aerated ponds in series followed by a polishing pond is recommended. The minimum hydraulic detention time in the aerated ponds should be 15 days with the first pond providing approximately one-third and the second pond providing two-thirds the total volume. The decision between floating and fixed mechanical aerators should be based on costs. The required aeration capacity should be based on a minimum of 1.4 lbs. oxygen transferred per pound of BOD_5 satisfied. In computing field oxygen transfer effectiveness from manufacturer's data, consideration must be given to temperature and elevation effects.

A hydraulic detention time of three to five days is recommended for the polishing pond. Depth of the pond should be maximized to minimize light penetration and algae growth.

8.2.3 Large Communities

No process will be recommended in this report for communities with flowrates greater than 1 mgd or for those with other than a typical domestic wastewater. As discussed in the section on limitations previously given, process optimization for larger communities must be based on the specific wastewater and community characteristics and for a particular proposed site. This will be accomplished in the Areawide Technical Planning component of the LWRCOG 208 Plan.

8.3 COST OF RECOMMENDED FACILITIES IMPROVEMENTS

Based on the limitations and processes discussed above, and assuming the proposed EPA pond standards are adopted, costs have been developed for all required treatment facilities improvements for small communities in the Larimer-Weld region. A summary of the costs is presented in Table 8.3-A. As shown in the table, total capital costs amount to $4,800,000, and total present worth and equivalent annual costs are $8,277,000 and $780,000/year, respectively. If the proposed pond standards are not adopted, costs would increase to $8,043,000 capital costs, $12,560,000 present worth, and $1,186,000/year equivalent annual cost.

TABLE 8.3-A. PROJECTED COSTS - WASTEWATER TREATMENT FACILITIES IMPROVEMENTS - SMALL COMMUNITIES - LARIMER-WELD REGION

INDEX NO.	AGENCY	YEAR OF CONST.	FACILITY DESIGN CAPACITY (mgd)		RECOMMENDED PROCESS (i)	CAPITAL COST ($1000) (g)	AVG. FLOW (mgd)	AVG. O&M COST ($1000/yr) (h)	PRESENT WORTH ($1000)			EQUIV. ANNUAL COST ($1000/yr) (h)
			INCR.	TOTAL					CAP. REC.	O&M (h)	TOTAL (h)	
EXPANSION & UPGRADING												
1	Ault S.D.	1979	.10(a)	.23	ASP-IRR	180	.18	12	157	84	241	23
		1989	.10	.33		100	.28	15	44	112	156	15
		Total				280			201	196	397	38
2	Eaton	1990	.06	.40	OD	160	.37	27	66	189	255	24
3	Erie W.S.D.	1977	.04(a)	.18	ASP	150	.16	11	150	117	267	25
4	Fort Lupton	1977	.85(a,b)	1.50(a,b)	ASP	385	1.00	30	385	318	703	66
		-	.72(c)	.72		125	.72	6	117	64	181	17
		Total				510			502	382	884	83
5	Hill-n-Park S.D.	1978	.23	.35	ASP	190	.24	15	177	105	282	27
		1988	.30	.65		200	.50	23	95	183	278	26
		Total				390			272	288	560	53
6	Hudson S.D.	1977	.10(a)	.15	ASP	160	.10	10	160	106	266	25
7	Johnstown	1980	.13	.38	ASP	130	.31	16	106	170	276	26
8	Keensburg S.D.	1977	.08(a)	.13	ASP	140	.09	1	140	11	151	14
9	Kersey S.D.	1977	.15	.20	OD	240	.12	18	240	74	314	30
		1982	.10	.30		160	.25	23	114	230	344	32
		Total				400			354	304	658	62
10	LaSalle	1988	.09	.45	ASP	90	.40	19	43	201	244	23
11	Lochbuie	-	0.15	0.15	ASP	140	.08	8	131	85	216	20
12	Mead S.D.	1977	.04(a)	.07	ASP	120	.05	8	120	85	205	19
13	Milliken S.D.	1978	.28(a)	.40	AS-CM	356	.34	28	333	297	630	60
14	Pierce	1986	.13	.30	SP	40	.18	12	37	127	164	16
15	Platteville	1981	.20	.40	ASP	91	.30	16	69	165	234	22
16	Red Feather Lakes	1978	.50	.50	ASP	345(e)	.25	22	322	154	476	45
		1978	.50	.50		61(f)	.25	43	57	341	398	37
		Total				406			379	495	874	82
17	Severance	1977	.08	.08	ASP	246(d)	.04	4	246	42	288	27
18	Texaco (I-25)	1977	0.025(a)	0.025	ASP	75	.02	7	75	74	149	14
19	Timnath	-	.075	.075	ASP	340(d)	.04	10	318	106	424	40
20	Tri-Area S.D.	1977	.23(a)	.75	ASP	310	.63	27	310	226	536	51
		1990	.19	.94		140	.85	29	58	203	261	24
		Total				450			368	429	797	75
UPGRADING ONLY												
21	Johnson's Corner	1977	.05	.05	ASP	40	.02	7	40	74	114	11
22	Weld Central High School	1977	.02	.02	AS-EA	1	.01	7	1	74	75	7
EXPANSION ONLY												
23	Gilcrest S.D.	1983	.08	.13	ASP-ND	80	.10	9	53	95	148	14
	TOTAL					4800			4164	4113	8277	780

(a) Includes upgrading of existing facilities.
(b) Includes industrial wastewater.
(c) Reclaimed water facilities.
(d) Includes collection system.
(e) Treatment system.
(f) Waste hauling equipment.
(g) Excludes minor upgrading requirements.
(h) Excludes existing costs.
(i) Recommended Process Legend:

SP = Non-Aerated Stabilization Pond
ASP = Aerated Stabilization Pond
OD = Oxidation Ditch
AS-CM = Activated Sludge - complete mix mode
AS-EA = Activated Sludge - extended aeration mode
IRR = Effluent Reuse for Irrigation - no discharge to surface water
ND = Non-Discharging System

9.0 INDUSTRIAL WASTEWATER DISCHARGERS

The preceeding chapters dealt almost exclusively with municipal wastewater flows and projections. This chapter will describe the industrial wastewater dischargers in the Larimer-Weld region, and assess their compliance with current State and EPA effluent requirements. Subsequent reports will recommend, where appropriate, revised effluent standards and in-stream water quality standards. The location of these industries is shown on Figure 2.1-B.

Three categories of industries will be identified. The first two categories are those with direct discharges to surface waters. The first category will describe major dischargers; the second will describe minor dischargers. The third category will deal with major industrial dischargers to municipal wastewater treatment plants.

9.1 MAJOR DIRECT INDUSTRIAL DISCHARGERS

The major industries in the region which discharge directly to a watercourse are Eastman Kodak Company, three Great Western Sugar Company plants, Loveland Packing Company, and Public Service Company's Fort St. Vrain Power Plant. Each of these will be discussed separately, and Table 9.1-A briefly describes each industry.

9.1.1 Eastman Kodak Company

Eastman Kodak Company has established a manufacturing plant in Windsor through its Kodak Colorado Division (KCD). KCD processes photographic products. Deomstic wastewater is treated at the Windsor sewage treatment plant. Some of the industrial wastewater is pretreated by KCD at the point of production prior to entering the main waste stream. The main waste stream, with a volume of about 1 million gallons per day (mgd), is treated in two aerated lagoons followed by sand filtration and chlorination prior to discharge to the Cache la Poudre River. Chemical feed facilities exist, mainly for pH and solids control.

EPA has not set effluent limitations for the photographic industry, per se; therefore, KCD's NPDES permit conditions are dictated by current in-stream standards.

TABLE 9.1-A DESCRIPTION OF MAJOR DIRECT INDUSTRIAL WASTEWATER DISCHARGERS

INDUSTRY NAME	PROCESS OR PRODUCT	FLOW RATE	TREATMENT AND PROCESS DESCRIPTION	RECEIVING WATERS	EXTRAORDINARY WASTEWATER CHARACTERISTICS	MEETS NPDES REQIMTS.	
						YES	NO
Eastman Kodak Company - Kodak Colorado Division	Photographic Products	1 mgd	Two aerated lagoons sand filtration, Cl2. Chemical feed facilities exist. Domestic waste treated at Windsor.	Cache la Poudre River	BOD_5, TSS, CN, Phends, NH_3, Cl_2, Metals (Ag, Al, Cr, Zn, B)		*-1
Great Western Sugar Co., Loveland Facility	Sugar & Molasses	4.3 mgd	Clarified ash flume water and condenser water flows are treated in 2 lagoons. There is some seepage from lime and acid water pond.	Big Thompson River	BOD_5, Fecal Coliform, Temperature	X	
Great Western Sugar Co., Greeley Facility	Sugar	*-2	Ash flume water is clarified and recycled. Condenser water is used for land application.	Cache la Poudre River *-2	BOD_5, Fecal Coliform, Temperature	X	
Great Western Sugar Co., Johnstown Facility	MSG *-3	5.4 mgd	Aerated lagoons	Little Thompson River	BOD_5, Fecal Coliform, Temperature	X	
Loveland Packing Co.	Pork Products	0.05 mgd	Grease trap, screening, extended aeration plant-projected pre-treatment facility	Big Thompson River	BOD_5, SS, Oil and Grease		*-4

*-1 NPDES Permit is based on proposed water quality standards.
*-2 Normally no discharge, but a permit has been obtained so emergency discharge is allowed.
*-3 The GWS-Johnstown facility has recently stopped producing molasses.
*-4 Projected discharge to Loveland municipal system.

TABLE 9.1-A DESCRIPTION OF MAJOR DIRECT INDUSTRIAL WASTEWATER DISCHARGERS Page 2

INDUSTRY NAME	PROCESS OR PRODUCT	FLOW RATE	TREATMENT AND PROCESS DESCRIPTION	RECEIVING WATERS	EXTRAORDINARY WASTEWATER CHARACTERISTICS	MEETS NPDES REQIMTS.	
						YES	NO
Public Service Company, Fort St. Vrain	Nuclear electrical generating plant	1.5 mgd	Cooling towers and ponds. Reactor building wastewater (8-10,000 gal/yr) treated by ion exchange.	South Platte River	TDS, Temperature, SS, Cl_2	X	

9.1.2 Great Western Sugar Company

Great Western Sugar Company operates two beet sugar processing plants and one monosodium glutamate (MSG) plant in the region. Those are located in Loveland, Greeley, and the MSG plant in Johnstown. Great Western has recently closed a plant in Eaton and a portion of its Johnstown facility.

The wastewater treatment systems at the Greeley and Loveland plants are very similar. The flume water which is used to transport and clean the beets is settled in a conventional clarifier. The effluent is reused. The settled material is routed through ash ponds and is then mixed with condenser water. At Loveland, this mixture is treated in two aerated lagoons prior to discharge to the Big Thompson River. At Greeley, this water is sprayed on farm land or discharged to the Cache la Poudre River.

The Johnstown plant does not process any beets, but uses by-products from other Great Western plants as raw material. Wastewater is treated in a series of aerated lagoons prior to discharge to the Little Thompson River.

All three of these Great Western plants meet the best practicable treatment (BPT) standards required in the NPDES permits.

9.1.3 Loveland Packing Company

Loveland Packing Company is a slaughtering operation which cuts and packages pork and pork products, including hams, bacon, and sausages. Wastewater is now being treated in an extended aeration treatment plant which is organically overloaded. Instead of upgrading the waste treatment plant, the company plans to discharge to the Loveland municipal system.

9.1.4 Public Service Company - Fort St. Vrain Power Plant

This electrical generating unit is a nuclear-powered facility located on the South Platte River near Platteville. Most of its 1.5 mgd of discharged water is cooling tower blowdown. This water is no different from that used in any other fuel-fired power plant.

Each year there is a discharge of 8,000 to 10,000 gallons of reactor-building wastewater. This wastewater is treated by ion exchange prior to discharge. It is discharged at a rate not to exceed 10 gpm, and is mixed with cooling tower blowdown before discharge in the South Platte River. All wastewater is chlorinated. All required standards are being met.

9.2 MINOR DIRECT INDUSTRIAL DISCHARGERS

Almost all of the minor industrial dischargers can be placed into one of four groups. These are sand and gravel companies, trout rearing units, potable water treatment plants, and a category of industries which discharge only non-contact cooling water. The minor direct industrial dischargers are shown in Table 9.2-A., together with an indication of whether or not the discharges comply with existing State and EPA standards.

9.2.1 Sand and Gravel Companies

There are twelve sand and gravel companies in Larimer and Weld Counties. The water discharged from these operations is normally fairly high quality groundwater from the gravel pits. The main pollutant from these operations is suspended solids in the form of silt or sand particles.

The normal treatment method consists of a settling pond to remove suspended material. The NPDES permits limit aluminum and pH in cases where companies use alum to aid settling. None of the sand and gravel companies in the region use alum, or any other flocculant aid.

The permits also limit oil and grease. This limitation is a safeguard against an operator changing the oil in a truck or other equipment and dumping it with discharged water.

All of the sand and gravel companies in the region are required to meet BPT standards.

9.2.2 Trout Rearing Units

There are seven fish hatcheries in Larimer County, and one in Weld County. Two of the hatcheries are privately owned; the remaining units are owned and operated by the Colorado Division of Wildlife. The owners of the two privately owned hatcheries have indicated that no discharge occurs, so no NPDES permit has been obtained.

The Wildlife Department has four NPDES permits for its facilities. The normal treatment technique is to use settling ponds prior to discharge. The waste from the Watson Lake Hatchery is pumped to Watson Lake.

TABLE 9.2-A. DESCRIPTION OF MINOR DIRECT INDUSTRIAL WASTEWATER DISCHARGERS

INDUSTRY NAME	PROCESS OR PRODUCT	FLOW RATE	TREATMENT AND PROCESS DESCRIPTION	RECEIVING WATERS	EXTRAORDINARY WASTEWATER CHARACTERISTICS	MEETS NPDES REQIMTS.	
						YES	NO
Cowan Concrete Products	Sand & Gravel	*-1	Settling - no chemicals added	Cache la Poudre via Spring Creek	SS - Groundwater pumped from pits	X	
Flatiron Paving Co., Greeley Facility	Sand & Gravel	*-1	Settling	Cache la Poudre	SS - Groundwater pumped from pits	X	
Flatiron Paving Co., Windsor Facility	Sand & Gravel	*-1	Settling	Cache la Poudre	SS - Groundwater pumped from pits	X	
Flatiron Paving Co., Loveland Facility	Sand & Gravel	*-1	Settling - no chemicals added	Big Thompson River	SS - Groundwater pumped from pits	X	
Flatiron Paving Co., Greeley Facility (West)	Sand & Gravel	*-1	Settling - no chemicals added	Cache la Poudre	SS - Groundwater pumped from pits	X	
Greeley Sand & Gravel Co.	Sand & Gravel	*-1	Settling - no chemicals added	Cache la Poudre	SS - Groundwater pumped from pits	X	
Eldred M. Johnson	Sand & Gravel	*-1	Settling - no chemicals added	South Platte	SS - Groundwater pumped from pits	X	
Floyd Haag Sand & Gravel	Sand & Gravel	*-1	Settling - no chemicals added	Big Thompson River	SS - Groundwater pumped from pits	X	

TABLE 9.2-A. DESCRIPTION OF MINOR DIRECT INDUSTRIAL WASTEWATER DISCHARGERS Page 2

INDUSTRY NAME	PROCESS OR PRODUCT	FLOW RATE	TREATMENT AND PROCESS DESCRIPTION	RECEIVING WATERS	EXTRAORDINARY WASTEWATER CHARACTERISTICS	MEETS NPDES REQIMTS.	
						YES	NO
Mountain Aggregate, Ft. Collins	Sand & Gravel	*-1	Settling - no chemicals added	Cache la Poudre via Fossil Creek Ditch	SS - Groundwater pumped from pits	X	
Mountain Aggregate	Sand & Gravel	*-1	Settling - no chemicals added	St. Vrain River	SS - Groundwater pumped from pits	X	
Norden & Son Land Leveling	Sand & Gravel	*-1	Settling - no chemicals added	Ft. Lupton Bottom	SS - Groundwater pumped from pits	X	
Poudre Pre-Mix	Sand & Gravel, Ready-Mixed Concrete	*-1	Settling - no chemicals added	Cache la Poudre River	SS - Groundwater pumped from pits	X	
Colorado Div. of Wildlife, Bellvue Unit	Trout Rearing	1 mgd	Settling ponds	Cache la Poudre	SS - Water is frequently recycled through Watson Lake	X	
Colorado Div. of Wildlife, North Fork Unit	Trout Rearing	3 mgd	Settling ponds	North Fork Big Thompson	SS	X	
Colorado Div. of Wildlife, Poudre River Unit	Trout Rearing	4 mgd	Settling ponds	Cache la Poudre	SS	X	
Colorado Div. of Wildlife, Watson Lake	Trout Rearing	12 mgd	Wastes pumped to Watson Lake	Cache la Poudre	SS - Water is frequently recycled	X	

TABLE 9.2-A. DESCRIPTION OF MINOR DIRECT INDUSTRIAL WASTEWATER DISCHARGERS Page 3

INDUSTRY NAME	PROCESS OR PRODUCT	FLOW RATE	TREATMENT AND PROCESS DESCRIPTION	RECEIVING WATERS	EXTRAORDINARY WASTEWATER CHARACTERISTICS	MEETS NPDES REQIMTS.	
						YES	NO
Colorado Div. of Wildlife Estes Park Unit	Brood fish for egg production	3 mgd	Settling	Fall River		*-2	
Blacky Valencia	Trout Rearing	0	No discharge	N/A	N/A		
Western Fisheries Consultants	Trout Rearing	0	No discharge	N/A	N/A		
Ft. Collins-Poudre Canyon Water Treatment Plant	Potable Water	-	Waste solids to holding ponds; water re-used	Cache la Poudre	SS, Al, pH	X	
Greeley-Bellvue Water Treatment Plant	Potable Water	-	Waste solids to holding ponds; water re-used	Cache la Poudre	SS, Al, pH	X	
Greeley-Boyd Lake Water Treatment Plant	Potable Water	-	Waste solids to holding ponds; water re-used	Big Thompson	SS, Al, pH	X	
Loveland Water Treatment Plant	Potable Water	-	Partial sedimentation	Big Thompson	SS, Al, pH		X

TABLE 9.2-A, DESCRIPTION OF MINOR DIRECT INDUSTRIAL WASTEWATER DISCHARGERS Page 4

INDUSTRY NAME	PROCESS OR PRODUCT	FLOW RATE	TREATMENT AND PROCESS DESCRIPTION	RECEIVING WATERS	EXTRAORDINARY WASTEWATER CHARACTERISTICS	MEETS NPDES REQIMTS.	
						YES	NO
Hydraulics Unlimited Mfg. Co.	Chrome Plating	20,000 gpd	Non-contact cooling water only. No chemicals added	Eaton Town Ditch	Temperature	X	
Monfort Packing Co.	Red meat Products	1.7 mgd	Non-contact cooling water only. No chemicals added	Cache la Poudre	Temperature	X	
Lone Star Steel Co.	Steel Pipe	30,000 gpd	Non-contact cooling water only. No chemicals added	Spring Creek	Temperature	X	
Terra Resources Inc., Clark's Lake Muddy Sand Unit	Oil Well	9,000 gpd	Normally re-inject. Permit for emergency discharge	N. Poudre Irrigation Ditch	TDS, Oil & Grease, SS	X	

*-1 Flow from gravel operations is highly variable, dependent on amount of groundwater entering the gravel pit being worked.

*-2 The Estes Park Unit does not have an NPDES permit because it has less than 20,000 pounds of production per year.

9.2.3 Water Treatment Plants

There are four water treatment plants in the region for which NPDES permits have been issued. All of these are in Larimer County, although two belong to the City of Greeley. Fort Collins and Greeley have recently upgraded the waste control facilities for their plants so discharge standards can be met. Loveland had a wastewater treatment design prepared, but control facilities have not yet been installed because bids were higher than anticipated.

Wastewater from these water treatment plants carries suspended solids which are settled in the treatment process. Often alum is used to enhance settleability, so aluminum and pH is regulated in their discharges.

9.2.4 Industries Discharging Only Cooling Water

There are three industries in the region which discharge only non-contact, once-through cooling water. These are Lone Star Steel Company, Monfort Packing Company, and Hydraulics Unlimited Manufacturing Company. Heat is the only pollutant from these sources. The maximum allowable discharge temperature is 90° F (32.5° C). All of the plants meet this requirement.

9.3 MAJOR INDUSTRIAL DISCHARGERS TO MUNICIPAL SYSTEMS

A major industrial discharger to a municipal system is defined as one which meets one or more of the following criteria:

a) Industrial flow is greater than 50,000 gpd;
b) Industrial flow is greater than 5 percent of the total flow;
c) The industrial flow adversely affects the quality of discharge from the treatment facility;
d) The industrial wastewater carries toxic pollutants.

These industries are subject to pre-treatment requirements. The Colorado Health Department enforces pre-treatment requirements through the municipality, rather than directly to the industry. Municipalities with industries in this category will be mentioned, and the industries briefly described.

9.3.1 Loveland

There is one major industrial discharger in Loveland--Hewlett-Packard Company. Hewlett-Packard's wastewater is similar to wastes from other metal-plating operations. Chemical treatment is provided prior to discharge to the city's sewers.

9.3.2 Fort Collins

Fort Collins has three major industries which discharge to the city system. Woodward Governor and Teledyne-Water Pic discharge plating wastes. Both of these facilities discharge to the Fort Collins No. 2 plant on Drake Road. The Western Food Products Company, Inc., is a pickling industry which discharges its vats at the end of the season to the Fort Collins No. 1 plant on Highway 14.

9.3.3 Windsor

The Eastman Kodak plant in Windsor has the option of discharging to the municipal treatment plant. This was normal operation for Kodak until September, 1976, when it received an NPDES permit and began to use its own facility.

9.3.4 Johnstown

The Carnation Milk Company has a powdered milk manufacturing plant in Johnstown. This plant discharges an equivalent population of 1,100 to the waste treatment plant.

9.3.5 Fort Lupton

The Fort Lupton Canning Company, a vegetable cannery, discharges a population equivalent of 3500. Although it only discharges during canning season, this amounts to a significant portion of the capacity of the treatment plant.

9.3.6 Greeley

There are two major industries discharging to Greeley's treatment plants--a meat packer and a dairy. The dairy discharges to the First Avenue Plant. The whey waste is believed to be the cause for settling difficulties with scum in the final clarifier.

Monfort of Colorado operates the meat processing plant for slaughtered cattle and sheep. Wastewater is treated at a municipally-owned and operated treatment plant which was constructed specifically for separate treatment of the Monfort wastes.

10.0 WASTEWATER SYSTEMS OPERATION AND MAINTENANCE

In the past, enforcement agencies and engineers often overlooked operation and maintenance (O&M) problems while evaluating treatment plant performance. Although a sincere effort is being made to change this situation, a thorough O&M assessment still needs to be conducted for all facilities and certainly prior to the installation of any new structures. If additional facilities are to be built, an assessment of the community's ability to operate such a facility should also be conducted.

10.1 INTRODUCTION

The EPA has recognized the importance of operation and maintenance to the performance of wastewater treatment plants. EPA had hopes that requiring O&M manuals to be prepared for new treatment works would correct this problem. While this is certainly a step in the right direction, it is not a panacea, particularly for small communities.

Part of the problem stems from the generalized effluent standards originally required by EPA which are still in effect. No consideration was given to the volume of flow of the effluent or of the receiving stream, or to the real effect to the receiving water of various forms of suspended solids. These standards virtually eliminated lagoons from being a viable treatment alternative. As a result, mechanical treatment plants were designed and constructed for small towns which otherwise would have used lagoon systems. In Colorado most of these mechanical plants were package activated sludge plants. These plants require a great deal of skill to be correctly operated, and most small towns--predictably--could not and would not allocate the funds required to properly operate these plants. Fortunately, EPA is considering relaxing the suspended solids standard for lagoon systems, which have inherent economical and functional advantages.

10.2 COMMON OPERATION AND MAINTENANCE PROBLEMS IN THE REGION

An analysis of the operation and maintenance of wastewater treatment plants serving most communities in Larimer and Weld Counties has been conducted. This assessment is based on numerous site visits to each of the facilities over the past two years. Budgetary data from several communities was obtained and analyzed. This information was compared to known effluent quality data, particularly in regards to compliance or non-compliance with effluent standards. Table 10.2-A illustrates which communities are normally in compliance with standards.... and in what areas the communities need improvement. Unfortunately, a detailed analysis of municipal non-compliance is beyond the scope of this report. It is dependent on plant capacity and on the quality of operation and maintenance which a treatment facility receives.

TABLE 10.2-A. EXISTING O&M CONDITIONS IN THE REGION

COMMUNITY	WASTEWATER SYSTEM CONDITIONS					MEETING STANDARDS?
	LIFT STATION	LAB.	PLANT MAINT.	PLANT OPERATION	DATA/ RECORDS	
Ault	C	C	I	I	I	NSD
Berthoud	NA	NP	NP	I	I	YES
Bo Mar School	-	C	C	C	C	NSD
Boxelder	NP	NP	NP	NP	NP	YES
Del Camino	I	C	I	I	I	NO
Eaton	NA	C	I	C	I	NO
Erie	NA	C	C	C	I	NO
Estes Park	I	NP	NP	NP	NP	YES
Evans	NA	NP	NP	NP	NP	YES
Ft. Collins	NA	NP	NP	NP	NP	YES
Ft. Lupton	I	C	I	I	I	NO
Gilcrest	NA	C	C	I	I	NSD
Greeley	NP	NP	I	I	NP	NO
Grover	NA	I	NP	NP	I	NSD
Hill-n-Park	NA	I	I	I	I	NO
Hudson	C	I	I	I	I	NO
Johnson's Corner	-	C	C	C	C	NO
Johnstown	NA	I	I	I	I	NO
Keenesburg	NA	I	NP	I	I	NSD
Kersey	NA	C	I	C	I	NSD
LaSalle	C	NP	NP	I	I	NSD
Loveland	NA	I	I	I	I	NO
Mead	-	I	I	I	C	NO
Milliken	C	C	I	C	I	YES
Pingree Park-CSU	I	NP	NP	NP	NP	NSD
Pierce	-	I	I	I	I	NSD
Platteville	I	I	I	I	I	NSD
Ramada Inn	NA	C	I	C	C	NSD
River Glen	NA	NP	NP	NP	NP	YES
S. Ft. Collins S.D.	NP	NP	NP	NP	NP	YES
Texaco-Del Camino	NA	I	NP	I	I	NO
Tri-Area	NA	I	NP	NP	I	NO
Weld C. H.S.	-	C	I	C	C	NO
Wellington	NA	I	I	I	I	YES
Windsor	NP	NP	NP	I	NP	YES

I = Intermittent Problems
C = Continuous Problem
NP = No Problem
NA = Data not Available
NSD = No Surface Discharge

The communities of Greeley, Loveland, Fort Collins, Estes Park Sanitation District, and Upper Thompson Sanitation District were excluded from the study. All of these communities have or recently have had professional help to analyze their staffing and budgets as related to their treatment plants.

Wastewater systems consist of collection and treatment facilities. Some of these facilities are mechanical, such as lift stations, aerators, comminutors, and flow recording devices. As such, there are moving parts which must be maintained. Other facilities have no moving parts, such as sewer lines, bar screens, buildings, and dikes, but maintenance is still required.

Operations refers to the science (or art) of producing the best possible effluent quality from a given treatment works. In the case of a lagoon system, this can be determining the most efficient aerator timing or pond sequence. In the case of activated sludge plants it is determining the optimum food-to-microorganism ratios and sludge wasting rates.

It is not the purpose of this report to identify all O&M problems and solutions, but to identify some of the more common problems in the region and their possible solutions.

10.2.1 Sewer Lines

Over a period of time, blockages may occur in sewer lines due to solids deposition, grease build-up, large objects in the line, etc. This problem can best be handled by preventative maintenance. Periodically the lines should be flushed by pouring a large quantity of water in the line very quickly. This will scour the line, carrying solids toward the treatment plant. Normally fire equipment is used. It is good practice to establish a schedule to flush all lines in the community every 4 to 6 months.

Even with good preventative maintenance programs, major stoppages may occur. In this case, if the community has no sewer cleaning equipment, a contractor's services would have to be utilized.

10.2.2 Lift Stations

Most of the lift stations in the Larimer-Weld region comply with the standards published by the Colorado Department of Health. Two of the more critical requirements and the reasons for the requirements will be briefly reviewed.

One of the most important requirements is to have a working fan in all wet and dry wells. This fan should preferrably come on automatically when the entranceway to the well is opened. The purpose of the fan is to circulate fresh air through the area for safety. Toxic gases, such as H_2S, can accummulate in the wells if air circulation is not provided, thereby causing safety problems. This situation can exist anywhere raw sewage is allowed to stand in an enclosed area. Two communities which have this problem are Ault and LaSalle. Ault has a lift station with only a wet well which is very deep. LaSalle has a concrete structure with a flume located just upstream of the wet well. The entire structure is underground, with access by a manhole.

A source of standby power should be provided at all lift stations. This is needed so that in the event the primary power source should fail, the secondary power source can be used to keep raw sewage from backing into basements or overflowing on the ground. This can be done by supplying power from at least two sources, or by providing a standby generator. An alarm system should be installed which is activated in the event of pump failure, power failure, high water, and other causes of lift station failure. Fort Lupton, Hudson, and Platteville need standby power. It is believed that several other communities also need standby power.

Lift stations should be checked at least daily. Pumps and motors should be kept well greased and in good running order. Packings are commonly neglected. Packings are seals which work around moving parts such as rotating shafts in pumps and valves. When packings fail, wastewater leaks through. Some leakage can be controlled by simply tightening the packing, but eventually they must be replaced.

10.2.3 Stabilization Ponds

As discussed in Chapter 7.0, stabilization ponds can be either mechanically aerated or non-aerated. According to the EPA, 25 percent of the wastewater treatment plants in this country are lagoons*. Nearly 90 percent of these wastewater treatment ponds serve communities of 5000 population or less.

The reason they are so popular with small communities is because initial installation costs and O&M costs are relatively low. This latter factor is very important to smaller communities.

* Federal Register, Environmental Protection Agency, Water Programs Secondary Treatment Information, September 2, 1976.

Due to the fairly long detention times in lagoons, they are less susceptible to shock loads or breakdown than are mechanical plants. Even if they are neglected from an O&M standpoint, a well-designed lagoon system is still capable of producing a fairly respectable effluent. This is not true of mechanical plants which, if not well supervised, frequently discharge an extremely low quality, putrid effluent. This is certainly not to say that lagoon systems do not require operation and maintenance--only that requirements are much less stringent than for mechanical plants.

The two most common maintenance problems with ponds are control of weeds and bank erosion. Weeds growing out of the water create excellent breeding grounds for mosquitoes and other insects. Insects that breed in this water can carry diseases which are transferrable to humans and farm animals. Bank erosion can intensify weed problems by providing shallow soil conditions for the weeds. Both problems can cause lagoons to lose capacity. These problems are so common that almost all communities served by lagoons have the problems to some extent. Boxelder Sanitation District and Gilcrest have particularly severe bank erosion problems. Boxelder has experienced weed problems directly as a result of the erosion problem. Gilcrest's lagoon system was constructed in very unstable, sandy soil and little erosion protection was provided. Erie Sanitation District's second cell lost at least half of its capacity as a result of an exorbitant amount of weeds growing in it.

Weeds are best controlled by pulling them. Although Windsor has some erosion problems along the north dike of its south pond, it has done an excellent job of controlling weeds by pulling them. In the past, Pierce has also done an excellent job of weed control.

An agricultural weed burner can also be used to control weeds, but the county health department should be notified to find out if a burning permit is required.

Use of soil sterilants is not recommended. Algae grows in lagoons, and helps supply dissolved oxygen. Soil sterilants kill the algae as well as weeds. The benefits of dissolved oxygen will be discussed below.

Erosion can best be controlled by rip-rapping dikes with concrete or rock. Many communities save all concrete and rock material as it becomes available when structures in town are torn down. Fort Lupton has done a good job of rip-rapping its lagoons. Growing a healthy stand of grass on the dikes can also help control erosion and improves aesthetics.

A common problem with non-aerated stabilization ponds is a floating solids buildup on the first pond. These solids can be a source of very obnoxious odors. This can be broken up with the spray from the water hose of a fire truck or by dragging a rope across it. This problem has occurred at one time or another at Hill-n-Park, Hudson, and Pierce.

Odors can be a problem, especially in the spring right after the ice melts. Odors develop when there is no dissolved oxygen in the water, referred to as "anaerobic conditions". The microorganisms which are capable of surviving without oxygen produce methane and odorous compounds as a byproduct. Thus, the way to control odors is to keep the level of dissolved oxygen in the water above 2.0 mg/l. This is most effectively accomplished with mechanical aeration.

If aerated lagoons develop odors, the problem can be solved by operating the aerators more hours a day, or by increasing the number of aerators. Keenesburg and Wellington installed aerators to increase capacity and to control odors. LaSalle has sufficient aeration capability but for some reason does not operate the aerators a great deal of the time.

Odor problems are most common with non-aerated stabilization ponds. This problem can best be solved by adding aerators to get mechanical mixing. Some communities have lagoons which do not discharge, and are reluctant to allocate the money required to install aerators. To help alleviate the odor problem, chemical fertilizers with high nitrogen content can be added to the lagoon. This does not provide an immediate result, but encourages algae growth. Algae, like all other green plants, supplies oxygen.

10.2.4 Mechanical Plants

Volumes have been written about the operation and maintenance of various mechanical plants. This document will not attempt to explain how to operate a plant, but will point out problems that are common in the area

Maintenance on equipment at mechanical plants in the region is generally good. This is probably due to the fact that most operators have a good mechanical background.

Plant operation is as basic to effluent quality as is plant design. Unfortunately, there are very few mechanical plants in Colorado that are operated to their maximum potential.

An example of the difference between good and poor operation was demonstrated at Colorado State University's Pingree Park treatment plant. This plant is an extended aeration package plant followed by sand filters. During the summer of 1975, the secondary effluent was very turbid and a great deal of pin-floc was being carried over the clarifier weirs. Very little effluent data was collected, and no in-plant laboratory testing was conducted. During the summer of 1976, CSU retained the services of one of Fort Collins' treatment plant operators. A testing program was initiated, and a basic operational program was established. During this time, the BOD_5 of the secondary effluent prior to filtration never exceeded 10 mg/l, and was normally less than 5 mg/l!* This is excellent effluent quality.

Most of the mechanical plants in the region are some type of extended aeration plant similar to the Pingree Park plant. It is a common misconception to believe that sludge wasting in these plants is unnecessary. The fact is that proper sludge wasting is essential to continuously good effluent quality.

Communities in the region which need to improve their sludge wasting practices are Bo Mar Subdivision, Eaton, Kersey, Milliken, and Weld Central Junior-Senior High School. Even Berthoud, which has one of the best quality secondary effluents in Colorado, needs to improve its sludge wasting procedures. The Bo Mar Subdivision, located just south of the Hewlett-Packard Plant in Loveland, is in terrible operational condition. This plant is an extended aeration package plant followed by a polishing pond. Unfortunately, it represents a particularly difficult problem for enforcement agencies because the polishing pond has no surface discharge. Nevertheless, it is potentially a severe health hazard because nearby residents have installed portable hoses and pumps so they can irrigate their yards with wastewater from the polishing pond.

Another major cause of poor operation is that little or no laboratory equipment is provided to the operator, so plant efficiency cannot be determined. When an operator makes a process change, he needs the equipment to determine the effect of that change.

* Grimes, Max. Personal Communication, August, 1976.

The type of equipment needed is somewhat dependent on the type of plant. The District Engineer with the Colorado Department of Health will assist a community in determining the types of equipment needed for its plant.

Another typical problem is that not enough man-hours are allocated to the operation and maintenance of many treatment plants. This problem is observable in both large and small communities.

10.3 CAUSES AND EFFECTS OF OPERATION AND MAINTENANCE PROBLEMS

There is no one cause of operation and maintenance problems, but some significant reasons for poor O&M can be pinpointed. Coversely, the effect of poor O&M is not solely poor effluent quality.

10.3.1 Secondary Effects of Poor Operation and Maintenance

Of primary concern with poor O&M, at least as far as enforcement agencies are concerned, is degraded effluent quality. Another significant effect is in shortened life of equipment.

For example, if lift station wet and dry wells are not kept clean and raw sewage is allowed to accumulate, H_2S is produced. H_2S is extremely corrosive to metals, and particularly to steel. Ault has had significant corrosion to its piping and pumps in its lift station. Another cause of corrosion is simply because metal parts are not kept painted as they should be.

As previously mentioned, weeds and erosion can seriously reduce capacity in waste stabilization ponds. The Boxelder Sanitation District has already experienced erosion problems, and has begun to lose pond capacity as a result. This system was built less than four years ago. Many other examples of decreased life expectancy could be cited.

It is impossible to assess accurately the monetary loss caused by poor maintenance, but it is undoubtedly significant. When one realizes that even a small lagoon system costs $50,000 and could be ruined due to negligence, the problem begins to come into perspective.

10.3.2 Underlying Causes of Poor Operation and Maintenance

The two most direct causes for poor O&M is that budgets are low and insufficient staffing is provided. The two problems are related. These problems will be discussed separately.

There is an underlying reason for insufficient budgeting and staffing at treatment facilities. All communities work under very tight budgets. Increasing taxes to raise more revenues is politically unpopular. The present budgets and staff levels will be preserved unless governmental agencies begin to enforce existing regulations on operator certification and on effluent standards. Pressure to comply with effluent levels would be welcomed by some administrators who could then have good reason to demand adequate funds to provide improved O&M from town governing bodies.

10.3.2.1 Budgets

Chapter 7.0 presents consolidated literature data on suggested operation and maintenance budgets for several treatment processes. The reader should be cautioned that this data relates to very generalized treatment alternatives, and does not include costs of operating and maintaining such items as collection systems. Also, some treatment plants have specialized equipment. The cost of operating this equipment must be considered to be an extra cost. Most literature data is presented by very specific treatment units. For example, the operation and maintenance costs of raw sewage pumping, pre-treatment (bar screens and grit chambers), primary sedimentation, and several types of secondary treatment methods, are presented separately. Two excellent publications which give specific data are listed below:

> "Estimating Staffing and Cost Factors for Small Wastewater Treatment Plants Less than 1 MGD - Parts I and II", Iowa State University, June, 1973; EPA Grant No. 5P2-WP-195-0452.
>
> "A Guide to the Selection of Cost-Effective Wastewater Treatment Systems", Office of Water Program Operations, EPA, July, 1975.

Several cities, towns, and sanitation districts were contacted, and were very helpful in supplying the Council of Governments with their operation and maintenance budgets. This information was compared with literature data. It was found that this data did not correspond well with that in the literature, ranging from 20 percent to 240 percent of the suggested budgets.

Further investigation helped reveal the discrepancy. The large majority of the communities in the area have only one or two people who do all of the city's work on the wastewater plant, water plant, collection and distribution lines, roads, etc. It is extremely difficult for these communities to know how much time is spent on any one aspect of these responsibilities.

Most small communities receive one utility bill for all their electrical expenses. This bill may combine costs for such items as potable water pumping, wastewater pumping, aerators or compressors, and even the lights in City Hall!

Finally, very few communities have separated the operation and maintenance costs for collection systems from treatment costs. Costs of maintaining collection systems can vary greatly from one community to another. Variables include whether or not one or more lift stations are used, slope of the sewer lines, size of the lines, length of lines as compared to the number of connections on the system, and many other factors.

Despite the problems involved with analyzing budgets, it is apparent that most budgets in the region are very low. For example, many communities run only effluent samples at the frequency required by the NPDES permits. In many cases, no in-plant sampling which provides basic operational data is conducted.

10.3.2.2 Staffing

Another typical problem is that not enough man-hours are allocated to the operation and maintenance of collection systems and treatment plants. The predominant reason for this fact is that budgets are low.

The Colorado Department of Health requires that all wastewater treatment plants be operated by a certified operator. The regulations requiring this are reproduced in Appendix F. The certification requirements are based on the size and type of treatment plant, as indicated in these regulations. The classification of each treatment plant in Larimer and Weld Counties is shown in Table 10.3.2-A.

TABLE 10.3.2-A CURRENT CLASSIFICATION OF WASTEWATER TREATMENT PLANTS - LARIMER & WELD COUNTIES

ENTITY	CLASSIFICATION
Ault S.D.	D
Berthoud	C
Bo Mar Subdivision	C
Boxelder S.D.	D
Del Camino	C
Eaton	C
Erie W.S.D.	D
Estes Park S.D.	B
Evans S.D.	D
Fort Collins No. 1 and 2	A
Fort Lupton	D
Gilcrest	D
Greeley	A
Grover	D
Hill-n-Park S.D.	D
Hudson S.D.	D
Johnson's Corner	D
Johnstown	D
Keenesburg S.D.	D
Kersey S.D.	C
LaSalle	C
Loveland	B
Mead S.D.	D
Milliken S.D.	C
Pingree Park	C
Pierce	D
Platteville	D
Ramada Inn	C
River Glen S.D.	D
South Fort Collins S.D.	B
Texaco - Del Camino	C
Tri-Area S.D.	C
Upper Thompson S.D.	A
Weld Central High School	C
Wellington	D
Windsor	D

There is a clause in the regulations called a "Grandfather Clause" which allows the operator to receive a restricted certificate if that person operated the treatment plant on or before July 1, 1973. However, operators should be encouraged to obtain certification status by taking and passing the examination.

Many communities have had trouble obtaining and keeping certified operators. South Fort Collins Sanitation District has recently undergone an episode which typifies this problem. A great deal of time and money was spent on operator training. After the operator had passed his "B" examination, he was offered a job at a larger plant, which he accepted. This was a bitter experience for SFCSD, and one with which many other communities are familiar. This problem can be partially solved with an operator incentive program whereby the operator receives an automatic raise in pay for each successive operator's license he receives up to the required classification. This will not completely solve the problem because large communities will generally provide higher salaries than smaller ones.

Some communities have satisfied the certification requirements by retaining a consulting engineering firm with a certified operator. This is fine if the engineer actually operates the plant or works very closely with the plant operator. Unfortunately, in many cases, the only real service provided is that effluent samples required by the NPDES permit are run. While this satisfies the requirements of the law, the spirit of the law (i.e., to improve operations) is not satisfied.

Like budgets, recommended staffing levels are related to specific treatment units. The reader is again directed to the publications mentioned in Section 10.3.2.1.

10.3.3 Future Conditions

Despite the proportion of O&M problems and adverse consequences of continuing with the status quo, it is doubtful that any significant improvement will be made without outside pressure or innovative ideas, or both. If the State and EPA continue with lax enforcement of operator certification requirements and effluent standards, little or no improvement can be expected in the current situation.

10.4 ALTERNATIVE OPERATION AND MAINTENANCE MANAGEMENT PROGRAMS

Presently each community in the region operates and maintains its own treatment works. There is little or no cooperation between communities. There is nothing wrong with this as long as optimum O&M is provided, but it may be beneficial to combine resources. For this reason, alternatives of individual operation, a regional concept, and a combined approach were analyzed. For any of the alternatives analyzed, additional money must be expended to correct the existing bad situation.

10.4.1 Individual Community Operation of Treatment Works

Each community in the region should evaluate its operation and maintenance program. The previous sections indicate some of the factors which should be considered. The literature referenced and the District Engineer with the Colorado Department of Health are helpful sources of information.

Exclusive individual community operation and maintenance of treatment works will probably not improve O&M levels unless effluent standards, permit conditions, and operator certification regulations are enforced.

10.4.2 Regional Operation and Maintenance Management System

The feasibility of a cost-sharing, regional approach to wastewater operation and maintenance management was analyzed. Again, the communities of Greeley, Loveland, Fort Collins, Estes Park Sanitation District, and Upper Thompson Sanitation District were excluded. Several advantages of this concept are apparent. Highly-skilled operators could be provided if the communities jointly hired a staff. Total staffing requirements could be reduced, since lesser skilled men could be directed by a chief of operations. Specialists such as chemists could also be provided.

A fully-equipped laboratory could be provided and the chemist could analyze sufficient in-plant and effluent samples so that good operation could be provided. Alternatively, a private laboratory could be contracted to perform this work.

Other equipment not normally owned by small communities, such as sewer line rodding equipment, could be jointly owned and operated utilizing this concept.

Unfortunately such an approach could not greatly reduce operation and maintenance costs to communities. As mentioned in Section 10.3.2.1, many of the communities have only one or two men who have several responsibilities other than wastewater treatment. This "town man" would still be a necessity.

The remaining budget for wastewater treatment consists mainly of costs of chemicals such as weed killers or chlorine, power to run such things as lift stations and aerators, parts for equipment, and laboratory testing. Most of these expenses would not be affected utilizing a regional operation and maintenance concept. The only exception is the cost of laboratory testing. A few municipalities have their own equipment for testing, but these are in the minority. The greatest percentage of municipalities utilize the services of private laboratories to meet the self-monitoring requirements of their permits.

10.4.3 A Combined Approach to a Regional Management System

To be feasible, a regional operation and maintenance program must be capable of meeting the needs of the municipalities while cooperatively utilizing existing manpower of these municipalities. The management system should have a skilled individual who could provide overall direction to the municipalities. To be effective, the individual would have supervisory authority over the labor force in each municipality on a part-time basis. He also should be a certified operator with at least a "B" license in order to satisfy the certification requirements of the communities.

Individual communities would still be required to have personnel to operate and maintain the treatment works. Assistance would be available from the management system. The biggest advantage of such an arrangement would be that communities would be able to achieve the highest quality effluent obtainable from their treatment plants.

Laboratory testing and sewer line maintenance could also be cost-effectively provided to individual communities utilizing a cooperative, regional approach to wastewater O&M management.

10.4.4 Comparison of Alternative Concepts

The cost of a regional O&M approach as outlined in Section 10.4.2 would be substantial, and the program would not significantly reduce other expenditures of individual communities. This concept offers no advantage over and above the combined approach, even though costs of the program would be greater.

A combined, regionally or sub-regionally-assisted operation and maintenance program offers the benefits of a regional operation and maintenance approach, at a substantially reduced cost. Much less manpower for this cooperative approach is required, since the existing labor pool in the communities is utilized in conjunction with assistance from a regional management system.

The costs of the combined approach to a regional O&M management system would be greater than continued operation by individual communities, assuming extension of the current weak enforcement policies. However, assuming enforcement policies are strenghtened, the costs of the combined regional approach would approximate the total cost of improved O&M by individual communities. The real advantage of the combined regional approach is that, it in itself will result in improved O&M, and consequently plant effluent quality.

10.5 OVERVIEW OF REGIONAL-ASSISTED O&M PROGRAM

There are several advantages to implementing a regionally-assisted O&M management program as outlined in Section 10.4.3. Most of these advantages were discussed above, and will be reiterated here:

- Better operation of wastewater treatment systems would be provided through increased skill and better in-plant laboratory testing;
- Each community would have a better chance to comply with the effluent standards by simply increasing the efficiency of the treatment plants;
- Offers advantage of large scale while not affecting autonomy of communities or altering the personnel structure;
- Could reduce the duplication of administrative costs;
- The Colorado Department of Health certification requirements would be satisfied;
- Increased equipment life could be expected;
- This program would result in savings for effluent monitoring and possibly for sewer line maintenance;
- The autonomy of communities would be retained.

With any new program, there are disadvantages associated which should not be overlooked. These include:

- Costs may increase slightly over existing levels;
- It is difficult to forecast how much benefit each individual town would receive in comparison with the other communities, so that the costs of the program would be fairly distributed;
- Compliance with effluent standards could not be guaranteed, since some plants are hydraulically or organically overloaded;
- Since laboratory testing would be provided, it would possibly be in competition with private laboratories.

10.5.1 Suggested Participating Communities

While every community in the region could potentially benefit from a regional assistance program, some would benefit much more than others. Some communities are large enough or have good enough O&M now that the incremental benefit to them would be insignificant. These communities could assist the others with operational suggestions or chemical tests. This will be analyzed in a subsequent study.

Wastewater agencies which could derive substantial benefit from a cooperative, regionally-assisted approach to wastewater operation and maintenance are tabulated below:

- Ault S.D.
- Del Camino
- Eaton
- Erie W.S.D.
- Fort Lupton
- Gilcrest S.D.
- Hill-n-Park S.D.
- Hudson S.D.
- Johnson's Corner
- Johnstown
- Keenesburg S.D.
- Kersey S.D.
- Mead S.D.
- Milliken S.D.
- Pierce
- Platteville
- Tri-Area S.D.
- Weld Central High School
- Wellington

10.5.2 Responsibilities of the Regionally-Assisted Program

This program would be charged with providing operation and maintenance assistance to participating communities. It would be responsible for in-plant testing so that basic operational data would be obtained. The program's chief operator would be required to know what type and frequency of laboratory testing would be necessary at each plant so an operating program can be established. Once the chief operator has determined an operational program, he must be able to convey to the community's operators the method of carrying out the program. Further, he should explain the reasons for the process methods selected to the community's operators in an effort to improve the skill of these people.

The communities would be expected to provide enough manpower to work with the program. Most of the actual maintenance of the collection and treatment systems would be required to be conducted by the individual communities.

10.5.3 Staffing Requirements

It is estimated that a staff of four would be required initially to implement this assistance program. The person in charge should be a skilled operator with at least a "B" certificate. This person should have management experience and should be capable of working well with people not directly employed by him. This includes both city councils and the operators.

Under this person's direction should be a chemist and one other operator. The chemist should be familiar with water chemistry. An alternative to hiring a chemist would be to either contract with a private laboratory or utilize another agency's laboratory, such as the Weld County Health Department's laboratory. The other operator should be skilled also, but not necessarily as skilled as a "B" operator. He should also have enough knowledge of chemistry to be able to help in the laboratory and to be able to explain the tests to the town's operators.

Finally, secretarial help would be necessary to help keep records and conduct normal secretarial duties.

10.5.4 Cost of Implementation

It is estimated that salaries and fringe benefits for the four staff personnel would cost approximately $80,000 annually. Other costs include travel expenses, the expense of setting up and operating a laboratory, rent for office space, utility expenses, etc. It is expected that telephone expense would be fairly high because a great deal of liaison would be conducted by telephone. Other costs are estimated to amount to approximately $65,000 annually. Thus the total annual budget is estimated to be about $145,000.

This estimate is based on the participation of 19 communities, so the cost per community is about $7,600 if it were equally divided. Actually, some communities, particularly those with mechanical plants, would receive much more benefit than others. Some plants require weekly effluent monitoring; some are required to monitor effluents only four times a year. The communities which receive more services should pay more than the communities that receive less benefit.

10.5.5 Implementation Program

As has been shown above, the regionally-assisted O&M management program may cost participating communities more than their individual costs. It is doubtful that communities would spend extra money for these services as long as the benefits are not demonstrated.

There is a need to analyze specific costs of implementing such a program. The estimate in the previous section is difficult to refine at this time. Further, there is a need to determine an equitable allocation of costs to participating communities.

It is believed that if such a program was initiated, the value of such a program would be obvious to local communities. If this program was allowed to continue, its scope could be expanded as desired. For example, rodding equipment could be obtained to help communities with sewer line maintenance. These services could then be made available to municipalities for a fee which would be less than a private contractor would charge.

Unfortunately, the many uncertainties which exist regarding actual costs and relative benefits to communities will make the regionally-assisted concept difficult for communities to accept. For this reason and because the concept is new in the region, a specific process for developing such a program needs to be outlined. Such a developmental process is presented in Table 10.5-A.

TABLE 10.5-A. PROCESS FOR DEVELOPING A REGIONALLY-ASSISTED O&M MANAGEMENT PROGRAM

1. Contact and obtain feedback from individual community pertaining to program participation.

2. Define specific existing costs and levels of O&M for communities expressing interest for participation; refine individual community benefits from a regionally-assisted program.

3. Identify alternatives for entities to implement regionally-assisted O&M management program:

   a) Utilization of outside consultants;
   b) Existing agencies: LCHD, WCHD, LWRCOG;
   c) Liaison with WQCD.

4. Obtain input from LWRCOG institutional/financial consultant concerning institutional feasibility of such a program.

5. Refine the regionally-assisted O&M management program:

   a) Scope of program responsibilities, services, and costs;
   b) Extent of community participation;
   c) Individual community costs and benefits.

6. Develop specific implementation program:

   a) Intergovernmental agreements;
   b) Demonstration project.

APPENDICES

APPENDIX A

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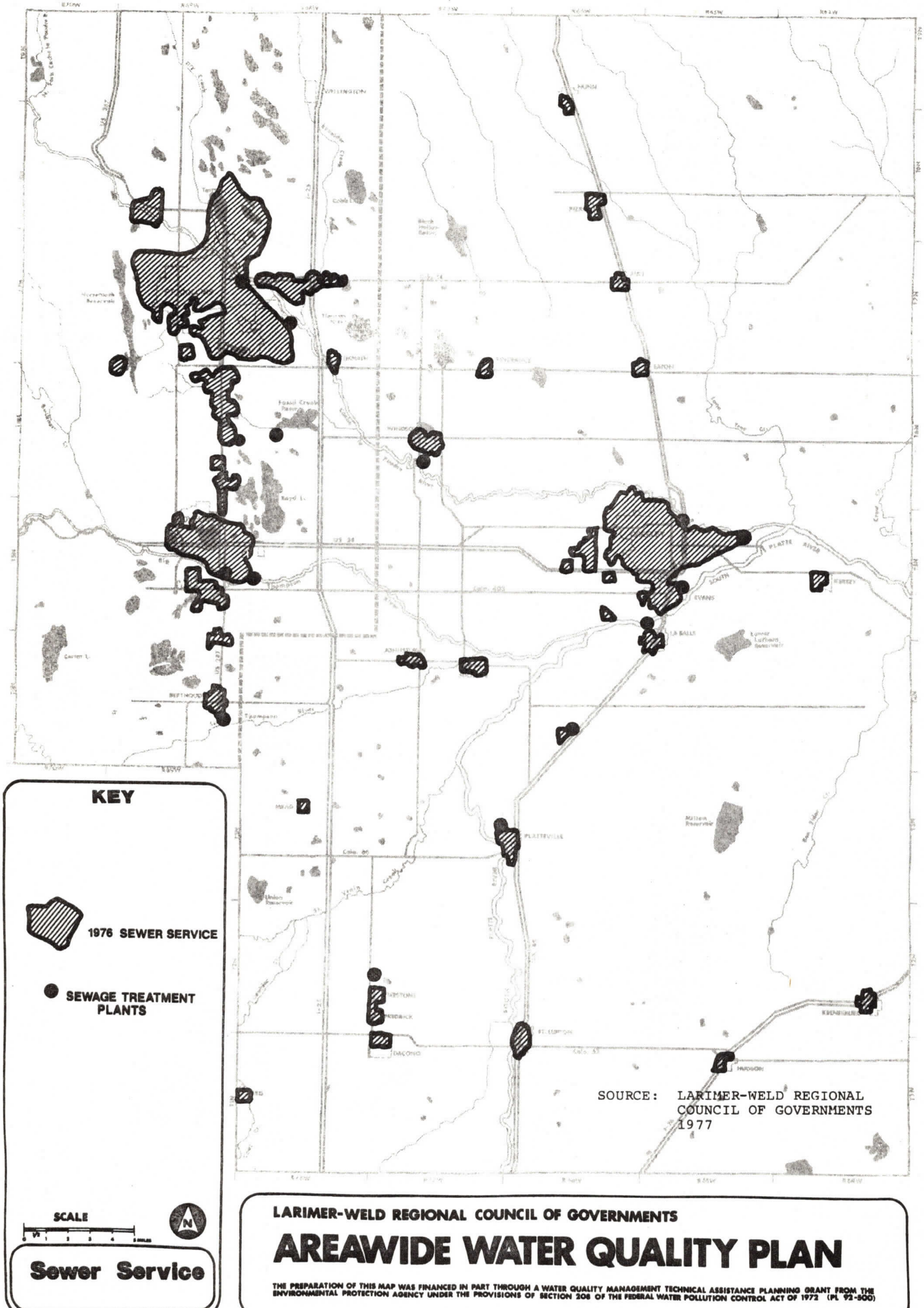
APPENDIX B

EXISTING SEWER SERVICE AREAS MAP



LARIMER-WELD REGIONAL COUNCIL OF GOVERNMENTS

AREAWIDE WATER QUALITY PLAN

THE PREPARATION OF THIS MAP WAS FINANCED IN PART THROUGH A WATER QUALITY MANAGEMENT TECHNICAL ASSISTANCE PLANNING GRANT FROM THE ENVIRONMENTAL PROTECTION AGENCY UNDER THE PROVISIONS OF SECTION 208 OF THE FEDERAL WATER POLLUTION CONTROL ACT OF 1972 (PL 92-500)

APPENDIX C

CALIFORNIA DEPARTMENT OF HEALTH - WASTEWATER RECLAMATION GUIDELINES

STATE OF CALIFORNIA DEPARTMENT OF HEALTH

GUIDELINES FOR USE OF RECLAIMED WATER FOR SURFACE IRRIGATION CROPS

1. Reclaimed water shall meet the Regional Water Quality Control Board requirements and the quality requirements established by the State of California Department of Health for health protection.

2. The discharge shall be confined to the area designated and approved for disposal and reuse. Irrigation should be controlled to minimize ponding of wastewater and runoff should be contained and properly disposed.

3. Maximum attainable separation of reclaimed water lines and domestic water lines shall be practiced. Domestic and reclaimed water transmission and distribution mains shall conform to the "Separation and Construction Criteria" (see attached).

   a. The use area facilities must comply with the "Regulations Relating to Cross-Connections," Title 17, Chapter V, Sections 7583-7622, inclusive, California Administrative Code.

   b. Plans and specifications of the existing and proposed reclaimed water system and domestic water system shall be submitted to State and/or local health agencies for review and approval.

4. All reclaimed water valves and outlets should be appropriately tagged to warn the public that the water is not safe for drinking or direct contact.

5. All piping, valves, and outlets should be color-coded or otherwise marked to differentiate reclaimed water from domestic or other water.

6. All reclaimed water valves and outlets should be of a type that can only be operated by authorized personnel.

7. Adequate means of notification shall be provided to inform the public that reclaimed water is being used. Conspicuous warning signs with proper wording of sufficient size to be clearly read shall be posted at adequate intervals around the use area.

8. The public shall be effectively excluded from contact with the reclaimed water used for irrigation.

   a. The irrigated areas should be fenced where primary effluent is used.

   b. Irrigated areas must be kept completely separated from domestic water wells and reservoirs. A minimum of 500 feet should be provided.

9. Adequate measures should be taken to prevent the breeding of flies, mosquitoes, and other vectors of public health significance during the process of reuse.

10. Operation of the use area facilities should not create odors, slimes, or unsightly deposits of sewage origin.

11. Adequate time should be provided between the last irrigation and harvesting to allow the crops and soil to dry.

    a. Animals, especially milking animals, should not be allowed to graze on land irrigated with reclaimed water until it is thoroughly dry.

12. There should be no subsequent planting of produce on lands irrigated with primary effluent.

13. Adequate measures shall be taken to prevent any direct contact between the edible portion of the crops and the reclaimed water.

STATE OF CALIFORNIA DEPARTMENT OF HEALTH

GUIDELINES FOR USE OF RECLAIMED WATER FOR LANDSCAPE IRRIGATION

1. Reclaimed water shall meet the Regional Water Quality Control Board requirements and the quality requirements established by the State of California Department of Health for health protection.

2. The discharge shall be confined to the area designated and approved for disposal and reuse. Irrigation should be controlled to minimize ponding of wastewater and runoff should be contained and properly disposed.

3. Maximum attainable separation of reclaimed water lines and domestic water lines shall be practiced. Domestic and reclaimed water transmission and distribution mains shall conform to the "Separation and Construction Criteria" (see attached).

    a. The use area facilities must comply with the "Regulations Relating to Cross-Connections," Title 17, Chapter V, Sections 7583-7622, inclusive, California Administrative Code.

    b. Plans and specifications of the existing and proposed reclaimed water system and domestic water system shall be submitted to State and/or local health agencies for review and approval.

4. All reclaimed water valves, outlets and/or sprinkler heads should be appropriately tagged to warn the public that the water is not safe for drinking or direct contact.

5. All piping, valves, and outlets should be color-coded or otherwise marked to differentiate reclaimed water from domestic or other water.

    a. Where feasible, differential piping materials should be used to facilitate water system identification.

6. All reclaimed water valves, outlets, and sprinkler heads should be of a type that can only be operated by authorized personnel.

    a. Where hose bibbs are present on domestic and reclaimed water lines, differential sizes should be established to preclude the interchange of hoses.

7. Adequate means of notification shall be provided to inform the public that reclaimed water is being used. Such notification should include the posting of conspicuous warning signs with proper wording of sufficient size to be clearly read. At golf courses, notices should also be printed on

score cards and at all water hazards containing reclaimed water.

8. Tank trucks used for carrying or spraying reclaimed water should be appropriately identified to indicate such.

9. Irrigation should be done so as to prevent or minimize contact by the public with the sprayed material and precautions should be taken to insure that reclaimed water will not be sprayed on walkways, passing vehicles, buildings, picnic tables, domestic water facilities, or areas not under control of the user.

   a. Irrigation should be practiced during periods when the grounds will have maximum opportunity to dry before use by the public unless provisions are made to exclude the public from areas during and after spraying with reclaimed water.

   b. Windblown-spray from the irrigation area should not reach areas accessible to the public.

   c. Irrigated areas must be kept completely separated from domestic water wells and reservoirs. A minimum of 500 feet should be provided.

   d. Drinking water fountains should be protected from direct or windblown reclaimed water spray.

10. Adequate measures should be taken to prevent the breeding of flies, mosquitoes, and other vectors of public health significance during the process of reuse.

11. Operation of the use area facilities should not create odors, slimes, or unsightly deposits of sewage origin in places accessible to the public.

STATE OF CALIFORNIA DEPARTMENT OF HEALTH

GUIDELINES FOR WORKER PROTECTION AT WATER RECLAMATION USE AREAS

1. Employees should be made aware of the potential health hazards involved with contact or ingestion of reclaimed water.

2. Employees should be subjected to periodic medical examinations for intestinal diseases and to adequate immunization shots.

3. Adequate first aid kits should be available on location, and all cuts and abrasions should be treated promptly to prevent infection. A doctor should be consulted where infection is likely.

4. Precautionary measures should be taken to minimize direct contact of employees with reclaimed water.

   a. Employees should not be subjected to reclaimed water sprays.

   b. For work involving more than a casual contact with reclaimed water, employees should be provided with protective clothing.

   c. At crop irrigation sites, the crops and soil should be allowed to dry before harvesting by employees.

5. Provisions should be made for a supply of safe drinking water for employees. Where bottled water is used for drinking purposes, the water should be in contamination-proof containers and protected from contact with reclaimed water or dust.

   a. The water should be of a source approved by the local health authority.

6. Toilet and washing facilities should be provided.

7. Precautions should be taken to avoid contamination of food taken to areas irrigated with reclaimed water, and food should not be taken to areas still wet with reclaimed waer.

8. Adequate means of notification shall be provided to inform the employees that reclaimed water is being used. Such notification should include the posting of conspicuous warning signs with proper wording of sufficient size to be clearly read.

   a. In some locations, especially at crop irrigation use areas, it is advisable to have the signs in Spanish as well as English.

9. All reclaimed water valves, outlets, and/or sprinkler heads should be appropriately tagged to warn employees that the water is not safe for drinking or direct contact (direct contact is allowed at non-restricted recreational impoundments).

10. All piping, valves, and outlets should be color-coded or otherwise marked to differentiate reclaimed water from domestic or other water.

    a. Where feasible, differential piping materials should be used to facilitate water system identification.

11. All reclaimed water valves, outlets, and sprinkler heads should be of a type that can only be operated by authorized personnel.

    a. Where hose bibbs are present on domestic and reclaimed water lines; differential sizes should be established to preclude the interchange of hoses.

APPENDIX D

PROPOSED DISCHARGE STANDARDS FOR POND SYSTEMS

federal register

THURSDAY, SEPTEMBER 2, 1976

PART II:

ENVIRONMENTAL PROTECTION AGENCY

WATER PROGRAMS

Secondary Treatment Information

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 133]

[FRL 586-2]

WATER PROGRAMS

Secondary Treatment Information

The purpose of this proposed rulemaking is to amend the Secondary Treatment Information regulation (40 CFR, Part 133). The proposed amendment recognizes that properly designed and operated waste stabilization ponds are a form of secondary treatment which may not be capable of achieving the suspended solids limitations contained in 40 CFR 133 without supplemental treatment processes for the removal of suspended solids. Amendment of Secondary Treatment Information is proposed to allow upward adjustment of the suspended solids limitations in cases where ponds which have a design capacity of one million gallons per day or less are used as the process for secondary treatment.

The Secondary Treatment Information regulation contained in 40 CFR Part 133 was promulgated pursuant to sections 301 and 304 of the Federal Water Pollution Control Act Amendments of 1972 (the Act). Section 304(d) (1) requires that the Environmental Protection Agency publish information on the degree of effluent reduction attainable through the application of secondary treatment within sixty days after enactment of the Act and from time to time thereafter. Section 301(b)(1)(B) of the Act requires that effluent limitations, based on secondary treatment, be achieved for all publicly owned treatment works in existence on July 1, 1977, or approved for a construction grant prior to June 30, 1974 (for which construction must be completed within four years of approval). Secondary Treatment Information was promulgated on August 17, 1973, and recently amended for deletion of the fecal coliform bacteria limitations and clarification of the pH requirement.

At the time 40 CFR 133 was proposed for public comment, the issue of the ability of waste stabilization ponds to achieve the proposed effluent quality in terms of suspended solids was raised. The Environmental Protection Agency recognized at that time that ponds as then in use generally had not been capable of producing effluents which are consistently low in suspended solids because of algae which result from the normal operations of ponds. The response of the Agency when 40 CFR 133 was promulgated was that it believed that with proper design (including solids separation processes in some cases) and operation, the level of effluent quality can be achieved with waste stabilization ponds.

In establishing the criteria for 40 CFR 133 and in considering comments submitted in response to its proposal, the Environmental Protection Agency was guided, in part, by the following: (1) The basic approach of Pub. L. 92-500 is directed at achieving incremental improvements in wastewater treatment practices and water quality, and (2) the legislative history of Pub. L. 92-500 clearly indicates that Congress intended that the secondary treatment regulation include controls on the discharge of suspended solids. Applying this basic guidance to waste stabilization ponds, the Agency has embarked on an extensive and successful research and development program to develop techniques for upgrading ponds since promulgation of 40 CFR 133. In March of 1974, the Agency published a technical bulletin entitled "Wastewater Treatment Ponds" to serve as a guide to the EPA Regional Administrators on design criteria for ponds. The technical bulletin, as well as the results of the research and development program on ponds, recognizes that in many cases upgrading techniques for the reduction of suspended solids go beyond traditional and even advanced pond design (i.e., two or more cells capable of series or parallel operation and controlled discharge) and require the use of supplemental mechanical devices such as filters.

Wastewater treatment ponds (lagoons) are widely used throughout the United States. Ponds have become very popular with small communities, primarily because of their relatively low construction and operating costs. As a result, nearly 90 percent of the wastewater treatment ponds in this country are located in communities of 5,000 people or less. Approximately 25 percent of the municipal wastewater treatment plants in the country are ponds.

In addition to the economic advantages that ponds afford to small and moderate size communities, there are additional benefits derived from the use of ponds for the treatment of wastewater. These benefits include the following:

1. Low energy requirements because treatment relies mostly on natural processes;
2. Successful operation is not dependent on highly skilled operating personnel;
3. Ponds are less subject to breakdown or malfunction than are mechanical plants;
4. Many ponds achieve low fecal coliform bacteria concentrations without a separate disinfection process or the use of chemical disinfectants.

Despite the inherent advantages associated with the application of ponds for wastewater treatment, particularly in small communities, there has been a considerable amount of controversy relating to ponds in recent years, as noted above. This controversy has centered around the issues of whether ponds can meet the suspended solids limitations required for secondary treatment. Secondary treatment (as defined in 40 CFR 133) is the minimum level of treatment required for all publicly owned treatment works. Effluent limitations required for secondary treatment are 30 mg/l or less of BOD and suspended solids on a 30-day average (or at least 85 percent removal, whichever is more stringent), 45 mg/l or less of BOD and suspended solids on a 7-day average, and pH within the range of 6.0 to 9.0.

Algae are naturally formed in municipal wastewater treatment ponds. Nonaerated ponds, which are the vast majority of municipal wastewater treatment ponds in this country, are designed to rely on photosynthetic oxygenation (i.e., oxygen from algae) for the oxygen needed for waste treatment. Thus algae, in addition to being a natural phenomenon in ponds, are also an integral part of the pond system.

Live algal cells do not readily settle even in the quiescent conditions occurring in the ponds. It is important to note, however, that the putrescible solids found in untreated or partially treated wastewater do readily settle in ponds which incorporate proper hydraulic design because of the quiescent conditions. The reason that most ponds cannot comply with the suspended solids limitations is because of algae.

Further indication and consequence of the fact that algae are not readily removed from pond effluents is that traditional pond design has not provided for the removal of algae and that historically pond performance has been measured in terms of BOD alone and not suspended solids. The suspended solids to BOD (five-day) ratio in most municipal wastewater (untreated and effluents from municipal plants) is generally in the range of 1:1 whereas the suspended solids to five-day BOD ratio in pond effluents can typically be as high as 2-4:1. Properly designed pond systems are reported to be generally capable of achieving the BOD limitations of 40 CFR 133; it is the suspended solids limitations upon which questions concerning the ability of ponds to meet the secondary treatment requirements have been based.

Methods for removing algae from pond effluents have been developed but have not been widely demonstrated in all climatic regions of the country. The most promising techniques developed thus far involve the use of sand or rock filters and may additionally require the use of chemical coagulants. Such systems generally have been developed to retain the features of low cost and simplified operation for ponds; however, supplemental treatment methods unavoidably add to the complexity of pond design and may strain the operational capability of small communities where the vast majority of ponds are used. Because of the increased complexity of supplemental systems for ponds and the emerging status of such systems at the present time, many pond users and state regulatory agencies have been reluctant to use them and have indicated it may be necessary to replace ponds which are incapable of achieving the limitations required for secondary treatment with mechanical treatment plants.

The Environmental Protection Agency believes that ponds play a vital role in the Nation's water pollution control strategy and that, because of their advantages of simplicity and low cost, ponds should be retained as an option for smaller communities. Furthermore, historically ponds have been considered as "secondary treatment" for smaller communities. The Agency also recognizes that suspended solids due to live algae in pond effluents have fundamentally and substantially different characteristics than sewage solids or solids from other treatment processes. It is for these reasons that the amendment of the secondary treatment regulation to allow raising the suspended solids limitations for smaller ponds in accordance with the level of effluent quality achievable with pond technology is being proposed.

Special consideration is proposed for waste stabilization ponds in recognition of the fact that ponds without supplemental suspended solids removal processes may not be capable of achieving the suspended solids requirements of the Secondary Treatment Information regulation. The proposed amendment indicates that the suspended solids limitations of 40 CFR 133 may be adjusted to the level of effluent quality achievable by best pond technology, provided that: (1) Waste stabilization ponds are used as the process for secondary treatment, (2) the treatment works has a design capacity of one million gallons per day or less, and (3) performance data indicate that the treatment works cannot comply with the requirements of paragraphs (b)(1), (b)(2), and (b)(3) of § 133.102.

The proposed amendment allows the Regional Administrator (or the State, if the State has the authority to issue NPDES permits) to grant a variance with respect to the suspended solids requirements of 40 CFR 133 when establishing effluent limitations in NPDES permits for publicly owned treatment works which use waste stabilization ponds as the process for secondary treatment. A variance may be granted by the Regional Administrator or the authorized State agency, if the municipality can show that (1) the present system was designed in accordance with the traditional design of secondary treatment facilities, but (2) even if properly operated cannot meet the suspended solids limits of the secondary treatment standards, and (3) could not do so without the addition of treatment system elements not historically considered as secondary treatment (such as filtration systems). In granting a variance to a municipal pond user, the Regional Administrator or the State authority must specify the numerical suspended solids limitations which the pond will be required to meet; in no case, however, can facilities be exempted entirely from a suspended solids requirement. Effluent limitations for ponds established pursuant to the requirements of 40 CFR 133, including suspended solids limitations for ponds set in accordance with a variance procedure, will continue to be enforceable conditions of National Pollution Discharge Elimination System permits.

Variances would be granted to municipalities which apply for them based on the merits of individual requests and information specifically concerning the applicant and the pond facility under consideration. It is recognized, however, that it will be necessary for the efficient and effective implementation of a variance procedure for ponds for the Regional Administrator or authorized State agency to establish statewide or areawide limitations for the suspended solids concentrations achievable by best waste stabilization pond technology in that State or geographical area. Regional or State limitations would then be used as the basis for granting variances and setting suspended solids limitations for qualified ponds.

The proposed amendment authorizes the Regional Administrator (or the State) "to adjust the effluent limitations set forth in paragraphs (b)(1), (b)(2), and (b)(3) * * * based on the solids concentrations achievable by the best waste stabilization technology * * *" Regional or State acceptance and performance criteria for establishment of suspended solids limitations for ponds and for specific determinations concerning individual pond facilities must be set in accordance with this requirement. It it important to note that determinations of the "suspended solids concentrations achievable by best waste stabilization pond technology" must be based on ponds which are achieving the BOD limitations of 40 CFR 133. Such determinations will necessarily have to consider minimum pond design standards (e.g., hydraulic and organic loading rates, number of cells and operational flexibility) required for compliance with the BOD limitations of § 133.102(a), which remain unchanged.

In proposing this amendment to 40 CFR 133, the Agency also recognizes that approximately 40 percent of the municipal wastewater treatment ponds in this country discharge to waters where specific water quality standards are required pursuant to sections 301, 302, and 303. In accordance with section 301(b)(1)(c) "* * * any more stringent limitation including those necessary to meet water quality standards, treatment standards or schedules of compliance, established pursuant to any State law or regulations * * *" shall continue to apply in lieu of the requirements of 40 CFR 133, including a variance procedure for ponds. Accordingly, the granting of a variance for the suspended solids limitations ponds must consider any and all applicable water quality standards. Likewise, effluent limitations for suspended solids established in accordance with the variance must not cause water quality standards to be violated.

In proposing this amendment to 40 CFR 133 for small waste stabilization ponds, the Environmental Protection Agency does not intend to imply that supplemental treatment devices such as rock filters or intermittent sand filters are not acceptable methods for upgrading pond performance. Ponds which do not presently meet the discharge requirements pursuant to specific water quality standards can generally be economically upgraded to meet the required standards while preserving the basic concept of simplified operation. The Agency strongly believes that any large scale approach to replace ponds with mechanical plants would be ill-advised because the previously discussed advantages of ponds for small communities would be sacrificed.

Recommended methods for upgrading pond performance treatment requirements are detailed in the EPA Technical Bulletin on Wastewater Treatment Ponds (March 1974). Also available is the information presented at the Logan, Utah symposium on wastewater stabilization ponds. The report, entitled "Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards—Symposium Proceedings," presents the latest information on pond technology and stresses the methods by which ponds and pond design can be upgraded. Additional information on the subject of upgrading ponds is available from the EPA Technology Transfer Program.

Interested persons are invited to comment on the proposed amendments to Part 133 by sending written comments to the Office of Water Program Operations (WH-547), United States Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460. Prior to promulgation of the proposed amendments in final form, all comments received on or before November 1, 1976 will be carefully considered. All comments received may be inspected at the above location during normal working hours by interested members of the public.

In consideration of the foregoing, it is proposed to amend Part 133 of Chapter I of Title 40 of the Code of Federal Regulations as set forth below.

(Section 304(d)(1) and 301(b)(1)(B) of the Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1342, 1345, and 1361)).

Dated: August 25, 1976.

ALVIN Z. ALM,
Acting Administrator.

Section 133.103 is amended by adding paragraph (c) as follows:

§ 133.103 Special considerations.

(c) The Regional Administrator (or, if appropriate, the State subject to EPA approval) is authorized to adjust the minimum levels of effluent quality set forth in paragraphs (b)(1), (b)(2), and (b)(3) of § 133.102 for any publicly owned treatment works, to conform to the suspended solids concentrations achievable with best waste stabilization pond technology, provided that: (1) Waste stabilization ponds are the sole process used for secondary treatment; (2) the maximum facility design capacity is one million gallons per day or less; and (3) operation and maintenance data indicate that the requirements of paragraphs (b)(1), (b)(2) and (b)(3) of § 133.102 cannot be achieved. The term "best waste stabilization pond technology" means a suspended solids value, determined by the Regional Administrator (or, if appropriate, the State subject to EPA approval), which is equal to the effluent concentration achieved 90 percent of the time within a State or appropriate contiguous geographical area by waste stabilization ponds that are achieving the levels of effluent quality established for biochemical oxygen demand in § 133.102(a).

[FR Doc.76-25523 Filed 9-1-76;8:45 am]

APPENDIX E

COSTS OF ALTERNATIVE TREATMENTS PROCESSES

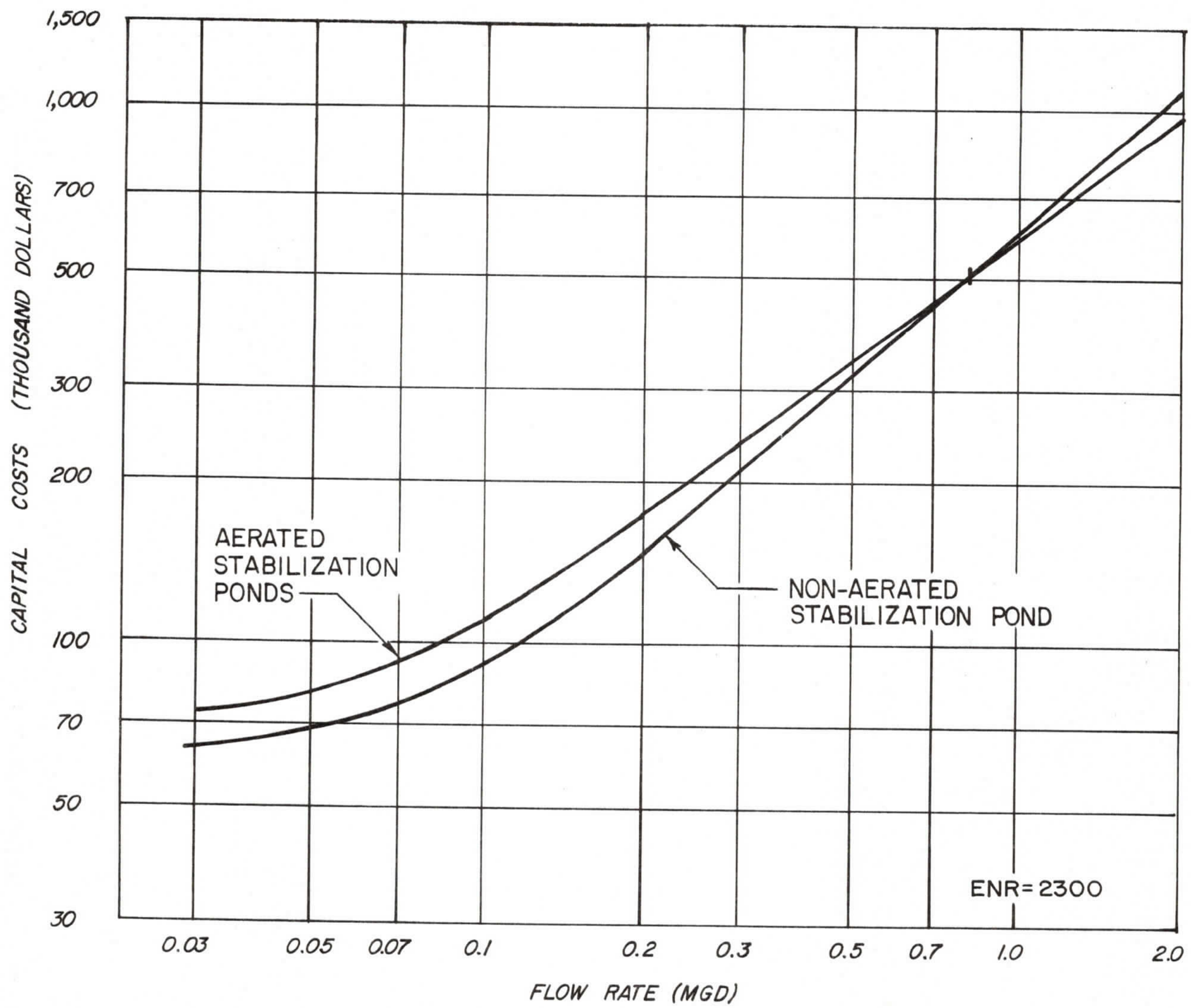


Fig. E-1. Capital Costs for Stabilization Ponds, Aerated and Non-aerated

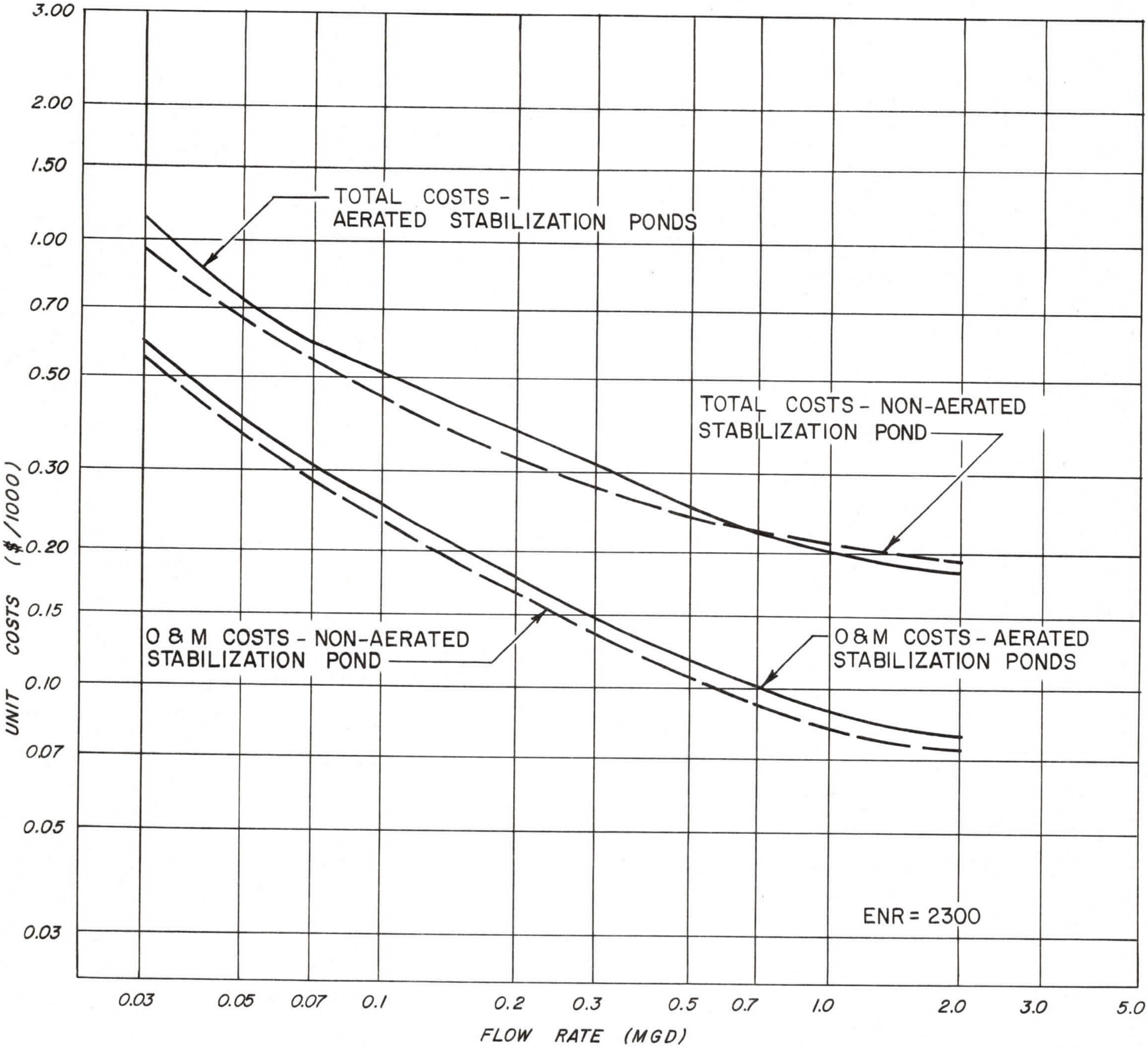


Fig. E-2. O & M and Total Costs for Both Aerated and Non-aerated Stabilization Ponds

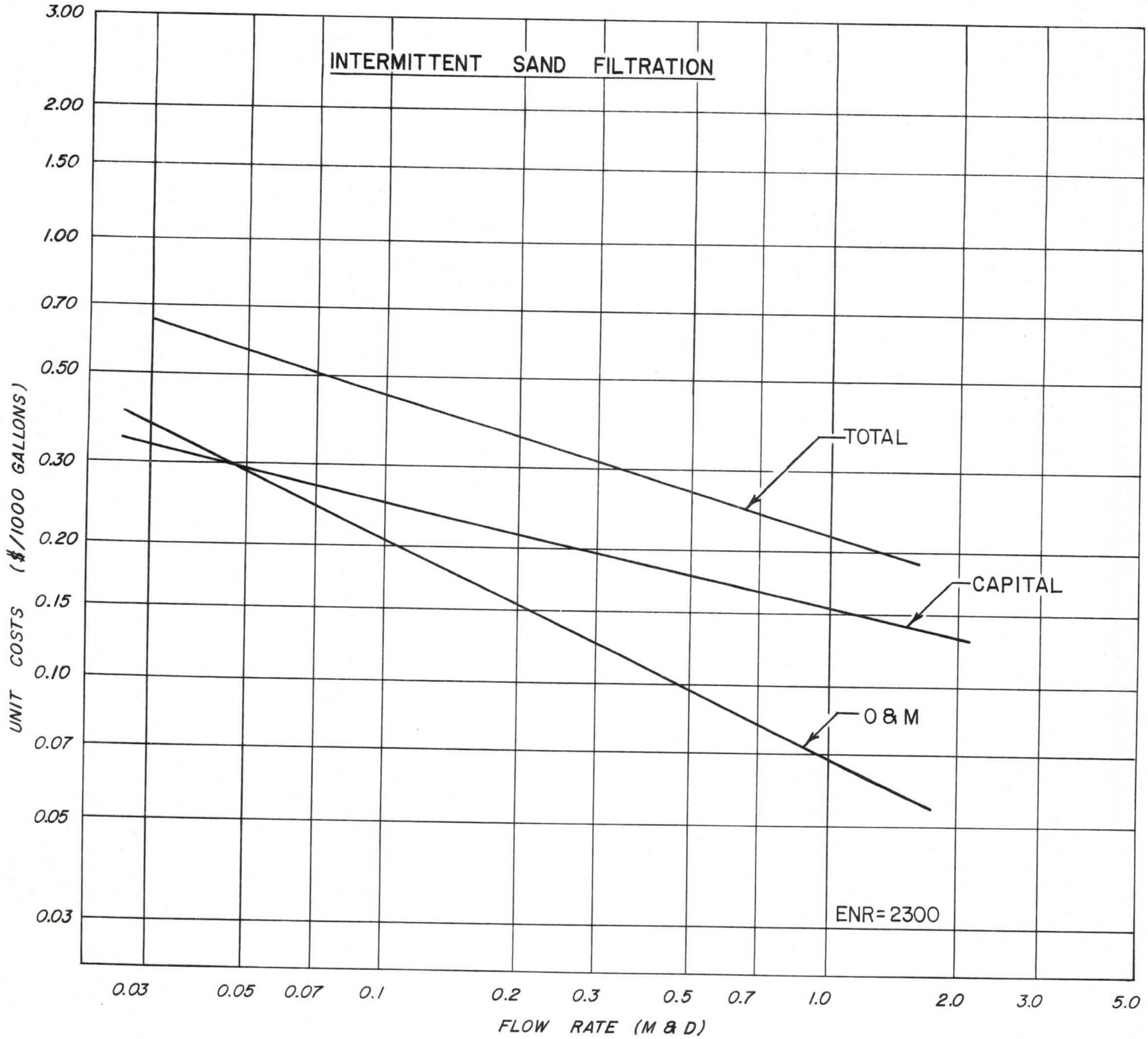


Fig. E-3. Capital, O & M, and Total Costs for Intermittent Sand Filter

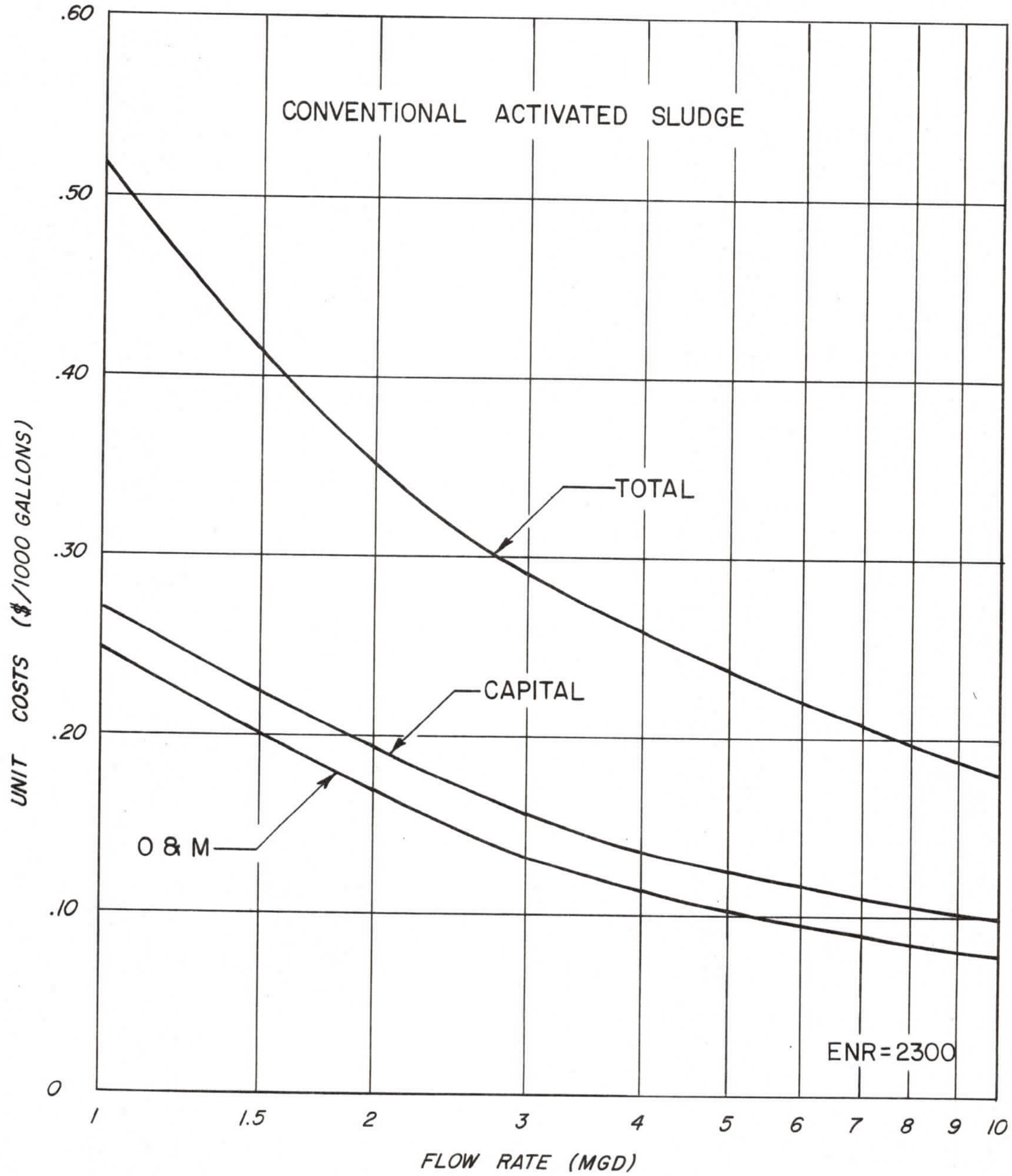


Fig. E-4. Costs of Conventional Activated Sludge Facilities

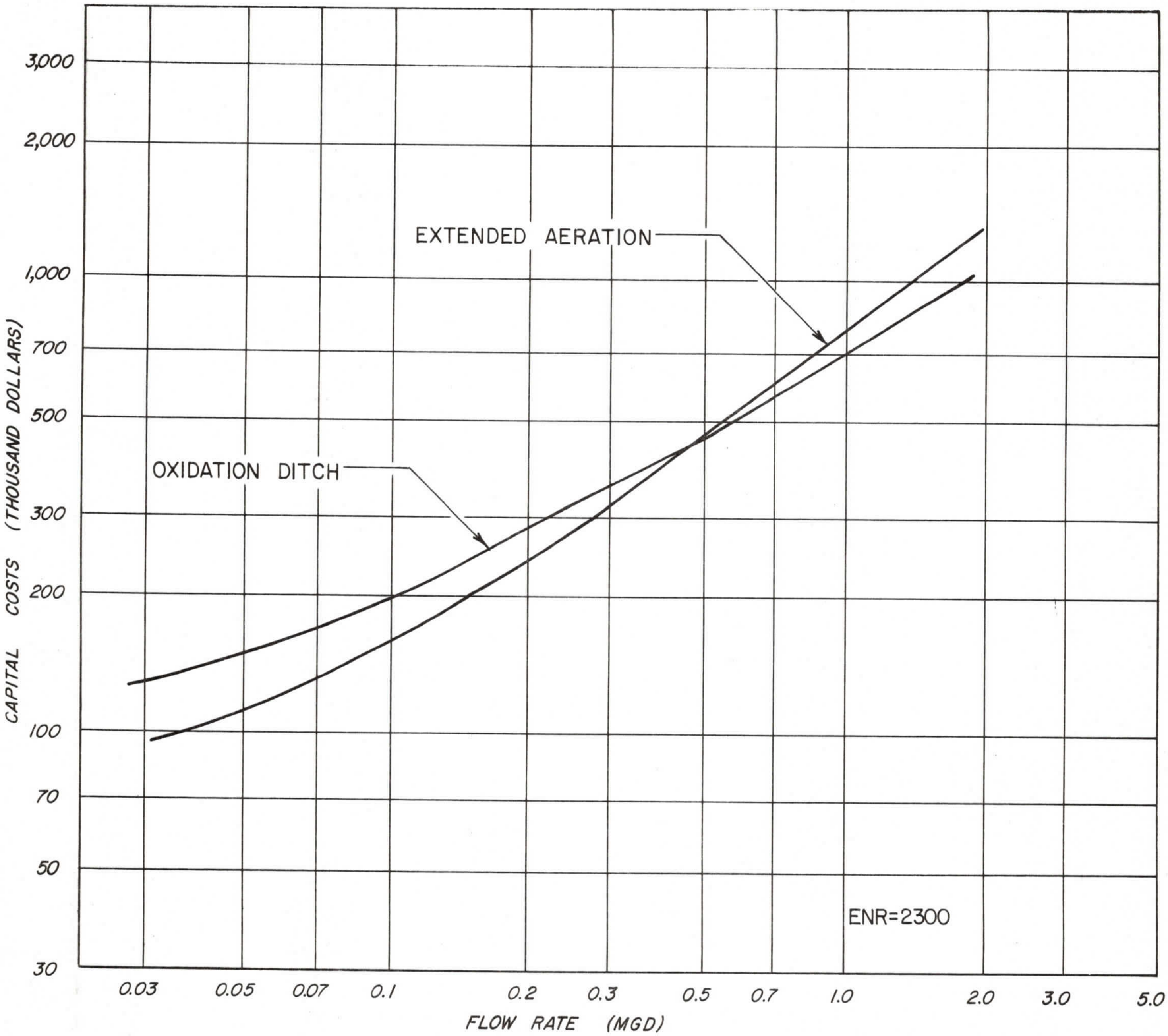


Fig. E-5. Capital Costs - Extended Aeration and Oxidation Ditches

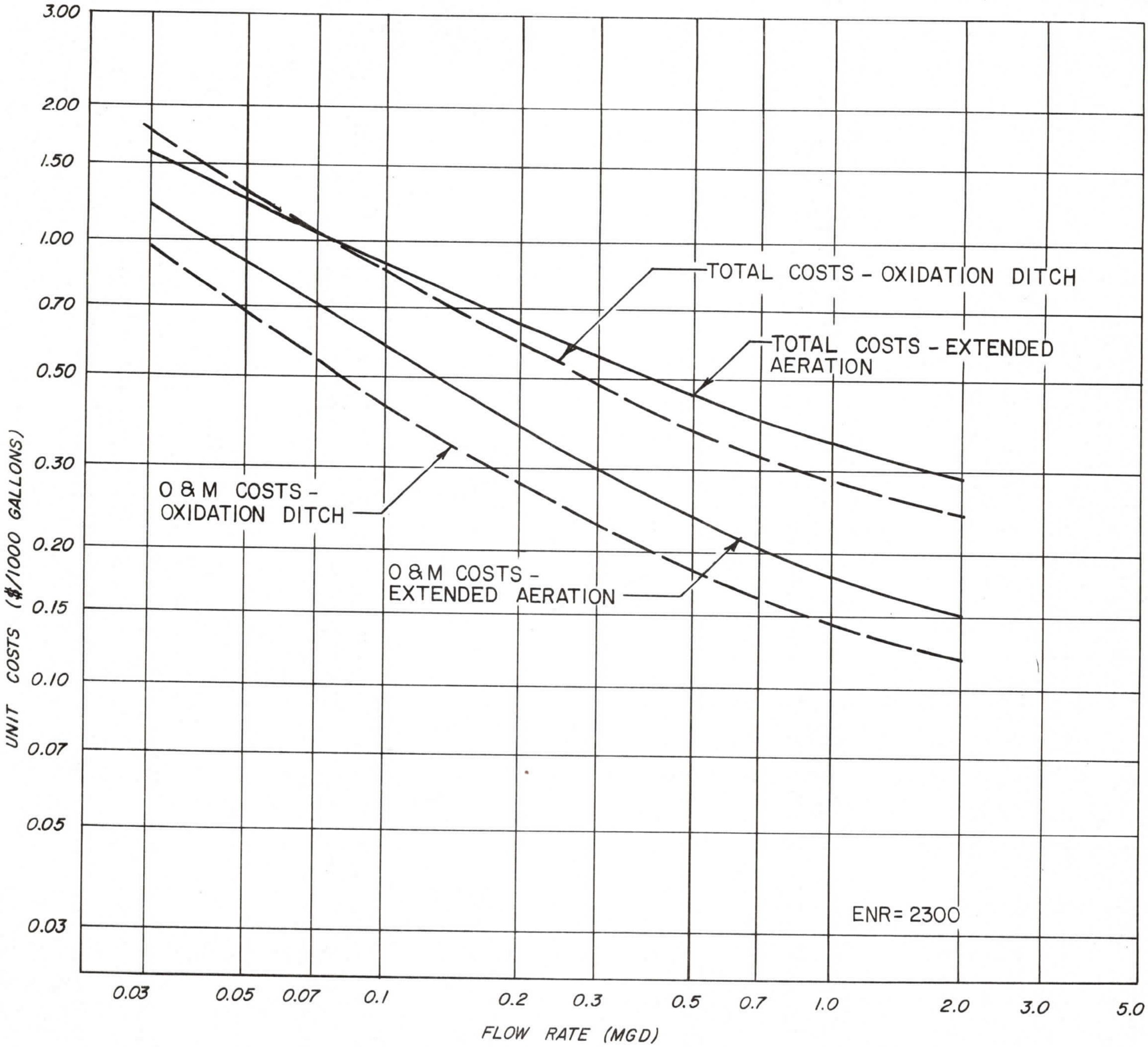


Fig. E-6. O & M and Total Costs for Extended Aeration and Oxidation Ditches

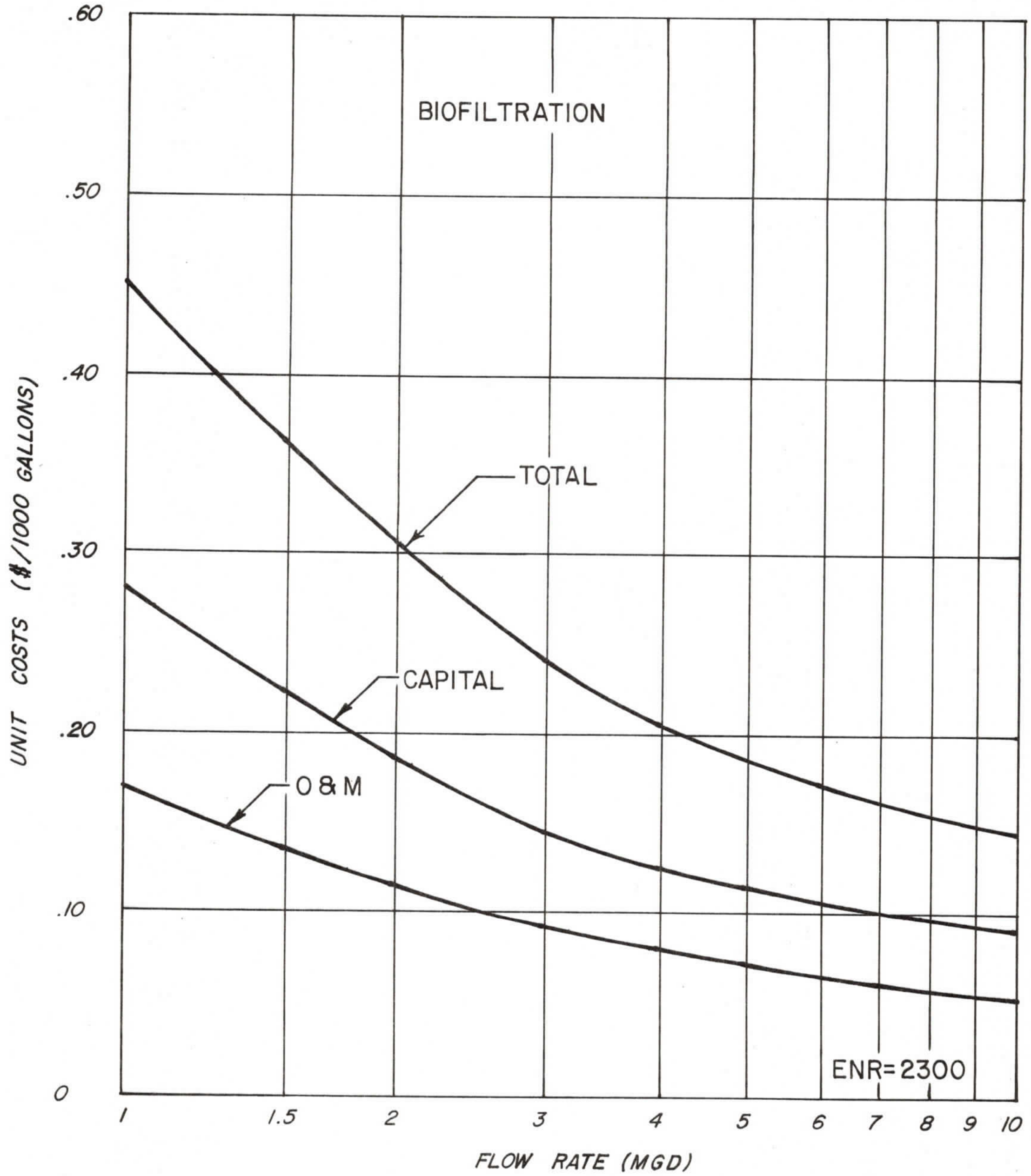


Fig. E-7. Costs of Biofiltration

APPENDIX F

REGULATIONS FOR
CERTIFICATION OF WATER TREATMENT PLANT
AND WASTEWATER TREATMENT PLANT OPERATORS

COLORADO DEPARTMENT OF HEALTH
COLORADO CERTIFICATION BOARD
4210 E. 11th Avenue
Denver, CO 80220

Adopted: November 20, 1975
Effective: April 20, 1976

REGULATIONS FOR CERTIFICATION OF WATER TREATMENT PLANT AND WASTEWATER TREATMENT PLANT OPERATORS

Pursuant to the authority of Article 9 of Title 25, C.R.S. 1973.

ARTICLE 9

25-9-101. Legislative declaration. To assure adequate operation of water and wastewater treatment facilities, and to preserve public peace, health, and safety, the provisions of this article and regulations authorized pursuant thereto are enacted to provide for the examination, classification, and certification of water and wastewater treatment plant operators and to establish minimum standards therefor based upon their knowledge and experience, to provide procedures for certification, to encourage vocational education for such operators, to provide a penalty for the wrongful use of the title "certified operator", to require each water and wastewater treatment plant to be under the supervision of a certified operator, to provide for the classification of all water and wastewater treatment plants in the state, and to provide a penalty for the operation of a water or wastewater treatment plant without supervision of a certified operator.

1. Purpose

1.1 One of the basic requirements of Article 9 of Title 25 C.R.S. 1973 is to have every operator in direct responsibility for a water treatment plant and wastewater treatment plant hold a certificate in a class equal to or higher than the class of his treatment plant.

1.1.1 Direct responsibility means being accountable for the day-by-day supervision of operation of the treatment facilities.

1.2 Certification under this statute is available to all operators who can meet the minimum qualifications of a given classification. Each operator is encouraged to apply for certification in the highest classification consistent with his qualifications.

2. <u>Duties of the Board.</u>

2.1 In carrying out its responsibilities the Board shall:

2.1.1 Advance the certification program.

2.1.2 Shall classify treatment plants and maintain records thereof.

2.1.3 Encourage other operators to become certified besides those required by virtue of their responsibility as operator-in-charge.

2.1.4 Establish and maintain standards for certification of operators in addition to those fixed by law.

2.1.5 Examine the qualifications of applicants for certification with special emphasis on experience.

2.1.6 Maintain records for operator qualifications, certification, and register of certified operators.

2.1.7 Promote regular training schools and program.

3. <u>Application for Certificate.</u>

3.1 An operator desiring to be certified shall file application with the Board 60 days prior to the date of examination on an application form provided by the Board.

3.2 Application fees will NOT be returned for any reason.

3.2.1 Applications shall be made on forms provided by the Secretary of the Board for that purpose.

3.3 The Board shall review applications and supporting documents, determine the eligibility of the applicant for examination, and notify him of his status.

4. <u>Examinations.</u>

4.1 The Board shall prepare written examinations to be used in determining knowledge, ability and judgment of operators.

4.2 Examinations shall be held at places and time set by the Board with suitable method of advance announcements made by the Board. These shall be conducted at least annually.

4.3 Except in such cases as the Board may decide to represent proper exceptions, pursuant to Section 25-9-107 C.R.S. 1973 all examinations shall be written. All examinations will be graded by the Board or by others designated by the Board. Applicants may review examination results with the Board upon written request.

4.4 Separate examinations will be prepared to cover basic differences in types of facilities, variations in wastewater or water quality, conditions of receiving waters, and other pertinent matters.

4.5 Applicants who fail to pass an examination may repeat the examination at the subsequent regularly scheduled examination.

5. Fees.

5.1 Fees for certification shall be as follows:

		Fee
5.1.1	Examination and Certificate. Ref. 25-9-107(1). First Examination in each category 25-9-108. i.e., water or wastewater.	$15
5.1.2	Certificate(for additional examination)Ref.25-9-108	$10
5.1.3	Certificate (Restricted) Ref. 25-9-107(6)	$15
5.1.4	Certificate (Reciprocal) Ref. 25-9-107(5)	$15
5.1.5	Certificate (Renewals) Ref. 25-9-107(4)	$ 5
5.1.6	Reexamination. Ref. 25-9-108	$10

(All statutory references are to C R S 1973.)

6. Issuance of Certificates.

6.1 Upon satisfactory fulfillment of the requirements provided herein the Board of Certification shall issue a suitable certificate to the applicant designating his competency.

6.2 Certificates shall be valid for five years unless revoked as provided in 7.1 of these regulations. Certificates of operators in good standing will be renewed every five years, upon written application, without examination. Operators must apply 60 days prior to expiration date of certificate.

6.3 Certified operators who desire to become certified in a higher grade must satisfactorily complete the requirements before a new certificate is issued.

6.4 No certificate will be valid if obtained through fraud, deceit or the submission of materially inaccurate data of qualification.

6.5 Certificates may be issued without examination in a comparable classification to any person who holds a certificate in any state, territory or possession of the United States or any country provided the requirements for certification of operators under which the person's certificate was issued do not conflict with the provisions of Article 9 of Title 25, C.R.S. 1973, as amended, and are of a standard not lower than that specified by regulations adopted under the said Chapter and providing further that reciprocal privileges are granted to certified operators of this state.

6.6 Restricted certificates of proper classification shall be issued without examination to applicants making application and who have been the operators of any facilities covered under this article on or before July 1, 1973. A certificate so issued shall be valid only for that particular treatment plant or system and for the classification determined by the Board on the basis of experience and education of the operator, and shall remain in effect unless revoked by the Board pursuant to the provisions of C.R.S, 1973, 24-4-104-105.

7. Revocation of Certificates.

7.1 The Board may revoke the certificate of an operator, as provided for in C.R.S. 1973, 25-9-107(6), following a hearing before the Board conducted pursuant to article 4 of title 24, C.R.S. 1973. The basis for revocation shall be the failure of the operator to display in practice the experience and qualifications required for certification by C.R.S. 1973, 25-9-105 and 25-9-106.

8. Classification of Water Treatment Plants.

8.1 Classification shall be in accordance with the following four classes except that the Board may make changes in classification in accordance with the needs created by particular complexities of any specific plant by reason of special features of design, or by reason of a source of supply which is particularly hazardous, or characteristics which make operation more difficult than normal, or a combination of such conditions.

8.1.1 CLASS A - All plants using filtration or chemical flocculation processes requiring chemical and bacteriological control of operation and designed to serve a population in excess of 15,000.

8.1.2 CLASS B - All plants using filtration or chemical flocculation processes requiring chemical and bacteriological control of operation and designed to serve between 2,000 and 15,000.

8.1.3 CLASS C

8.1.3.1 All plants using filtration or chemical flocculation processes requiring chemical and bacteriological control and designed to serve a population less than 2,000.

8.1.3.2 All plants using disinfection requiring bacteriological control of operation and designed to serve a population less than 15,000.

8.1.3.3 All other plants requiring chemical control of operation designed to serve a population in excess of 15,000.

8.1.4 CLASS D

8.1.4.1 All water systems not listed in other classes and designed to serve a population less than 15,000.

8.2 Classification of any water treatment plant may be changed at the discretion of the Board by reason of changes in any condition or circumstnaces on which the original classification was predicated. Due notice of any change shall be given to the owner of the treatment plant.

9. Classification of Wastewater Treatment Plants.

9.1 All wastewater treatment plants shall be classified in one of four classes. These classifications shall be made according to population served, type of works, character and volume of wastes to be treated, and the use and nature of the water resources receiving the plant effluent. Classifications shall be based on the population, or population equivalent which ever is larger, or for which the plant is designed except that plants may be classified in a group higher than indicated at the discretion of the Board by reason of the incorporation in the plant of special features of design or characteristics more difficult to operate than usual or by reason of a waste unusually difficult to treat, or by reason of conditions of flow or use of the receiving waters requiring an unusually high degree of plant operation control, or for combinations of such conditions or circumstances.

9.1.1

DESCRIPTION	POPULATION CLASS A	CLASS B	CLASS C	CLASS D
Chemical and/or Physical process providing a high degree of treatment, including tertiary treatment other than polishing ponds.	40,000 or more	40,000 or less	-	-
Activated sludge process or modification, other than extended aeration.	40,000 or more	40,000 or less	-	-
Extended aeration process.	40,000 or more	40,000 or less	10,000 or less	-
Trickling filter process	20,000 or more	10-20,000	10,000 or less	-
Waste Stabilization ponds, including plain	-	10,000 or more	5-10,000	5,000 or less

9.2 Classification of any wastewater treatment plant may be changed at the discretion of the Board by reason of changes in any condition or circumstances on which the original classification was predicated. Due notice of any change shall be given to the owner of the treatment plant.

9.3 Wastewater treatment plants dealing primarily with industrial wastes, as opposed to municipal wastes, are classified A. Such classification shall be reviewed by the Board upon application by the owner of such plant. The plant may be classified in a lower group upon a showing by clear and convincing evidence that effective supervision by an operator holding such lower classification corresponding to the plant classification will be sufficient to assure continuing compliance of the plant with all statutes, regulations, permit conditions, and other requirements of Articles 8 and 9 of Title 25, C.R.S. 1973.

10. Operator Qualifications and Classifications for Water Treatment Plants and Wastewater Treatment Plants.

10.1 Operators shall be examined by the Board as to education, experience, and knowledge as related to the classification of plants for which examined. Applicants must pass the required written examination.

10.2 In evaluating experience of operators the Board will be guided by the following:

10.2.1 Experience requiring some technical knowledge of the work and whether or not responsible charge of work was included. In large plants where responsibility is divided, supervisors of important divisions will be recognized as eligible for certification.

11. Supervision of Water or Wastewater Treatment Plants.

11.1 No owner of a water treatment plant or a wastewater treatment plant shall allow the plant to be operated without the supervision of a certified operator of classification equivalent to or higher than the classification of the plant.

11.2 Each plant shall have a supervising operator certified as shown in the following table:

Plant Classification	Supervising Operator Classification
A	A
B	A or B
C	A, B or C
D	A, B, C or D

11.3

11.3.1 A supervising operator shall supervise only one water or wastewater treatment plant unless the Board has specifically issued a permit based on an application from the plant owners for the supervision of more than one plant by a particular supervisor.

11.3.2 Such permit shall be limited to a named supervising officer and to named plants.

11.3.3 In determining whether to approve such an application the Board shall take into consideration the complexity of each such plant, the distance between plants and other like factors, the past performance of each such plant and the past performance and the experience of the proposed supervising operator. Such application shall not be approved unless the applicant demonstrates by clear and convincing evidence that operation of the plants under the supervision of the operator and the quality of water supplied or effluent discharge will comply with all regulations, orders, statutes, and conditions of pertinent permits, applying to the plants.

11.3.4 The permit may contain such conditions as the Board determines desirable to insure proper operation and maintenance. It shall not be transferable and shall expire within a period of time not to exceed 5 years.

11.3.5 Application shall be made on the Board's form and shall be duly signed and verified.

11.3.6 The permit may be revoked for cause upon notice and opportunity for hearing and shall be void if obtained by fraud or deceit.

12. Violation - Penalty

12.1 It is unlawful for any person to represent himself as a certified water treatment plant operator of any class, or a certified wastewater treatment plant operator of any class without first being so certified by the Board and without being the holder of a current valid certificate issued by the Board. Any person violating the provisions of this portion of this article is guilty of a misdemeanor and, upon conviction thereof, shall be punished by a fine of not more than three hundred dollars.

12.2 It is unlawful for any owner of a water treatment plant or a wastewater treatment plant in the state of Colorado to allow the plant to be operated without the supervision of a certified operator of the classification required by the Board for the specific plant. Any owner violating the provisions of this portion of this article is guilty of a misdemeanor and, upon conviction thereof, shall be punished by a fine of not more than three hundred dollars for each violation. Each day of violation constitutes a separate offense.