# WASTEWATER FACILITIES REPORT

CITY OF CAVE JUNCTION
WASTEWATER TREATMENT REPORT

APRIL, 1994

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# CITY OF CAVE JUNCTION
# WASTEWATER FACILITIES REPORT

## Executive Summary and Recommendations

This chapter provides an executive summary of findings and recommendations of this Report. The purpose of the Wastewater Facilities Report is to provide a planning document for the City which can be utilized for wastewater treatment needs in the community for the next 20 years.

*1.* The existing wastewater treatment facility of the City of Cave Junction is unable to meet existing hydraulic and biological loading demands.

*2.* Demand for connection to wastewater facilities within the City of Cave Junction is very high and will further impact the demand on the existing facility.

*3.* A preliminary analysis of the wastewater conveyance system resulted in the recommendation for improvements to provide additional capacity. **Priority I** collection system improvement costs are estimated to be $199,251 and will provide adequate capacity for an estimated year 2002 population of 2706 persons. **Priority II** collection system improvement costs are estimated to be $195,518 for an estimated year 2014 population of 4737 persons.

*4.* A review of the I/I Analysis & Study by T. Flatebo & Associates, Inc. dated January 15, 1994 revealed that approximately $93,665 in additional collection system improvements is needed to reduce existing infiltration by approximately 20 to 30 percent.

*5.* Four treatment alternates were analyzed for potential solutions to the treatment plant inadequacies. Of these four, only two: conventional activated sludge treatment and a continuous-flow sequencing batch reactor, were selected for cost analysis after initial screening. Treatment plant improvements were separated into two parts in order to provide for maximum grant participation and to provide a reasonable methodology to support the implementation of Systems Development Charges, which are proposed to provide capital to complete the second phase of these improvements without the need for costly loan financing. **Priority I** treatment plant improvement costs are estimated to be $2,232,240 for estimated year 2002 flows and loads, and **Priority II** treatment plant improvement costs are estimated to be $1,486,850 for estimated year 2014 flows and loads.

*6.* Existing and proposed biosolids management needs were analyzed and the requirements of EPA part 503 regulations were outlined for future biosolids activities. The City currently has an approved biosolids management plan, and a new plan will need to be developed and approved to provide management of biosolids generated by the proposed new treatment facility.

*7.* Systems Development Charge methodology was provided to enable the City of Cave Junction to implement the payment of systems development charges for new sewer connections. Maximum SDC's were established at $1,728 in addition to the actual costs of labor and materials to make the physical connection.

*8.* Priority I and Priority II financing options were reviewed to provide guidance to the City in the pursuit of federal grants and loans. A combination FmHA grant/loan and CDBG grant is recommended to provide funds for Priority I improvements. This will also require an increase in monthly user fees to approximately **$21.00** per month. Priority II improvements are to be constructed with the use of systems development charges.

# CITY OF CAVE JUNCTION
# WASTEWATER FACILITY REPORT

## CHAPTER 1

## INTRODUCTION

### 1.1 AUTHORIZATION

In January 1994, the City Council of the City of Cave Junction selected BST Associates, Inc. to develop a Wastewater Facility Report in conformance with the requirements of the Oregon Economic Development Department.

### 1.2 BACKGROUND

The City of Cave Junction is a Southwestern Oregon Community located along Oregon State Highway 199 approximately 28 miles southwest of Grants Pass, Oregon, and approximately 57 miles northeast of Crescent City, California. The current population of Cave Junction is 1200 persons.

Its location in the Illinois Valley provides an opportunity to be of significant commercial benefit to the neighboring communities of Kerby, Takilma, Bridgeview Holland and O'Brien, as well as providing support for the tourist activities associates with the Oregon Caves National Monument.

Numerous leisure-time attractions are located within a short distance from Cave Junction. The Illinois River is located directly west of town and provides numerous opportunities for fishing, rafting, picnicking and camping. The Siskiyou National Forest rises from the valley floor at an elevation of approximately 1350 feet directly to the west of the City to an elevation of approximately 4600 feet and provides facilities for camping and for hiking through the Kalmiopsis Wilderness area. The Oregon Caves National Monument is located approximately 18 miles to the east within the Siskiyou National Forest. The Smith River is located to the southwest of Cave Junction along Highway 199.

The climate in Cave Junction ranges from rain and periodic snow during the winter, with winter low temperatures as low as 10 degrees fahrenheit, to warm, sunny days in the summer, with temperatures as high as 100 degrees fahrenheit. The warm, sunny summers attract a significant tourist crowd as well as an influx of retirees from California and other states.

Rainfall in the Cave Junction area averages approximately 60 inches per year.

## 1.3 PLANNING SCOPE

The objective of this Report is to establish a long-range Wastewater Treatment Plan for the present and future needs of the City of Cave Junction and provide a discussion of other aspects of the City's wastewater system such that an expansion of this Report into a Comprehensive Wastewater Facility Plan can follow the outline and introductory discussion presented here.

Current demand for the expansion of existing sewer facilities, as well as the possibility that the adjacent community of Kerby may be required to connect to the Cave Junction wastewater system due to septic system/water well conflicts present the City of Cave Junction with the potential for an immediate doubling of existing wastewater flows. With the existing treatment plant running at capacity and the periodic bypassing of sometimes 5 times the design capacity of the existing plant the City is in serious need of expanding its wastewater treatment capacity.

An outline of the basic considerations of this Report is presented as follows:

- Determine the physical and socioeconomic characteristics of Cave Junction, and project the future population and the limits of the wastewater service area.

- Provide information on wastewater collection and treatment criteria, regulatory authorities, design criteria, and a basis of cost estimates.

- A brief examination of the existing wastewater collection system.

- Determine existing wastewater characteristics and project future flows and loadings which must be handled by the wastewater facilities.

- Review recent information on I/I and estimate the amount of I/I which can be removed from the system. Adjust flow projections for anticipated I/I removal. A Report on I/I was recently completed for the City of Cave Junction by others.

- Meet with DEQ to update the range and most stringent treatment criteria that could be applied to the treatment facility.

- Develop preliminary alternatives to improve the wastewater collection and treatment facilities.

- Determine improvements which are necessary to provide capacity for anticipated flows, meet treatment criteria and potential for a cost effective energy saving facility. The evaluation of alternatives shall include an assessment of environmental impacts, public concerns, system reliability, flexibility, ease of operation, and cost effectiveness, including energy measures.

- Develop alternatives for financing the necessary modifications to the wastewater system, and determine the range of local share funding which may be required.

## 1.4 PLANNING AREA

The planning area contains the City of Cave Junction and adjacent areas as presented on Figure 1. It is located at the intersection of Oregon State Highways 199 and 46 in Josephine County, Oregon.

The planning area includes the City Limits and Urban Growth Boundaries of Cave Junction as well as the town of Kerby which lies approximately 1.5 miles to the northeast along Highway 199. The Kerby area is included for planning purposes only, and not as a suggested annexation into the City Limits of the City of Cave Junction. If served, the sewer system in the town of Kerby would most likely represent a service customer of the City of Cave Junction.

## 1.5 PREVIOUS STUDIES AND REPORTS

Previous studies and reports which discuss the City of Cave Junction wastewater system, and which have been of significant value in the development of the current Report are as follows:

City of Cave Junction Comprehensive Plan:
Kelly & Rich, with Mary C. Hudson, Planning Assistant, November, 1984

Josephine County Areawide Water and Sewer Plan:
Stevens, Thompson & Runyan, July, 1972

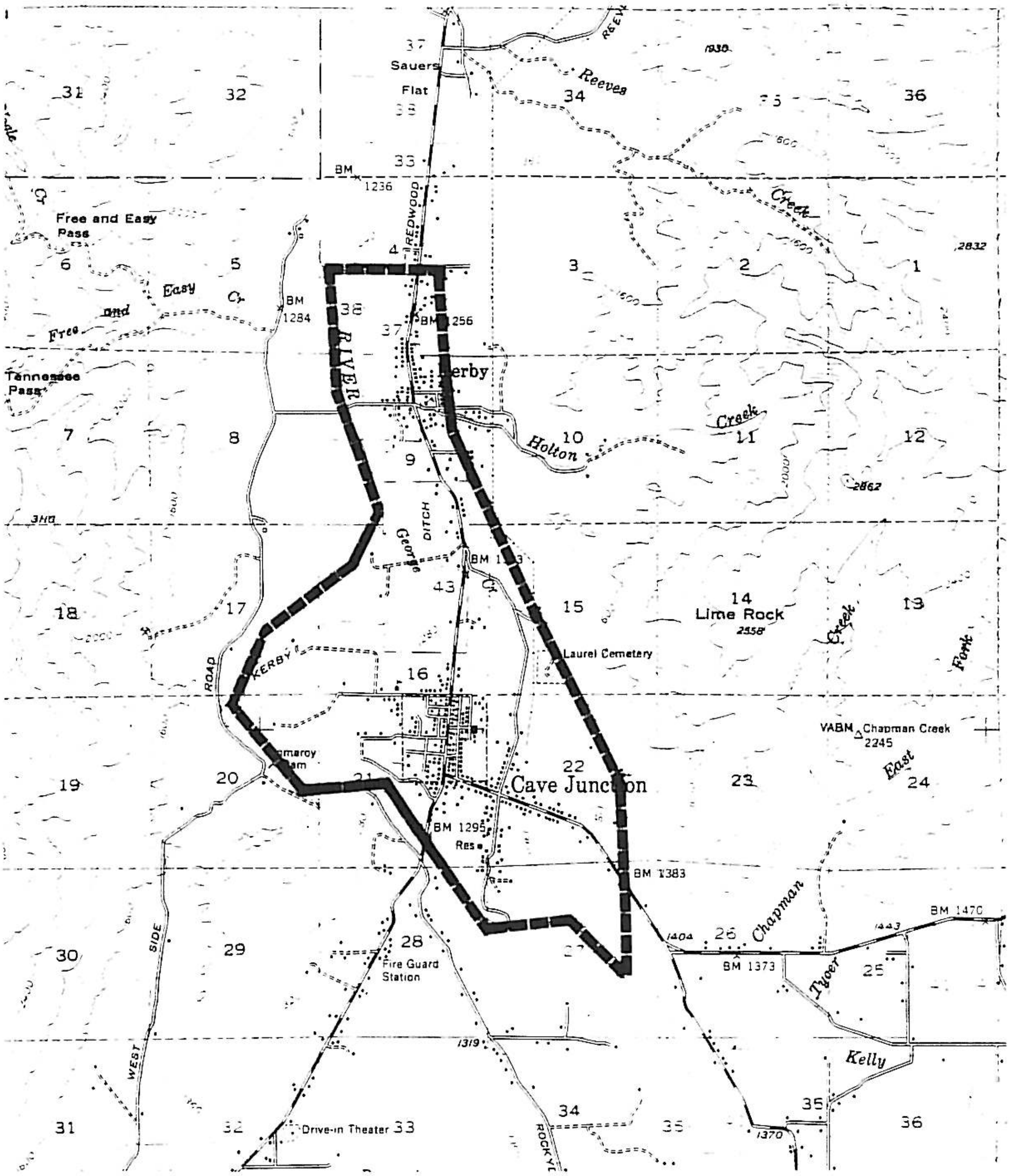
Facilities Plan, Municipal Waste Treatment Works:
T. Flatebo & Assoc., April, 1976

Report on Sewer Extension North Cave Junction:
T. Flatebo & Assoc., May, 1991

I/I Analysis & Study of Municipal Sewer System

T. Flatebo & Assoc., January, 1994

**FIGURE 1**


Sauers
Flat
Reeves
Creek
Free and Easy
Pass
Easy
Cr.
Free
and
Tennessee
Pass
BM
1236
BM
1284
BM 1256
REDWOOD
RIVER
Kerby
Holton
Creek
DITCH
George
Lime Rock
Creek
Fork
Laurel Cemetery
KERBY
ROAD
Cave Junction
VABM Chapman Creek
2245
East
BM 1383
Chapman
BM 1373
Tycer
Kelly
BM 1470
Fire Guard
Station
WEST
SIDE
Drive-in Theater 33
ROCKY

## 1.6 ORGANIZATION

The overall structure of this Report follows the flow of wastewater from customer to outfall. Separate chapters have been written to evaluate each of the following system components:

- Collection System
- Treatment Plant
- Effluent Discharge

Tables and figures in this Report are numbered consecutively within each chapter, and they generally appear in the text of the report on the page or pages following the first reference.

## 1.7 ACKNOWLEDGEMENTS

Preparation of this Report required the assistance of City Staff, and Cave Junction City Council members for compiling data and history on the Cave Junction Wastewater System, and in the development of information and data needed in the analysis of the various funding options. The courtesy, assistance and cooperation of J.R. (Sully) Sullivan, Mayor; Tim Stetz, Public Works Director; Jim Polk, City Recorder; and other City Staff representatives have been sincerely appreciated. We particularly wish to acknowledge the personal experience, assistance and background information provided by Charles Hensley, from the Oregon Department of Environmental Quality.

# CHAPTER 2

## STUDY AREA CHARACTERISTICS

### 2.1 STUDY AREA

The City of Cave Junction is an inland community located in Southwest Oregon in the Illinois Valley on Highway 199 between Grants Pass, Oregon and Crescent City, California. The study area for this Report encompasses the City Limits and Urban Growth Area (UGA) of Cave Junction as well as a portion of the town of Kerby. The planning process for this Report emphasizes developed areas within the UGA and portions of the Town of Kerby.

Kerby, an unincorporated area approximately 1.5 miles north from Cave Junction is under consideration in this Report because of the possibility that this area may request or may be required to connect to the City's wastewater system within this planning period. Existing conditions which warrant discussion of including Kerby in the Cave Junction wastewater system expansion are as follows:

1. There have been reports of illnesses in Kerby which may be waterborne.
2. The current drinking water sources for Kerby are private wells. Many of these wells are reported to be shallow and run dry in the summer.
3. The current wastewater disposal system for Kerby consists of individual septic systems.

The Josephine County Health Department is scheduling a survey of the residents of Kerby to help ascertain the source of the illnesses. It is suspected that the shallow wells may be polluted by their proximity to septic systems. Shallow wells which run dry in the summer typically show signs of significant surface water influence. In a similar manner, they also tend to show signs of influence from adjacent septic systems.

### 2.2 PHYSICAL ENVIRONMENT

Aspects of the physical environment for the project which might be applicable to this Report are outlined in this section. Items under consideration include: public health hazards, water sources, climate, air quality, energy consumption, and environmentally sensitive areas. This information will be utilized while performing the environmental assessment of various alternatives, which will be developed in later chapters, for improving the City of Cave Junction wastewater system.

## Public Health Hazards

Development within the city limits of Cave Junction is connected to the city's wastewater system and water system. Development in the outside the city limits is currently served by individual septic systems and to private water wells. As of this date there are not identified public health hazards associated with wastewater disposal within the planning area. Concerns over the potential for wastewater or other contamination of the private wells in Kerby will be evaluated by the Josephine County Health Department in the near future.

## Climate

The average annual temperature in Cave Junction is 53 degrees Fahrenheit, with an average August temperature of 69 degrees Fahrenheit.

## Precipitation

Nearly all precipitation in the Cave Junction area occurs as rainfall, although for the past few years there has been measurable snowfall. The winter climate is moist due to the frequency of rainfall, and the summers tend to be dry and warm.

According to the National Weather Service, the average annual rainfall for the Cave Junction area is 59.6 inches, which falls primarily in winter. For the past two years however, the aberrant meteorology has resulted in significant shifts in the seasonal timing of rainfall.

## Environmentally Sensitive Areas

### *Visual Resources*

From their location in the Illinois Valley, residents of and visitors to the study area enjoy views of the surrounding hills and mountains.

### *Habitat Areas*

The three major habitats in the area include forested uplands, river waterway areas and valley lowlands. The cobbled soils of these lowlands provide an excellent habitat for the Del Norte Salamander, and wetland and inundated areas within the area provide an appropriate location for the Yellowleg Frog. Although a formal herpetological evaluation of the study area was not conducted, these species were identified as the most likely to be found.

The Illinois River provides support for salmonoid fish such as the Coho Salmon or Steelhead.

Current efforts to establish minimum stream flows by the Department of Fish and Wildlife center around these two species, and can be expected to have a substantial affect on the potential for stream flow impacts.

*Endangered Species Act*

Although there are no identified endangered species within the study area, certain sensitive plants are known to exist in the area and can be expected to impact the development of sewer main extensions. The proposed treatment plant expansion project will not threaten or impact any species protected under the Endangered Species Act.

*Wild and Scenic River System*

There are no rivers designated as wild and scenic within the study area. This stage of the Illinois River is above the level established for the System.

**Air Quality**

The study area is in an area designated by the Oregon Department of Environmental quality as an Attainment area. There are no existing special requirements or restrictions due to air quality problems.

**Energy Production and Consumption**

No energy resources have been identified in the study area. Energy consumption is not expected to increase substantially with the implementation of increased wastewater treatment capacity and quality improvements recommended by this Report.

## 2.3 SOCIOECONOMIC ENVIRONMENT

Demands and the design capacity of the Cave Junction wastewater system are dependent upon population, land use patterns, and economic growth. Population projections based on historic data for the City are developed in this section. Land use and economic considerations are discussed later.

## Population

### *Historic Population*

According to Portland State University the 1970, 1980 and 1990 census estimated the City's year-round population at 415, 1023 and 1126 respectively. The January 1994 population is estimated at 1200 persons.

### *Historical Growth Rate*

This Report addresses the wastewater treatment needs of the community through the year 2014. It is extremely difficult to establish accurate population forecasts for several reasons, and the historic populations give evidence of this problem: The City's population more than doubled during the decade between 1970 and 1980, increased by only 10 percent between 1980 and 1990, and increased almost 6 percent in the first 3 years of the current decade. This latest increase is artificially low due to the hold the City has placed on sewer connections due to the lack of wastewater treatment capacity. The existing backlog for sewer connections including those which will result from pending land development projects is estimated at 823, which represents approximately 1893 persons.

### *Projected Annual Growth Rate*

Projected annual growth rates are typically developed through an analysis of historical growth rates and extrapolating the basic logic determined from the analysis. In the case of the Cave Junction study area, however, there is a lack of consistent basic logic in the historical annual growth rates on which to formulate a reasonable projection. The following facts are noted from a review of the historical data:

- Short-term annual growth rates varied considerably from period to period.
- Annual growth rates appear to be independent of circumstances within the direct control of the City of Cave Junction.
- The average annual growth rate from 1970 to 1994, which is 4.82 percent, appears to be a more reasonable measure of long-term growth than any other particular combination of short-term rates.

The potential for providing service to the core area of the town of Kerby provides an additional current equivalent population of approximately 200 persons. The introduction of sewer service to the Kerby area is likely to have a growth-inducing impact on the area unless access to this service is in some way restricted. As a result, we have estimated the projected annual growth rate for the Kerby area of 2 percent.

*Population Projection*

Rather than developing arduous and perhaps significantly inaccurate population forecasts we believe the approach which will provide the City of Cave Junction with the most useful long-range plan is to estimate the anticipated short-term growth based upon a combination of the backlog of anticipated connections and a reasonable growth rate. During a meeting with City representatives it was estimated that the developments currently in process will be built out through the next ten years, resulting in an estimated 2004 population of approximately 3100 persons. We have therefore allocated 25% of the estimated combined backlog for new sewer connections and those which will result from the subdivisions which are currently planned for the study area to the current population of 1200 and developed population forecasts every four years for the next 20 years using an annual growth rate of 5 percent, which is in line with long-term historic data. We used an annual growth rate of 2 percent for the anticipated service area of the town of Kerby. This will provide the City with Priority I improvements which meet the immediate needs to properly treat existing flows, capacity for the backlog of wastewater capacity demand, and provide the ability to handle a reasonable amount of anticipated intermediate-range growth. Long-range (Priority II) wastewater improvements can be made based upon population thresholds rather than an arbitrary growth rate, which could fluctuate dramatically over the next 10 years.

**CAVE JUNCTION WASTEWATER**
**SERVICE AREA POPULATION FORECASTS**

| Year | Cave Junction Population[1] | Town of Kerby[2] | Total |
|---|---|---|---|
| 1994 | 1673[3] | 200 | 1873 |
| 1998 | 2034 | 216 | 2250 |
| 2002 | 2472 | 234 | 2706 |
| 2006 | 3005 | 254 | 3259 |
| 2010 | 3652 | 275 | 3927 |
| 2014 | 4440 | 297 | 4737 |

1 Population forecasts generated using an annual growth rate of 5 percent.
2 Population forecasts generated using an annual growth rate of 2 percent.
3 Population includes 25% of estimated current wastewater connection demand.

## 2.4 LAND USE

Land use within the study area is categorized mainly into residential and commercial. For the purposes of this study these main categories affect the flow and quality of wastewater for the City of Cave Junction.

## 2.5 PUBLIC FACILITIES

Cave Junction's water system, street system and storm drainage system are the other relevant public facilities within the Study Area.

### Water System

Cave Junction obtains its water from the Illinois River and from water wells. The City operates a water filtration plant for water obtained from the Illinois River. Recent improvements to the water system include distribution line extensions and a new storage reservoir.

### Street System

The street system in Cave Junction is in average condition. Major arterials, collectors, and most local streets are paved. Fiscal constraints have historically oriented the city towards a policy of maintaining rather than improving its street system.

### Storm Drainage

Underground storm drainage has been constructed in some areas, but in most areas drainage is accomplished with ditches which drain to natural drainage points.

## 2.6 ECONOMICS

The median household income (MHI) in the study area is $12,923 based on the 1990 Census. Per capita costs for wastewater projects are frequently higher in small communities, partly because of the size and distribution of population. Smaller towns are less densely populated and consequently unable to take advantage of economics of scale associates with larger wastewater systems. EPA (CG-85) suggests that states establish a screening system to identify projects that have a high probability of encountering financial difficulties.

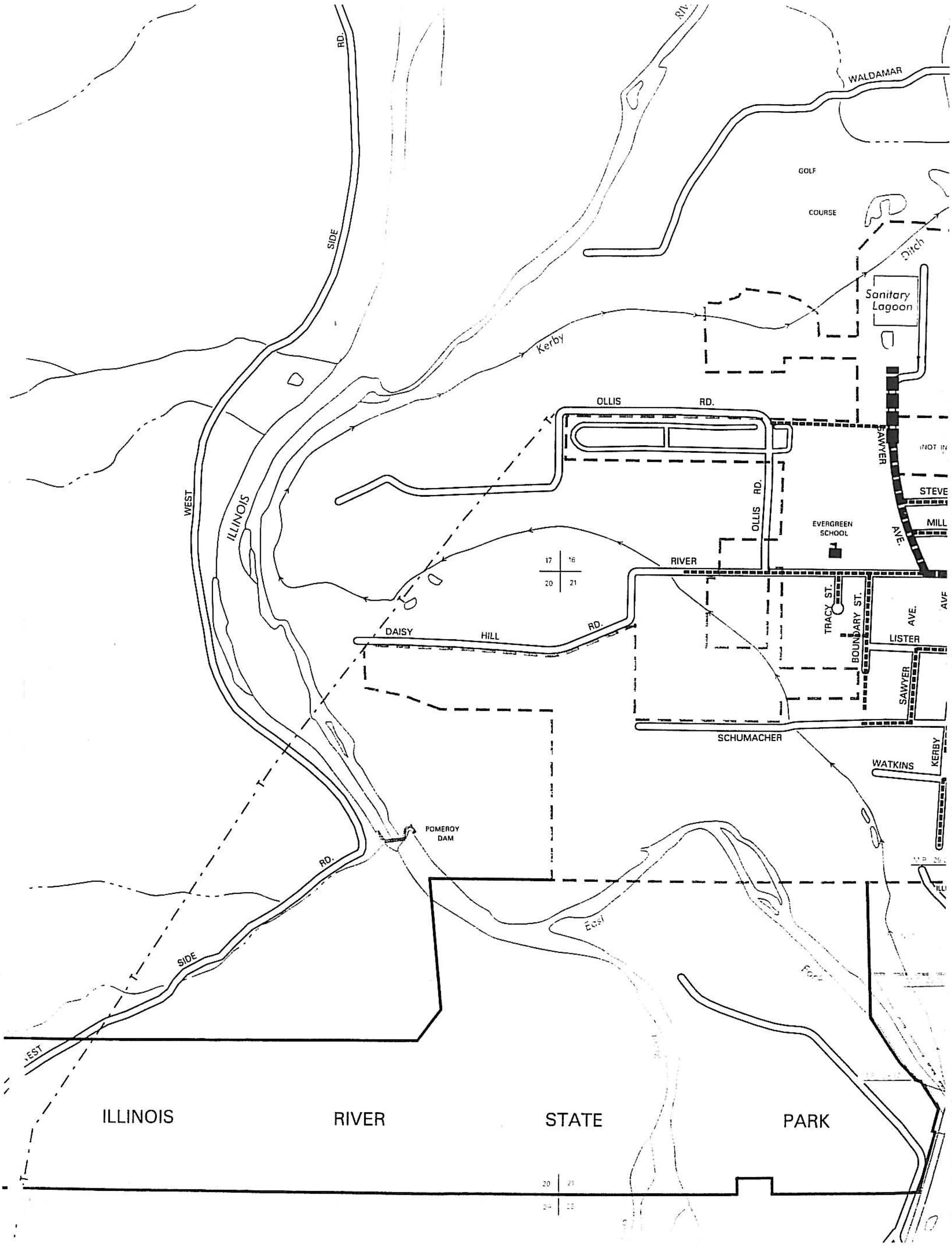
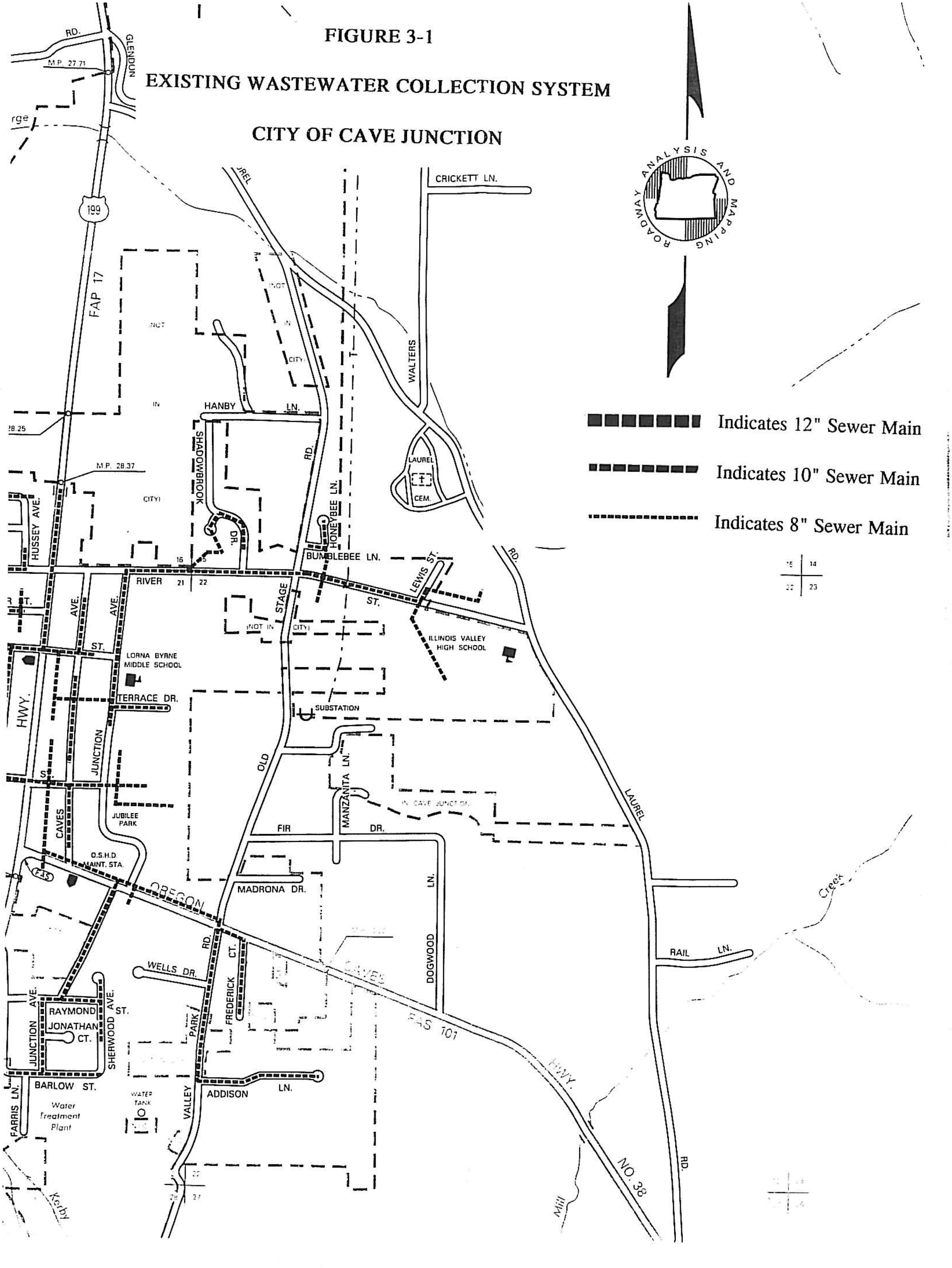

WEST SIDE RD.
ILLINOIS
WALDAMAR
GOLF
COURSE
Ditch
Sanitary Lagoon
Kerby
OLLIS RD.
SAWYER AVE.
NOT IN
STEVE
MILL
EVERGREEN SCHOOL
17
16
20
21
RIVER
TRACY ST.
BOUNDARY ST.
AVE.
LISTER
SAWYER
DAISY HILL RD.
SCHUMACHER
WATKINS
KERBY
POMEROY DAM
East
ILLINOIS RIVER STATE PARK
20
21
24
23

**FIGURE 3-1**

**EXISTING WASTEWATER COLLECTION SYSTEM**

**CITY OF CAVE JUNCTION**



# CHAPTER 3

## EXISTING SYSTEM

## 3.1 GENERAL

The City of Cave Junction operates and maintains a wastewater collection system, one wastewater pump station and a wastewater treatment plant (WWTP). A primary objective of this Report is to evaluate the alternatives for expanding the capacity of the City's wastewater treatment capabilities.

This chapter contains a description of the existing collection, treatment and effluent disposal system currently in operation. Information for developing these descriptions was obtained from City Staff, on-site field inspections, plant operating records, operation and maintenance manuals, previous engineering reports, and from original construction engineering documents.

## 3.2 COLLECTION SYSTEM

A map of the existing City of Cave Junction wastewater collection system is shown on Figure 3-1. The characteristics of the existing wastewater system were largely determined with the use of the following information.

### History

The original Cave Junction wastewater collection system was constructed in the 1963. This system included several sections of 8" ACP collector main, some 10" collector main and a treatment lagoon. The Cantex treatment Plant, control building, polishing lagoon and appurtenances were constructed in 1978. At that time a 12" ACP collector main was constructed parallel to the northerly section of the existing 10" main and connected to the treatment Plant.

Subsequent collection system improvements and extensions have incorporated the use of some ACP piping installed by City forces from inventory, but primarily PVC pipe.

### Existing Flows

We have reviewed treatment plant influent records for the past 36 months. Existing flows measured at the treatment plant over the past 12 months exceed those for the previous period and are as follows:

Dry Weather Flows:

| | |
|---|---|
| Average Daily Flow | 0.22 mgd |
| Peak Monthly Flow | 0.40 mgd |
| Peak Weekly Flow | 0.49 mgd |
| Peak Daily Flow | 0.72 mgd |

Wet Weather Flows:

| | |
|---|---|
| Average Daily Flow | 0.40 mgd |
| Peak Monthly Flow | 0.52 mgd |
| Peak Weekly Flow | 0.65 mgd |
| Peak Daily Flow | 1.10 mgd |

The recurrence probability for each category is as follows:

| Event | Probability of Recurrence |
|---|---|
| Dry Weather Flows | |
| Average Daily Flow | 0.5000 |
| Peak Monthly Flow | 0.1667 |
| Peak Weekly Flow | 0.0385 |
| Peak Daily Flow | 0.0055 |
| Wet Weather Flows | |
| Average Daily Flow | 0.2500 |
| Peak Monthly Flow | 0.0833 |
| Peak Weekly Flow | 0.0192 |
| Peak Daily Flow | 0.0027 |

## Capacity

The general capacity of the existing collection system is based primarily on the sizing and slope of collection piping. Figure 3-1 illustrates the existing wastewater collection system and pipe sizing.

We estimate that the existing collection system piping is capable of handling a total wastewater flow of approximately 411 gpm (.592 mgd) based upon a Mannings pipe roughness coefficient of 0.017 for the existing 10" ACP pipe flowing full at a minimum slope of 0.22%, but no more than 670 gpm (.959 mgd). The existing 12" AC collection main at the Wastewater Treatment Plant is estimated to be capable of handling a total wastewater flow of 696 gpm based upon a Mannings roughness coefficient of 0.014 at a slope of 0.22%.

It is apparent from these figures and the existing flow data that the larger collection piping within the existing collection system is at or above capacity. It is probable that the 10 inch collection piping flow impacts are partially mitigated by the ability of the existing manholes to help equalize the peak flows.

## Condition

The Cave Junction sewer collection system consists of approximately 36,000 lineal feet of 8" collection main, approximately 2,500 lineal feet of 10" collection main, and approximately 800 lineal feet of 12" collection main. All but a very minor portion of these mains consist of ACP pipe.

ACP sewer main is about as durable as concrete pipe in that it is susceptible to hydrogen sulfide decay and abrasive erosion. Its ability to remain impervious to infiltration depends upon its installation and the type of seals used between sections. Many wastewater systems throughout Oregon which incorporated the use of ACP sewer main have functioned adequately for 30 years or more.

The portion of the existing Cave Junction wastewater collection system consisting of ACP sewer main is in generally good condition. One exception is a portion of the section of 10" ACP sewer main along Sawyer Avenue between the Wastewater Treatment Plant and River Street. During the connection of a new residence along this section of line city staff discovered that the section of the existing pipe to which they were connecting had deteriorated significantly and was notably soft to the touch.

We are not aware of any significant problems associated with the sections of sewer main recently constructed using PVC pipe.

**Inflow/Infiltration**

Based on Needs Survey data from 270 Standard Metropolitan Statistical Area Cities, the national average for dry weather wastewater flow is 120 gallons per capita day (gpcd), including domestic wastewater, infiltration/inflow and nominal industrial and commercial flows. This standard is used to estimate excessive infiltration and inflow.

Average dry weather flows are defined for the purposes of this study as the average daily wastewater flow for the months of May through October. Average dry weather flow for 1993 (see above) was 220,000 gallons per day. The equivalent population for this period is estimated as follows:

| | |
|---|---|
| 1994 City Population | 1200 |
| Motels (2) (100 rooms) | 25 |
| Restaurants (10) | 60 |
| Laundromats (2) | 10 |
| County Building, Pool, Parks | 10 |
| TOTAL EQUIVALENT POPULATION | 1305 |
| | |
| Dry Weather Per Capita Flow: 220,000/1305= | 169 gpcd |

An I/I Analysis & Study has been prepared for the City of Cave Junction by T. Flatebo and Associates, Inc. dated January 15, 1994 which outlines specific recommendations to reduce excessive Inflow and Infiltration. Recommendations from the Study are incorporated in this Report in recommended improvements.

A review of historical influent flows at the treatment plant indicates a significant amount of Infiltration/Inflow. Infiltration is the flow of storm water runoff and groundwater into the wastewater collection system through permeable subsurface soils and leaky collection piping and manhole basins. Inflow is the direct flow of rainwater from storm water facilities into the wastewater system, and is characterized by a rapid increase in wastewater influent during a rain storm event.

Since groundwater levels in the Cave Junction area will vary with season, Infiltration will generally be higher during the rainy months of the year, particularly at times when the groundwater level is high.

Figure 3-2 illustrates the comparison between the recorded daily precipitation during March 1993, the recorded daily wastewater influent flows for March 1993, and the recorded daily wastewater influent flows for August 1992. March 1993 was chosen subjectively due to the variation in rainfall during the month and the high relative average wastewater influent flow. The August 1992 influent flows were included as a base wastewater flow. No precipitation occurred during August and the last 26 days of July, so infiltration is expected to be at a very low level during this period.

Figure 3-3 illustrates the same comparisons for December, 1992 (the rainiest month in the immediate past 5 years). The August 1992 wastewater flows are again included as a reference level.

From these figures it can be seen that as the groundwater level rises during accumulation of rainfall the amount of infiltration, as a percentage of total wastewater flows, also rises. The increases in wastewater flow which immediately follow rain events during December 1992 are small in comparison to similar increases in March, suggesting that as the groundwater level rises, each additional amount of rain results in a greater percentage increase in infiltration. It is also noted that the total monthly rainfall for December 1992 (18.54 Inches) was more than twice that for March 1993 (7.38 Inches).

We estimate that the Inflow contribution to total I/I is small. In Figure 3-3 it can be seen that after two significant storm events (December 10 and December 27) during which over 2 inches of rain fell in a 24 hour period, no significant increase in wastewater influent flow is seen, but in Figure 3-2 a reasonably significant increase in influent flow follows the storm events which occurred on March 3, March, March 16 and March 23. It is our opinion that these increases are actually due to rain-induced infiltration.

T. Flatebo, PE estimates that Infiltration contributes approximately 80 percent of total Infiltration/Inflow. We concur with this estimate.

## 3.3 TREATMENT PLANT

The existing wastewater treatment plant consists of a Cantex activated sludge package plant with a design capacity of .150 mgd and a hydraulic capacity of approximately .375 mgd. Plant flow records indicate that this plant has received flows over .60 mgd. Total Peak Daily Influent Flows

**FIGURE 3-2**

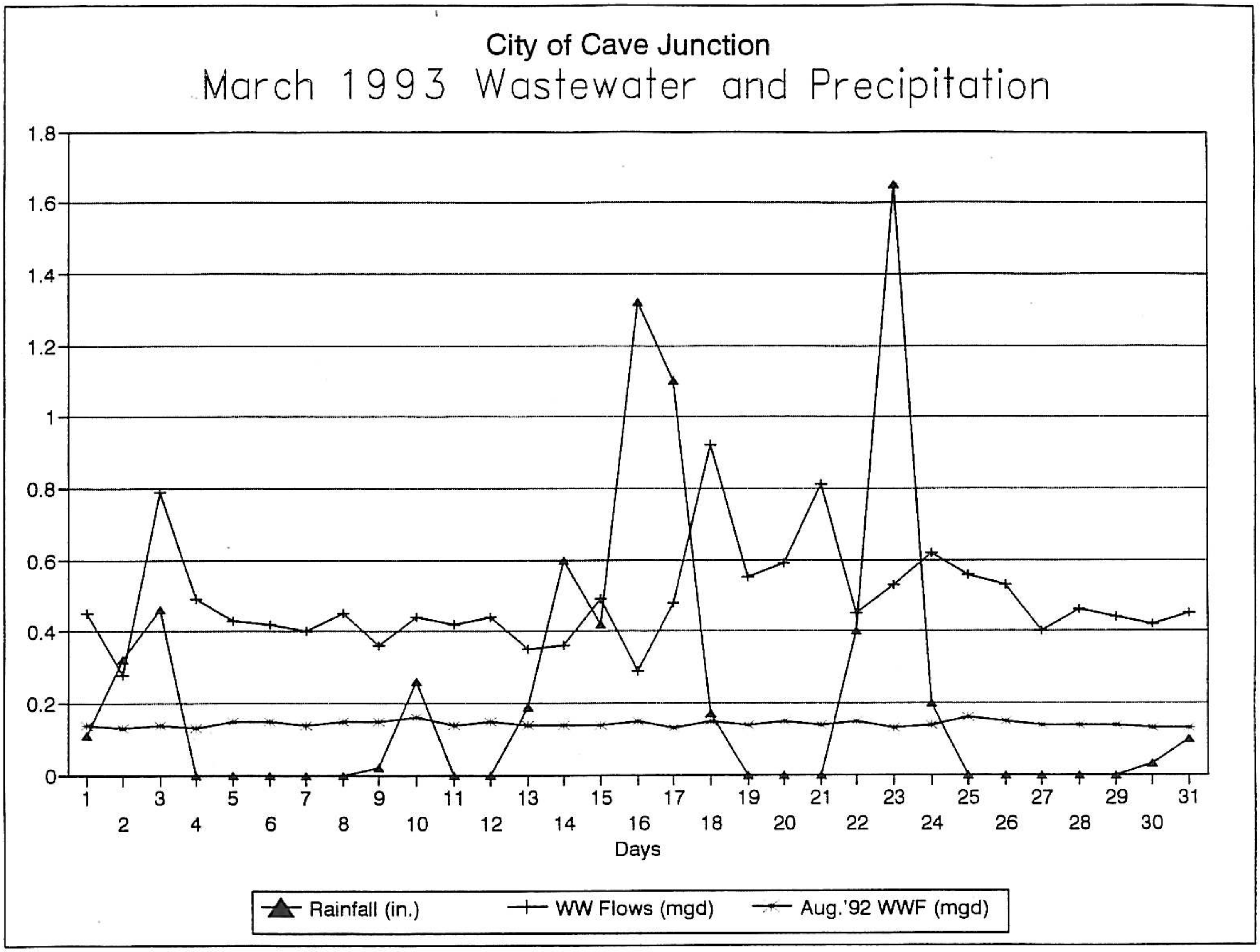
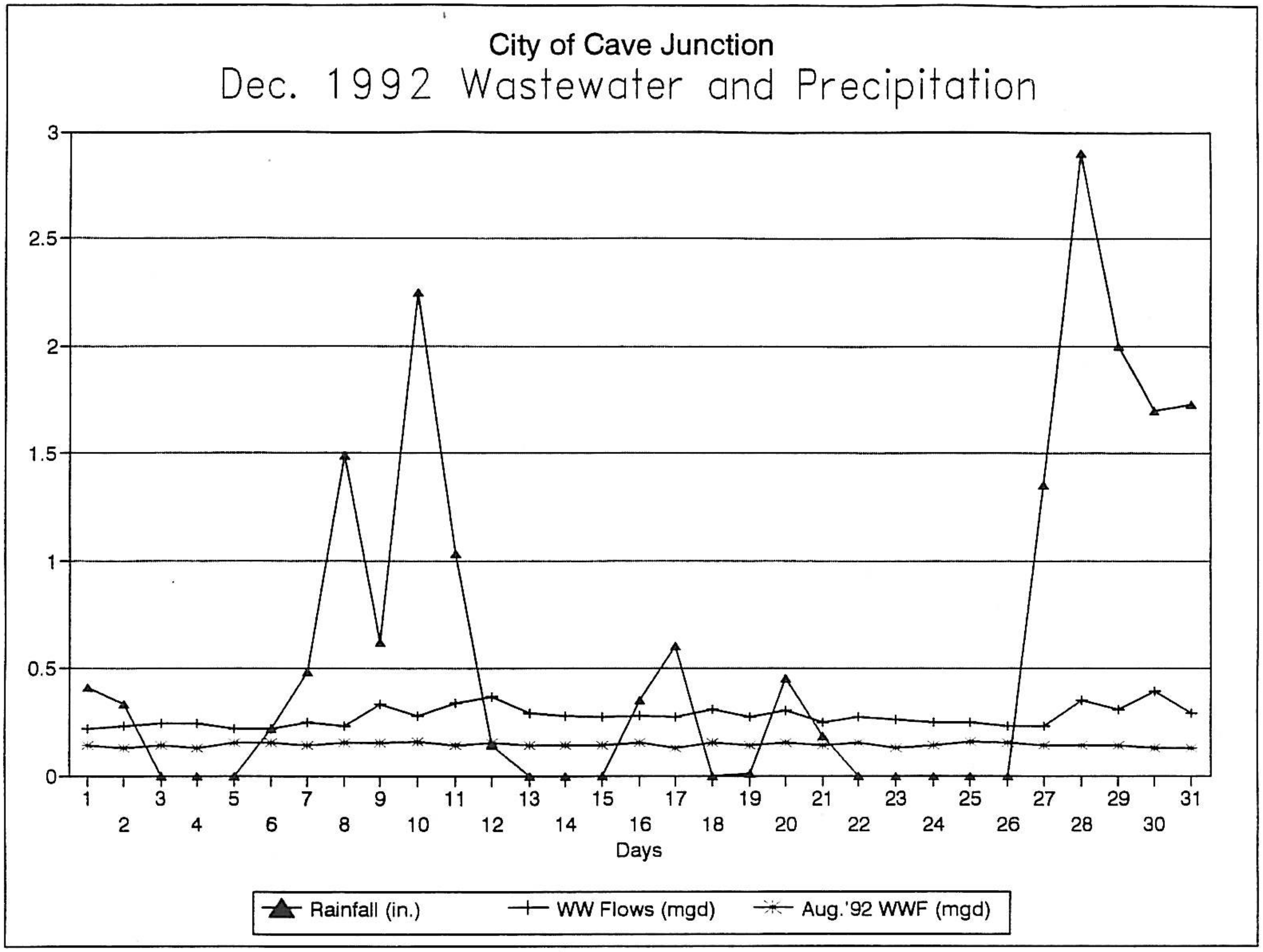

City of Cave Junction
March 1993 Wastewater and Precipitation
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Days
Rainfall (in.)
WW Flows (mgd)
Aug.'92 WWF (mgd)

**FIGURE 3-3**


City of Cave Junction
Dec. 1992 Wastewater and Precipitation
3
2.5
2
1.5
1
0.5
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Days
Rainfall (in.)
WW Flows (mgd)
Aug.'92 WWF (mgd)

have reached as high as 1.10 mgd, with over half of this flow bypassing the treatment plant and receiving facultative treatment and settlement in the lagoon. In 1993 the single cell of the lagoon was subdivided into three cells through the construction of two berm dikes.

When it was constructed in 1977, the existing treatment plant was constructed to implement improvement recommendations contained in the City of Cave Junction Municipal Waste Treatment Works Facilities Plan prepared by T. Flatebo & Assoc. in April, 1976. The Plan recommended dividing implementation of wastewater treatment improvements into two phases.

- Phase I included construction of improvements needed to handle a projected population of 1200 with a design flow of 125,000 gallons per day, including a 150,000 gpd activated sludge treatment plant with a stabilization lagoon and new chlorination facilities. The existing treatment lagoon was to remain as stand-by storage or equalization.

- Phase II included construction of a second 150,000 gpd treatment unit to run in parallel with the Phase I plant.

The anticipated average daily wastewater flow corresponding with the projected 1987 population of 1200 proved to be quite low, primarily due to I/I problems within the collection system. Current measurements estimate that average daily dry weather flows for the current population estimate of 1200 persons is 220,000 gpd which is 1.8 times the flows estimated at the time the 1976 Plan was drafted, and which were based upon average daily flows throughout the year.

It is obvious that the existing treatment plant is not capable of handling the existing wastewater flows, and the problem of hydraulic and process overloading will worsen with time.

## 3.4 LAGOONS

The original treatment lagoon was constructed in 1963 as a facultative treatment facility which met environmental constraints at the time. It is currently used as an overflow facultative treatment facility when flows exceed the capacity of the Cantex treatment plant.

## 3.5 EFFLUENT DISPOSAL

Effluent disposal consists of a combination of direct discharge of treated effluent into the Illinois River during the winter months and spray irrigation of an adjacent Golf Course during the summer months when direct river discharge is prohibited.

Direct discharge to the Illinois River is through outlet piping consisting of 12" ACP and concrete pipe with an estimated inside diameter of 14 inches. The outfall location is directly west of the north end of the facultative lagoon on the bank of the River. The outlet consists of a section of 12" CMP and is located such that during high river flows the outlet end is submerged, and during average and low river flow conditions it is out of the water.

The Golf Course irrigation system consists of permanent subsurface irrigation piping energized by a pumping facility and equalization pond. Water use records between the City of Cave Junction and the Golf Course are not consistent, but it appears that the Golf Course is currently capable of handling all the effluent processed by the Cave Junction wastewater treatment plant.

**Effluent Use Agreement**

The City of Cave Junction is currently under agreement with the Illinois Valley Golf Association, Inc., to provide 400,000 gallons of treated wastewater effluent for irrigation of their adjacent golf course during the summer months and at other times when the fairways and greens need irrigation. The Golf Course is able to use other sources of water, but the proximity of the treated effluent, the minimal price of the water, and the desire of the City to provide the effluent for spray irrigation make the relationship desirable for both parties. The current agreement began on May 1, 1979 and will expire on April 30, 1999.

The Oregon Department of Fish and Wildlife (ODFW) is currently establishing minimum river and stream flows throughout Oregon in an attempt to provide adequate stream flows for certain species of fish. It is possible that the ODFW will require that the effluent be returned to the Illinois River during the dry months in exchange for the City's withdrawal of water for its water system.

# CHAPTER 4

## WASTEWATER CHARACTERISTICS

### 4.1 WASTEWATER VOLUME

The design of wastewater collection, treatment and disposal facilities is primarily dependent on estimates of hydraulic and organic loading. Maximum Month Wet Weather Flow (MMWWF) usually determines the sizing and capacity of the major process units necessary to provide the desired degree of treatment, and Maximum Month Dry Weather Flow (MMDWF) typically determines the maximum organic loadings of the major process units. These flows and loadings vary from community to community and therefore must be based upon records for the particular community.

Unit design values based upon an evaluation of the daily operating records for the City of Cave Junction for the period from January 1, 1991 through December 31, 1993 will be developed, and will be used to estimate future hydraulic and organic loading in conjunction with population projections.

### 4.2 DRY-WEATHER FLOWS

DEQ recommends the MMDWF be computed utilizing a graph of monthly cumulative rainfall versus monthly plant flow, using data from the high groundwater season (January-May). Figure 4-1 represents a graph of this data for the years 1991-1993. A best-fit line was drawn through the data using the method of least squares. Normally 5 years of precipitation vs plant flow data would be shown, but plant flow data prior to 1991 would require a inordinate amount of recalculation to produce useful information from the raw data available. For the 5-year Dry Weather rainfall event the corresponding wastewater flow is 273,000 gpd. The graph contains substantial scatter.

Monthly flows and cumulative rainfall for May 1991-1993 are presented in Table 4-1. The average May wastewater flows measured during these three years is .283 mgd. The 5-year MMDWF computed using the methodology recommended by DEQ (273,000 gpd) is 4 percent lower than the average May flows and 31 percent less than the Maximum Monthly Dry Weather Flow, suggesting that the design MMDWF should be somewhat higher. Figure 4-2 suggests that the Maximum Monthly Dry Weather Flow typically occurs in May, and that the observed maximum monthly flow of .29 mgd measured in May 1991 represents a more reasonable MMDWF than the higher flows observed in May 1993. Therefore the observed maximum monthly dry weather flow of 0.29 mgd will be used for design purposes.

## FIGURE 4-1

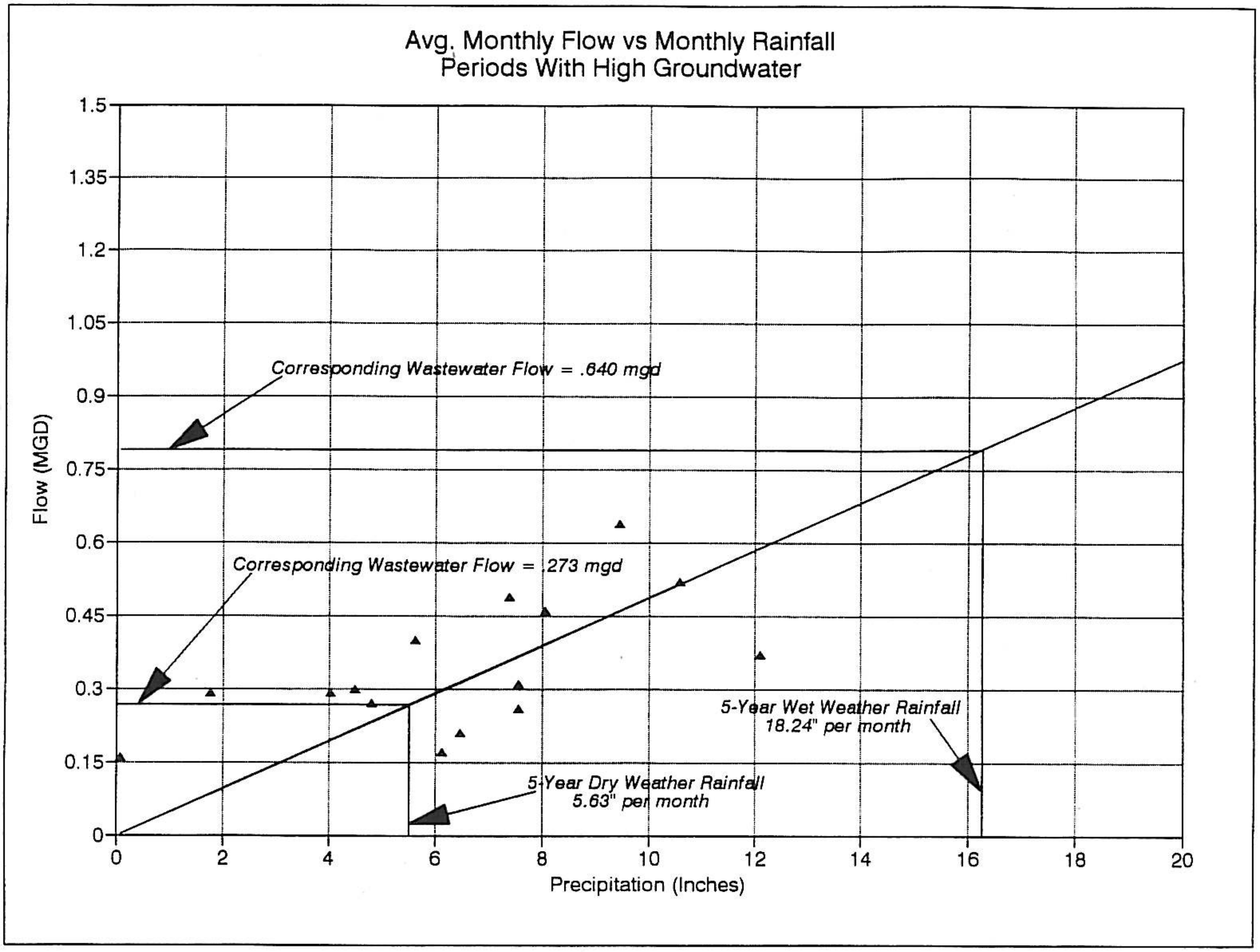
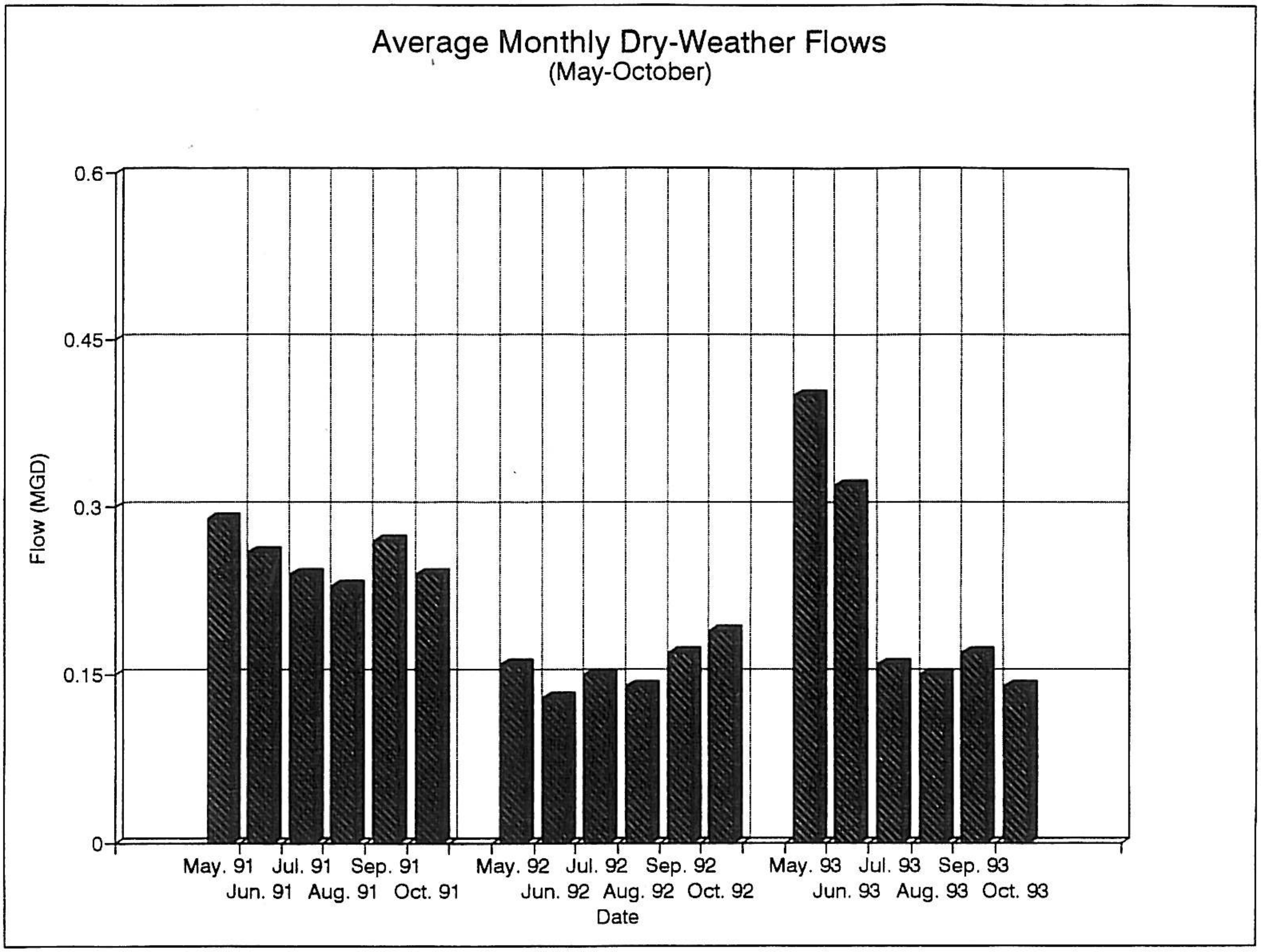

Avg. Monthly Flow vs Monthly Rainfall
Periods With High Groundwater
Flow (MGD)
Precipitation (Inches)
1.5
1.35
1.2
1.05
0.9
0.75
0.6
0.45
0.3
0.15
0
0
2
4
6
8
10
12
14
16
18
20
Corresponding Wastewater Flow = .640 mgd
Corresponding Wastewater Flow = .273 mgd
5-Year Wet Weather Rainfall
18.24" per month
5-Year Dry Weather Rainfall
5.63" per month

**FIGURE 4-2**


Average Monthly Dry-Weather Flows
(May-October)
Flow (MGD)
0.6
0.45
0.3
0.15
0
May. 91
Jun. 91
Jul. 91
Aug. 91
Sep. 91
Oct. 91
May. 92
Jun. 92
Jul. 92
Aug. 92
Sep. 92
Oct. 92
May. 93
Jun. 93
Jul. 93
Aug. 93
Sep. 93
Oct. 93
Date

## TABLE 4-1

## MAY PRECIPITATION, MONTHLY AND MAXIMUM MONTHLY DRY-WEATHER FLOWS

| Year | Total May Rainfall (Inches) | May Wastewater Flow (gpd) | Maximum Monthly Dry Weather Flow (gpd) |
|---|---|---|---|
| 1991 | 1.77 | 290000 | 290000 |
| 1992 | 0.08 | 160000 | 190000 |
| 1993 | 5.63 | 400000 | 400000 |
| Average | 2.49 | 283333 | 293333 |

### Peak Dry Weather Flows

Peak Dry-Weather Flows are lower than Peak Wet-Weather Flows and are of particular use for establishing the basis for design for biological loadings, which are highest during the dry-weather period.

Peak dry-weather flows are typically a function of rainfall. Over the past 5 years, however, the annual rainfall curve has been both low and unusually shaped. As can be seen from Figure 4-3, May precipitation for the past three years has been very inconsistent.

Our approach to establishing Peak Dry-Weather Flows was to review the various flow data over the dry months (May-October) for the past three years in order to establish reasonable and repeatable design flows.

### Peak Daily Dry-Weather Flow (PDDWF)

Figure 4-4 illustrates the Peak Daily Dry-Weather Flows by month for the period from May 1991 to October 1993.

It is obvious from a review of this data that the flows measured for May and June 1993 are extremely high. If these two months of data are ignored a reasonable measure for Peak Daily Dry-Weather Flow for the period is .40 mgd. This value was chosen as data for establishing peak dry-weather flows and will be used for design.

**FIGURE 4-3**

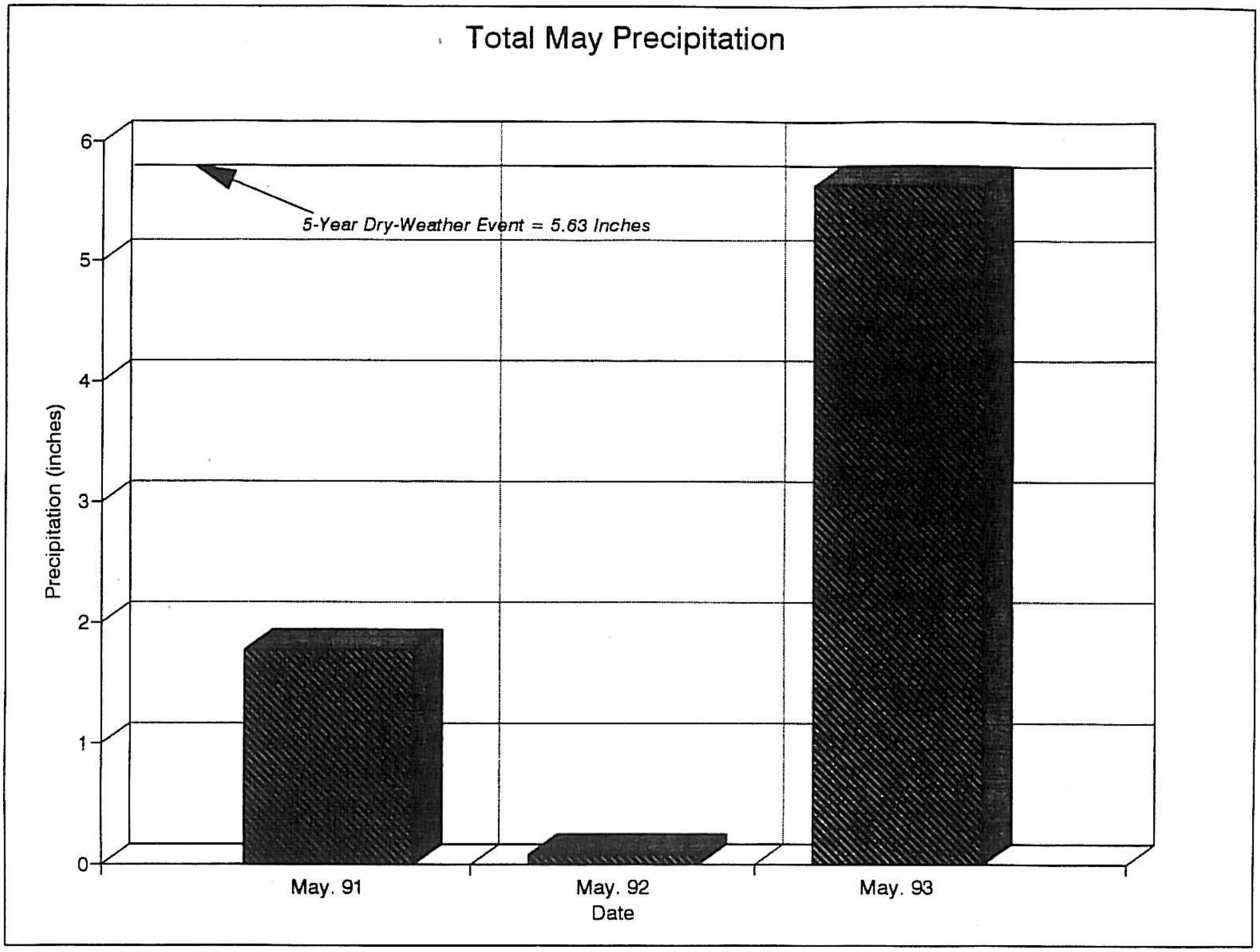
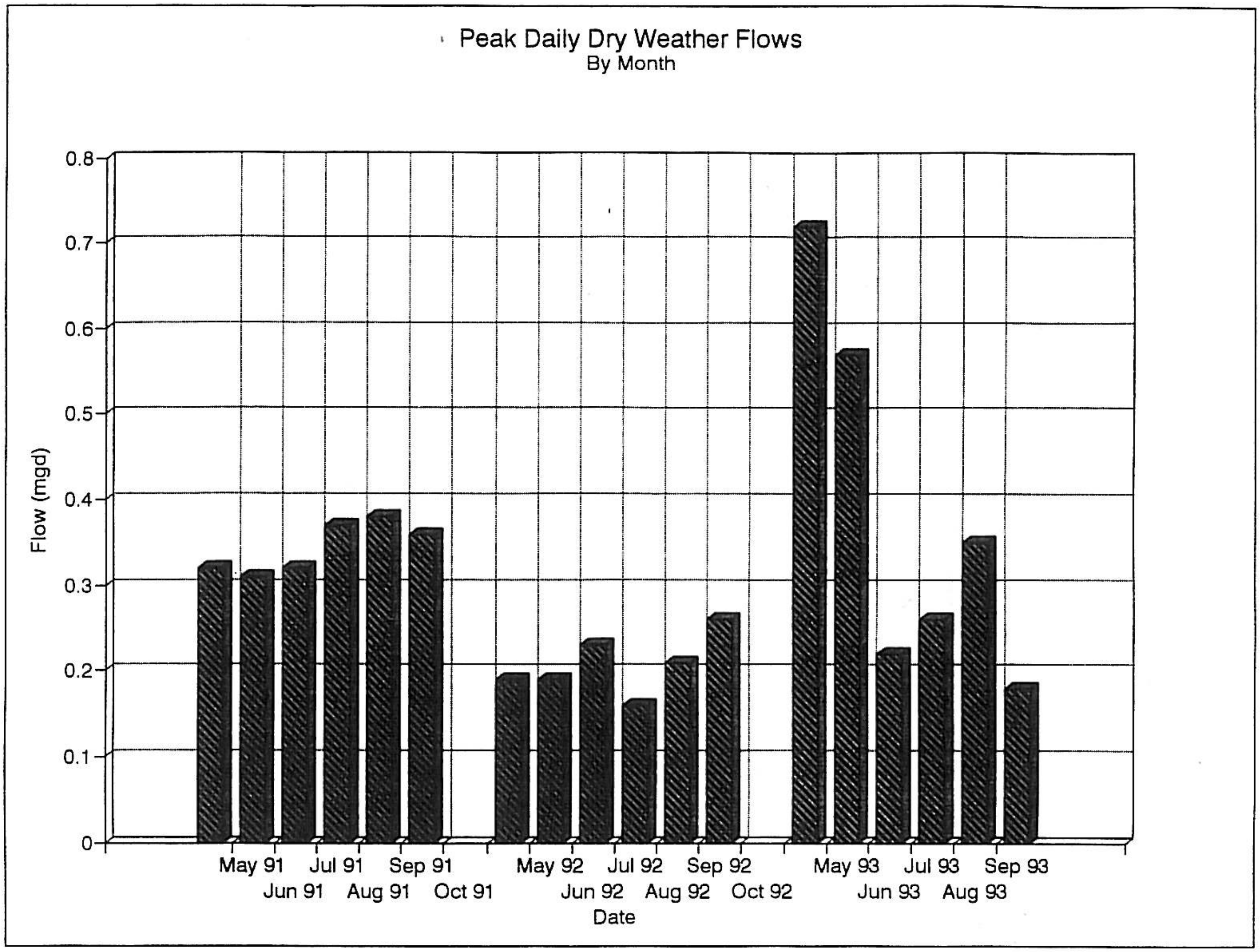

Total May Precipitation
Precipitation (inches)
6
5
4
3
2
1
0
5-Year Dry-Weather Event = 5.63 Inches
May. 91
May. 92
May. 93
Date

**FIGURE 4-4**


Peak Daily Dry Weather Flows
By Month
Flow (mgd)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
May 91
Jun 91
Jul 91
Aug 91
Sep 91
Oct 91
May 92
Jun 92
Jul 92
Aug 92
Sep 92
Oct 92
May 93
Jun 93
Jul 93
Aug 93
Sep 93
Date

**Peak Weekly Dry-Weather Flow (PWDWF)**

Figure 4-5 illustrates the Peak Weekly Dry-Weather Flows by month for the period from May 1991 to October 1993. The flow value typically chosen for design is the peak flow for the period for which data is available (typically 5 years).

In the current instance it is obvious by observation that the flow data for May and June 1993 are very inconsistent with the other data. We chose the May 1991 flow of ..301 mgd as representative data for Peak Weekly Dry-Weather Flow for the period to be used for design.

**Average Daily Dry-Weather Flow (ADWF)**

Average Daily Dry-Weather Flow is the average wastewater flow measured during the dry-weather period and represents the arithmetic mean of daily flows for the period May through October. Wastewater flows during this period of time are composed primarily of sanitary sewage and commercial waste.

During this time base infiltration is typically present and biological loads used to size biological treatment units are usually based on this flow rate.

For the City of Cave Junction this value was calculated as presented and is 0.21 mgd. The current NPDES permit for the City lists an ADWF of 0.15 mgd.

**Peak Hourly Dry-Weather Flow (PHDWF)**

Peak Hourly Dry-Weather flows are difficult to calculate directly for various reasons. A major problem in directly measuring these flows in the City of Cave Junction is the sizes of the existing collection system. We estimate, for instance, that the capacity of the existing 10" ACP collection main near the treatment plant is probably no greater than 670 gpm (or .959 mgd) flowing full, and yet plant records show daily flows near this amount. Since peak hourly flows tend to be significantly greater than measured daily flows it is probable that during these events the collection system is acting to equalize flows and deliver them to the treatment plant at less than peak quantity.

For the purposes of this study Peak Hourly Dry-Weather Flows were developed by extrapolating data for dry-weather flows along a best-fit line. Figure 4-6 illustrates this data and shows the resulting Peak Hourly Dry-Weather Flow of 0.45 mgd which will be used for design.

# FIGURE 4-5

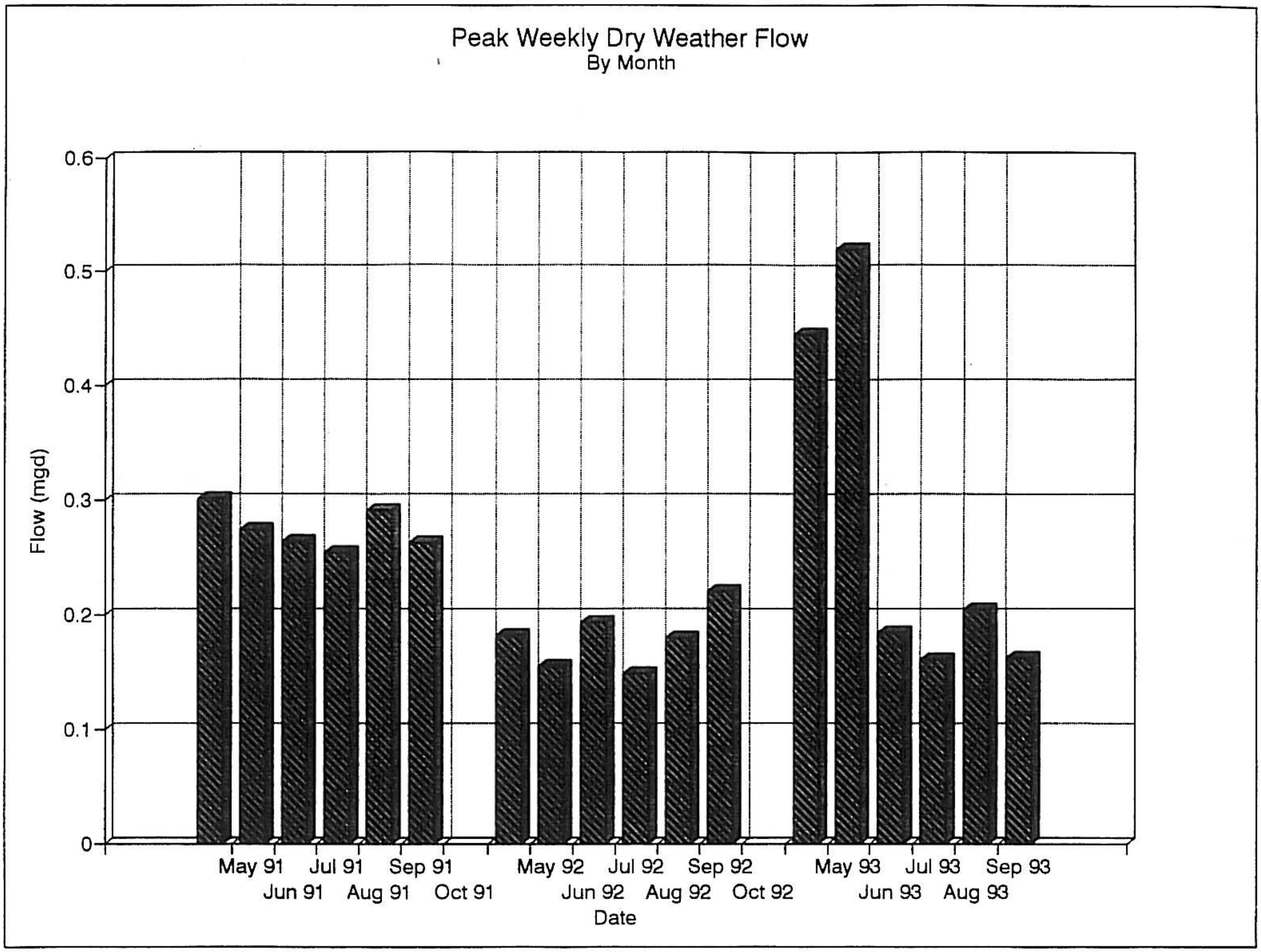
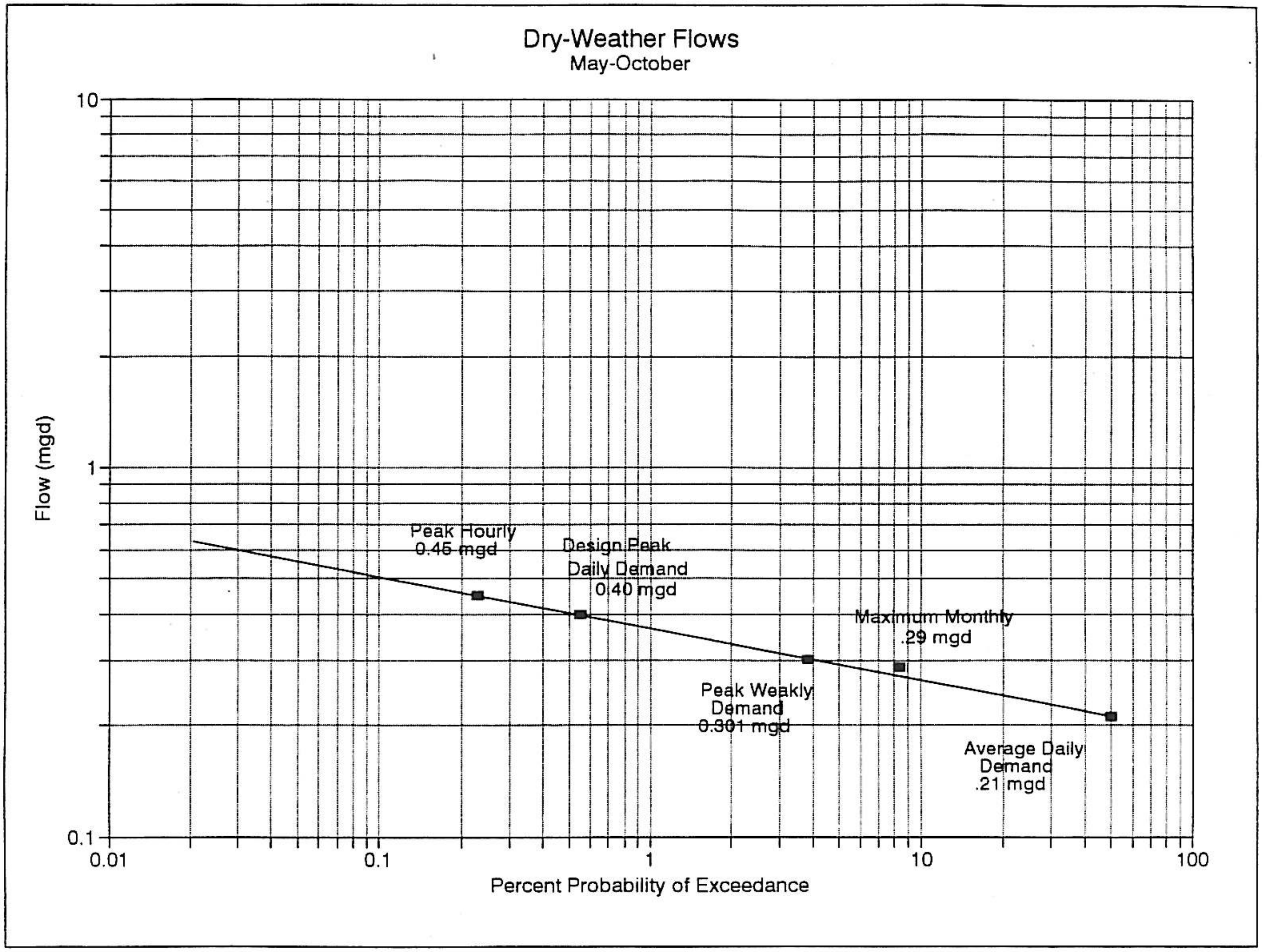

Peak Weekly Dry Weather Flow
By Month
Flow (mgd)
0.6
0.5
0.4
0.3
0.2
0.1
0
May 91
Jun 91
Jul 91
Aug 91
Sep 91
Oct 91
May 92
Jun 92
Jul 92
Aug 92
Sep 92
Oct 92
May 93
Jun 93
Jul 93
Aug 93
Sep 93
Date

**FIGURE 4-6**


Dry-Weather Flows
May-October
Flow (mgd)
10
1
0.1
0.01
0.1
1
10
100
Percent Probability of Exceedance
Peak Hourly
0.45 mgd
Design Peak
Daily Demand
0.40 mgd
Maximum Monthly
.29 mgd
Peak Weakly
Demand
0.301 mgd
Average Daily
Demand
.21 mgd

## 4.3 WET-WEATHER FLOWS

Wet-weather flows tend to dictate the hydraulic capacity of pumping facilities, piping and treatment unit sizes.

**Maximum Wet Weather Monthly Flow (MMWWF)**

The 5-year MMWWF is established by comparing Maximum Monthly flows with rainfall for a 5-year period. DEQ recommends that the MMWWF have at least a 5-year recurrence, which typically occurs in January.

Figure 4-7 graphically illustrates the rainfall in the Cave Junction area for the past 5 years. As discussed in Chapter 3 the high wastewater flows have not always coincided with high rainfall unless there is sufficient antecedent moisture in the soil in the form of groundwater. This can only occur after successive rains. It can be shown that the high monthly flow which occurred in January 1993 did not occur coincidentally with the unusually high rainfall during December 1992, but followed after an additional - but mild - rainstorm in early January. Furthermore, record flow data for January 1 through January 20 was missing due to a broken lagoon influent flow recorder and data which we include for that period of time was based upon flow data for the treatment plant and estimated based upon recorded lagoon effluent flows. Data presented in Figure 3-3 also shows that this substantial December rainfall there was no concomitant substantial rise in wastewater flows.

Figure 3-2 suggests that storms which occur later in the spring (March or April) have a substantially greater impact on wastewater flows, and flow data indicates a more predictable and reproducible set of wastewater flow events in April as illustrated in Figure 4-8. We have therefore chosen the April 1993 monthly flow of 0.52 mgd as the design event.

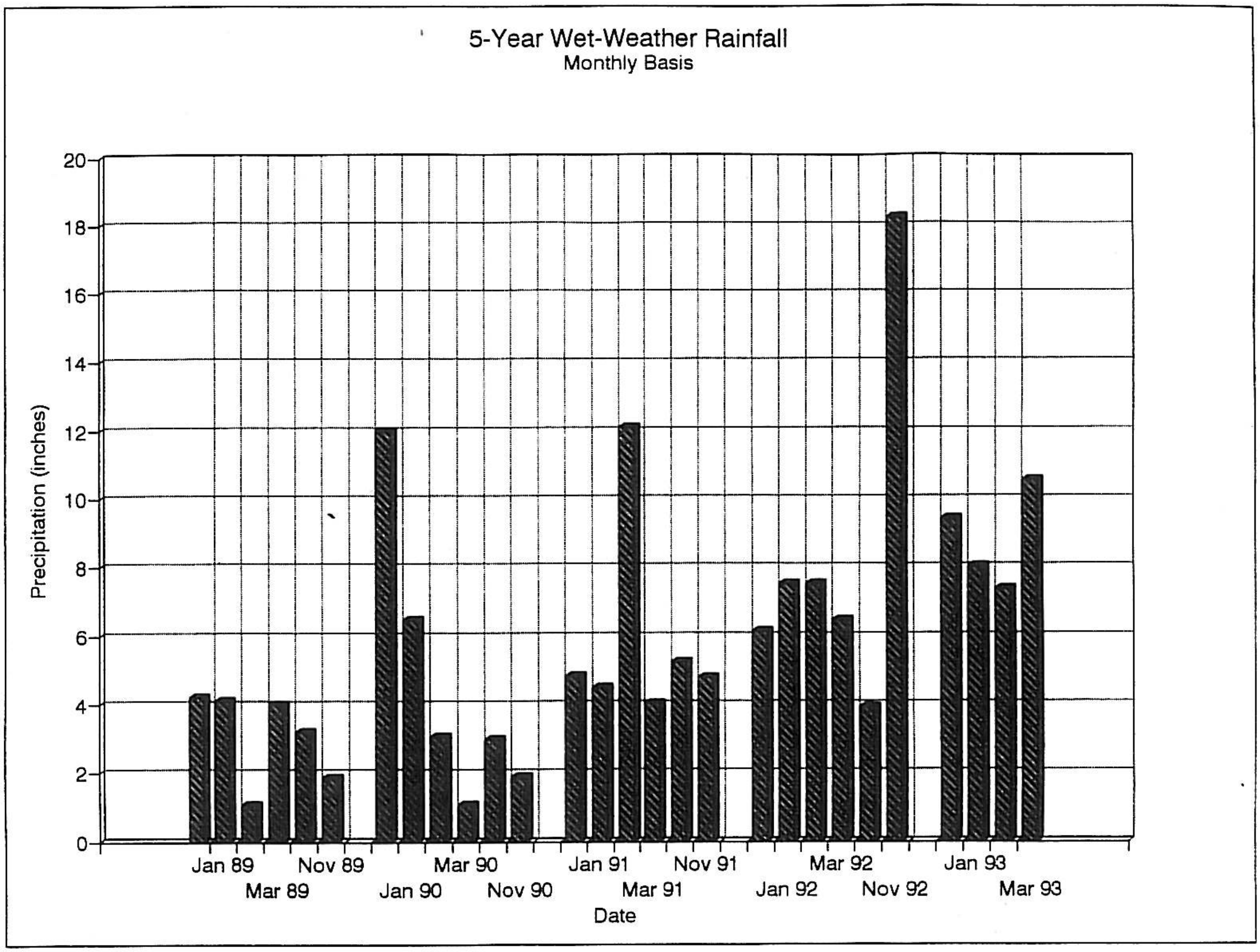
**Peak Daily Wet-Weather Flow (PDWWF)**

The Peak Daily Wet-Weather Flow observed for the City of Cave Junction occurred in January, 1993 as a result of the December storm mentioned above. For the reason that this storm event was unusual as shown in Figure 4-9 we have chosen the peak daily flow for March 1993 of 0.92 mgd as the design event.

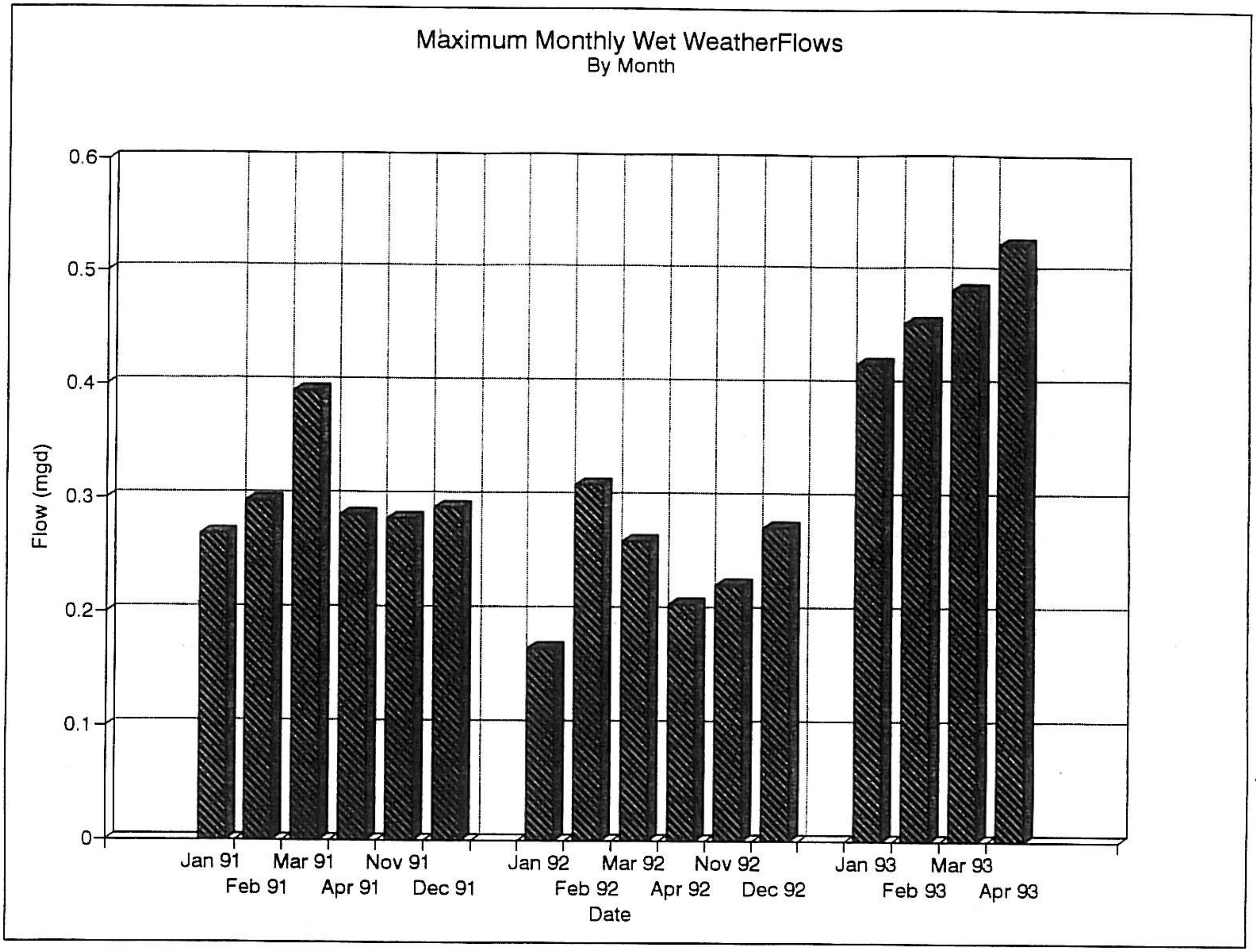
**Peak Weekly Wet-Weather Flow (PWWWF)**

As in the PDWWF, we eliminated the peak weekly flow for the month of January 1993 and concluded that the March 1993 peak weekly flow of 0.62 will be used for design for the same reasons (see Figure 4-10).

**FIGURE 4-7**

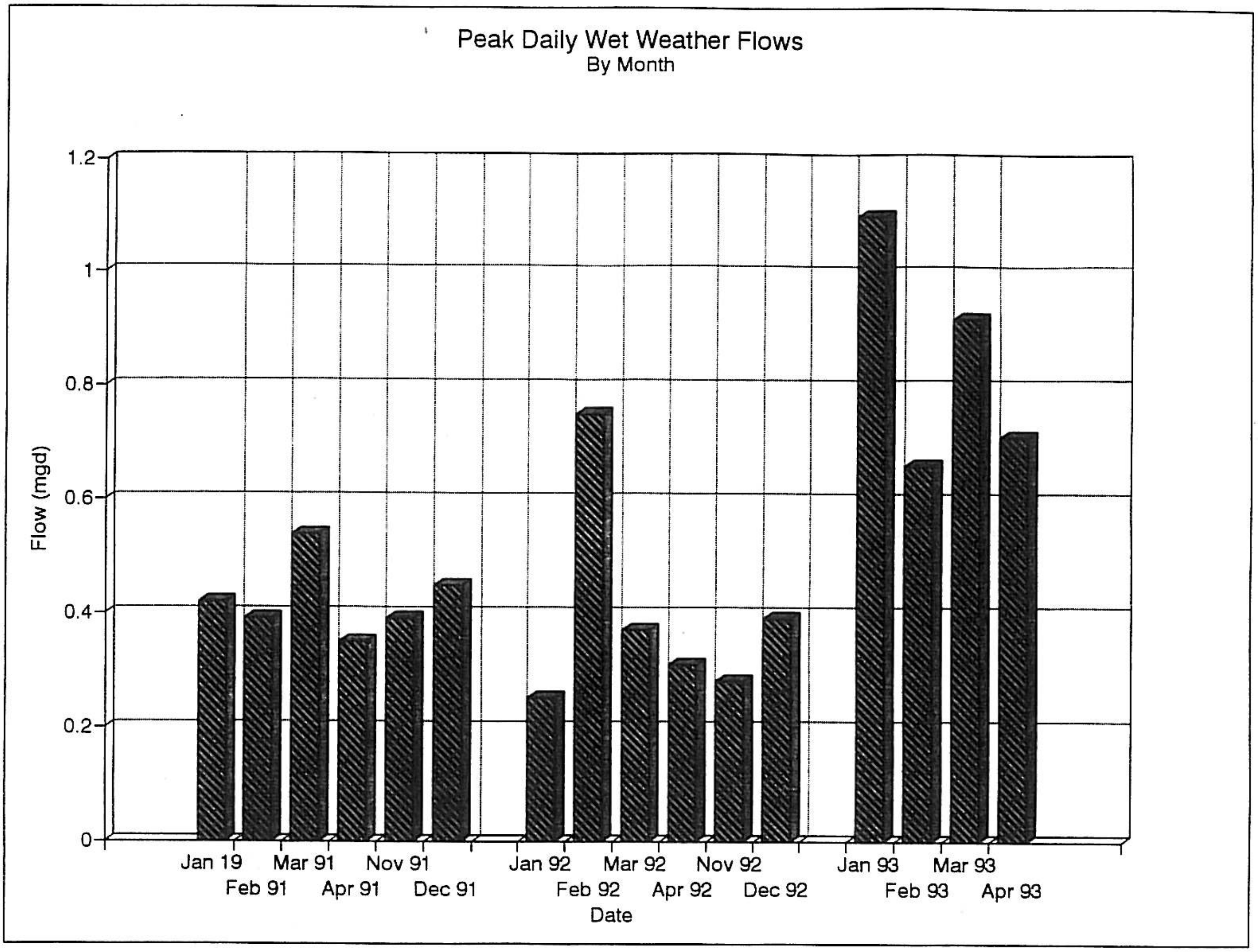

5-Year Wet-Weather Rainfall
Monthly Basis
Precipitation (inches)
20
18
16
14
12
10
8
6
4
2
0
Jan 89
Mar 89
Nov 89
Jan 90
Mar 90
Nov 90
Jan 91
Mar 91
Nov 91
Jan 92
Mar 92
Nov 92
Jan 93
Mar 93
Date

## FIGURE 4-8

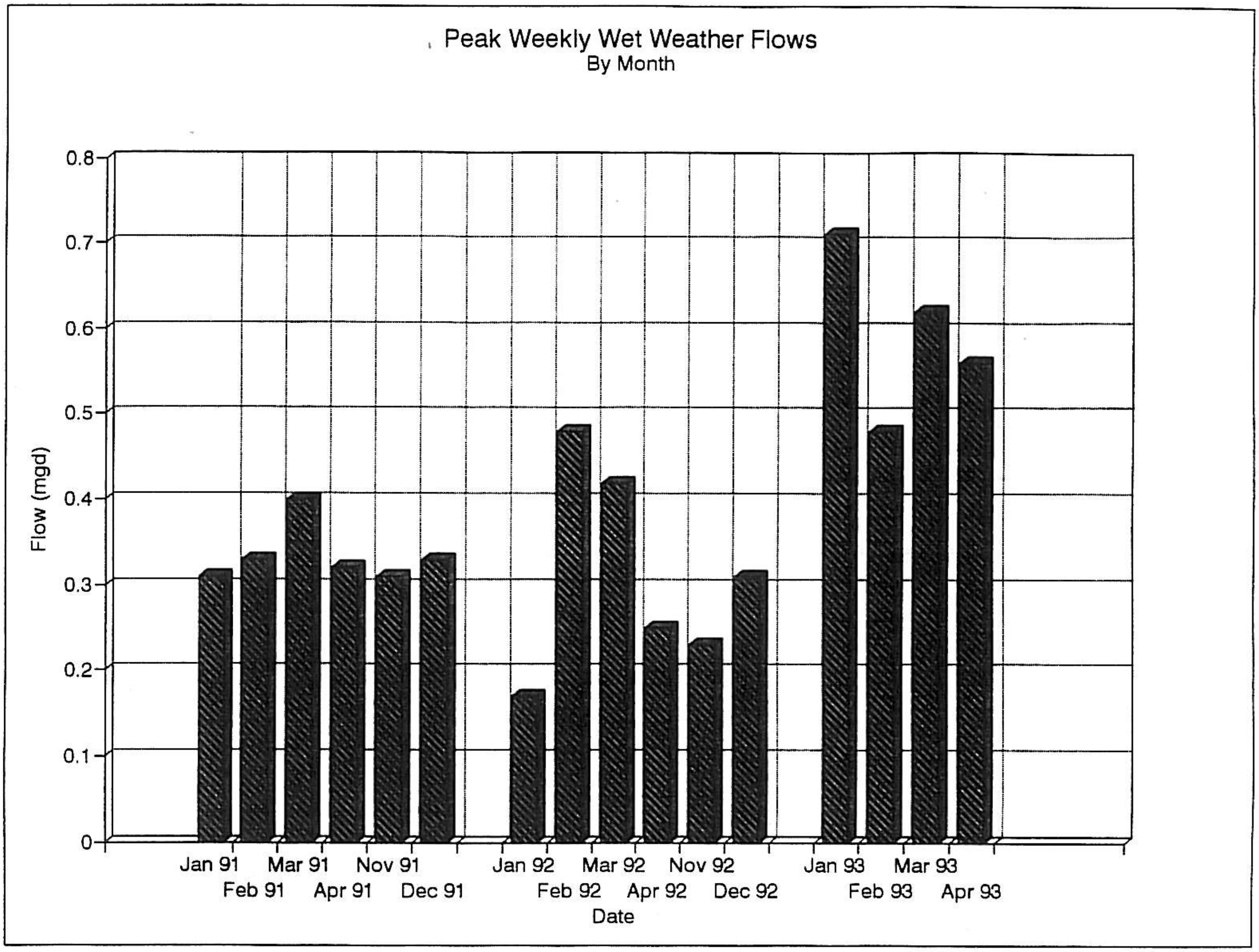


Maximum Monthly Wet WeatherFlows
By Month
Flow (mgd)
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan 91
Feb 91
Mar 91
Apr 91
Nov 91
Dec 91
Jan 92
Feb 92
Mar 92
Apr 92
Nov 92
Dec 92
Jan 93
Feb 93
Mar 93
Apr 93
Date

**FIGURE 4-9**


Peak Daily Wet Weather Flows
By Month
Flow (mgd)
1.2
1
0.8
0.6
0.4
0.2
0
Jan 19
Feb 91
Mar 91
Apr 91
Nov 91
Dec 91
Jan 92
Feb 92
Mar 92
Apr 92
Nov 92
Dec 92
Jan 93
Feb 93
Mar 93
Apr 93
Date

# FIGURE 4-10


Peak Weekly Wet Weather Flows
By Month
Flow (mgd)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan 91
Feb 91
Mar 91
Apr 91
Nov 91
Dec 91
Jan 92
Feb 92
Mar 92
Apr 92
Nov 92
Dec 92
Jan 93
Feb 93
Mar 93
Apr 93
Date

**Peak Hourly Wet-Weather Flow (PHWWF)**

The Peak Hourly Wet-Weather Flow was established in the same manner as the Peak Hourly Dry-Weather Flow; by extrapolation of data presented in graphic form comparing design events against percent probability of being exceeded. Figure 4-11 presents this information as well as the PHWWF, which is established as 1.60 mgd.

## 4.4 SANITARY SEWAGE

Average daily flow can be divided into two components; base sewage flow and base infiltration.

**Base Wastewater Flow**

Water consumption for the wet months of 1993 were examined to establish base wastewater flow. Since it is possible that tourism during December and March present a substantial impact on wastewater flows these months were excluded. The average per capita water consumption for this period was 114 gpcd. The base wastewater flow is therefore 136,800 gpd based on the estimated current population of 1200. Comparing this to wastewater flows for August 1992 suggests that the August flows contained minimal infiltration and inflow as would be expected for a very dry month following another very dry month in the dry season.

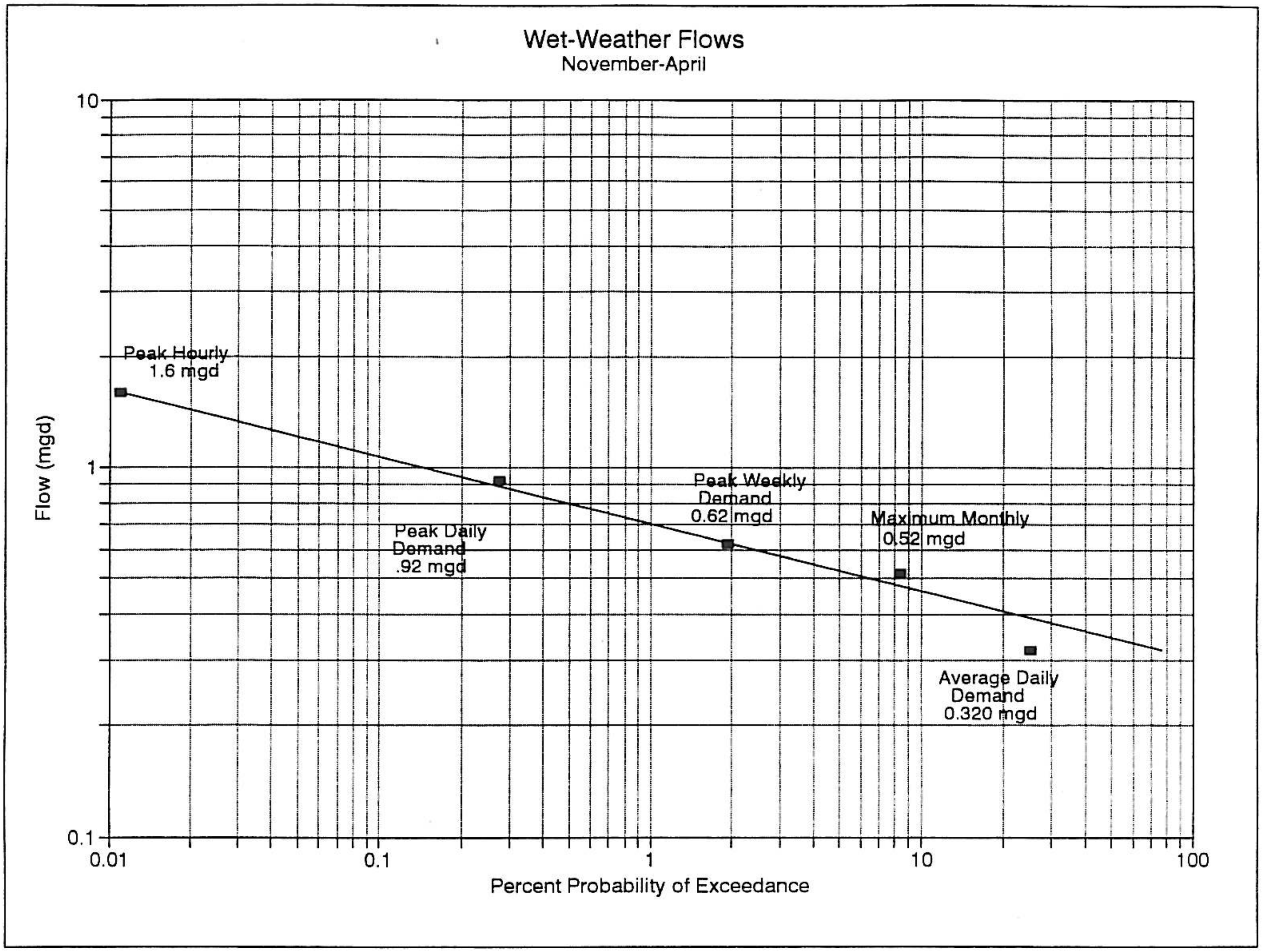
**Infiltration and Inflow (I/I)**

Existing I/I for the various design flow conditions can be determined by subtracting the base wastewater flow (136,800 gpd) from each of the design values.

Future population growth for the City of Cave Junction will occur both in areas where the existing wastewater system exists and where new pipe and manholes will be constructed and therefore where substantial Infiltration and Inflow increases are not expected to occur. There will be some additional I/I generated with the construction of new sewer mains, but future development will generally have less per capita I/I than the existing population.

For the sake of establishing future I/I estimates it can we believe that certain improvements proposed in the Capital Improvement Plan will decrease existing I/I to the same extent as future I/I is added. Therefore it is assumed that future per capita I/I will remain the same as the existing values.

# FIGURE 4-11


Wet-Weather Flows
November-April
Flow (mgd)
10
1
0.1
0.01
0.1
1
10
100
Percent Probability of Exceedance
Peak Hourly
1.6 mgd
Peak Daily
Demand
.92 mgd
Peak Weekly
Demand
0.62 mgd
Maximum Monthly
0.52 mgd
Average Daily
Demand
0.320 mgd

## 4.5 UNIT DESIGN FLOWS

Table 4-2 contains the Unit Design Flows established in this Chapter.

**TABLE 4-2**
**SUMMARY OF EXISTING FLOWS**

| Event | gpcd | mgd |
|---|---|---|
| **Dry Weather Flows** | | |
| Base Sewage | 114 | .136 |
| Base Infiltration | 61 | .073 |
| ADWF | 175 | .210 |
| MMDWF | 240 | .288 |
| Peak Weekly (PWDWF) | 251 | .301 |
| Peak Daily (PDDWF) | 333 | .400 |
| Peak Hourly (PIDWF) | 375 | .450 |
| **Wet-Weather Flows** | | |
| MMWWF | 433 | .520 |
| Peak Weekly (PWWWF) | 517 | .620 |
| Peak Daily (PDWWF) | 767 | .920 |
| Peak Hourly (PIWWF) | 1333 | 1.600 |
| **Wet-Weather I/I** | | |
| MMWW I/I | 319 | .383 |
| PI I/I | 1219 | 1.463 |

## 4.6 PLANT LOADINGS

Design plant loadings were used to establish design loads for plant improvements. These loads were compared to communities in the vicinity with similar demographic characteristics.

### Analysis of Plant Data

Samples are generally collected weekly and analyzed for BOD and TSS loadings. The results of these analyses were analyzed to determine existing influent loadings.

## Unit Design Loads

Table 4-3 illustrates the existing treatment plant influent wastewater loads. The average BOD and TSS in pounds per day is based upon the average flow for each weather condition. The maximum and minimum BOD and TSS in pounds per day is based upon the influent flow associated with the particular BOD and TSS reading.

**TABLE 4-3**
**EXISTING INFLUENT WASTEWATER LOADS**

| Parameter | Dry-Weather | Wet-Weather |
|---|---|---|
| BOD, mg/l (lbs/day) | | |
| Average | 229 (405) | 210 (560) |
| Maximum | 414 (483) | 456 (647) |
| Minimum | 126 (137) | 96 (360) |
| TSS, mg/l (lbs/day) | | |
| Average | 144 (255) | 114 (304) |
| Maximum | 434 (869) | 401 (1010) |
| Minimum | 20 (30) | 20 (38) |

## Infiltration and Inflow Guidelines

EPA has established guidelines for the preliminary determination of nonexcessive infiltration and inflow. These guidelines are as follows:

1. During periods of high groundwater the domestic base flow plus infiltration based on the highest 7-14 day average shall not significantly exceed 120 gpcd.

2. During a storm, the total daily flow shall not exceed 275 gpcd.

## Infiltration and Inflow Analysis

An I/I Analysis & Study of the Cave Junction Municipal Sewer System was conducted by T. Flatebo & Associates, Inc. during 1993. The Study recommends repair and replacement work which should result in an I/I reduction of 20% to 30%. Table 4-4 includes an immediate 20% reduction in projected wastewater flows.

## 4.7 PROJECTED WASTEWATER CHARACTERISTICS

Table 4-4 summarizes the existing and projected wastewater influent flows and loads for the years 1994 though 2014 on a four-year basis. The flows and loads are based on the unit design values presented in the preceding section and on the sewered population information. Projected flows are based on the assumption that implementation of the infiltration and inflow improvements will result in a 20 percent reduction in total I/I.

### TABLE 4-4
### PROJECTED INFLUENT WASTEWATER FLOWS AND LOADS

| Item | 1994 | 1998 | 2002 | 2006 | 2010 | 2014 |
|---|---|---|---|---|---|---|
| Population | 1873 | 2250 | 2706 | 3259 | 3927 | 4737 |
| Wastewater Flows, mgd: | | | | | | |
| Dry-Weather | | | | | | |
| 5-Year Ave. Daily | .328 | .394 | .474 | .571 | .688 | .830 |
| 5-Year Max. Monthly | .450 | .541 | .650 | .783 | .944 | 1.138 |
| 5-Year Peak Weekly | .470 | .565 | .679 | .818 | .985 | 1.189 |
| 5-Year Peak Daily | .624 | .750 | .902 | 1.086 | 1.308 | 1.578 |
| 5-Year Peak Hourly | .702 | .843 | 1.014 | 1.222 | 1.472 | 1.775 |
| Wet-Weather | | | | | | |
| 5-Year Max. Monthly | .692 | .831 | 1.000 | 1.204 | 1.451 | 1.750 |
| 5-Year Peak Weekly | .817 | .981 | 1.180 | 1.422 | 1.713 | 2.066 |
| 5-Year Peak Daily | 1.192 | 1.432 | 1.722 | 2.074 | 2.499 | 3.015 |
| 5-Year Peak Hourly | 2.040 | 2.451 | 2.947 | 3.550 | 4.277 | 5.159 |
| Wastewater Loads, ppd: | | | | | | |
| BOD-5 | | | | | | |
| Average Day | 601 | 722 | 868 | 1046 | 1260 | 1520 |
| Maximum Day | 2374 | 2852 | 3430 | 4131 | 4977 | 6004 |
| Maximum Week | 1781 | 2139 | 2573 | 3099 | 3734 | 4504 |
| Maximum Month | 1216 | 1461 | 1757 | 2116 | 2550 | 3075 |
| TSS | | | | | | |
| Average Day | 375 | 450 | 542 | 652 | 786 | 948 |
| Maximum Day | 2260 | 2715 | 3265 | 3932 | 4738 | 5716 |
| Maximum Week | 1108 | 1331 | 1601 | 1928 | 2323 | 2802 |
| Maximum Month | 840 | 1009 | 1214 | 1462 | 1761 | 2124 |

## pH

The average pH of the influent wastewater is 7.2 and ranges in extremes from 5.2 to 9.3. The typical range for pH for domestic wastewater is from 6.8 to 7.6. No information is available on influent nitrogen, phosphorous or heavy metals. Because the influent wastewater is almost entirely from domestic sources, typical values can be based on documented sources. If there is a change in the characteristics of wastewater due to future growth, it may be necessary to reevaluate influent strengths to maintain good process control.

# CHAPTER 5

## COLLECTION SYSTEM ANALYSIS

### 5.1 GENERAL

In this Chapter we will present recommended improvements to the Cave Junction wastewater collection system.

Collection system piping improvements should be designed for a 50-year life. Although any collection system will include capabilities to equalize flows, it is prudent to design collection system piping improvements for maximum flows and let the available equalization capacity help mitigate any instantaneous flows beyond reasonable prediction.

### 5.2 EVALUATION OF COLLECTION SYSTEM NEEDS

Improvements recommended to reduce Inflow and Infiltration in the I/I Analysis & Study by T. Flatebo & Associates, Inc. are incorporated in this Report by reference and are outlined in the Capital Improvement Plan. It is estimated that these improvements will reduce I/I by approximately 20 percent, and the flows used to evaluate the collection system needs include this reduction.

Providing adequate hydraulic capacity in the wastewater collection system is necessary to prevent overflows and bypasses of untreated water to the surface or to surrounding waters. Since the scope of this Report is directed at wastewater treatment and it is fairly obvious that projected flows will pass the hydraulic capacity of the collection system, we have limited our evaluation to an analysis of the existing 10 inch and 12 inch collection mains. Further analysis is recommended at a later date to provide needed local improvements in the outlying collection system.

#### Existing Collection System

As discussed in Chapter 3 the existing 10 inch collection main near the treatment plant is capable conducting a flow of approximately .663 mgd and the 12 inch main is capable of a flow of approximately 1.08 mgd.

Since our desire is to construct improvements with the longest estimated life and since it is necessary to assure a minimum flow velocity of 2 fps within the collection piping our recommendation is to provide conveyance piping improvements which will handle maximum design period flows and yet provide this minimum velocity during average dry weather flow periods.

Calculations estimate that an 18" PVC collection main with 0.22% slope will handle a maximum flow of 4.95 mgd, and will conduct .220 mgd at 2.07 fps at a depth of 2.68 inches. This will provide capacity for 5-Year Peak Daily Wet Weather Flows for the estimated 2014 population of 4737 persons, while providing the 2 fps minimum flow velocity for the current Average Daily Dry Weather Flows.

At the intersection of River Street and Kerby Avenue the collection system picks up approximately 20% of total City of Cave Junction flows. Upstream collection piping can therefore be sized based upon 80 percent of City flows, which is approximately 2.26 mgd for the estimated year 2014 population. At the intersection of Lister Street and Hussey Avenue the collection system picks up an additional approximately 40 percent of total City of Cave Junction flows. Upstream collection piping from this point can therefore be sized based upon 40 percent of City flows, or 1.13 mgd.

**Basis of Cost Estimates**

Estimated construction costs in this Report are based on actual construction bidding results for similar work, published cost guidelines, and other construction cost experience of the authors within the State of Oregon. Estimates are based on layouts of the proposed improvements.

Future changes in the cost of labor, equipment, and materials may justify comparable changes in the cost estimates presented herein. For this reason, it is common engineering practice to relate the cost estimates to a particular index that varies in proportion to long term changes in the national economy. The Engineering News Record (ENR) construction cost index is most commonly used. It is based on a value of 100 for the year 1913, and its value for the past 10 years is shown in Table 5-1.

Construction of the Cave Junction wastewater improvements is anticipated to begin by January, 1995. The costs presented in this Report are based on an ENR index of 5489. The applicable ENR is based on an annual increase of 3.5 percent over the 17 month period between August 1993 and January 1995. Construction costs estimates ENR = 5230[1 + 0.035(17/12)] = 5489.

Construction costs will increase in the future. Therefore, the cost estimates presented in this Report should be updated depending on the actual time of construction. Estimates can be prepared at any future date by comparing the predicted ENR Construction Cost Index with the projected index value of 5489.

Engineering, inspection and construction management costs have been assumed to be 16 percent of the construction cost. This includes costs for the engineering company to conduct preliminary surveys, perform detailed design analysis, prepare the required Pre-Design Report, prepare construction drawings, prepare construction specifications, process the design drawings and specifications with the appropriate authorities, advertise for construction bids, conduct construction stakeout surveys, provide partial inspection during construction, administer construction related activities such as change orders, and to prepare final drawings showing the project as built.

**TABLE 5-1**

**ENR COST INDEX PROJECTION**

| Year | 20-City ENR (August) | % Annual Change |
|---|---|---|
| 1984 | 4146 | 2.0 |
| 1985 | 4195 | 1.2 |
| 1986 | 4295 | 2.4 |
| 1987 | 4401 | 2.5 |
| 1988 | 4541 | 3.2 |
| 1989 | 4607 | 1.5 |
| 1990 | 4751 | 3.1 |
| 1991 | 4892 | 3.0 |
| 1992 | 5032 | 2.9 |
| 1993 | 5230 | 3.9 |
| 1995 (Jan.) | 5489 (est.) | 3.5 (est.) |

Contingencies

A contingency factor equal to 10 percent of the estimated construction cost have been added. In recognizing that the cost estimates are based on preliminary design, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigation and studies, and other difficulties that cannot be foreseen at this time, but which may tend to increase final costs.

Legal and Administrative

An allowance of 5 percent of construction cost has been added for legal and administration. This allowance is intended to include internal project planning and budgeting, grant administration, liaison, interest on interim financing, legal services, review fees, advertising, and other administrative expenses associated with the project.

Cost Estimate Summary

Cost estimates presented in this Report include a combined allowance of 35 percent for contingencies, engineering, legal and administrative costs.

## Recommended Improvements

The existing City of Cave Junction wastewater collection system is at or near capacity. Recorded maximum daily flows have exceeded this capacity on several occasions, and this problem will only get worse. The question is always how much rehabilitation is reasonable for Priority I improvements.

The existing 10" collection piping is capable of conveying approximately 39 percent of the estimated year 2002 Five-Year Peak Daily Flows. Since it is estimated that the City of Cave Junction water system is incapable of producing the water needed to provide development which will impact the wastewater plant to the degree predicted, and since water system improvements are not planned for the immediate future, it would be unreasonable to rehabilitate the wastewater collection system far beyond the capacity of the water system. Therefore, we have established recommended Priority I Collection System Improvements which will provide design period capacity immediately upstream of the treatment plant and will leave the further rehabilitation of the collection system for Priority II Improvements which can be done at a later date.

Priority II Improvements will include improvements necessary to allow growth for the City of Cave Junction through development of properties within the existing City Limits. As such, these improvements can be paid for by the efforts of those desiring to develop these properties.

*Priority I Improvements:*

We recommend that the following improvements be constructed immediately to provide the minimum collection system capacity required to convey wastewater flows to the upgraded plant:

- Construct 18" PVC wastewater main from the treatment plant headworks to the intersection of River Street and Kerby Avenue.

| | |
|---|---|
| 2200 lf 18" PVC @ $59.00/lf | $129,800 |
| 5 Sewer Manholes @ $1,800 ea | 1,800 |
| Abandon Existing Main and Manholes | 20,500 |
| Engineering, Inspection and Construction Management (16%) | 24,336 |
| Contingencies (10%) | 15,210 |
| Legal and Administration (5%) | 7,605 |
| Total Construction Costs | $199,251 |

| | |
|---|---|
| Total Cost of Priority I Conveyance System Improvements | $199,251 |

The portion of recommended Priority I Improvements that is in excess of that required to meet current demand has been determined by estimating the cost of installing collection piping which will just meet current demand. A 12" PVC collection main will just handle existing flows, and the added cost of installing the recommended 18" collection main to meet future demands is estimated at $4.00/lf. The portion of Priority I Improvement costs associated with excess capacity is estimated as follows:

| | |
|---|---|
| 2200 lf @ $4.00/lf | $ 8,800 |
| Engineering, Inspection and Construction Management (16%) | 1,408 |
| Contingencies (10%) | 880 |
| Legal and Administration (5%) | 440 |
| Excess Capacity Portion of Priority I Improvements | $11,528 |

*Priority II Improvements:*

We recommend that the following improvements be implemented prior to Year 2002. Flows estimated for the populations predicted beyond that date will be in excess of the capacity of the existing gravity conveyance system.

- Construct 15" PVC wastewater main from the intersection of River Street and Kerby Avenue, along Kerby Avenue and Lister Street to the intersection of Lister Street and Hussey Avenue.

| | |
|---|---|
| 1050 lf 15" PVC @ $49.00/lf | $ 51,450 |
| 3 Sewer Manholes @ $1,800 ea | 5,400 |
| Engineering, Inspection and Construction Management (16%) | 9,096 |
| Contingencies (10%) | 5,685 |
| Legal and Administrative (5%) | 2,843 |
| Total Construction Costs | $ 74,474 |

- Construct 10" PVC wastewater main from the intersection of Lister Street and Hussey Avenue, along Lister Street to Highway 199.

| | |
|---|---|
| 250 lf 10" PVC @ $40.00/lf | $ 10,000 |
| 1 Sewer Manhole @ $1,800 ea | 1,800 |
| Engineering, Inspection and Construction Management (16%) | 1,888 |
| Contingencies (10%) | 1,180 |
| Legal and Administrative (5%) | 590 |
| Total Construction Costs | $ 15,458 |

- Construct 10" PVC wastewater main from the intersection of Lister Street and Hussey Avenue, along Hussey Avenue and Watkins Street to the intersection of Watkins Street and Caves Avenue.

| | |
|---|---|
| 1700 lf 10" PVC @ $40.00/lf | $ 68,000 |
| 7 Sewer Manholes @ $1,800 ea | 12,600 |
| Engineering, Inspection and Construction Management (16%) | 12,896 |
| Contingencies (10%) | 8,060 |
| Legal and Administrative (5%) | 4,030 |
| Total Construction Costs | $105,586 |

| | |
|---|---|
| Total Cost Priority II Conveyance System Improvements | $195,518 |

Priority II Improvements are required to provide collection system capacity in excess of current demand.

# CHAPTER 6

## TREATMENT PLANT ANALYSIS

### 6.1 GENERAL

The alternatives for liquid stream treatment of the wastewater are affected by factors such as flow rates, mass load limitations, and the water quality parameters of the receiving stream/surface. The City will be required to provide a high quality secondary treated effluent to meet their mass load limitations. This section will examine broad alternatives for preliminary, primary and secondary treatment processes.

The City of Cave Junction received a new National Pollutant Discharge Elimination System (NPDES) Permit in November 1991, which establishes the parameters for planning for treatment plant improvements. This permit establishes the minimum effluent quality and discharge conditions that will be permitted through August 31, 1996.

### 6.2 EVALUATION OF TREATMENT PLANT NEEDS

For planning purposes, a range of alternatives should be considered. These alternatives include no action, upgrading the existing treatment facilities and construction of a new treatment facility. The following is a discussion of these basic alternatives.

#### No Action

The City of Cave Junction could choose to continue treating their effluent with the existing 0.15 mgd plant and lagoon without upgrading. Since it is possible that the DEQ may apply a Stipulation and Final Order to the existing condition in the near future if no action is taken, and that significant fines could result if the City refuses to improve the existing treatment process, this alternative is considered unreasonable. As discussed in previous Chapters the existing treatment facility is hydraulically overloaded. Economic growth would be significantly restricted if the treatment facility is not improved.

#### Upgrade Existing Wastewater Facilities

Given the existing NPDES permit effluent restrictions the City of Cave Junction could choose to expand the existing treatment facilities. Two ways to do this include the addition of a second activated sludge treatment plant and expansion of the existing facultative lagoon. Either of these options could easily include improvements which would meet the conditions of the existing NPDES permit and will therefore be discussed in further detail.

**Construction of a New Wastewater Treatment Facility**

A clear alternative is the replacement of the existing treatment plant with a new treatment facility capable of treating anticipated future flows and loads. This would allow the use of the existing treatment plant tankage for another purpose, such as for sludge digestion, and the existing lagoon for equalization storage. The City owns enough contiguous real estate for the addition of a new treatment facility without the complete removal of either of these two existing components.

## 6.3 PRELIMINARY TREATMENT

The City provides preliminary treatment in the form of a bar screen and comminutor. These remove a majority of floatable materials which can create maintenance problems with downstream processes. Existing preliminary treatment does not include grit removal equipment.

Although not technically part of the treatment process, flow monitoring and composite sampling of the influent is usually accomplished during this phase. Preliminary treatment is required with all of the secondary treatment alternatives being considered. In addition we recommend the addition of grease traps at all restaurants and food processing facilities.

## 6.4 PRIMARY TREATMENT

Primary treatment is often used to reduce BOD loadings on secondary treatment, as on certain activated sludge processes, and will be examined in connection with some of the secondary treatment alternatives. Circular or rectangular tanks (clarifiers) with sludge collection assemblies are normally used. BOD and TSS reduction is in the range of 30 to 50 percent respectively.

## 6.5 EFFLUENT LIMITATIONS

Although the current NPDES permit restricts average effluent concentrations for BOD/TSS to 30/30 for discharge to the Illinois River, application of the requirements for best practicable waste treatment technology in the design of treatment components could provide significantly better effluent quality. It is also probable that future effluent restrictions for the City of Cave Junction wastewater treatment plant will be increased to 10/10, and it is therefore not only feasible but also prudent to provide for this higher effluent quality during the development of the treatment processes.

## 6.6 LIQUID STREAM TREATMENT ALTERNATIVES

The process considered for secondary treatment includes several variations of the activated sludge process; facultative lagoons, trickling filter/solids contact process, conventional activates sludge process and the sequencing batch reactor.

### Facultative Lagoons

The main component of a facultative lagoon system is the lagoon itself. The lagoon would be divided into several cells to provide flexibility in the flow scheme. Some type of lining would be required; bentonite or a synthetic membrane are the most common types. Based on an average organic loading rate of 15 ppd BOD/acre a total effective area of 101 acres would be needed to treat anticipated year 2014 flows, without taking into consideration the impacts of 60 inches of annual rainfall.

The benefits of a facultative lagoon system include a reasonably low annual cost, relatively low cost of construction, and a lagoon acts as an equalization basin, thereby leveling out peak flows. Drawbacks include the difficulty controlling algae blooms and reducing effluent suspended solids.

Additional treatment of the lagoon effluent would be required in order to bring the suspended solids concentrations within the mass load limitations. A rock filter or wetlands treatment system are two systems that could act as a polishing process. Additional land areas would be required for either of these additional units.

Expansion of facultative lagoons for future wastewater flows presents a substantial difficulty from the standpoint of available area. The City would be required to purchase a substantially larger adjacent parcel of land in order to expand a lagoon system. Hydraulic compatibility would require either a topographically similar parcel or the installation of equipment to offset differences in elevation.

### Trickling Filter/Solids Contact (TF/SC)

The TF/SC is a process which incorporates a primary clarifier, a trickling filter, solids contact tank, and a secondary clarifier. The trickling filter is a circular unit with a sixteen foot deep rock media bed. Synthetic media may be used in place of rock. Effluent from the primary clarifier is evenly distributed over the trickling filter media. Trickling filter effluent flows to the solids contact tank, which is an aerated channel ahead of the secondary clarifier. Within this process unit secondary sludge from the secondary clarifier is also added to enhance the settleability of solids in the clarifier and improve the quality of the trickling filter effluent. From the solids contact tank flow travels through the secondary clarifier before being disinfected and discharged to the receiving body. Solids from the secondary clarifier that are not recirculated back to the solids contact tank are usually wasted to a digester.

The main advantage of this type of process is that it uses less energy than an activated sludge process and is a simpler process with generally lower operation and maintenance costs. Redundancy requirements make it necessary to provide two primary clarifiers, two secondary clarifiers, a two-compartment solids contact tank and additional recirculation pumps.

Expansion of a Trickling filter requires the construction of additional treatment units similar to, yet separate from, the original units.

**Conventional Activated Sludge**

Biological waste treatment with the activated sludge process is typically accomplished using two basins: an aeration basin and a clarifier or settling tank. Organic waste is introduced into the aeration basin where it is mixed by the use of diffused or mechanical aeration, which also serve to maintain the mixed liquor in a completely aerobic state. The mixed liquor flows from the aeration basin to the clarifier where the solids settle. A portion of the solids or sludge that settles is recycled back to the aeration basin and a portion is wasted, typically to a digester. Many versions of this basic process are in use today; complete mix, step feed, contact stabilization and extended aeration. The existing facility uses the contact stabilization mode.

Following the aeration basins two circular clarifiers would be required to satisfy the redundancy requirements. Pumping facilities would be required for the transport of returned activated and waste activated sludge. Aerobic digestion is typically used for sludge stabilization with this type of process in these smaller plants because of the high costs of anaerobic digesters.

Expansion of the conventional activated sludge process would be simpler than those processes considered so far in that aeration basin units could be added to the original basins and share common walls. The construction of additional secondary clarifier units would require the construction of tankage separate from the original units.

**Sequencing Batch Reactor (SBR)**

In this process there is normally more than one SBR tank, and each tank serves as both the aeration basin and secondary clarifier. Each tank is filled with raw sewage and aerated for a set period of time. The resulting mixed liquor is then allowed to settle quiescently for another set period of time, after which the clear supernatant liquid is decanted as effluent. This decanting is accomplished below the surface to prevent surface scum from entering the effluent. The majority of the tank acts as a large clarifier during settling and decant phases. During the settling and decant phases, the other tank(s) is(are) filling and aerating. The typical cycle is about 4 hours.

Although the process has been in limited use for a long time, it wasn't until dependable automated controls could be developed that it gained wide acceptance. Because the process continually runs through cycles, operation would be labor intensive without programmable controls. There are a number of manufacturers that provide complete automated systems.

The SBR process has several advantages. Because the aeration process and clarification take place in the same tank, future expansion is straight forward as more rectangular tanks are added, sharing common walls. Also the return of activates sludge is not necessary.

One disadvantage is that since discharging effluent is not continuous, the downstream process must be designed for higher flows or the decant surges must be equalized to a smooth average in a surge control or equalization basin. This can also be easily accomplished by constructing this tankage at the outlet end of each SBR tank unit.

Because settling is accomplished in a very quiescent environment, and since cycle and process timing can be adjusted to accomplish exceptionally qualitative nitrification and denitrification, the resulting effluent quality is extremely good, often operating in the 5/5 range.

Expansion of the SBR system is quite simple because the original tankage is rectangular and there is no need for separate clarifier or digester tankage. The construction of additional treatment units could be accomplished by construction of tankage which would share common walls with existing units.

## 6.7 SELECTION OF ALTERNATIVES

Each alternative was evaluated with respect to potential cost, regulatory requirements and site requirements. Based on this screening process, only the most viable alternatives will be considered further. The viability of each alternative is discussed below.

### No Action

Since it is almost certain that the City will be issued a Stipulation and Final Order with a schedule for required improvements by the Department of Environmental Quality if no action is taken, this is not a viable alternative. The City does not want to be assessed civil penalties and wishes to promote population and economic growth in the area.

**Expand Existing Wastewater Facilities**

The treatment design capacity of the existing plant is 0.150 mgd compared to a year 2014 Maximum Monthly Wet-Weather flow of 1.750 mgd. Expanding the existing Cantex package plant to 12 times its existing capacity is not a reasonable plan when constructing a new facility is actually less costly.

**Construct New Treatment Facility**

This option could easily be undertaken while maintaining the operation of the existing facility to handle flows during construction. For this and other reasons, this alternative will be evaluated further.

**Preliminary Treatment**

Preliminary treatment is an important component of the secondary treatment process. All viable secondary treatment alternatives will include preliminary treatment with grit removal.

**Primary Treatment**

Primary treatment, settling, adds a dimension of complexity and cost which can be avoided by sizing activated sludge processes to accommodate the 30 percent BOD load that it removes. However, primary treatment is essential ahead of processes which cannot handle heavy solids or BOD loadings.

**Facultative Lagoon**

Additional treatment of the lagoon effluent would be required in order to meet the mass load limitations. This treatment process would increase the large land areas required for the lagoons. Due to excessive land requirements and the lack of available land, this alternative will not be considered further.

**Trickling Filter/Solids Contact**

If the City was currently using the trickling filter process, then this alternative could be viable. To develop a totally new TF/SC facility there would be substantially higher capital costs than the activated sludge processes being considered. For redundancy requirements, the TF/SC alternative must have two primary clarifiers, two secondary clarifiers and a segmented solids contact chamber. Seven concrete structures would be required versus two for the SBR process and three for the conventional activated sludge process. The cost of increased tankage as compared to the activated sludge alternatives renders this alternative not viable.

**Conventional Activated Sludge**

City staff is familiar with operating this type of facility. This process has a proven record in Cave Junction and elsewhere, and will be evaluated further. Drawbacks to the conventional activated sludge process include clarifier upsets from spikes in peak flows.

**Sequencing Batch Reactor**

The SBR has the advantage of being able to treat large volumes of wastewater in a relatively small area. Future expansion is also more easily achieved. Peak wastewater flows are more easily accommodated by an SBR through automatic cycle retiming than other alternatives. Peak flows are easily managed by reducing the aeration cycle and decanting more often. The SBR process is selected as a viable alternative and will be evaluated further.

## 6.8 SOLIDS MANAGEMENT

This section reviews Cave Junction's current grit and solids handling operations, and describes alternative methods for solids treatment and grit removal. The City presently has a sludge management plan which appears to be workable for the future needs of the community.

**Grit Removal and Disposal**

At the present time Cave Junction is allowing wastewater grit to flow into the aeration basins and the aerobic digester with the liquid stream. This practice is allowing grit to accumulate within the existing plant, and will increase in volume as the wastewater system continues to age and as additional grit is delivered to the plant. This has frequently been found in wastewater treatment systems which were constructed with limited resources, and should be discontinued with planned expansion of the liquid stream and solids handling improvements. Since grit collection will become an increasingly larger problem, a program to allow accumulation of grit in existing tankage, and manual cleaning on an intermittent basis is not an acceptable long term solution to the problem. A fine mesh hydrasieve is recommended to remove screenings from the liquid stream, and a permanent disposal site for the screenings needs to be located, probably in a sanitary landfill. A similar program for disposal of screenings from the liquid stream has worked will for other communities and should be encouraged for Cave Junction. It should be possible to dispose of grit in an identical fashion. Permanent arrangements should be pursued with the City's franchised solid waste receiving service.

## Sludge Disposal

The existing Cave Junction wastewater treatment facility utilizes aerobic digestion of non-thickened secondary sludge for sludge stabilization. Digested sludge from the treatment facility is pumped to a sludge lagoon at the treatment plant site. The City is presently negotiating a receiving site for land application.

## Description of Sludge Stabilization Processes

Stabilization processes include aerobic and anaerobic digestion, and lime stabilization.

### *Aerobic Digestion*

In the aerobic digestion process, the volatile solids are reduced aerobically in a tank which is supplied with oxygen, normally by means of blowers and diffusers. The process has been in common use since the 1950's. Because it has a low capital cost and is simple to operate, its use became extremely popular for small plants in the 1970's. Since the process uses large amounts of energy to provide the required oxygen, its use has been declining since the mid-1970's jump in the cost of energy.

Federal regulations governing municipal sludge requires a minimum 38 percent reduction in volatile solids. One of the guidelines to achieve this reduction is to provide for an aerobic digester storage time of 60 days, plus process time in the aeration basin. This approach should easily provide the required reduction of volatile solids.

### *Anaerobic Digestion*

In this process, sludge is digested in a closed tank in the absence of oxygen while $CO_2$ and methane gas are produced. The gas can be flared or utilized to heat the digester contents and to generate electricity. The process has been in use for over a century and has become extremely reliable. the major advantage of anaerobic over aerobic digestion is the energy savings.

Anaerobic digestion is a net energy producer if the sludge gas is utilized, and produces a sludge that is easily dewatered. Disadvantages include the high capital cost for the tanks and the associated gas handling system, susceptibility to upsets, complexity in operation and a strong supernatant that must be recycled and treated.

*Lime Stabilization*

This process consists of adding lime ($CaCO_2$ or CaO) to the raw sludge. Sludge pH must be raised to pH 12 for two hours under continuous mixing without the addition of more lime. Normally this requires 0.3 lbs of lime per pound of sludge. The high pH eliminates the pathogens. It does not permanently stabilize the sludge and eventually sludge will begin to decompose and produce odors, but very slowly. Lime stabilization does increase the volume because a chemical is added. Treating with lime could reduce the flexibility of disposal if landowners would not accept the lime treated sludge. Lime stabilization is being used at the City of Toledo and Canby following aerobic digestion. Currently, there are no known lime stabilization facilities within the State that do not have some type of digestion prior to lime addition.

**Selection of Sludge Storage and Disposal**

Aerobic digestion and anaerobic digestion are both common, proven processes which would merit further consideration. However, because the existing wastewater treatment plant was constructed with aerobic digestion, this system would appear to offer the greatest advantages and we recommend continued usage of this process for sludge digestion. Aerobic digestion is more flexible and can be added in stages as growth demands increased facilities. The City's plant operators are already familiar with this process, and construction costs of aerobic digesters average approximately one-half that of anaerobic digestion. Capital costs for conversion of the existing Cantex treatment plant for use as an aerobic digester would also be substantially lower than any recommendation for alternative digestion means.

Continued pursuit of approved land disposal sites is recommended for ultimate disposal of solids form the Cave Junction wastewater treatment process.

Costs for aerobic digestion of solids is provided as an integral portion of the liquid stream wastewater handling plan. No further capital costs for solids handling improvements are projected for implementation at this time.

## 6.9 DISINFECTION

The existing Cave Junction wastewater treatment plant disinfects the plant effluent through the use of Chlorine. Two chlorinators have been installed; one at the treatment plant settling pond and one at the outlet of the facultative lagoon.

Although chlorination is an effective method of disinfection, chlorination of effluent adds to the toxicity of the discharge. In sensitive receiving waters, such as the Illinois River, it may become necessary to eliminate this chlorine-induced toxicity by effluent dechlorination.

An alternative to chlorination which has proven effective is Ultraviolet (UV) irradiation. The benefits of UV disinfection include the fact that nothing is actually being added to the effluent, and therefore nothing must be removed to meet receiving water limitations. It is important, however, to provide adequate UV intensity for proper disinfection.

## 6.10 DEVELOPMENT AND EVALUATION OF TREATMENT ALTERNATIVES

The following is a cost analysis of the liquid stream treatment alternatives. The remaining alternatives under consideration are the conventional activated sludge treatment plant and the sequencing batch reactor.

### Operation And Maintenance Costs

O&M costs will vary with size and type of treatment. The City's existing current estimated expenses for Operation and Maintenance of the wastewater system is shown in Table 6-1.

**TABLE 6-1**
**ESTIMATED CURRENT ANNUAL O&M EXPENSES**

| Item | Estimated Cost |
|---|---|
| Personnel | $ 50,951 |
| Material & Supplies | 7,146 |
| Repair & Replacement | 4,469 |
| Utilities | 7,450 |
| Chemicals & Testing | 2,980 |
| Sludge Expenses | 2,861 |
| Insurance | 3,881 |
| Miscellaneous | 12,250 |
| **Estimated Total Current Annual Operation and Maintenance Costs** | **$91,988** |

## Alternative 1 - Conventional Activated Sludge

A flow schematic for this alternative is shown in Figure 6-1. Raw wastewater flows to the new headworks as previously discussed. From the headworks, flow would enter two aeration basins. At the aeration basins, the operator would have the option of where, which section, the flows should enter. A channel with slide gates running down the center of the basin would allow flows to enter one or both basins at various points along the basin. After the aeration basins, there would be a flow splitter which would divide flows equally to each of two circular clarifiers. From the clarifiers the secondary effluent would enter the ultraviolet disinfection channel prior to being discharged. Sludge stabilization would be accomplished by an aerobic digester. Digested sludge would be land applied.

Design data are listed in Table 6-2, with cost estimate data listed in Table 6-3. Each aeration basin would be a rectangular concrete structure with a length to width ratio of approximately 7:1 and a side water depth of 16 feet. The initial portion of the basins may be used as an anoxic zone to discourage filamentous growth. Baffle walls would be used to separate the zones. Total basin volume would be based on 7 hours detention at MMWWF. A diffused air system with fine bubble diffusers would be used. One or both basins may be operated at the same time.

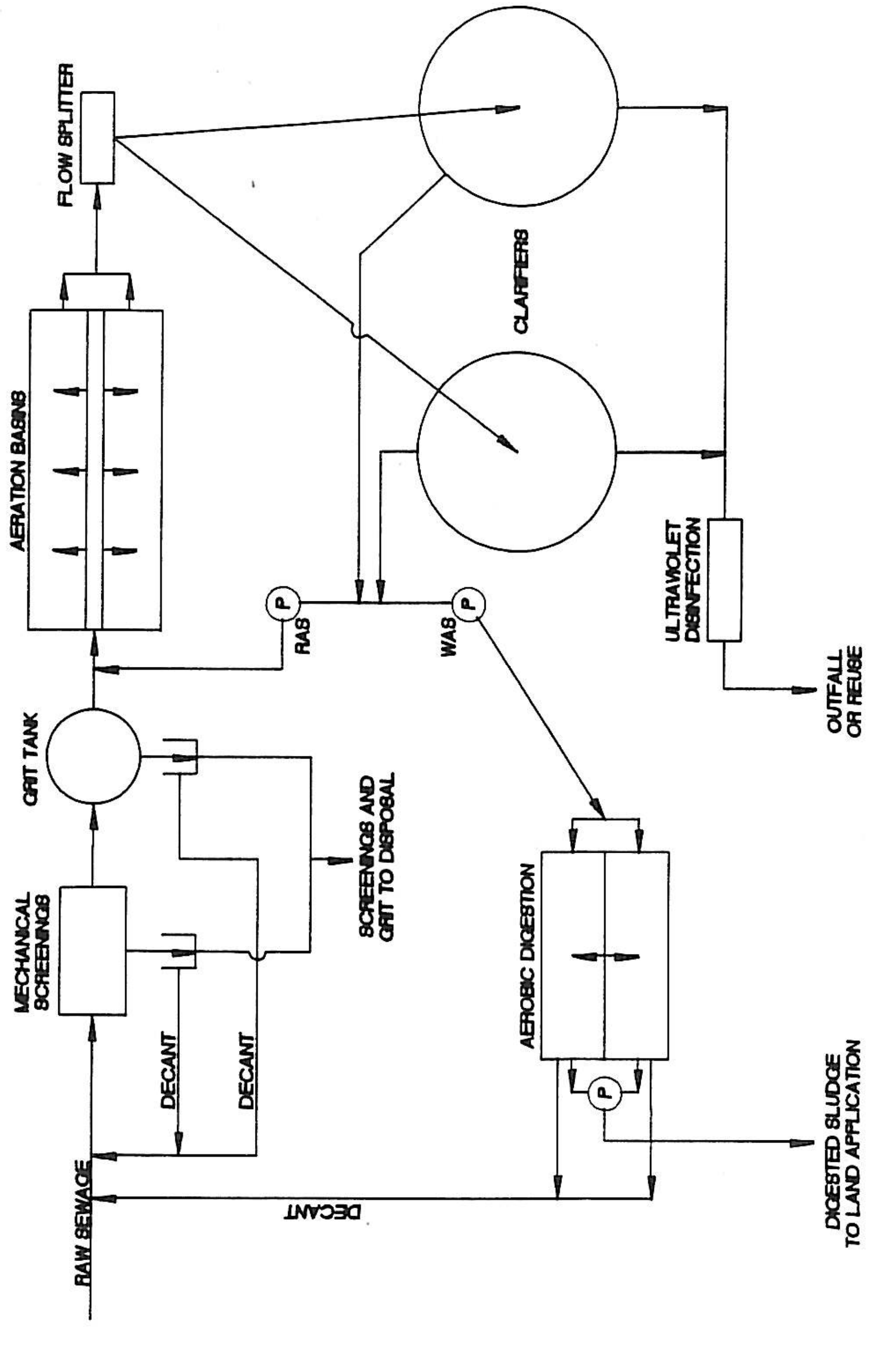
The secondary clarifiers would be center feed type with peripheral effluent weirs. Sizing of each clarifier would be based on an overflow rate of 350 gpd/sf at ADWF and a side water depth of 16 feet. Each clarifier would have sludge collection equipment in the bottom of the tank and scum collection equipment at the top. The scum would be sent back to the headworks. The sludge would be returned to the aeration basin as return activated sludge or wasted to the aerobic digester, as waste activated sludge.

A pump station would be used to convey the sludge from the clarifiers. The return activated sludge would be pumped to the head of the aeration basin inlet channel. The waste activated sludge would be sent to either basin of the aerobic digester.

Aerobic digestion would take place in a two-compartment tank constructed by conversion of the existing Cantex treatment plant as a digester. Waste activated sludge from the aeration basin could be pumped to either compartment. Piping and valving would be such that flows could enter one or both of the basins. An air-lift pump would be provided to transfer solids from one basin to the other. The two compartments could be operated in series or parallel. This unit would be sized to allow for solids retention of 60 net days to assure compliance with EPA requirements..

Clarifier effluent would receive UV disinfection. Following this there would be a flow metering station and composite sampler. Flows would then be discharged.

FIGURE 6-1




FLOW SCHEMATIC
ALTERNATIVE 2 - CONVENTIONAL ACTIVATED SLUDGE

## TABLE 6-2
## ALTERNATIVE 1 DESIGN DATA
## CONVENTIONAL ACTIVATED SLUDGE

| Item | Value |
|---|---|
| Flow, MMWWF | 1.00 mgd |
| Load | |
| BOD, avg. | 868 ppd |
| BOD, max. month | 1757 ppd |
| SS, avg. | 542 ppd |
| SS, max. month | 1214 ppd |
| Headworks | |
| Mechanical Screen | |
| Number | 1 |
| Capacity | 3.0 mgd |
| Grit Tank | |
| Number | 1 |
| Capacity | 3.0 mgd |
| Aeration Basin | |
| Number | 2 |
| Side Water Depth | 16 feet |
| Detention Time @ MMWWF | 9 hrs |
| MLSS | 2000 mg/l |
| Blowers | |
| Number | 4 |
| Total Capacity | 2500 scfm |
| Secondary Clarifiers | |
| Number | 2 |
| Diameter | 42 feet |
| Overflow Rate @ ADWF (one clarifier) | 350 gpd/sf |
| Overflow Rate @ MMWWF (two clarifiers) | 361 gpd/sf |
| Return Sludge Pumps | |
| Number | 2 |
| Capacity, each | 250 gpm |

| | |
|---|---|
| Ultraviolet Disinfection | |
| Lamps, Number | 40-46 |
| Capacity | 600-750 gpm |
| | |
| Aerobic Digester | |
| Number of Basins | 2 |
| Sidewater Depth | 20 feet |
| Volume, each | 16,500 cf |

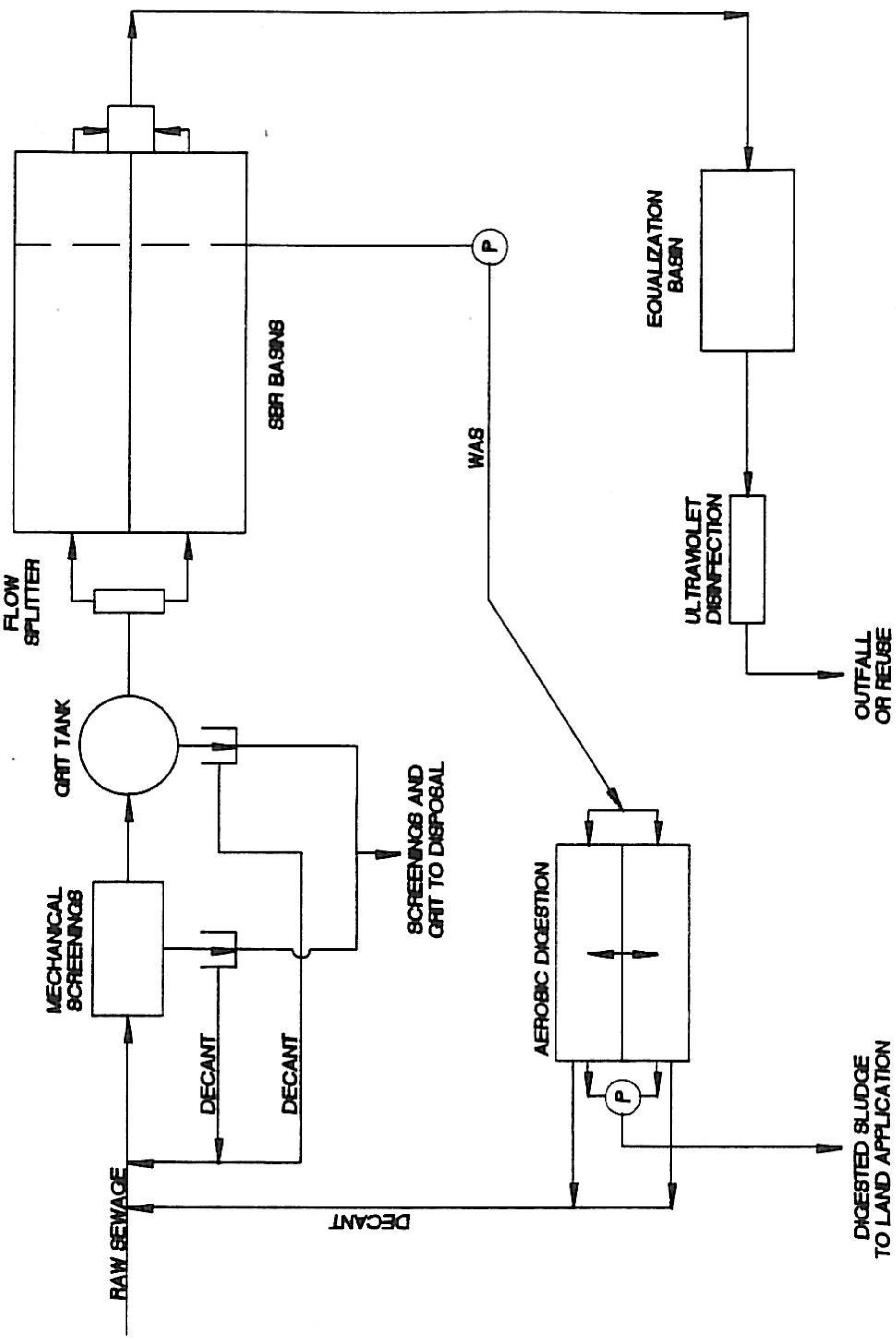
**TABLE 6-3**
**ALTERNATIVE 1 - ESTIMATED COSTS**

| Item | Estimated Cost (Thousand Dollars) |
|---|---|
| Mobilization | 125 |
| Sitework | 94 |
| Headworks | 215 |
| Aeration Basins | 494 |
| Equipment | 124 |
| Secondary Clarifiers | 515 |
| Aerobic Digesters | 85 |
| Disinfection | 225 |
| RAS/WAS Pump Station | 110 |
| Aerobic Digester | 85 |
| Control Building Improvements | 45 |
| Site Piping | 65 |
| Sub-Total | 2,182 |
| | |
| Contingency (10%) | 218 |
| Engineering, Inspection and Construction Management (16%) | 349 |
| Administration and Legal (5%) | 109 |
| | |
| **Total Capital Cost** | **2,858** M |

## Alternative 2 - Sequencing Batch Reactor

A flow schematic for this alternative is shown in Figure 6-2. Raw waste would arrive at the new headworks as indicated under Alternative 1, and then would flow by gravity to a flow

FIGURE 6-2




FLOW SCHEMATIC

ALTERNATIVE 2 - SEQUENCING BATCH REACTOR splitter which would divide the flows entering the two SBR basins. The 2 cell design is based on the type of SBR which contains a baffled inlet so that it can continue to receive flow during the settling cycle without impairing treatment effectiveness. Then all flows could be sent to one basin to allow for maintenance and repairs of the other. SBR systems that do not have this capability would require three tanks. Then when one tank is down for maintenance the other two can alternate. There are several commercial SBR manufacturers in the United States, but only one type is designed for continuous feed. The design with two tanks is based on this type.

After the SBR, there would be an equalization basin which would store flows for a short time to allow for more uniform flows to the disinfection channel and a smaller disinfection unit. After disinfection the secondary effluent would be discharged as previously discussed. Sludge stabilization would be accomplished with an aerobic digester also as previously discussed.

Design data is listed in Table 6-4, with estimated cost information in Table 6-5. Each SBR basin would be a concrete rectangular structure. Top water level would be 15.0 feet and bottom water level 9.52 feet. Total basin volume would be based on 20 hours detention at MMWWF. In each basin there would be a pre-react zone which acts as an organic selector which inhibits filamentous growth which can cause sludge bulking. Since each basin acts as an aeration basin and clarifier, no return activated sludge equipment is required. Scum would be removed by floating skimmers in each basin and sent back to the headworks for dewatering and compaction. Waste sludge is pumped from each basin to the aerobic digester with small submersible pumps. The aerobic digesters would share a common tank wall with each treatment unit.

The equalization basin and ultraviolet disinfection channel would also be concrete. Following disinfection there would be a flow metering station (parshall flume, or magnetic meter), and composite sampler. Flow from the equalization basin would be controlled by an automatic slide gate, based on water levels in the surge basin and flow rate through the effluent meter.

**TABLE 6-4**
**ALTERNATIVE 2 DESIGN DATA**
**SEQUENCING BATCH REACTOR**

| Item | Value |
|---|---|
| Flow, MMWWF | 1.00 mgd |
| Load | |
| BOD, avg. | 868 ppd |
| BOD, max. month | 1757 ppd |
| SS, avg. | 542 ppd |
| SS, max. month | 1214 ppd |

| | |
|---|---|
| Headworks | |
| Mechanical Screen | |
| Number | 1 |
| Capacity | 3.0 mgd |
| Grit Tank | |
| Number | 1 |
| Capacity | 3.0 mgd |
| Sequencing Batch Reactor | |
| Number of Basins | 2 |
| Top Water Depth | 15 feet |
| MLSS @ Bottom Water Level | 4636 mg/l |
| Blowers | |
| Number | 2 |
| Capacity, each | 585 scfm |
| Waste Sludge Pumps | |
| Number | 2 |
| Capacity, each | 18 gpm |
| Equalization Tank | |
| Number | 1 |
| Capacity | 115,000 |
| Ultraviolet Disinfection | |
| Lamps, Number | 40-46 |
| Capacity | 600-750 gpm |
| Aerobic Digester | |
| Number of Basins | 2 |
| Sidewater Depth | 15 feet |
| Volume, each | 9690 cf |

## TABLE 6-5
## ALTERNATIVE 2 - ESTIMATED COSTS

| Item | Cost (Thousand Dollars) |
|---|---|
| Mobilization | 125 |
| Sitework | 94 |
| Headworks | 165 |
| SBR Basins | 285 |
| SBR Treatment Equipment | 490 |
| Equalization Basin | 125 |
| Disinfection | 225 |
| Aerobic Digester | 85 |
| Control Building Improvements | 45 |
| Site Piping | 65 |
| Sub-Total | 1,704 |
| Engineering, Inspection and Construction Management (16%) | 273 |
| Contingency (10%) | 170 |
| Legal and Administration (5%) | 85 |
| **Total Capital Cost** | 2,232 |

## 6.11 Recommended Treatment System and Priorities

In this chapter we have evaluated four alternatives for treatment of Cave Junction wastewater; Facultative Lagoon, Trickling Filter, Conventional Activated Sludge and Sequencing Batch Reactor. Consideration has been given to initial cost, operational simplicity, flexibility in providing adequate treatment to varying wastewater conditions and ease of expansion.

It is our opinion that the recommended treatment system should be capable of treating the BOD and flow peaks experienced by the Cave Junction wastewater system, be relatively simple to operate and maintain, and present the least cost to the existing system users and those applying for new connections.

Historically the Sequencing Batch Reactor had been the theoretical choice for wastewater treatment systems, because of the optimum quiescent clarification and multiple use of tankage. The effluent quality of an SBR cannot be emulated by a Conventional Activated Sludge process, and operational expense of the SBR is reduced because of the reduced need for pumping. However, SBR systems available prior to the past few years have presented a serious complexity problem for the operators and a great operational expense for the rate payers. Previous SBR control systems relied upon complex relay systems subject to frequent mechanical failure. Advances in computer and control technology over the past decade have resulted in SBR control systems which are now very simple to operate and are extremely dependable. Contemporary control units are managed by the use of solid state PLC's which not only provide programming and retiming capabilities, but can be connected to the SBR manufacturer by means of a computer modem to facilitate adjusting any bugs out of the process.

Power surges or outages due to lightning or other electrical disturbances which would destroy a relay bank are reduced to minor problems by means of surge protection and computer memory. Temporary influent storage is provided by the redundant reactor tankage until power is restored. Reprogramming of PLC's is not necessary once the power is restored, and the system quickly picks up where it left off. Any problems with which the operator may be unfamiliar are quickly solved by calling the manufacturer, who can directly read plant data and programming information through the modem connection to the plant's control system PLC and make any adjustments via modem while talking to the operator on the other telephone line.

Each treatment process can be adjusted to fit influent flow and load requirements to provide the best possible effluent quality and obtain qualitative nitrification/denitrification. As discussed previously the SBR is capable of handling spikes in peak flows by adjustment of aeration timing and decant frequency. This is of particular concern for the Cave Junction wastewater system because of the presence of significant rain-induced I/I. Such peak flows can easily upset the clarifier units of a conventional activated sludge process.

For the reasons above and due to the cost considerations quantified in this Chapter we recommend that the City of Cave Junction construct a Sequencing Batch Reactor wastewater treatment plant with the plant flow/load characteristics illustrated previously as **Priority I** Improvements. This will provide wastewater treatment capacity for the estimated year 2002 population of 2706 persons. Additional treatment units can be added to accommodate the additional anticipated population illustrated in Chapter 4 as **Priority II** improvements can be financed directly from Systems Development Charges as discussed in Chapters 9 and 10. A preliminary layout of the proposed treatment units is illustrated in Figure 6-3.

We estimate that the portion of Priority I Improvements needed to satisfy existing capacity demands is 85%. The added cost of constructing the recommended facility over constructing a similar facility which will provide for existing demand is very small as a percentage of overall costs.

Priority II Improvements consist of the addition of tankage and equipment to provide for year

2014 projected flows and loads. Priority II Improvements are required to provide collection system capacity in excess of year-2002 demand. Priority II costs are estimated to be illustrated in Table 6-6.

**TABLE 6-6**
**PRIORITY II TREATMENT IMPROVEMENTS - ESTIMATED COSTS**

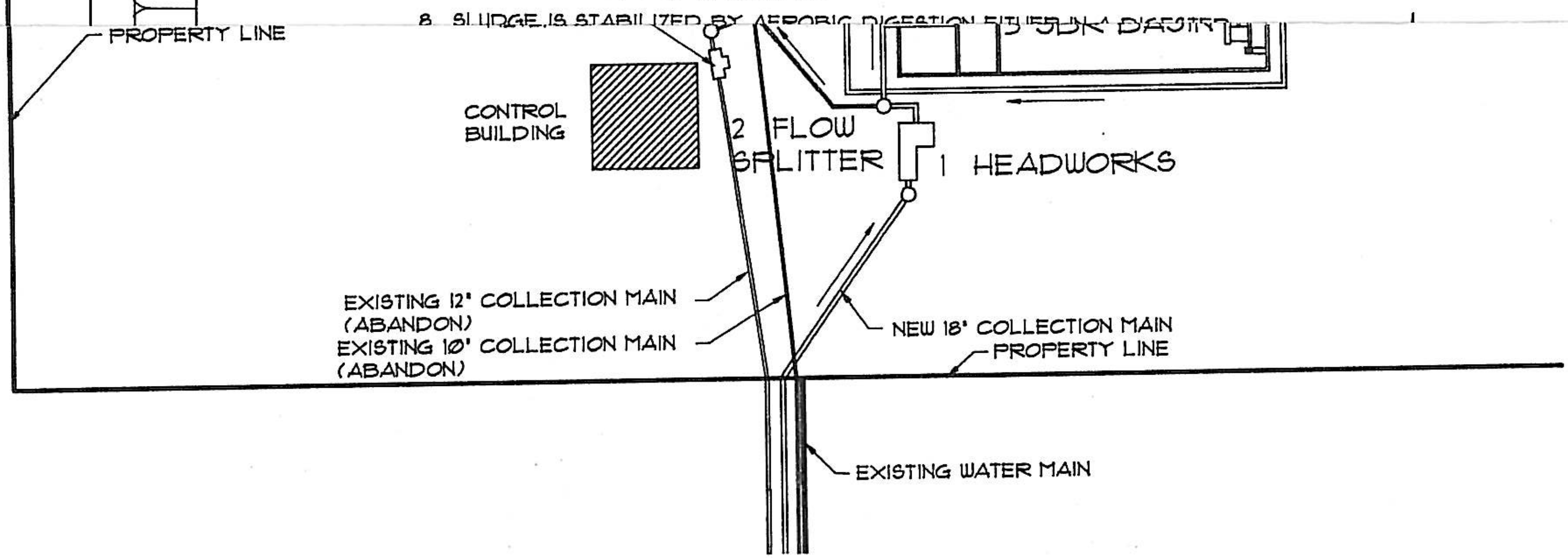
| Item | Cost (Thousand Dollars) |
|---|---|
| Mobilization | 100 |
| Sitework | 65 |
| Headworks | 0 |
| SBR Basins | 285 |
| SBR Treatment Equipment | 490 |
| Surge Basin | 0 |
| Disinfection | 65 |
| Aerobic Digester | 85 |
| Control Building Improvements | 0 |
| Site Piping | 45 |
| Sub-Total | 1,135 |
| Engineering, Inspection and Construction Management (16%) | 182 |
| Contingency (10%) | 114 |
| Legal and Administration (5%) | 57 |
| **Total Capital Cost** | **1,488** |

FIGURE 6-3

# CITY OF CAVE JUNCTION PROPOSED TREATMENT PLANT SITE PLAN

## PLANT OPERATION

1. INFLUENT RECEIVES PRELIMINARY TREATMENT AT THE HEADWORKS.
2. FUTURE PEAK FLOWS IN EXCESS OF PLANT CAPACITY CAN BY DIVERTED AT FLOW SPLITTER INTO INFLUENT EQUALIZATION LAGOON (7).
3. SCREENED AND DEGRITTED INFLUENT IS TREATED IN ALTERNATING SBR BASINS.
4. SBR EFFLUENT SURGES ARE EQUALIZED IN THE EFFLUENT SURGE TANK.
5. EFFLUENT RECEIVES UV DISINFECTION.
6. EFFLUENT FLOWS BY GRAVITY TO OUTFALL.
7. PEAK INFLUENT STORED IN INFLUENT EQUALIZATION LAGOON IS PUMPED (8) TO INFLUENT LINE FOR TREATMENT.
8. SLUDGE IS STABILIZED BY AEROBIC DIGESTION [illegible]



# CHAPTER 7

## BIOSOLIDS MANAGEMENT

### 7.1 GENERAL

The removal, handling and disposal of wastewater treatment biosolids are regulated by EPA 40 CFR Part 503. This chapter contains suggestions for the management of these biosolids.

In consideration of approval of the expansion of the Cave Junction wastewater treatment system certain conditions will be placed on activities associated with the disposal of wastewater and the associated biosolids. Part 503 contains a thorough discussion of concerns surrounding domestic wastewater biosolids management, and the intent of the this Chapter is to implement the strategies set forth in those regulations.

The City has prepared a Biosolids Management Plan which appears to meet the requirements of the EPA regulations and the Oregon Department of Environmental Quality. The following information should be incorporated into a new Biosolids Management Plan which will be drafted for the management of biosolids generated by the new wastewater facility and appurtenances. Requirements associated with septic system effluent are added to reflect the biosolids management requirements of the anticipated service extension into the Kerby area.

### 7.2 SOURCES OF SOLIDS

In Cave Junction, wastewater is generated from domestic sources. No septage is accepted and no industries discharge to the facility. The estimated total quantities of sludge are as follows, at the rate of 0.5 gallons of wet sludge per 100 gallons of raw wastewater:

| Year | Population | Sludge Production (gal/day) |
|---|---|---|
| 1994 | 1,873 | 1,640 |
| 1998 | 2,250 | 1,970 |
| 2002 | 2,706 | 2,370 |
| 2006 | 3,259 | 2,855 |
| 2010 | 3,927 | 3,440 |
| 2014 | 4,737 | 4,150 |

## 7.3 SLUDGE COLLECTION AND DISPOSAL

All sludge should be managed in accordance with the current Sludge Management Plan approved by the Department of Environmental Quality (DEQ). No substantial changes should be made in sludge management activities which significantly differ from operations specified under the approved plan without the prior written approval of the DEQ.

Primary disposal consideration for the treated and stabilized biosolids should be given to land application for beneficial use. Since the organic and nutrient content of these solids make them a valuable resource to use both in improving marginal lands and as a supplement to fertilizers and soil conditioners, such application should be given high priority.

During removal, solids should be pumped, handled, transported and deposited in such a way as to prevent the spillage of sludge material, and shall be done in accordance with the requirements of 40 CFR, Part 503 as amended from time to time. During each removal event, the sludge should be sampled for various parameters. Percent volatile solids reduction will be calculated monthly. In response to the adoption of new federal sludge requirements (Part 503) five additional sludge metals shall be sampled.

Solids should be pumped from the digester tanks a minimum of once every six months.

Solids shall be pumped from the pumping stations a minimum of once every twelve months.

Collected solids may be disposed of by the City by application to approved land at agronomic rates, or by a DEQ licensed sewage disposal service business through a competitive bidding process. It will be the responsibility of the sewage disposal service business to assure that solids are disposed of at a DEQ-permitted disposal site, and that all solids are alkaline stabilized when required by the DEQ.

## 7.4 EPA PART 503 REQUIREMENTS

EPA Part 503.14 Management Practices should be incorporated in the Cave Junction sludge management activities, in part as follows:

- Bulk sewage sludge shall not be applied to the land if it is likely to adversely affect a threatened or endangered specie listed under section 4 of the Endangered Species Act or its designated critical habitat.

- Bulk sewage sludge shall not be applied to agricultural land, forest, a public contact site, or a reclamation site that is flooded, frozen, or snow-covered so that the bulk sewage sludge enters a wetland or other waters of the United States, as defined in 40 CFR 122.2, except as provided in a permit issued pursuant to section 402 or 404 of the Clean Water

- Bulk sewage sludge shall not be applied to agricultural land, forest, or a reclamation site that is 10 meters or less from waters of the United States, as defined in 40 CFR 122.2, unless otherwise specified by the permitting authority.

- Bulk sewage sludge shall be applied to agricultural land, forest, a public contact site, or a reclamation site at a whole sludge application rate that is equal to or less than the agronomic rate for the bulk sewage sludge, unless in the case of a reclamation site, otherwise specified by the permitting authority.

# CHAPTER 8

## CAPITAL IMPROVEMENT PLAN

### 8.1 PROPOSED PROJECT

A summary of the proposed improvements is presented in Table 8-1 with t he preliminary estimated costs for construction, engineering and inspection, legal and administration, and contingency costs.

### 8.2 IMPROVEMENT IMPLEMENTATION

The City of Cave Junction should set an initial scope for the project based on recommendations in this Report. The scope should include improvements the Council believes will satisfy the highest priority needs in the community and which will be affordable to residents.

**TABLE 8-1**

**CITY OF CAVE JUNCTION**
**SUMMARY OF ESTIMATED IMPROVEMENT COSTS**

**Priority I Wastewater System Improvements** - Immediate

*Capital Improvement Costs:*

| Proposed Improvements | Construction Costs | Engineering & Inspection | Legal & Admin. | Contingency | Other Costs | Total Costs |
|---|---|---|---|---|---|---|
| Collection System Improvements | $152,100 | $24,336 | $7,605 | $15,210 | 0 | $199,251 |
| Treatment Plant Improvements | $1,704,000 | $272,640 | $ 85,200 | $170,400 | 0 | $2,232,240 |
| I/I Improvements | $71,500[1] | $11,440 | $3,575 | $7,150 | 0 | $93,665 |
| Total | $1,927,600 | $308,416 | $96,380 | $192,760 | 0 | $2,525,156 |

1 See I/I Analysis & Study of Municipal Sewer System in City of Cave Junction, Josephine County, Oregon by T. Flatebo & Associates, Inc. dated January 15, 1994.

*Operation and Maintenance Costs:*

Table 8-2 outlines the estimated operation and maintenance costs associated with the implemented Priority II improvements. Although the capacity of the proposed treatment plant is significantly greater than the existing facility, manpower and other requirements associated with the new plant will not increase proportionately with facility size.

**TABLE 8-2**
**ESTIMATED ANNUAL O&M EXPENSES**
**FOR PRIORITY I IMPROVEMENTS**

| Item | Estimated Cost |
|---|---|
| Personnel | $ 57,259 |
| Material & Supplies | 9,077 |
| Repair & Replacement | 7,232 |
| Utilities | 25,139 |
| Chemicals & Testing | 3,771 |
| Sludge Expenses | 6,215 |
| Insurance | 4,851 |
| Miscellaneous | 15,290 |
| **Estimated Priority I Annual Operation and Maintenance Costs** | **$128,834** |

**Priority II Wastewater System Improvements** - Immediate

*Capital Improvement Costs:*

| Proposed Improvements | Construction Costs | Engineering & Inspection | Legal & Admin. | Contingency | Other Costs | Total Costs |
|---|---|---|---|---|---|---|
| Collection System Improvements | $149,250 | $25,288 | $7,903 | $15,805 | 0 | $198,246 |
| Treatment Plant Improvements | $1,135,000 | $181,600 | $56,750 | $113,500 | 0 | $1,486,850 |
| Total | $1,284,250 | $206,888 | $64,653 | $129,305 | 0 | $1,685,096 |

*Operation and Maintenance Costs:*

Table 8-3 outlines the estimated operation and maintenance costs associated with the implemented Priority II improvements.

**TABLE 8-3**
**ESTIMATED ANNUAL O&M EXPENSES**
**FOR PRIORITY II IMPROVEMENTS**

| Item | Estimated Cost |
|---|---|
| Personnel | $ 73,476 |
| Material & Supplies | 16,053 |
| Repair & Replacement | 11,024 |
| Utilities | 32,196 |
| Chemicals & Testing | 6,615 |
| Sludge Expenses | 10,719 |
| Insurance | 7,320 |
| Miscellaneous | 18,000 |
| **Estimated Priority I Annual Operation and Maintenance Costs** | **$175,403** |

## 8.3 SEWER SERVICE RATES

There are lengthy and cumbersome methods for establishing sewer rates. Since we expect that Federal and other grant sources will be pursued for the implementation of this Capital Improvement Plan we propose that these rates be set in accordance with the expectations of the most probable construction funding sources.

### Most Probable Funding Sources

*FmHA Loan/Grant Program*

Farmers Home Administration (FmHA) provides funds for the development of wastewater system improvements similar to those needed in the City of Cave Junction. Grant and loan participation is available for communities of under 10,000 population and is based primarily upon median household income (MHI) as measured by the 1990 census data.

Maximum FmHA grant availability based on MHI from 1990 census data is as follows:

| | | |
|---|---|---|
| * | Less than $22,205 | 75% maximum grant |
| * | $22,205 to $27,756 | 55% maximum grant |
| * | Greater than $27,756 | Ineligible for grant |

The City of Cave Junction has a MHI (1990 census) of $12,923, and could qualify for up to 75% grant funding of the project cost. However, FmHA has a limited amount of grant funds available at the State and Federal level. Also, FmHA requires eligible communities to finance the project with loans up to the extent of the community's ability to pay; then the grant is available to cover the remainder. Combining this grant/loan program with another grant program (such as OEDD) would reduce the FmHA project grant demand and therefore stand a better chance of being approved.

In addition to the above, FmHA requires that loans be obtained to the maximum degree possible based on loan debt service being at least a certain minimum percentage of MHI. For the City of Cave Junction, the dept service requirement amounts to 0.5% of $12,923 per EDU, or $5.38/month/EDU (see Chapter 9 for EDU definition). With monthly operation and maintenance costs per EDU for the Priority I improvement project estimated to be $14.15/month/EDU the monthly sewer rate per EDU would be $19.53 per month.

Cave Junction falls within the established criteria for FmHA loans, and this is an excellent financial assistance program. Eligibility criteria for borrowers are as follows:

* Be unable to obtain needed funds from other sources at reasonable rates and terms.

* Have legal capacity to borrow and repay loans, to pledge security for loans, and to operate and maintain the facilities or services.

* Be financially sound and able to manage the facility effectively.

* Have a financially sound facility based on taxes, assessments, revenues, fees, or other satisfactory sources of income to pay all facility costs including operation and maintenance, and to retire the indebtedness and maintain a reserve.

FmHA loans are available for sewer system improvements at the following interest rates as of December 31, 1993:

| | | |
|---|---|---|
| * | MHI less than $22,205 | 5 percent |
| * | $22,205 to $27,756 | 5.125 percent |
| * | Greater than $27,756 | 5.25 percent |

Cave Junction falls into the lowest interest rate bracket (5 percent). The maximum term for all loans to cities is 40 years. However, no repayment period can exceed any local statutory limitation on borrowing authority, nor the useful life of the improvement to be financed. Interest rates are set periodically and are based on the current market yields for municipal obligations. The City would need to advertise bonds on the open market before receiving a FmHA loan, to demonstrate that comparable financing from another source is not available. However, this is often just a formality, as low interest, long term loans are very difficult to obtain in the financial market place.

Since the Cave Junction wastewater improvement project will involve a substantial commitment of FmHA Loan Funds to one project, it may be possible and expected that a combination of loan and grant sources be considered. This could allow for a commitment of loan and some grant funds from FmHA and additional funds from another program, such as the State of Oregon Economic Development Department.

*CDBG Grant Program*

The State of Oregon Economic Development Department administers the Community Development Block Grant (CDBG) program. This program is funded by the U.S. Department of Housing and Urban Development. Funds allocated under this grant program are provided for projects designed specifically to improve the conditions of low and moderate income housing areas. The maximum grant for 1994 will be $750,000 for a construction project. To qualify for a grant the project must meet at least one of the following three national objectives:

* Benefit to low and moderate income persons
* Prevention/elimination of slums and blight
* Urgent need

**Recommended Sewer Rate Structure**

Recent FmHA policy has been to require communities to bring their monthly user rates in line with the average of similar communities in the State of Oregon. This would currently require that Cave Junction raise its monthly sewer rates to $30.00/ month. Since this defeats the purpose of the FmHA grant/loan program, which is to provide funds to needy communities to solve existing water/wastewater infrastructure problems - particularly since the MHI in Cave Junction is so far below the threshold for FmHA funding - we recommend that the City negotiate a more reasonable level of monthly sewer rates which will provide a more reasonable solution to the existing wastewater system problems. We recommend that monthly sewer rates be increased to $21.00 per EDU per month, and that monthly rates for non-residential users be based on the number of EDU's for each facility as indicated on Table 9-1, with one EDU equal to 290 gpd.

## 8.4 Implementation

Based upon the above discussion and recommendations, implementation of Priority I improvements should proceed immediately with the use of FmHA/OEDD financing. The estimated debt service of $5.35/month/EDU will amortize a principal debt of $836,124 for 40 years at 5%. If the ineligible portion of these improvements ($267,128), which represents that portion which provides excess capacity, are added to this debt, the monthly debt service would increase to $7.06/month/EDU, which would require a monthly service fee of $21.21 (including operation and maintenance costs). The balance of the total project cost, or $1,421,904, would be eligible for FmHA/OEDD grants, for a total possible grant participation of 56%.

Systems development fees may be used to reimburse the City for costs associated with the above ineligible portion of the Priority I improvements (or to amortize the loan obtained to pay those costs), and would also be used to finance the proposed Priority II improvements. Chapter 9 outlines these proposed systems development charges.

# CHAPTER 9

## SYSTEMS DEVELOPMENT CHARGES

### 9.1 BACKGROUND INFORMATION

Systems Development Charges (SDC's) are charges assessed against new development in an attempt to recover some of the costs incurred by local government in providing the capital facilities required to serve the new development. SDC's are applied to new development to generate revenue for expansion or construction of municipal facilities located outside the boundaries of new development. This is different from localized improvement districts (LID's) which are often used to assess the cost of constructing or expanding City services on-site, within the development.

Although up-front fees have commonly been charged throughout Oregon in past years to new home buyers and new businesses for expanding City services, the methodology for assessing charges have not always been fair.

During the 1989 Legislature session, lobbyists for local government, the League of Oregon Cities, and the home building industry reached agreement on a bill regulating the use of Systems Development Charges. HG 3224, the Oregon Systems Development Charges Act passed by the 1989 Legislature, governs the requirements for Systems Development Charges as of July 1, 1991.

The purpose of this Chapter is to develop a Systems Development Charge Report for the Wastewater System of the City of Cave Junction which will meet with the 1989 System Development Charge Act (HB 3224).

### 9.2 SUMMARY OF SDC LAW

The League of Oregon Cities prepared the following summary of major features of the SDC law.

1. *Authorized Government Objectives.*

The charge must be for capital improvements that are facilities or assets used for:

a. Water supply, treatment and distribution.
b. Wastewater collection, treatment and disposal.
c. Drainage and flood control.
d. Transportation.
e. Parks and recreation.

Administration office facilities are authorized only if they are an incidental part of the listed capital improvements. Routine maintenance may not be funded from system charges. Charges collected for future improvements must be spent on capacity increasing capital improvements in proportion to the capacity requirements of current projected development.

2. *Methodology.*

An ordinance or resolution must establish the Systems Development Charges. Two general types of fees could be combined into a single charge for each infrastructure system, depending on whether infrastructure improvement capacity was pre-financed or whether the monies are collected toward a future improvement. Several factors, such as the cost of the facilities, value of unused capacity and others must be considered in the methodology.

3. *Infrastructure Plan Relationship.*

A capital improvement plan, public facilities plan, master plan or comparable plan should list the improvements that would be eligible for Systems Development Charges. Modification of the lists in the plans is allowed at any time in order to keep current with development trends. Amendment procedures may exist in other statutes or rules or may, for some types of plans, need to be developed locally. This provision allows the City to measure and analyze facility standards and services that may be related to current or projected development.

4. *Segregated Funds and Fund Accountability.*

The charges collected must be segregated from the general fund and reserved for use only on the specific infrastructure systems for which they were collected. An annual accounting is needed to report total revenues collected for each system and the projects funded.

5. *Credit for Other Exactions.*

There must be a credit available if a builder/developer pays an SDC and also contributes toward the same infrastructure improvement through a development exaction. The credit need not exceed the amount of the systems charge paid. Cities will rely on the plan and methodology to identify instances where the two forms of contribution for one improvement occur. This provision only affects off-site development exactions. It should be noted that the City's existing policy regarding development exactions may not be in conformance with this requirement.

6. *Existing Deficiencies.*

In general, cities will not be authorized to use charges to correct system deficiencies. However, the governing language in the bill is in concept of "capacity increasing" improvements. No short definitions were used to sort out the elusive meaning of rehabilitation or repair.

7. *Judicial Review.*

A statute of limitations outlines a time period to contest methodology. The City would adopt administrative review procedures to enable a challenge of an expenditure. The decision of the City is appealed only by a writ of review. The legal challenge procedures are clear, well-defined and efficient. The remedy for misspent expenditures is replenishment of the fund by a time certain.

## 9.3 REIMBURSEMENT FEE AND IMPROVEMENT CHARGE

The Oregon Systems Development Act permits two types of Charges: a reimbursement fee and an improvement charge.

A **reimbursement fee** is a charge for unused capacity in capital improvements already constructed or under construction. This is a "buy-in" charge for new development to utilize excess capacity in an existing facility that was paid for by others.

Care must be taken to make sure that new development is not charged twice for capital improvements. For example, if an existing improvement was financed with property taxes, then all property, including undeveloped property, paid for the improvement and it may not be equitable to charge a reimbursement fee. Reimbursement fees must be established by City ordinance or resolution setting forth a methodology that considers the cost of the existing facility or facilities, prior contributors by existing users, the value of unused capacity, financing and other relevant factors. The new law requires that the methodology used be available for public inspection.

An **improvement charge** is a fee associated with capital improvements to be constructed. Revenues from improvement charges can only be spent on "capacity increasing" capital improvements. The portion of improvements funded by improvement charges must be related to new development. The Oregon SDC Act requires improvement charges be established by ordinance or resolution setting forth a methodology that considers the cost of projected capital improvements needed to increase the capacity of the systems to which the fee is related. The methodology for establishing fees shall be available for public inspection.

## 9.4 ACCUMULATION OF SYSTEMS DEVELOPMENT CHARGES

This Report identifies certain capital improvements for the City of Cave Junction wastewater system.

Although preliminary Phasing plans have been developed, it is difficult to accurately predict when the facilities will actually be constructed. Therefore, the City needs to periodically review growth patterns (at least once every 5 years) and update the Phasing plan. SDC's historically have been accumulated for time periods of 10 years or less before the money is spent. Developers in some states have filed suits against cities which pooled the money for longer periods of time. We recommend that the City plan to construct high priority items as funding becomes available and the SDC's not be accumulated for any longer than 10 years.

## 9.5 SYSTEMS DEVELOPMENT CHARGE METHODOLOGY

The following methodology has been used to develop the recommended Systems Development Charges.

### General

Development of an equitable SDC for the wastewater system in the City of Cave Junction is needed to help fund future capital improvements. A significant amount of improvement is needed to complete the wastewater system as outlined in this Report.

### Existing Planning Documents

The planning documents used to developed a Capital Improvement Plan and to determine equitable wastewater system SDC's, in addition to this Report, is:

**I/I Analysis & Study of Municipal Sewer System**
**In City of Cave Junction, Josephine County, Oregon**
T. Flatebo & Associates, Inc.
PO Box 100 Ophir, Oregon 97464
January 15, 1994

### Proportionate Share of Costs

Oregon's new SDC Act requires equity among types of development - equal development should pay equal amounts. Charges need to be proportioned based on the burden created by the user. An equitable method is to proportion charges based on the number of equivalent dwelling units (EDY's) created by the development. However, establishing a fair methodology for determining the value of an EDU is one of the most difficult tasks when developing SDC's.

We believe that the fairest method for proportioning the costs of wastewater improvements is based upon proportionate base wastewater flow, which is a function of water use. The flow associated with a typical single family dwelling in Cave Junction is equivalent to 1 EDU and can be calculated as follows:

114 gallons per day per person X 2.54 people/dwelling = 290 gpd/EDU

The flow associated with a new development can be calculated using the typical unit flows shown in Table 10-1 and the facilities to be provided. The number of equivalent dwelling units can then be calculated by dividing the flow for the development by 290 gpd/EDU.

**TABLE 9-1**
**TYPICAL WATER FLOWS**
**BASED UPON TYPE OF FACILITY**

| Type of Facility - Wastewater Source | Average Flow, gpd |
|---|---|
| Assembly Hall | 2 per seat |
| Churches w/Kitchen | 5 per seat |
| Dwellings | |
| - Apartments | 114 per person |
| - Single Family Dwelling | 114 per person |
| Hospitals | 200 per bed |
| Large Commercial | * |
| Laundromat | 450 per machine |
| Motels | 100 per bedroom |
| Restaurants & Lounges | 40 per seat |
| Resorts | * |
| Schools | 20 per student |
| Service Station | 10 per vehicle served |
| Small Commercial Business | 190 |
| Travel Trailer Parks | |
| - w/Individual Water and Sewer Hook-up | 125 per space |
| - w/o Hook-ups, w/Central Bath House | 45 per space |

Notes: * To be calculated by City Engineer on a case by case basis based upon the facilities to be provided.

Unit flows for units not listed shall be as determined by the City Engineer.

## 9.6 WASTEWATER SYSTEM CAPITAL IMPROVEMENT PLAN

The Capital Improvement Plan outlined in Chapter 8 for the wastewater system has been developed as improvements which were identified Chapters 5 and 6, including cost estimates.

## 9.7 REIMBURSEMENT CHARGE

The improvements listed under Priority I in the Capital Improvement Plan within this Report can be divided into those needed to meet existing demand (associated with existing users) and those which will allow future growth (for extra capacity, associated with future users). The latter category of improvements should be paid for through Improvement Charge SDC's.

Existing users will utilize 85 percent of the capacity of the Priority I treatment plant improvements and $11,528 of the Priority I collection system improvements identified in Chapters 5 and 6., or a total of $267,128 in Priority I improvement costs. The maximum improvement fee that the City of Cave Junction could assess for these proposed improvements is as follows:

Assuming that SDC's are collected on a monthly basis continually from January 1, 1995 through December 31, 2002 to cover these costs and that the interest rate charged for amortizing a loan for $267,128 obtained to pre-pay these improvement costs is 5%, the total of monthly payments collected during this period of time represents the total of reimbursement charges collected from the number of EDU's represented implementation of the improvements outlined in the Capital Improvement Plan.

| | |
|---|---|
| a. Total of monthly payments from 1-1-95 through 12-31-02: | $347,147 |
| b. Additional Population served by Priority I and II improvements (4737-1200): | 3537 persons |
| c. Number of EDU's represented by this population(b/2.54): | 1393 EDU |
| d. Maximum Reimbursement Charge (a/c): | $250 |

## 9.8 IMPROVEMENT CHARGE

Priority II improvements are for future users, and Priority II improvements are entirely for future users, and these should be paid for through Improvement Charge SDC's. The January 1995 estimated cost for these improvements is $1,685,096, which can be attributed to new development. If an inflation factor of 4% is used to project these costs to year 2002, these improvements will cost $2,371,099 to construct at that time. The maximum improvement fee that the City of Cave Junction could assess for the proposed improvements is as follows:

Assuming SDC's are collected on a continuous monthly basis from 1-1-95 through 12-31-02 and placed in a sinking fund which pays 4% annual interest rate, the improvement charge SDC per EDU would be the total of such sinking fund payments needed to produce the cost of Priority II improvements on 12-31-02 divided by the number of EDU's represented by the increase in capacity resulting form those improvements.

| | |
|---|---|
| a. Total of sinking fund payments to produce $2,371,099 on 12-31-02: | $2,058,540 |
| b. Number of additional EDU's available ((4737-1200)/2.54): | 1393 |
| c. Maximum Improvement Charge SDC (a/b): | $1478 |

## 9.9 MAXIMUM SYSTEMS DEVELOPMENT CHARGE

The maximum Systems Development Charge which can be collected form developers wishing to connect to the Cave Junction Wastewater system is the sum of the above charges, or $1,728. The actual "hook-up fee" that the City can charge for a new service is the sum of the SDC, the actual cost of the labor and materials for the new service, and the administration costs associated with the new service.

## 9.10 UPDATING WASTEWATER SDC'S

Cost estimated presented in this report should be updated periodically to account for actual inflation. The SDC's should also be updated accordingly. The costs presented above are based on an estimated ENR Construction Cost Index for 1995 as shown in Chapter 5.