Section 5

Wastewater Flows and Loads

SECTION 5
WASTEWATER FLOWS AND LOADS

5.1. General

In order to select and size both collection and treatment facilities for the planning period, projected wastewater flow and organic loading must be determined. The projected flows and organic loadings were determined based on a number of variables including the following:

- Rate of projected population increase
- Land use zoning within the UGB
- Projected per capita and per acre flowrates and organic loadings.

This section develops wastewater flow and loading projections which are used for sizing the collection system components as well as the treatment plant components. The projected design flowrates were determined based on a number of variables including zoning of land within the service area, anticipated development density at buildout and within a 20-year planning period, and projected per capita and per acre flowrates.

5.2. Wastewater Flows

Dry weather flows, wet weather flows, and infiltration and inflow (I/I) are factors that are important in the design of wastewater collection, treatment and disposal facilities. The MMDWF usually determines the maximum organic loadings of the major process units. The MMWWF determines the size and capacity of the major process units necessary to provide the desired degree of treatment. The PHF determines the hydraulic capacity of pipelines, pumps, channels, and inlet structures and the reserve capacity of units such as clarifiers and disinfection facilities.

5.2.1 Flow Classification

For the purposes of monitoring wastewater flows and identifying future design flows, the following flow classifications will be used. The definitions are generally listed in order of increasing flows.

- Base Sewage Flow (**BSF**) – Average daily wastewater flow during the dry summer months. During these periods, base infiltration may be present, but rainfall induced infiltration and inflow is absent. Therefore, the flows consist mainly of sanitary sewage, as well as commercial and industrial waste discharges. The base sewage flow is assumed to be the average daily measurement over the months of August and September.

- Average Dry Weather Flow (**ADWF**) - Average daily wastewater flow during the months of May through October. This time period corresponds to the time when surface water discharge is typically prohibited in systems permitted to discharge during only the winter months. This value is used to size summer land application facilities as well as summer storage facilities. The ADWF is usually slightly higher than the base sewage flow due to modest amounts of infiltration and inflow that occur on the shoulders of the dry season.

- Average Annual Flow (**AAF**) - Average daily wastewater flow during the entire year.

- Average Wet Weather Flow (**AWWF**) - Average daily wastewater flow during the months of November through April. This time period corresponds to the time when surface water discharge is typically permitted in systems allowed to discharge during only the winter months.

- Maximum Month Dry Weather Flow (**MMDWF**) - The monthly average flow with a 10 percent probability of exceedence during the months of May through October in any given year. In other words, this flow represents the wettest dry weather season monthly average flow that is anticipated to have a ten-year recurrence interval. For western Oregon. May or October are usually the months which have the highest dry weather flow.

- Maximum Month Wet Weather Flow (**MMWWF**) - The monthly average flow which with a 20 percent probability of exceedence during November to April in any given year. This flow represents the wettest wet season monthly average flow that is anticipated to have a five-year recurrence interval. For western Oregon, December or January are usually the months that have the highest wet weather flow.

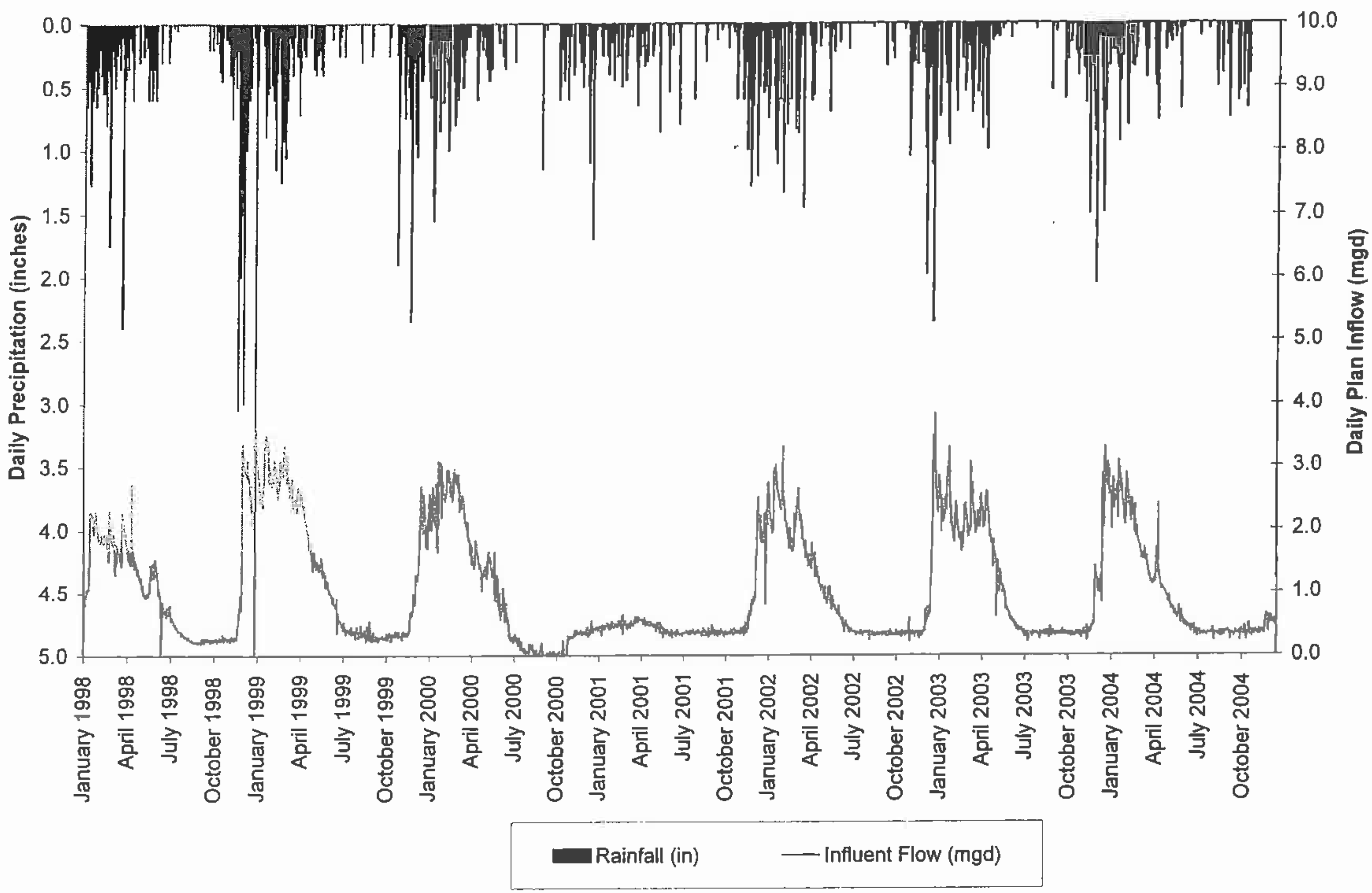
- Peak Daily Average Flow (**PDAF**) – The peak daily flow associated with a 5-year, 24-hour storm. In western Oregon the peak daily flow always occurs during the wet season. Therefore PDAF is often referred to as the maximum day wet weather flow.

- Peak Hour Flow (**PHF**) - Maximum flow over an hour duration experienced during a five-year, 24-hour storm. This value typically determines the maximum hydraulic capacity of major process units, trunk sewers and pump stations without surcharging.

5.2.2 Existing Wastewater Flows

To determine the existing wastewater flows, data from the discharge monitoring reports (DMR's) from January 1998 through October 2004 was analyzed. Daily plant inflow and rainfall measurements recorded at the WWTP are plotted in **Figure 5-1** over this timeframe. As shown in **Figure 5-1**, plant inflow is strongly related to rainfall. This is common for wastewater collection systems in the Willamette Valley. Winter rains cause groundwater levels to rise. The groundwater enters the collection system through faults and cracks in the collection piping and manholes (infiltration) and through direct connections to storm drainage collection facilities (inflow). Infiltration and inflow (I/I) results in increased flows measured at the treatment plant. As shown in **Figure 5-1**, plant inflows during the winter months are significantly higher than flows during the dry summer months.

Figure 5-1: Precipitation Effects on Plant Inflow



In some collection systems, rainfall induced infiltration and inflow causes flows to increase above the capacity of the pump stations and gravity collection piping. When this happens, the conveyance facilities can no longer convey the flow and water backs up or surcharges the collection piping. Surcharging reduces the hydraulic gradient between the water outside of the conveyance facilities and the water inside the conveyance facilities. Since the hydraulic gradient is reduced, the driving force pushing the water into the pipes and manholes is reduced and a net decrease in the total volume of infiltration and inflow occurs. If the conveyance facilities had infinite capacity, no surcharging would occur and the amount of infiltration and inflow would approach some theoretical maximum value. This theoretical maximum value would vary depending upon the degree to which the soil was saturated, the ability of the soil to convey water, the number of faults in the collection system, and the amount of rainfall that has recently occurred. One challenge in wastewater facilities planning is to estimate the maximum amount of infiltration and inflow that would occur if the conveyance facilities had infinite capacity and were not subject to surcharging. This theoretical maximum flow rate is often referred to as the amount of flow that would occur if all bottlenecks in the system were removed.

A typical approach used to estimate peak flows without bottlenecks involves first assuming a strong correlation between rainfall and wastewater flows exists. This assumption is typically valid in gravity collection systems in the Willamette Valley. A mathematical relationship is then established between rainfall and flow. Linear regression or multiple linear regression techniques are typically used to establish the relationship between rainfall and wastewater flow. The data used to establish the relationship is carefully chosen to avoid using measurements collected under a surcharged condition. In this way, the mathematical relationship between flow and precipitation does not include the flow-decreasing effects of surcharging. OAR 340-041 prohibits the discharge of raw sewage to waters of the State except during storm events greater than the 5-year, 24-hour storm. To this end, the DEQ recommends at a minimum treatment facilities should be hydraulically sized to accommodate flowrates expected from a wet weather 5-year, 24 hour storm. Based on historic trends, the rainfall associated with a 5-year, 24-hour storm may be readily determined. This rainfall amount is entered into the precipitation-flow model to predict the wastewater flow associated with a 5-year, 24-hour storm.

This approach works well for most systems in the Willamette Valley. However, in Junction City, several unusual factors are present. Together, these factors make it difficult to correlate rainfall and wastewater flow rates. Without such a correlation, estimating the maximum flows that would occur if all the bottlenecks were removed is more complicated. Brief discussions on each of these factors together with their effect on wastewater flows are presented in the following paragraphs.

- <u>Faulty collection piping</u> – A significant portion of the gravity collection piping in the City was constructed in 1948 using concrete mortar joint pipe. In this type of construction, concrete mortar is used to seal the joints between individual pipe sections. As the pipes settle and shift, the mortar readily cracks leading to a loss of water tightness in the joint. Concrete pipe is typically constructed in three-foot sections. Therefore more joints are needed in a concrete pipeline than in a PVC pipeline. The concrete pipelines in Junction City are now more than 50 years old. Due to the age of the piping, there are likely to be a large number of faults in the concrete pipe material in addition to the faults at the joints. In round numbers, there is approximately 100,000 feet of gravity collection mains in the City. During the peak day, approximately three million gallons of I/I is collected and conveyed to the WWTP. Therefore, across the entire system, the average volume of I/I collected per foot of pipe is approximately 30 gallons per foot of mainline sewer. This number is extremely high when compared to newer systems. In short, the high frequency of pipe faults results in an unusually high infiltration rate. If the bottlenecks in the system were removed, the amount of I/I collected would likely increase to the point that treatment becomes economically unfeasible.

- <u>Flat Topography</u> - Junction City is relatively flat across the entire UGB. The difference between the maximum and minimum elevations in town is approximately 15 feet. As a result, nearly all of the gravity collection piping is constructed at minimum grades. Therefore, when the system becomes surcharged, the surcharging extends across a relatively large area. As explained above, surcharging tends to decrease the total amount of groundwater that infiltrates into the collection piping. Due to the relatively flat nature of the gravity collection piping, the extent to which this effect occurs is rather pronounced in Junction City. The relatively leaky nature of the collection piping and the flatness of the collection piping make it difficult to find periods of rainfall induced infiltration and inflow that are not affected by surcharging.

- <u>Hydraulically Conductive Soils</u> – Much of Junction City is constructed over alluvial deposits placed as the Willamette River channel meandered across the floodplain. Therefore, much of the native material surrounding the gravity collection piping is composed of high percentages of sand and gravel. Groundwater readily flows through these types of formations. Therefore, a relatively large amount of water is required to saturate these materials to the point that groundwater elevations rise. Likewise, once saturated, a large amount of water must be removed to lower groundwater elevations.

  The rate at which groundwater enters the collection piping is a function of the hydraulic gradient or driving force across the pipe wall. During dry periods when the groundwater elevation is below the gravity piping, no hydraulic gradient exists across the pipe wall, and no infiltration occurs. During these periods, even significant amounts of rainfall do not increase wastewater flows. As the surface water percolates though the ground it moves past the piping to the groundwater level. Due to the relative ease with which water flows through the unsaturated material, very little water pressure is developed on the outside of the pipe. With hydraulically conductive soils, very little infiltration will occur until the groundwater increases above the top of the pipe. At this point, a positive hydraulic gradient across the pipe wall is established and groundwater is forced into the pipe through cracks and faults.

In 1986, Westech Engineering prepared and I/I control plan for the City. In this document, groundwater elevations were plotted on the same graph as plant inflows. The results of this analysis showed that very little infiltration and inflow occurred until groundwater elevations rose above elevation 316 as measured at the 7th & Front Street well. Though the City no longer collects groundwater elevation data, the current flow data shows that this effect still exists. The reader is again referred to **Figure 5-1**. During dry periods when groundwater elevations are below the collection system piping, the wastewater flow rates remain relatively constant. However, with the onset of winter rains the groundwater becomes saturated and dramatic increases in the flow are observed. In Junction City, infiltration is either "on" or "off" depending upon whether the groundwater is above or below the elevation of the gravity collection piping. As is often the case, the exception proves the rule. Consider the winter or 2000-2001. This was a particularly dry year. Based on the rainfall data, a total of approximately 18 inches of rainfall fell between November 1, 2000 and April 30, 2001. This is approximately half the depth of rainfall normally observed over this timeframe. Due to the lack of rainfall, the groundwater elevations never rose above the collection piping and very little infiltration occurred.

Due to a combination of the above factors, drawing a mathematical correlation between rainfall and wastewater flow that may be accurately used to predict the wastewater flow rate that would occur if all bottlenecks were removed is difficult. Very little rainfall induced infiltration occurs until the groundwater level rises above the elevation of the gravity piping. Once this happens, flows dramatically and rapidly increase over a few days. Due to the quantity of infiltration, the system is almost immediately surcharged and the amount of infiltration tends to reach some constant value that is relatively uninfluenced by rainfall quantities. This situation is further complicated by the fact that all wastewater in Junction City is pumped to the treatment plant. To some extent, the quantity of infiltration is a function of the pumping capacity of the wastewater pump stations. As explained in **Section 4**, during wet periods, all of pumps at both the 14th and Elm and 9th & Ivy stations run continuously for weeks at a time. If the capacity of these stations were to be increased, the quantity of infiltration would also increase. At some point, as the capacity of the pump stations was increased, the system would eventually be dewatered. However, the expense of conveying, treating, and disposing of this quantity of water is likely to be cost prohibitive.

A mathematical correlation could likely be drawn between wastewater flow and groundwater elevation if groundwater elevation data were available. Ultimately rainfall controls both groundwater elevations and, consequently, infiltration rates. Therefore, a model could be developed that considers both rainfall and groundwater. Such a model would be of a regional nature and would be very complex, data intensive, and expensive to develop. Needless to say, such a model is beyond the scope of the typical facilities planning effort. Furthermore, it would be of limited use in Junction City since there is very little flow data that is influenced by infiltration when surcharging is not widespread in the collection system.

As described in the previous paragraphs, the City's collection system accumulates excessive amounts of I/I. For this reason an aggressive I/I reduction program is recommended in **Section 6**. As the older portions of the collection system are rehabilitated, I/I in these areas will decrease. At the same time, other areas of the collection system will continue to age and I/I in these areas will increase. For planning purposes, it is assumed that the I/I reduction from the rehabilitation program will be cancelled by the I/I increases in other areas of the collection system and the total amount of I/I will remain equal to what it is today. One of the primary recommendations of this plan is to implement I/I reduction efforts aimed at maintaining existing levels of I/I. As such, there is no need to estimate peak flows in the absence of bottlenecks. In order to project future flows, existing I/I is assumed to remain constant through the planning period.

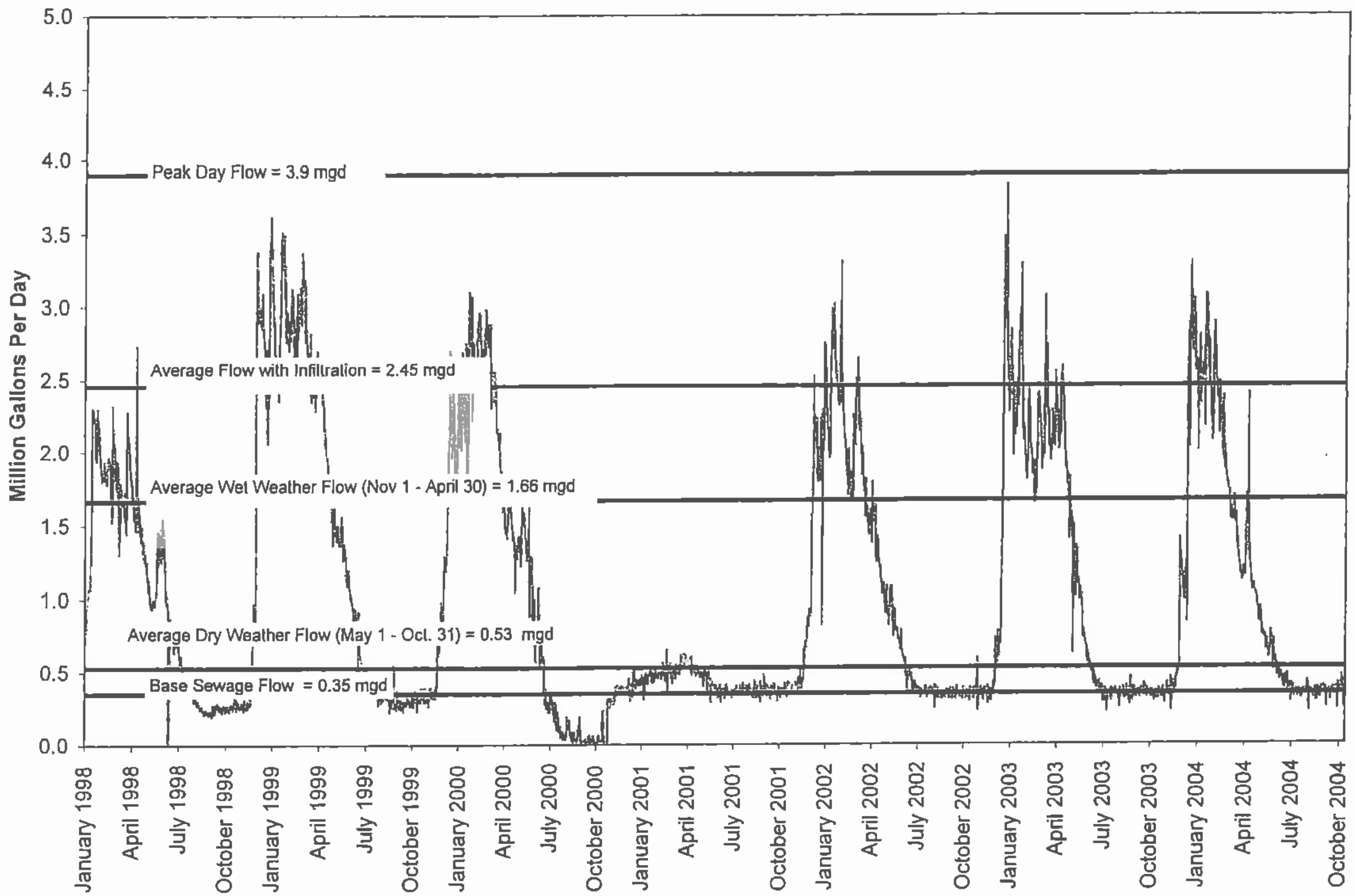
The existing flows may be determined from the data presented in **Figure 5-1** as illustrated in **Figure 5-2**. Only data from November 1, 2001 to October 31, 2004 was used in the calculations. This data is believed to be the most representative. A new flow meter was installed at the WWTP in summer of 2001. All measurements collected prior to this time were made by the old flow meter installed as part of the original plant in 1968. Due to the age of the flow meter, the reliability of the data prior to the summer of 2001 is suspect. Also, the effect of population changes from late 2001 to the present are less dramatic than the effects of population growth from 1998 to the present.

As shown in **Figure 5-2**, the base sewage flow is 0.35 mgd. This flowrate is the average flow during the months of August and September. It is assumed to be composed of wastewater with only a slight possibility of base infiltration. This value is fairly consistent and repeatable during the dry season and from year to year. The average dry weather flow is 0.53 mgd. This is the average flow between May 1 and October 31. These dates correspond to the time when surface water discharge is prohibited in systems permitted to discharge during the winter months. It is slightly elevated over the base sewage flow due to modest amounts of infiltration that occurs during the shoulders of the dry season. The average wet weather flow is 1.66 mgd. This is the average flow between November 1 and April 30. The average flow during the wettest winter months is 2.45 mgd. This value is comprised of two components. The first component is the base sewage flow (0.35 mgd). The flow above the base sewage flow (i.e., 2.1 mgd = 2.45 mgd – 0.35 mgd) is assumed to be the amount of infiltration that occurs when the groundwater is above the elevation of the collection piping. This represents the flow observed at the treatment plant when the groundwater is "on." The difference between the peak day flow and the average flow with infiltration (i.e., 1.45 mgd = 3.9 mgd – 2.45 mgd) is assumed to be the result of rainfall induced infiltration and inflow. The existing flow components are listed in **Table 5-1**.

TABLE 5-1
Existing Flow Components with Bottlenecks

Flow Component	Base Sewage Flow Component (mgd)	Groundwater Infiltration Component (mgd)	Rainfall Induced I/I Component (mgd)	Total Flow (mgd)
BSF	0.35	0	0	0.35
ADWF (May 1 – Oct 31)	0.35	0.18	0	0.53
AWWF (Nov 1 – April 30)	0.35	1.31	0	1.66
Average Flow with Infiltration	0.35	2.10	0	2.45
PDAF	0.35	2.10	1.45	3.90

Figure 5-2: Existing Flows
(Measured at the WWTP)



5.2.3 Wastewater Flow Projections

The development and forecasting of wastewater flowrates is necessary to determine the design capacity of the different components of the collection and treatment system. Average and peak flowrates need to be developed for both the existing conditions and the future (design) conditions. The design of different components of the collection and treatment system is based on different magnitude flowrates and loadings.

5.2.3.1 Basis of Flow Projections

The major components of the total wastewater flow include domestic, commercial, industrial and institutional sources which are either existing or anticipated to develop during the study period, as well as adequate allowances for infiltration and inflow (I/I). The basic criteria used for projecting future wastewater flows in this section are outlined in **Table 5-2**.

TABLE 5-2
Flow Projection Basis

Flow Category	Design Criteria
• Base Sanitary Sewer Flow in Existing Sewered Areas	1000 gpad
• Future Base Sanitary Sewer Flow	100 gpcd
• Average Household Size	2.35 people/unit
• Housing Unit Density	
- Low Density Residential	5.5 units/acre
- Medium Density Residential	17 units/acre
• Base Sanitary Flow Per Acre	
- Low Density Residential	1300 gpad (13 people/acre)
- Medium Density Residential	4000 gpad (40 people/acre)
- Commercial/Residential	4000 gpad (40 people/acre)
- Commercial	1500 gpad (15.0 people/acre)
- Industrial (assumes 'dry' industries)	1500 gpad
- Technological (assumes 'dry' industries)	1500 gpad
- Public	1500 gpad
- Agricultural	1500 gpad
Peaking Factors for Estimating Peak Hourly Flow Rates	
• Residential Flows	3.0
• Commercial Flows	3.0
Infiltration/Inflow (I/I)	
• Net Population Density	5 people acre (4,342 people / 869 acres)
• New Gravity Sewers	320 gpcd (1600 gpad / 5 people acre)
• Existing Sewers	As measured
Projected Flow = (Existing Base Flow + New Base Flow)*Peaking Factor + Existing I/I + I/I From New Development	

A short discussion of each of these flow and loading components follows.

a) Domestic Flows

Domestic flow is waste generated from normal residential households. For planning purposes, the average daily per capita rate of 100 gallons per capita per day (100 gpcd) has been selected for this study. The population densities listed in **Table 5-2** were used together with the average daily per capita flow rate to project domestic use on a per acre basis.

b) Commercial Flows

Allowances for commercial sewage flows often can be equated with the per capita flows developed for domestic sewage. For this study, sewage flows expected from commercial areas were based on an anticipated average employed population of 30 employees per acre. Average sewage contribution from commercial areas can vary from 10 to 150 gpcd, with a typical average of 50 gpcd. Office and retail establishments usually contribute 12 to 25 gpcd while hotel and motels contribute flows from 50 to 150 gpcd. Based on 30 employees per acre and average commercial flow of 50 gpcd, this would mean that flow contribution from these areas would be 1,500 gallons per acre per day (gpad). It is assumed that the peak flow for these commercial areas would follow the same relationship that has been established between the peak and average flow rates for residential areas.

c) Industrial and Technological Flows

It is difficult to predict the exact type or extent of future industrial development that may occur in the industrial and technological land use designations in Junction City. Industrial flows vary considerably depending on the type of industry (wet or dry). Flows from industries such as light manufacturing and machinery typically are not much greater than flows from residential areas.

Some industrial users (i.e., food processors or silicon wafer fabricators) require very large quantities of water and generate correspondingly high wastewater flows and loadings. For the purposes of this study, projected wastewater loadings from projected industrial development in Junction City are based on "dry industries." BOD and suspended solids concentrations similar to domestic sewage are assumed. Should any industrial user capable of producing large wastewater flows, higher concentrations, or hazardous effluent want to locate in Junction City, a careful review should be made to determine if the collection system and the treatment and disposal system can adequately serve the industry.

For this study, wastewater flow rates were based on an average employed population of 30 persons per acre and an average employee wastewater flow contribution of 50 gpcd. This means for lands zoned as industrial or technological within the study area, the average flow would be 1,500 gpad. The peak flow for these industrial acres would follow the same general relationship as was discussed previously for residential areas.

d) Peaking Factors

Sanitary wastewater flows into the collection system will vary significantly throughout the day. In order to adequately design a sewage collection and treatment system, it is critical to be able to predict the peak wastewater flows rather than simply the average flowrates. Peaking factors are the ratio of peak flow to average flow, and are often related to the population served. It can be noted that as the population increases, the peaking factor tends to be less pronounced. At the population levels projected to occur in the basins throughout the City, peaking factors of 2.75 to 3.5 are typical. For the purposes of this report a peaking factor of 3.0 was assumed.

e) Infiltration and Inflow

Estimates of peak I/I flows are necessary to adequately size sewers, pump stations, and treatment facilities, in order to prevent bypasses of untreated or partially treated sewage into waterways or other areas.

Although modern sewer construction techniques make it possible to install sewer systems that will be relatively tight initially, infiltration and inflow into these systems may increase over time due to various physical factors and deterioration of sewer system components. Proper inspection and maintenance of the collection system is essential to controlling I/I over the long term.

For planning purposes, the portion of I/I contributing to the existing peak flows as identified above is assumed to remain constant through the planning period. The City currently has an I/I reduction program. As discussed in **Section 6**, the recommended improvements include expanding the scope of the City's I/I reduction plan. The recommended I/I reduction plan includes replacing much of the old collection system over a period of many years. As such, I/I in the target areas will be reduced. However, as other portions of the collection system continue to age I/I in these areas will likely increase. Therefore, it is assumed that the I/I reductions resulting from the recommended corrective work will be offset by increases in I/I associated with the continued aging of the system and no change in the system-wide I/I quantities will occur. Therefore, the existing I/I identified above will be included without modification in the projected wastewater flows.

An I/I allowance of 1600 gallons per acre for the peak hour I/I flow was assumed for areas to be developed in the future. The information presented in the City's existing Comprehensive Plan was used to determine the total land requirements required to accommodate the projected population increase during the planning period. Based on the buildable lands inventory included in the City's Comprehensive Plan, the population was expected to increase by 4,342 people from 1980 to 2000. Based on the development densities identified in the Comprehensive Plan, an additional 869 acres of land was estimated to be required to accommodate this additional population. These development assumptions equate to a net increase in developed area of 0.2 acres people per person (869 acres/4,342 people). The projected I/I from future development was therefore determined by multiplying 1600 gpad * 0.2 acres per person * the population increase.

5.2.3.2 Future Wastewater Flows

The projected flowrates are based on the following assumptions.

- Flow rates will increase in proportion to population increase.
- The per capita flow rate will remain constant during the planning period.
- The population will increase by the projected percentage each year during the planning period.
- There will be no contribution from "wet" industries during the planning period. Commercial and industrial development will be "dry" with flows comparable to residential developments.
- The City's infiltration and inflow reduction program will prevent any increase in infiltration and inflow into the existing collection system.
- All growth will occur in conformance with current land use policies as outlined in the City's Comprehensive Plan.

Table 5-3 summarizes the projections for the different components of the wastewater flow over the 20-year planning period for the WWTP.

TABLE 5-3
Wastewater Flow Projections

Year	Population	BSF (mgd)	ADWF (mgd)	AAF (mgd)	AWWF (mgd)	PDAF (mgd)	PHF (mgd)
2004	4900	0.350	0.530	1.090	1.660	3.900	4.600
2005	5330	0.393	0.577	1.155	1.744	4.073	4.867
2010	6030	0.463	0.653	1.262	1.881	4.354	5.301
2015	6810	0.541	0.738	1.380	2.034	4.668	5.784
2020	7690	0.629	0.834	1.514	2.207	5.022	6.330
2025	8690	0.729	0.943	1.666	2.403	5.424	6.950
2029	9580	0.818	1.040	1.801	2.577	5.781	7.502

5.2.3.3 Projected Flows By Sewer Basin

In order to evaluate the capacity of each pump station and the associated trunk sewers, the peak discharge from each basin must be estimated for the design year. The peak flow from each basin at a buildout condition was determined by summing the following quantities.

- Existing base sewage flow
- Existing I/I contribution
- Additional base sewage flow
- Additional I/I from future development

The total existing base sewage flow was allocated to each basin by multiplying the total base flow by the ratio of the number of connections in each basin to total number of connections in the City. The pump run times for the last five years were used to estimate the portions of the I/I from each basin. This analysis showed that 14th & Elm and 9th & Ivy are the largest contributors to the total I/I. The additional base sewage flow was determined by multiplying the sewage flow per acre for each of the land uses (see **Table 5-2**) by the area of undeveloped land for each land use within each basin. The additional I/I from future development was determined by multiplying 1600 gallons per acre per day by the total undeveloped area within each basin.

The projected flows at buildout are listed for each basin in **Table 5-4**. It is worth noting that the sum of the projected flow from each basin at the end of the planning period is greater than the projected flow for the entire City. This is due to the fact that not all basins will peak at the same time. Basins that are largely comprised of residential uses will peak in the mornings and the evenings. Basins that are comprised of predominately Industrial or Commercial uses are likely to peak at other times. The flows listed in **Table**

5-4 are peak hourly flows that each of the pump stations serving the basins must be able to convey.

One final point of emphasis should also be made. This Facilities Plan is based on the assumption that existing I/I flows will not increase. Much of the City's core collection system is more than 50 years old. Therefore, many of the original pipes are likely to approach the end of their useful life during the planning period. As the system continues to age, the City must aggressively implement I/I correction measures. This is discussed in more detail in **Section 6.**

TABLE 5-4
Projected Peak Flows By Basin
(Estimated peak hour flows for pump station and trunk sewer sizing)

Basin	Total Area (Acres)	Developed Area 2004 (Acres)	Undeveloped Area 2004 (Acres)	2004 PHF (mgd)	Buildout PHF (mgd)
14th & Elm	291	277	14	2.505	2.588
17th & Ivy	90	32	58	0.193	0.545
Chapel Creek	145	87	58	0.405	1.014
Rosewood Estates	60	39	21	0.183	0.296
10th & Rose	159	68	91	0.318	0.849
9th & Ivy	134`	134	0	0.998	0.998
3rd & Maple	194	77	118	0.356	1.103
1st & Monaco	216	31	185	0.143	1.272
West 10th	333	0	333	0	1.685
Prairie Road	207	0	207	0	1.242
South Industrial	263	0	263	0	1.604
Totals	2091	745	1346	5.101	13.195

5.3. Wastewater Composition and Loading

The composition and concentration of wastewater constituents are important in the design of wastewater treatment and disposal facilities. Treatment processes are designed hydraulically to pass the design flowrates while providing adequate treatment, or removal, of the organic and solids components from the wastewater. Wastewater composition is less important for the design of collection and pumping systems where the hydraulic considerations control.

For the purposes of monitoring wastewater loads and identifying future design loads, the following classifications will be used:

- Average Load - Average daily wastewater load.
- Maximum Load - Maximum month wastewater load.

5.3.1 Historic Wastewater Composition

The BOD and TSS concentrations in the influent wastewater are measured on a weekly basis. These concentrations have been converted to loading rates and are shown for 2002 through 2004 **Table 5-5**.

TABLE 5-5
Historical Annual & Monthly Loading At WWTP

Year	Population	BOD			TSS		
		Average Annual (ppd)	Maximum Month (ppd)	Average Annual Per Capita Loading Rate (ppcd)	Average Annual (ppd)	Maximum Month (ppd)	Average Annual Per Capita Loading Rate (ppcd)
2002	4750	3,372	5,585	0.71	4,615	8,542	0.97
2003	4750	3,837	6,905	0.81	5,059	10,719	1.06
2004	4900	2,514	5,555	0.51	2,666	8,955	0.54
Average	4,800	3,241	6015	0.68	4113	9,405	0.86

Based on the engineering literature, typical BOD values in domestic wastewater fall in the range of 0.11 – 0.26 pounds per capita per day. TSS values are typically in the range of 0.13-0.33 pounds per capita per day. As shown in **Table 5-5**, BOD and TSS loading rates in Junction City are well above these ranges. The elevated BOD and TSS measurements suggest that a high-strength industrial user contributes a relatively large organic and solids load to the City's waste stream.

As part of the facilities planning effort, the City collected and analyzed wastewater samples at various locations in the collection system to determine the source of the high-strength waste. Through this work, the City believes they have identified the source of the high-strength waste stream and have entered into negotiations with the industrial user to remove the waste stream from the City's system. The city collected 24-hour composite samples for several days at both the WWTP and in a manhole immediately downstream of the industrial user. These samples were analyzed for both BOD and TSS concentrations. Influent flow rates at the plant and water meter readings from the industrial user were used to calculate loading rates for each day. The results of this sampling effort are shown in **Table 5-6**.

As shown in **Table 5-6**, the average BOD and TSS loading rates at the WWTP over the duration of the sampling period were 1612 lbs./day and 691 lbs./day respectively. Over this same time period, the average BOD and TSS loading rates for the industrial user's waste stream were 1021 lbs./day and 305 lbs./day respectively. The solids and organic loading for the balance of the users may be calculated from this data by subtracting the industrial waste stream from the plant influent and dividing by the population of the City (i.e., 4,900). These calculations yield domestic per capita BOD and TSS loading rates of 0.12 and 0.08 respectively. These values are within the ranges of those typically observed for domestic wastewater.

TABLE 5-6 High-Strength Industrial User Solids and Organic Loading Rates										
Day	WWTP					Industrial User				
	Flow (MGD)	BOD Conc. (mg/L)	TSS Conc. (mg/L)	BOD Loading (ppd)	TSS Loading (ppd)	Flow (MGD)	BOD Conc. (mg/L)	TSS Conc. (mg/L)	BOD Loading (ppd)	TSS Loading (ppd)
11/16/2004	0.370	439	140	1355	432	0.018	4670	1250	714	191
12/01/2004	0.410	266	192	910	657	0.018	2920	580	446	89
12/07/2004	0.480	529	257	2118	1029	0.021	8780	3490	1534	610
12/08/2004	0.530	467	146	2064	645	0.019	8560	2040	1388	331
Averages	0.448	425	184	1612	691	0.019	6233	1840	1021	305

Based on the data presented in **Table 5-6**, the industrial user accounts for approximately 60% of the total organic loading at the WWTP. It is cost prohibitive to size the recommended treatment facilities to include the high strength industrial user's waste. Maximum loading rates for facultative lagoons in Western Oregon are typically 35 pounds per acre per day. In order to treat the industrial waste stream and additional 29 acres (1021 ppd / 35 ppad = 29 acres) of lagoons must be constructed. At a rough cost of $65,000 per acre, the total cost for these lagoons would be $1,885,000. Clearly, this is a significant burden for the City's ratepayers. It is unreasonable to expect the City to underwrite the industrial user's operating costs. As such, the City has entered into negotiations with the industrial user to remove their waste stream from the City's system. This will require that the industrial user either pretreat their wastewater or make process modifications. It is further recommended that the City require the industrial user to install a metering manhole in accordance with Section 4.16(i) of the City's Public Works Design Standards. In addition, the City should perform an evaluation to determine if any other industrial users are categorical as set forth in 40 CFR 403. If other categorical industrial users are found, the City should establish a pretreatment program.

At the time this document was originally written, the industrial user was still in the process of installing a pretreatment system. Until that system is in place for a few years, it will be impossible analyze the plant influent strength without the industrial user. As described on the previous page, the spot measurements listed in **Table 5-6** show that when the loads from industrial waste stream are subtracted from the total inflow to the plant, the waste strength is similar to that of typical residential wastewater. Therefore, it seems reasonable to conclude that without the high strength industrial user, the influent loading to the treatment plant will be equal to that commonly observed for residential wastewater. The approach described below for determining the wastewater load projections is based on this conclusion. Therefore, a fundamental assumption of this facilities planning effort is that the high-strength industrial user will be removed from the City's waste stream. Once the industrial user's pretreatment system is in place, it will be incumbent upon the City to continuously monitor the influent wastewater loading to the plant to ensure that the pretreatment system is functioning properly. A dramatic and sudden increase in influent loading rates to the treatment plant is an indication that the industrial user's pretreatment system is not working properly.

5.3.2 Wastewater Load Projections

Similar to flows, the total wastewater loads are expected to increase directly proportionally to the increase in population. As discussed in the previous section, it is assumed that the high-strength industrial user will be removed from the City's waste stream and that the facilities will be sized for typical domestic waste strength only. The projected loadings are based on the following assumptions.

- Design values of 0.22 ppcd and 0.24 ppcd for average dry weather load conditions were used for BOD and TSS, respectively.
- The loads will increase proportionally with population and commercial/industrial development, which will increase by the projected percentage each year during the planning period.
- The per capita BOD and TSS load rate multiplied by the projected population equals the residential, commercial and industrial component of the load.
- There will be no significant industrial contribution beyond typical residential strength sewage during the planning period.

The per capita loads and resulting load projections for 20-year planning are shown in **Table 5-7**.

TABLE 5-7
Wastewater Load Projections

Year	Population	Average Daily BOD (ppd)	Average Daily TSS (ppd)
2004	4900	1078	1176
2005	5330	1173	1279
2010	6030	1327	1447
2015	6810	1498	1634
2020	7690	1692	1846
2025	8690	1912	2086
2029	9580	2108	2299

5.4. Summary of Flows and Loading

The recommended design flows and loads for the City's wastewater treatment facilities are summarized in **Table 5-8**. These values will be used in subsequent sections of this Facilities Plan.

TABLE 5-8
Projected Flows And Loads, 2029

Component	
BSF – Base Sewage Flow (mgd)	0.818
ADWF – Average Dry Weather Flow (mgd)	1.040
AAF – Average Wet Weather Flow (mgd)	1.801
AWWF – Annual Average Flow (mgd)	2.557
PDAF – Peak Daily Average Flow (mgd)	5.781
PHF – Peak Hour Flow (mgd)	7.502
Average BOD (ppd)	2108
Average TSS (ppd)	2299