CHAPTER 4. WASTEWATER FLOWS AND LOADS

Operations personnel at the Water Reclamation Facility (WRF) regularly monitor influent and effluent parameters and report these data to Oregon Department of Environmental Quality (DEQ) on a monthly basis as required by their National Pollutant Discharge Elimination System (NPDES) permit. This chapter summarizes data from the discharge monitoring reports (DMRs) and analyzes recent data to estimate current wastewater flows and loads. Unit flow and loading rates were then developed and used along with population and land use projections presented in Chapter 2 to prepare flow and load projections for future conditions through the year 2029. The flow and load projections serve as the basis for assessing the adequacy of the existing treatment systems and sizing new treatment facilities.

EXISTING FLOWS

The analysis of historical flow and load data forms the basis of developing wastewater flow projections. The following assessment of current flow conditions for the WRF is based on operating data from January 1996 through September 2007.

Wastewater Flows

Since wastewater flows are variable seasonally and in response to precipitation, a number of different flow conditions are important in sizing and evaluating wastewater treatment plants.

Definitions. The flow rated and related parameters discussed in this chapter are defined below:

- *Average Summer Flow (ASF).* The average daily flow over the 3-month summer period, July through September.
- *Average Dry Weather Flow (ADWF).* The average of daily flows over the six-month dry weather season, from May 1 through October 31.
- *Average Annual Flow (AAF).* AAF is defined as the average daily influent flow at the treatment plant. It is calculated as the average of ADWF and AWWF.
- *Average Wet Weather Flow (AWWF).* The average flow at the plant during the wet weather season (November 1 through April 30) during a year with average rainfall.
- *Maximum Month Dry Weather Flow (MMDWF).* The monthly average flow corresponding to the wettest dry weather month of high groundwater (May) with a 10 percent probability of occurrence in any given year. The recurrence interval of this flow is ten years.
- *Maximum Month Wet Weather Flow (MMWWF).* The anticipated monthly average flow corresponding to the wettest wet weather month of high groundwater (January) with a 20 percent probability of occurrence in any given year. The recurrence interval of this flow is five years.
- *Maximum Week Wet Weather Flow (MWWWF).* The weekly wet weather average flow with a 20 percent probability of occurrence in a given year.

- *Maximum Week Dry Weather Flow (MWDWF).* The weekly dry weather average flow is the flow with a recurrence probability of 1.92 percent in a given year.
- *Maximum Day Dry Weather Flow (MDDWF).* The anticipated daily flow corresponding to a 1-in-10 year recurrence interval during the dry season (May through October).
- *Maximum Day Wet Weather Flow (MDWWF).* The anticipated daily flow resulting from a 24-hour storm with a 1-in-5 year recurrence interval during a period of high groundwater and saturated soils.
- *Peak Hour Flow (PHF).* The peak flow sustained for one hour during the 24-hour, five-year return frequency storm at a time when groundwater levels are high and soils are already saturated by previous storms.

Rainfall Records

Rainfall has a large effect on flow rates during the wet weather season. DEQ flow analysis guidelines incorporate rainfall records into the recommended statistical analysis. Daily rainfall data collected at the WRF have been used for this analysis. Statistical summaries of climatological data prepared by National Oceanic and Atmospheric Administration (NOAA) were also used. NOAA prepares statistical summaries of climatologic data for selected meteorological stations. The most recent climatologic statistical summary for the McMinnville Weather Station was issued in 2004 and is based upon data collected from 1971 through 2000.

Flow Records and Measurement

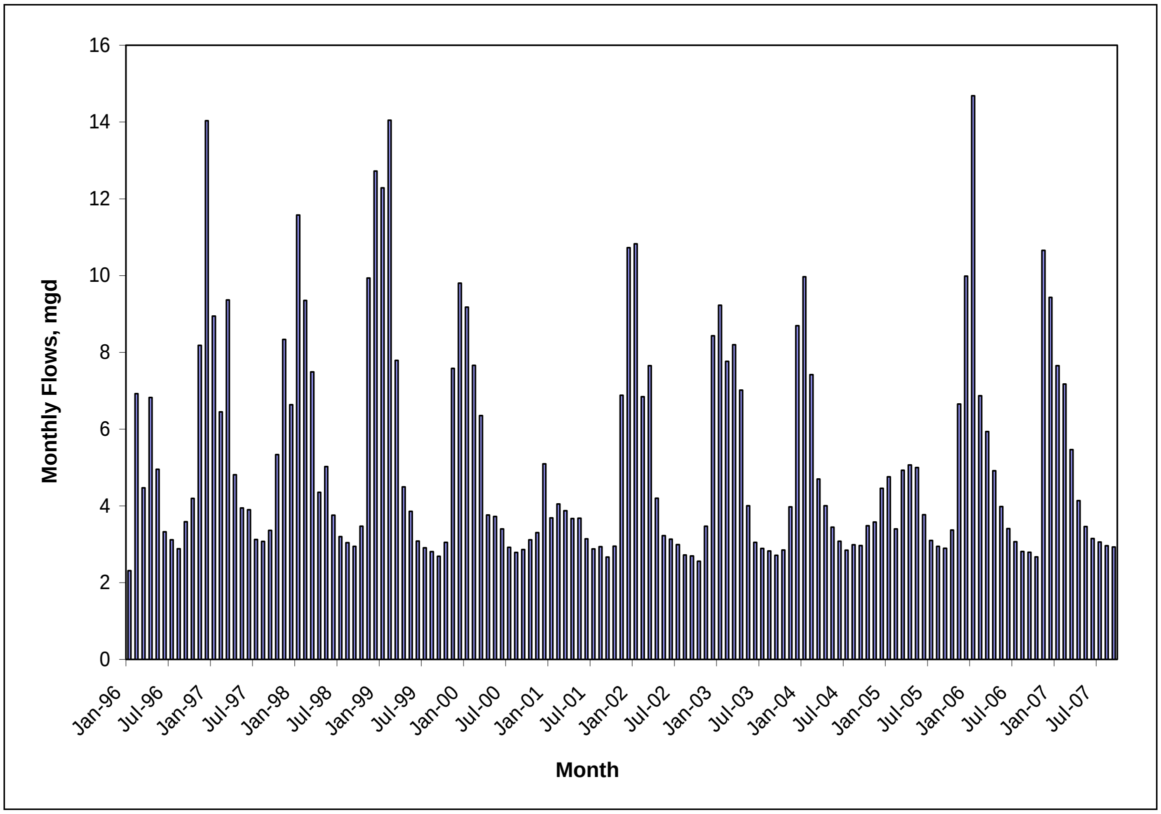
When analyzing the flow monitoring records, it is important to identify any limitations or inconsistencies in the data or flow measurement equipment. For the WRF, the following factors must be considered when reviewing historical flow records:

- Raw sewage enters the WRF via the raw sewage pump station (RSPS), which has a reported capacity of approximately 32 mgd. During peak flow events, wastewater backs up in the collection system due to capacity limitations.
- Some sewers are undersized relative to their peak flows, which attenuates flows through surcharging.
- WRF has reported emergency overflows in the collection system during past peak flow events. The occurrence of overflows indicates that not all of the City's peak flow reaches the plant.

Flow Analysis

The current flow conditions for the WRF were established through analysis of historical influent flow records. Figure 4-1 presents the monthly average flow for the plant during the period of record.

Figure 4-1. Average Monthly Plant Influent Flows



Average Summer Flow. Table 4-1 presents the average summer flows (July to September) for the period 1996 to 2007. Based on this period of record, the average summer flow is estimated at 3.0 mgd (Table 4-1).

Table 4-1. Average Summer Flow

Year	Average Flow, mgd
1996	3.20
1997	3.19
1998	3.06
1999	2.80
2000	2.86
2001	2.83
2002	2.80
2003	2.81
2004	2.93
2005	2.98
2006	2.89
2007	2.98
Average	3.0

[a] Average flow from July through September each year.

Average Dry Weather/Wet Weather Flows. The ADWF is the average flow during the dry weather season months of May through October. Table 4-2 presents the seasonal summary of rainfall and influent plant flows for the period January 1996 through September 2007. The seasonal values shown in the table indicate that the influent flows are highly dependent upon rainfall as I/I sources significantly contribute to the total wastewater flow. Therefore, in order to accurately estimate average plant flows, it is necessary to use flow periods that are in the range of mean climatological conditions experienced in the WRF's service area. The NOAA climatological data summaries indicate that the dry weather season mean rainfall for McMinnville is 8.36 inches. Based on average rainfall conditions during the period of record, ADWF for the WRF is estimated at 3.3 mgd (Figure 4-2).

The AWWF is the average flow during the wet weather months of November through April during a year with average wet season rainfall and is determined based on the relationship developed between total rainfall and average influent flow for the wet season (Figure 4-3). Due to insufficient climatological data for the wet season of 2001, this period was omitted in this analysis. Using the average wet weather season rainfall of 33.30 inches, the current AWWF is estimated at 7.5 mgd. The relatively large difference between the ADWF and AWWF indicates that the seasonal variations in wastewater flow are caused by rainfall dependant infiltration and inflow (I/I).

The AAF is estimated by averaging the ADWF and AWWF for the period of record. For WRF, the AAF is estimated at 5.4 mgd.

Table 4-2. Summary of Wet and Dry Season Rainfall and Influent Flow

Water Year[a]	Dry Season[b]		Wet Season[c]	
	Rainfall, in.	Average Plant Influent Flow, mgd	Rainfall, in.	Average Plant, Influent Flow, mgd
1996	17.04	3.68	—	—
1997	16.19	3.79	47.07	8.63
1998	7.39	3.58	34.56	7.96
1999	5.56	3.07	40.09	10.21
2000	6.90	3.14	22.97	7.39
2001[d]	8.35	3.04	12.68	3.95
2002	5.69	2.89	37.27	7.86
2003	5.63	3.06	37.84	7.35
2004	9.51	3.13	28.82	6.46
2005	12.50	3.51	17.99	4.37
2006	5.24	3.12	38.61	8.17
2007	—	—	36.56	7.42
Averages	9.09	3.3	34.18	7.58

(a) Water year runs from the preceding November through October.
(b) Dry Season is May through October. Long-term average dry weather rainfall = 8.36 inches per year.
(c) Wet Season is November through April. Long-term average wet weather rainfall = 33.30 inches per year.
(d) 2001 wet weather data not included in average calculation due to missing data for November of 2000.

Figure 4-2. Average Dry Weather Flow

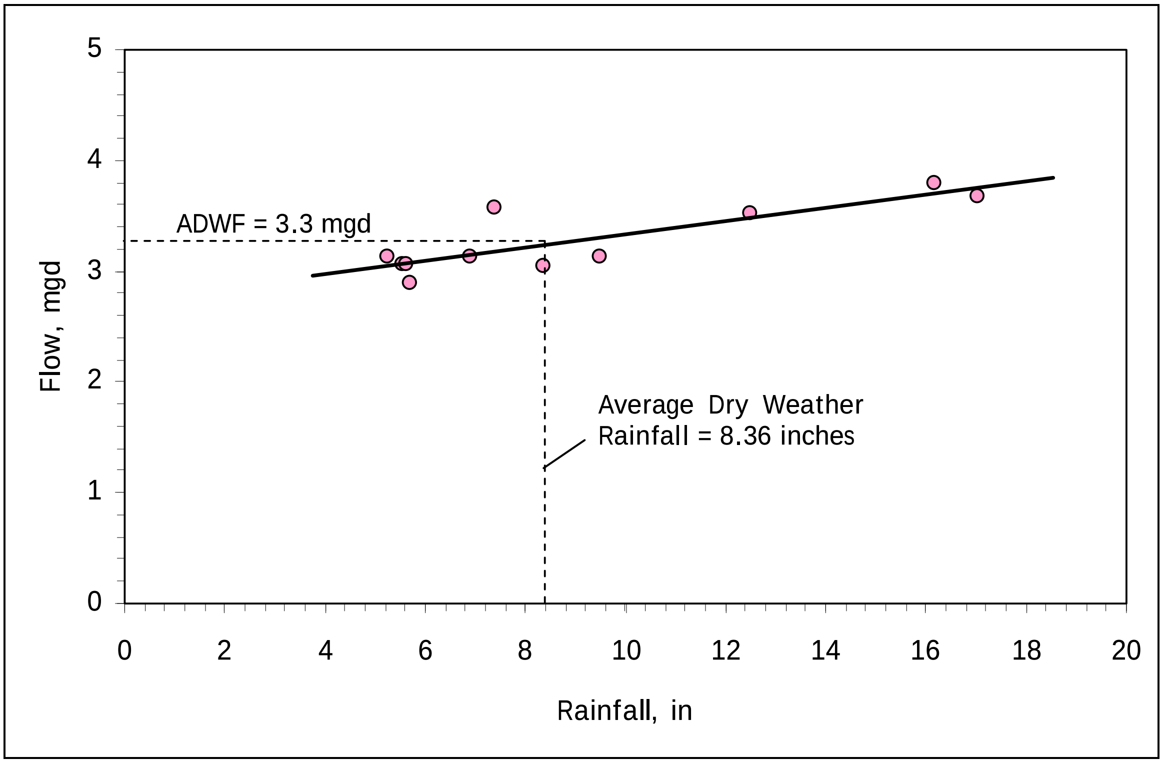
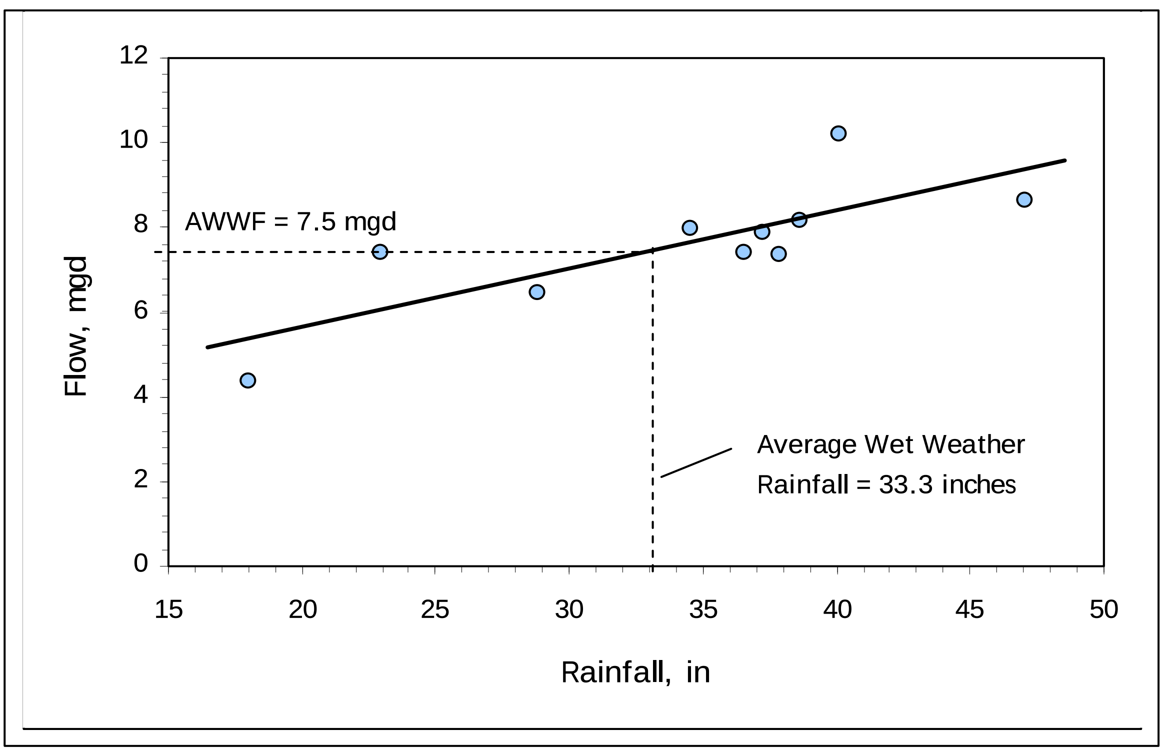


Figure 4-3. Average Wet Weather Flow

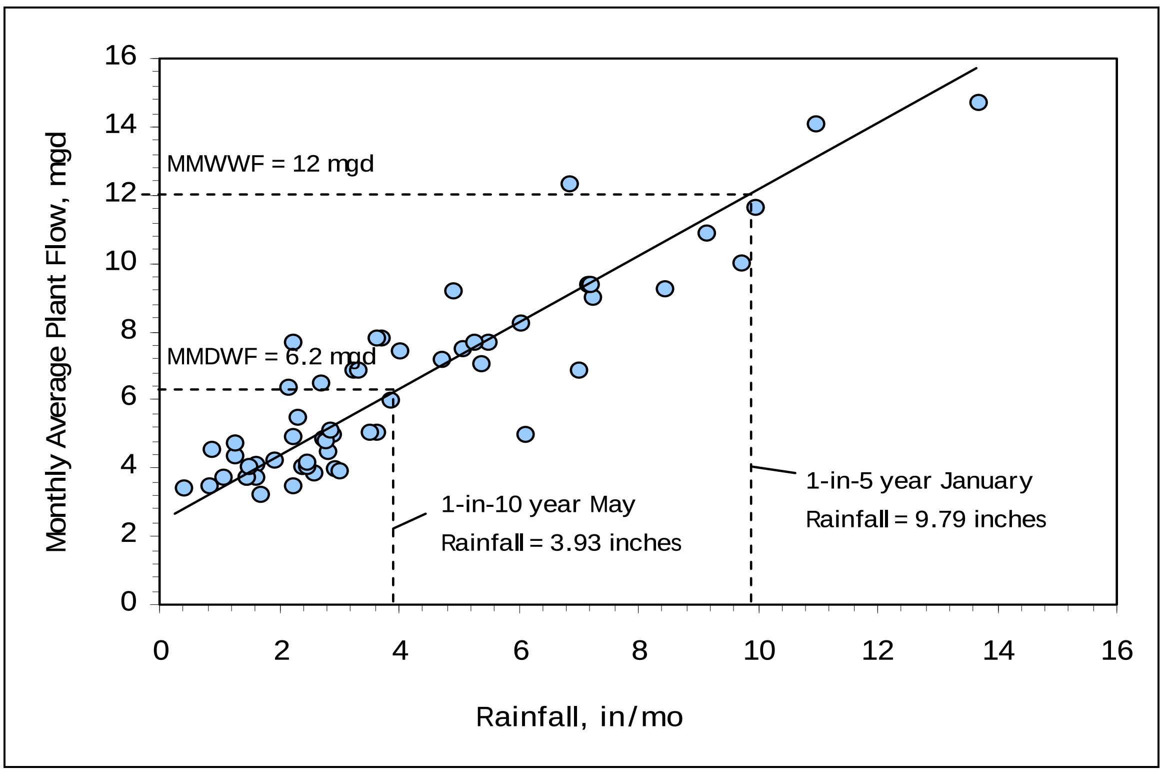


Maximum Month Flows. The DEQ methodology for estimating maximum month flows includes plotting monthly average plant flow for the months of January through May against the corresponding monthly rainfall, and developing a linear relationship between flow and rainfall as shown in Figure 4-4.

The maximum month dry weather flow (MMDWF) is defined as the flow that would be expected to occur when rainfall is at the 1-in-10 year probability level for the wettest month of the dry weather season. October is the wettest dry weather month for the area, but the average May rainfall is used for this analysis because groundwater levels are higher in the spring. For McMinnville, the 1-in-10 year May rainfall is 3.93 inches based on the NOAA climatological data summary. By approximating a linear relationship between the monthly average influent flow and rainfall, the MMDWF is estimated at 6.2 mgd.

Similarly, the maximum month wet weather flow (MMWWF) is defined as the flow expected to occur when rainfall is at the 1-in-5 year high rainfall for the month of January (9.79 inches). From Figure 4-4, the MMWWF is estimated at 12 mgd.

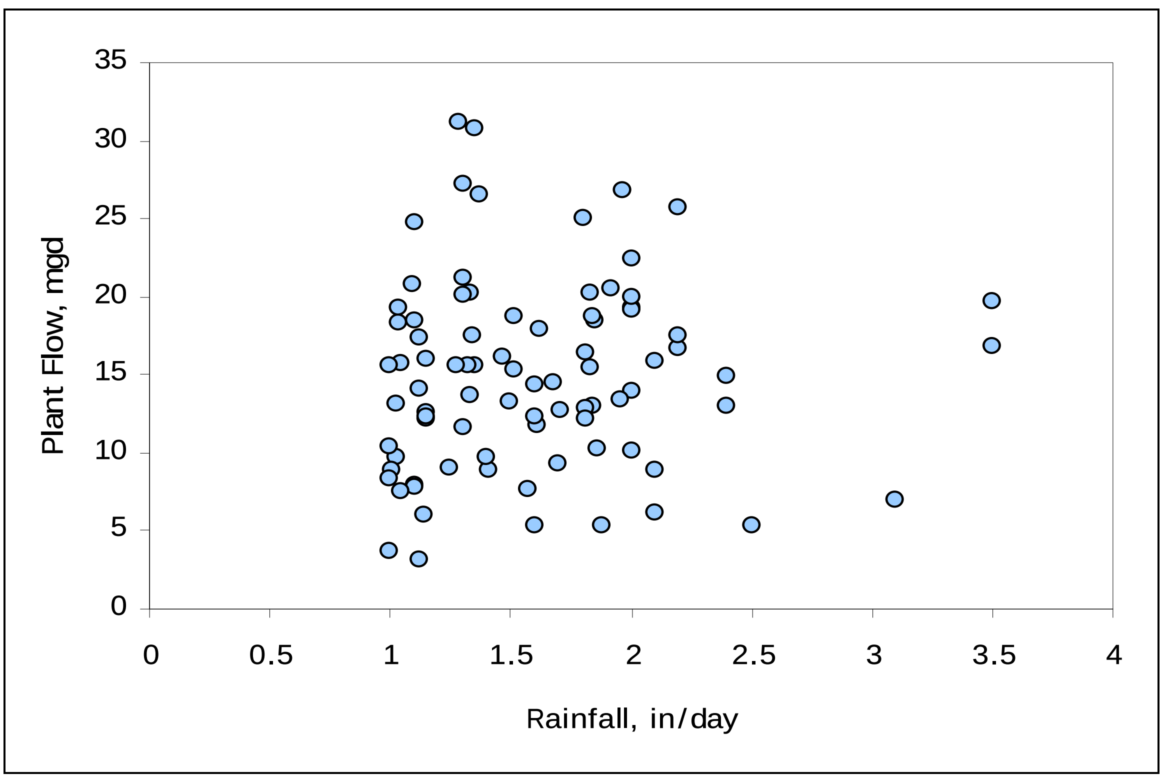
Figure 4-4. Maximum Month Flows



Peak Flows. The maximum day wet weather (MDWWF) flow is defined as the daily average flow rate that occurs during the 1-in-5 year, 24-hour storm event. For the WRF service area, the 1-in-5 year, 24-hour storm corresponds to 3.1 inches of rain (NOAA, as cited in Chapter 3 of the Conveyance System Master Plan). According to DEQ's methodology, MDWWF is estimated based on the linear relationship that exists between the daily average plant influent flow data during significant wet season storm events and daily rainfall. In Figure 4-5, only those days with over 1.0 inches of recorded rainfall and with at least 1.5 inches of cumulative rainfall in the previous four days were considered. This ensures that the soils were saturated and I/I contributions were significant. However, for the WRF, a linear relationship is not present in the historical flow data.

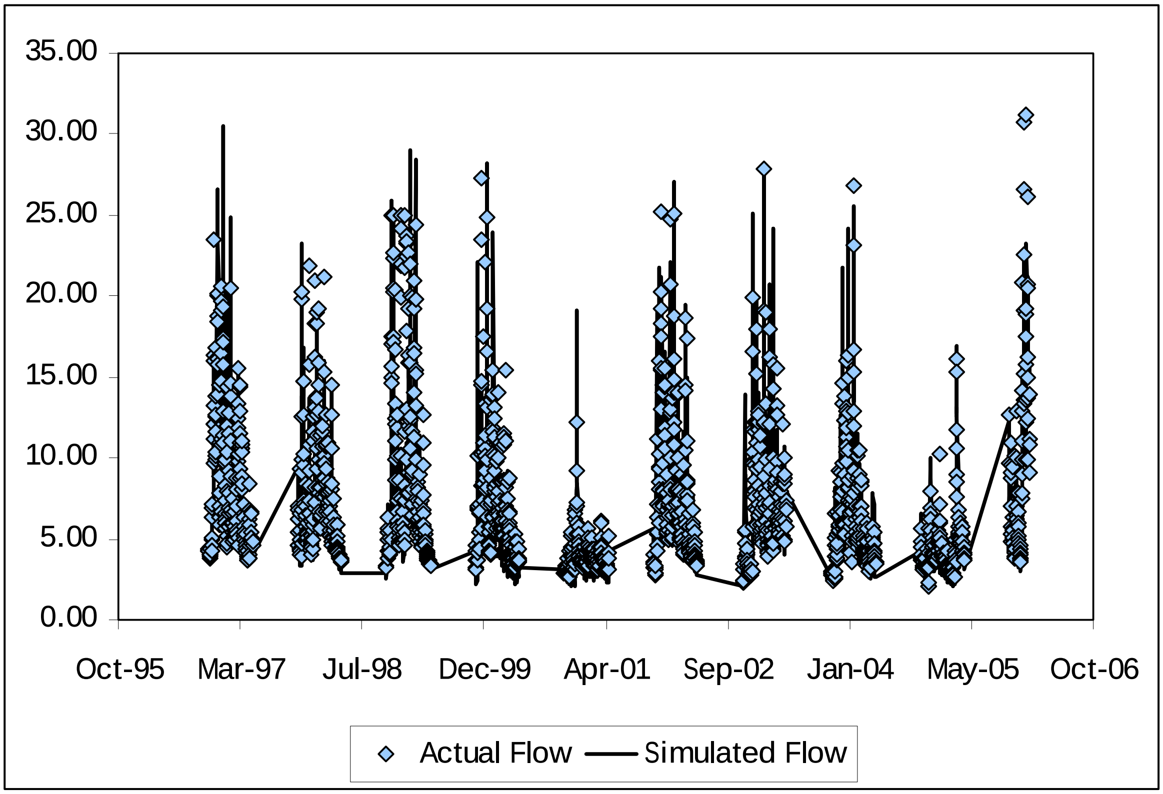
An empirical flow model provides an alternative method for developing peak flow estimates. The model used in this analysis considers the past 50 years of historical daily rainfall values. This approach allows the incorporation of antecedent conditions into the flow/rainfall relationship. Using the rainfall and flow data from 1996 to 2006, an empirical flow equation was developed based on the daily rainfall, preceding 7-day average rainfall, preceding 30-day average rainfall, and preceding 90-day average rainfall to account the effects of groundwater infiltration and rainfall dependent I/I. The resulting calibrated flows for the WRF during wet weather season are shown in Figure 4-6. Constants in the equation were adjusted so that the predicted flow values matched measured flow values as closely as possible. This ensures that the modeled empirical equation is appropriately calibrated for the existing conditions in the collection system and the facility's service area.

Figure 4-5. Daily Plant Flow during High Rainfall Events



After, the equation was optimized, the 50 years of available rainfall data were used to produce 50 year's worth of daily wet weather simulated flows (Figure 4-7). The MDWWF is estimated from this simulated flow data such that it corresponds to the 1-in-5 year, 24-hour storm event. The MDWWF estimated by this method is 32 mgd.

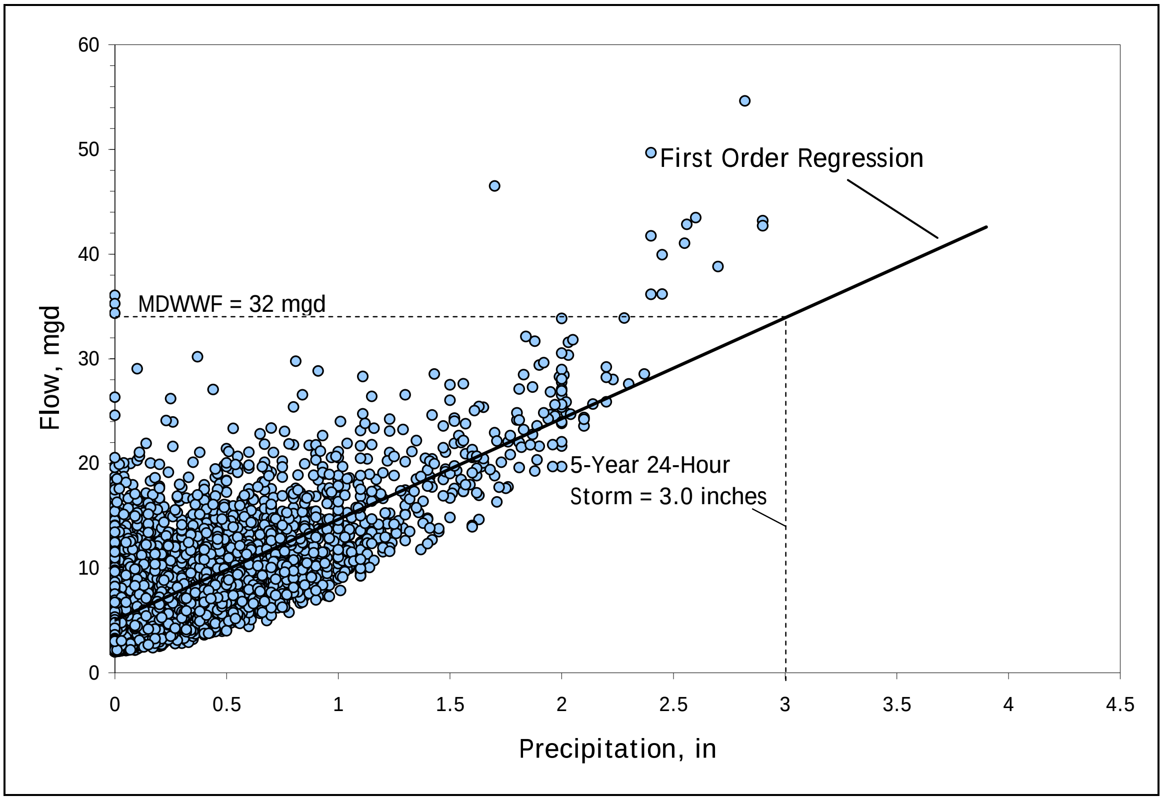
Figure 4-6. Calibrated Wet Weather Influent Flows



DEQ guidelines prescribe using a probability methodology to estimate the remaining peak flow conditions. This analytical technique assumes that the AAF, MMWWF, MWWWF, MDWWF, and PHF will occur during a 1-in-5 high rainfall year such that the recurrence probabilities associated with each of the flows are as follows:

- AAF is exceeded half the time (50% probability).
- MMWWF is exceeded during one month (8.3% probability).
- MWWWF is exceeded during one week (1.92% probability).
- MDWWF is exceeded on one day (0.27% probability).
- PHF is exceeded during one hour (0.011% probability).

Figure 4-7. Simulated MDWWF



The resulting flow values are plotted on Figure 4-8 according to their probability. Based on this method, the PHF is estimated at 56 mgd. Since this value greatly exceeds the capacity of the RSPS, no data is available that can provide direct verification.

The MWWWF can also be estimated based on a probability analysis of historical flow rates. Seven-day average flows are sorted according to their magnitude and assigned a recurrence probability. Based on this method, the MWWWF is estimated at 19.7 mgd (Figure 4-9). This is in close agreement with the value estimated using the method prescribed by DEQ as presented in Figure 4-8. Hence a MWWWF of 20 mgd will be used for further analysis.

The maximum week dry weather flow (MWDWF) and the maximum day dry weather flow (MDDWF) are also estimated based on a probability analysis. For MWDWF, the 7-day average plant flows for the months May through October were sorted according to their magnitude and assigned a recurrence probability. MWDWF is estimated as the flow corresponding to the 1-in-10 year recurrence probability. Based on this method, MWDWF is 7.2 mgd. Similarly, MDDWF is estimated by sorting May through October daily average plant flows according to their magnitude. MDDWF is estimated at 14.4 mgd. Table 4-3 summarizes the current wastewater flows derived from this analysis.

Figure 4-8. Probability Analysis

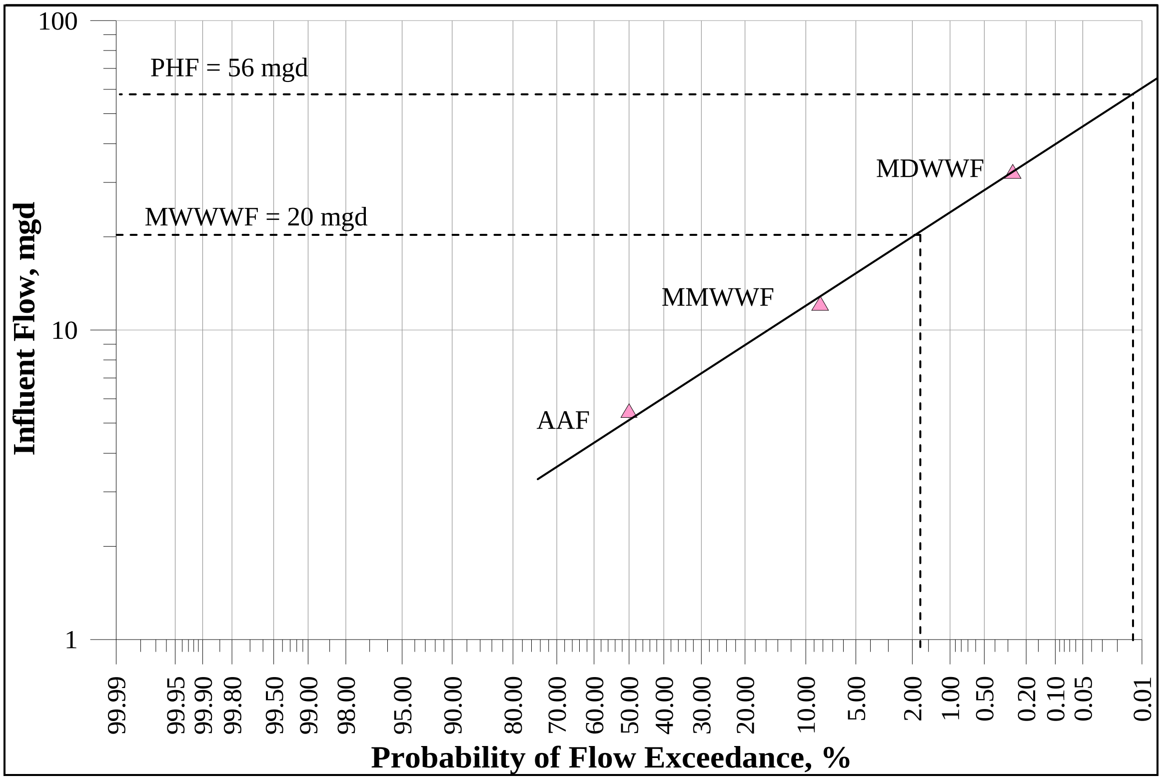


Figure 4-9. MWWWF Determination

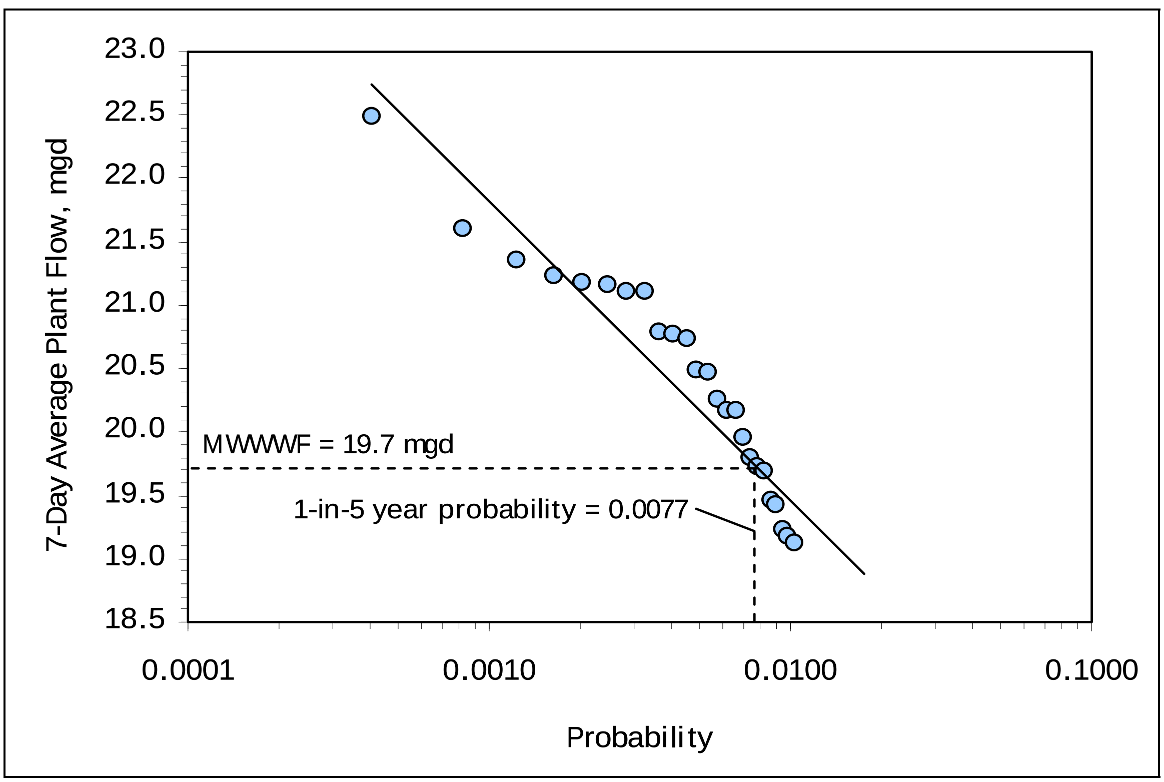


Table 4-3. Current Wastewater Flows

Flow Parameter	Flow, mgd
Average Summer Flow (ASF)	2.9
Average Dry Weather Flow (ADWF)	3.3
Average Annual Flow (AAF)	5.4
Average Wet Weather Flow (AWWF)	7.5
Maximum Month Dry Weather Flow (MMDWF)	6.1
Maximum Week Dry Weather Flow (MWDWF)	7.2
Maximum Day Dry weather Flow (MDDWF)	14.4
Maximum Month Wet Weather Flow (MMWWF)	12.0
Maximum Week Wet Weather Flow (MWWWF)	20.0
Maximum Day Wet Weather Flow (MDWWF)	32.0
Peak Hour Flow (PHF)	56.0

CURRENT WASTEWATER LOADS

Wastewater loading data are important for determining the sizing of certain treatment processes. The wastewater loading components of principal interest are the five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) of the raw sewage. BOD_5 is a measure of the amount of oxygen required to biologically oxidize the organic material in the wastewater over a specific time period. A 5-day BOD test is conventionally used for domestic wastewater testing. TSS is a measure of the particulate material suspended in the wastewater. The loading parameters of interest are the annual average loading, maximum month loading, maximum week loading, and peak day loading for BOD_5 and TSS load.

The primary nutrients of interest at a wastewater treatment facility are nitrogen and phosphorus. In domestic wastewater, nitrogen is primarily in the form of ammonia, while the majority of the phosphorus is in the form of soluble phosphate. Nutrients are necessary for the growth of microorganisms and aquatic plant life. However, many effluent receiving waters have excessive algal growth that is caused in part by high nitrogen and phosphorus levels. Nutrient concentrations in the raw wastewater must be sufficient to support the growth of microorganisms in the biological treatment process. However, most wastewaters contain more of these constituents than needed to support the process and the excess would pass through to the effluent unless specific nutrient reduction measures at taken in the design and operation of the facilities. Therefore, many treatment facilities incorporate treatment processes which remove nutrients prior to effluent discharge.

Load Analysis

Historical data from the DMRs provide the basis for characterizing loadings.

BOD_5 and TSS Loading Analysis. Daily BOD_5 and TSS concentrations for the period January 1996 to September 2007 are presented in Figures 4-10 and 4-11, respectively. Figures 4-12 and 4-13 illustrate the seasonal variation in BOD_5 and TSS loading. The outlying data points were reviewed and eliminated as deemed appropriate. Using this approach, the average annual wastewater loading was calculated at 6,100 pounds per day (ppd) of BOD_5 and 7,600 ppd of TSS as illustrated in Figures 4-14 and 4-15, respectively.

A more focused loading analysis was conducted on the data collected in the recent five year period of 2003 through 2007 for the maximum month, maximum week and peak day loading conditions. This more recent data is more representative of the existing sanitary characteristics within the WRF service area and accounts for the results of source control efforts that have been undertaken in recent years. The maximum month loads were determined by averaging the recorded values for each month and then selecting the month with the highest average. Maximum week loads were estimated by averaging at least two successive readings that are taken in a 7-day period. Peak day loads were estimated by reviewing the highest recorded values. A summary of the resulting loading conditions for this period is shown in Table 4-4.

Figure 4-10. Biochemical Oxygen Demand (BOD_5) Concentrations: 1996-2007

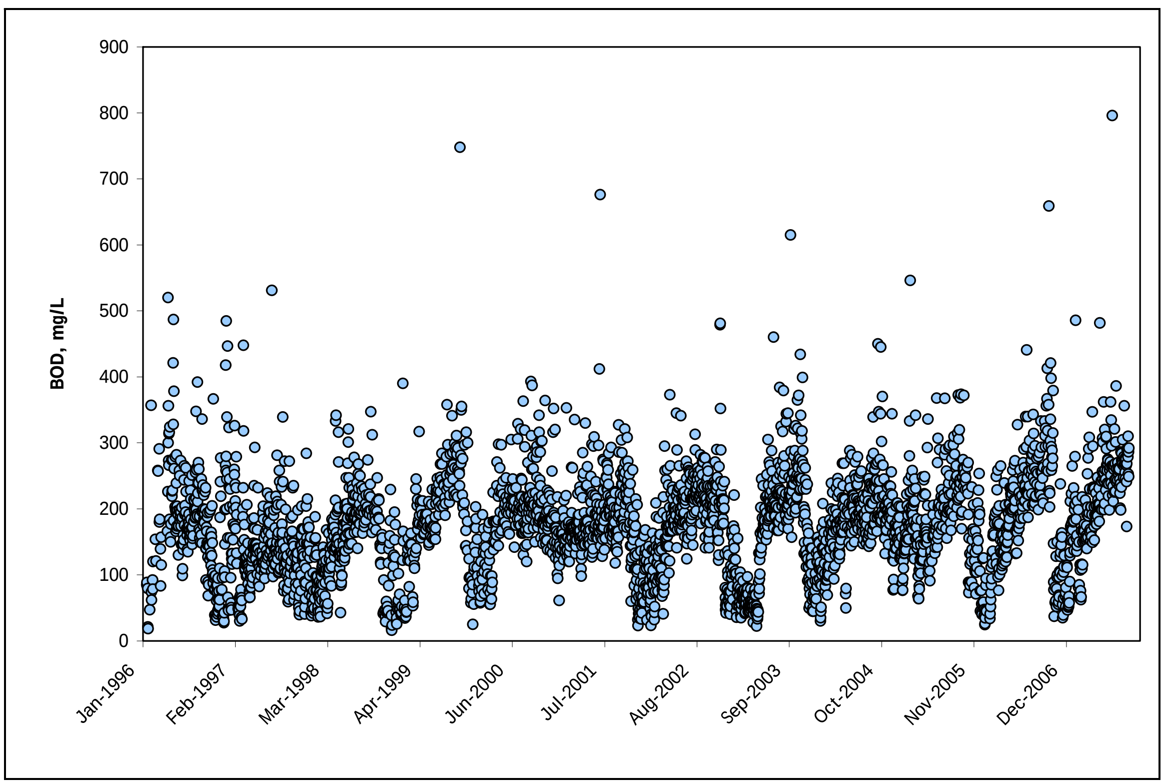


Figure 4-11. Total Suspended Solids (TSS) Concentrations: 1996-2007

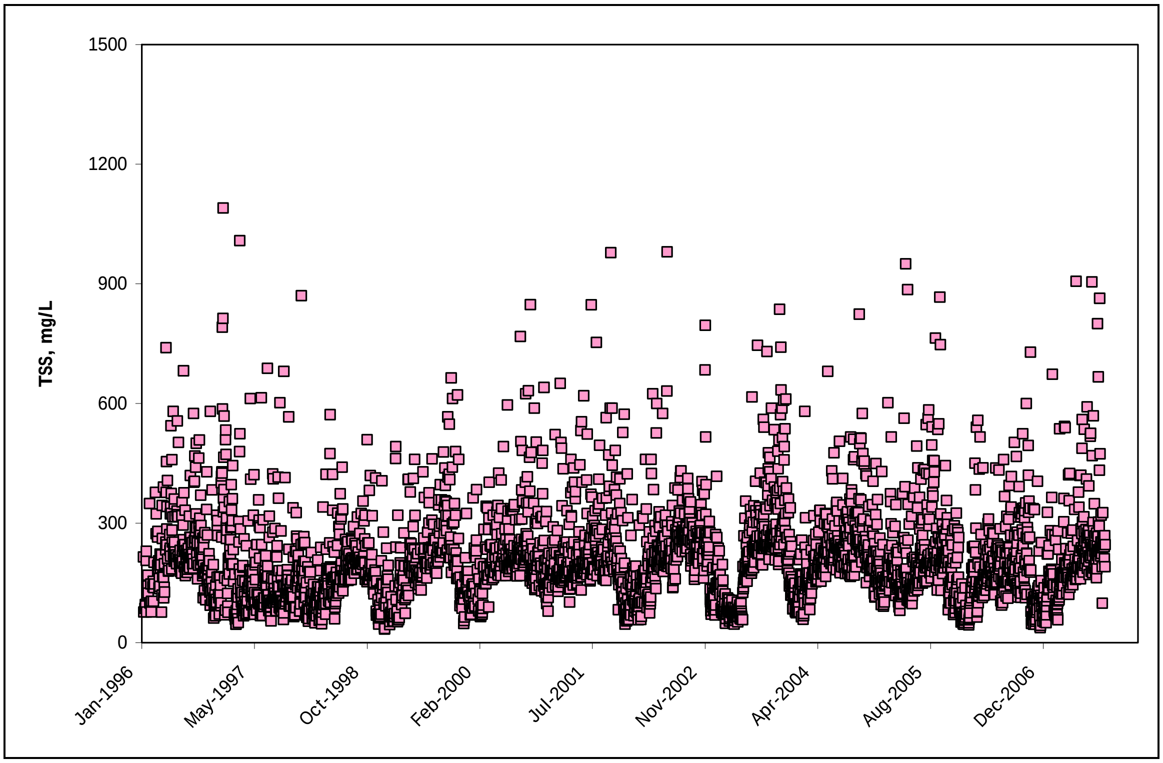


Figure 4-12. Daily Plant BOD5 Loading: 1996-2007

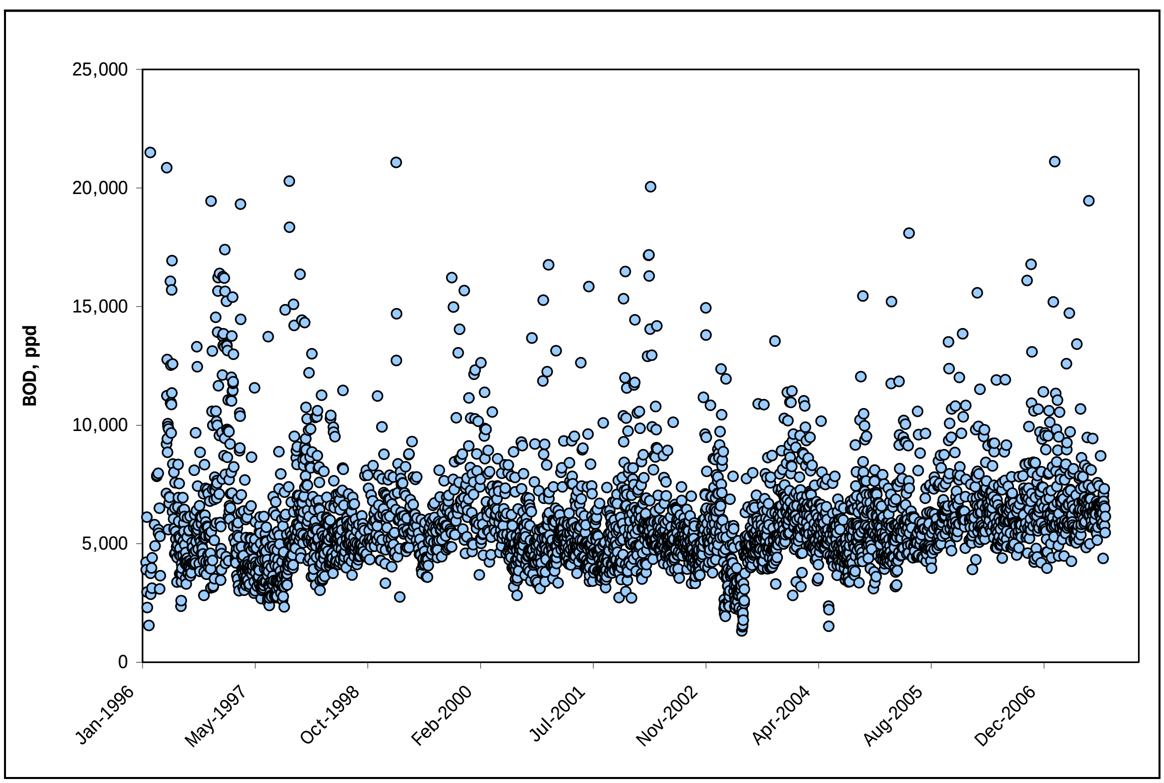


Figure 4-13. Daily Plant TSS Loading: 1996-2007

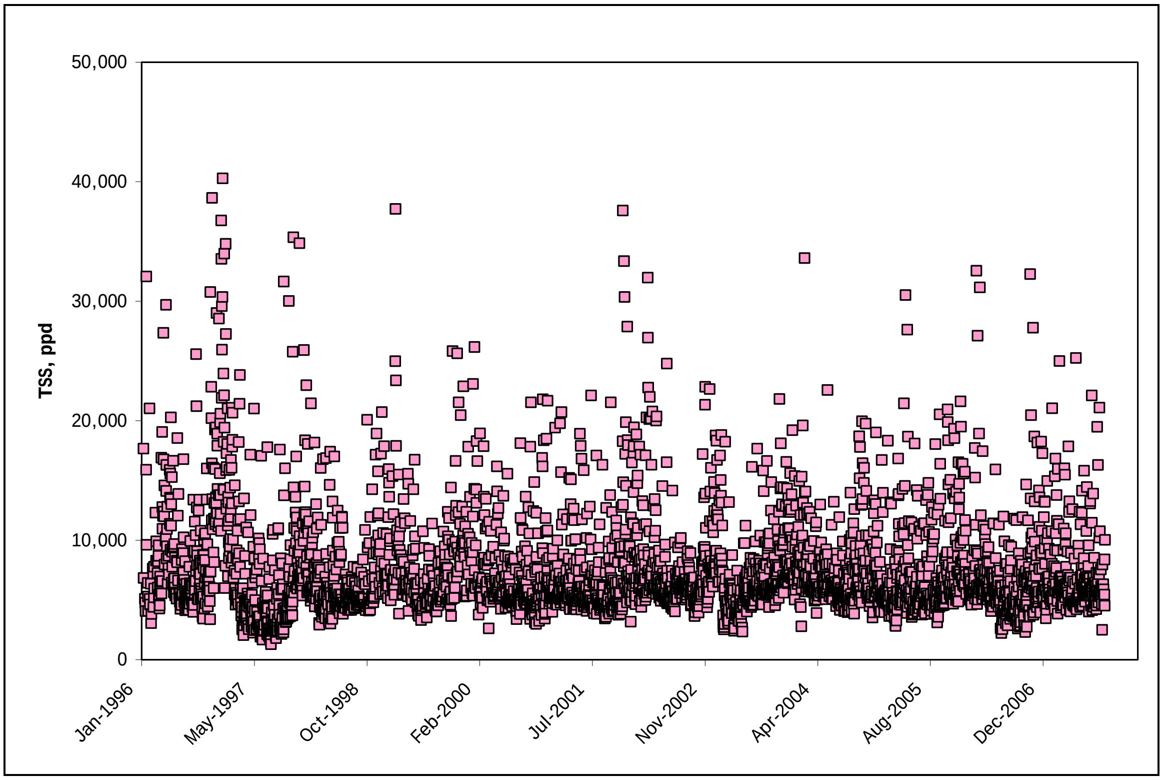


Figure 4-14. Average Monthly BOD5 Load

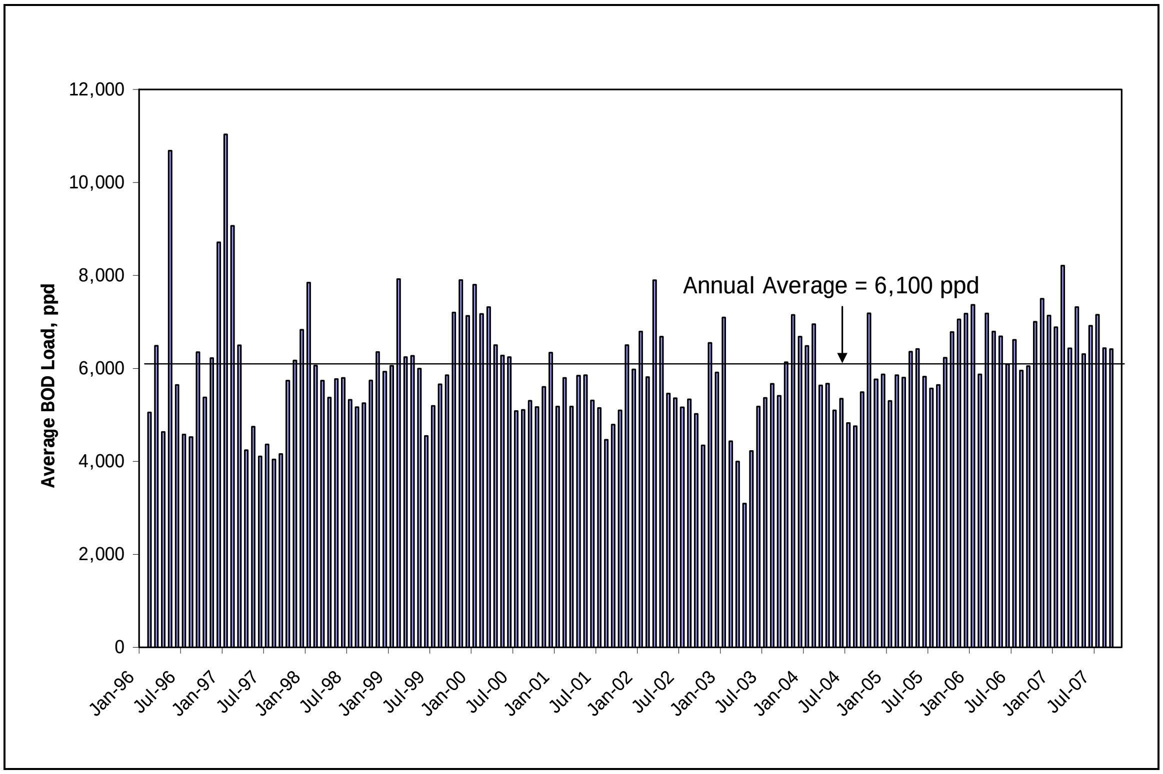


Figure 4-15. Average Monthly TSS Load

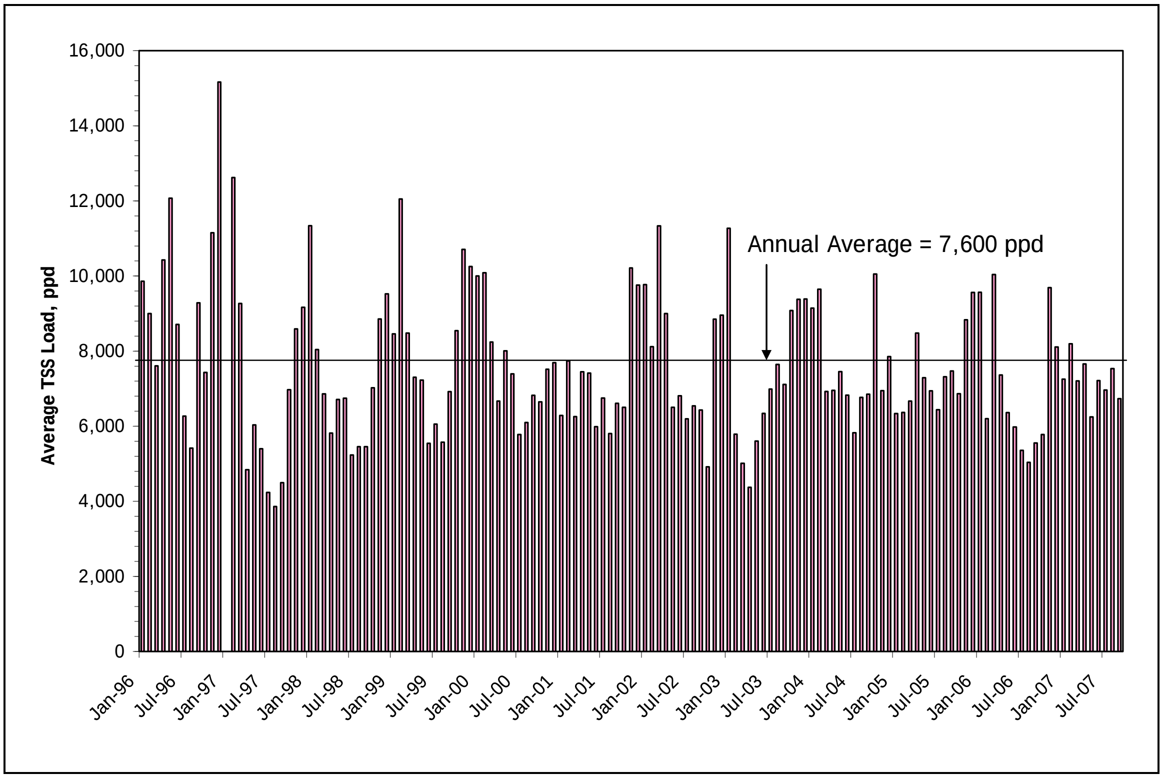


Table 4-4. Plant Loading Summary

Parameter	BOD Load, lbs/day	TSS Load, lbs/day
Annual Average	6,100	7,600
Maximum Month[a]	8,200	11,300
Maximum Week[a]	11,600	14,400
Peak Day[(a)]	16,800	33,600

(a) Maximum month, maximum week and peak day loading were estimated using the recent 5 year data (2003-2007).

Nutrient Loading Analysis. Nutrients of primary concern at a wastewater treatment facility are nitrogen and phosphorus. Nitrogen data is required to evaluate the treatability of sewage by biological processes, as it is vital for protein synthesis. Typically, nitrogen in raw sewage is primarily in the form of ammonia, with concentrations ranging from 15 to 35 mg/L. The majority of phosphorus in raw sewage is in soluble form, with typical concentrations between 3 to 10 mg/L. The WRF samples influent wastewater for ammonia and total phosphorus. The influent concentrations for ammonia and total phosphorus are presented in Figures 4-16 and 4-17, respectively.

Daily plant loading data for ammonia and total phosphorus from January 1996 through September 2007 are presented in Figures 4-18 and 4-19. The nutrient loading summary is presented in Table 4-5.

Figure 4-16. Ammonia Concentrations

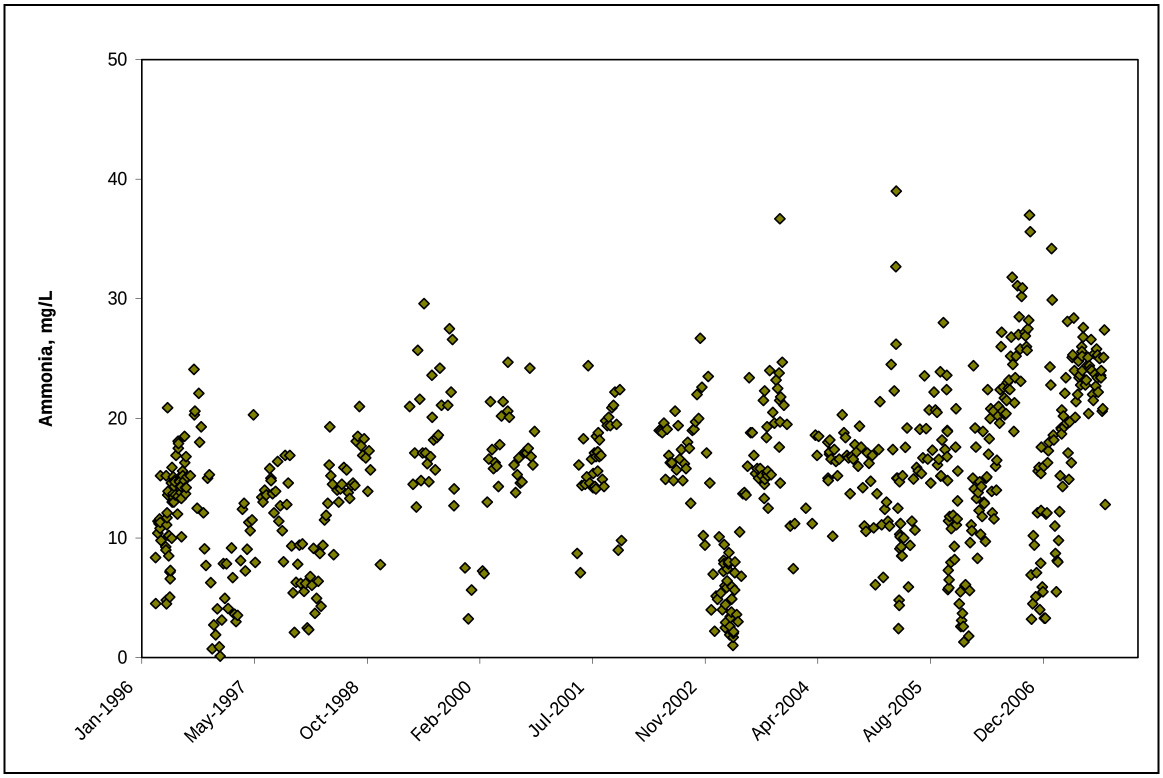


Figure 4-17. Phosphorus Concentrations

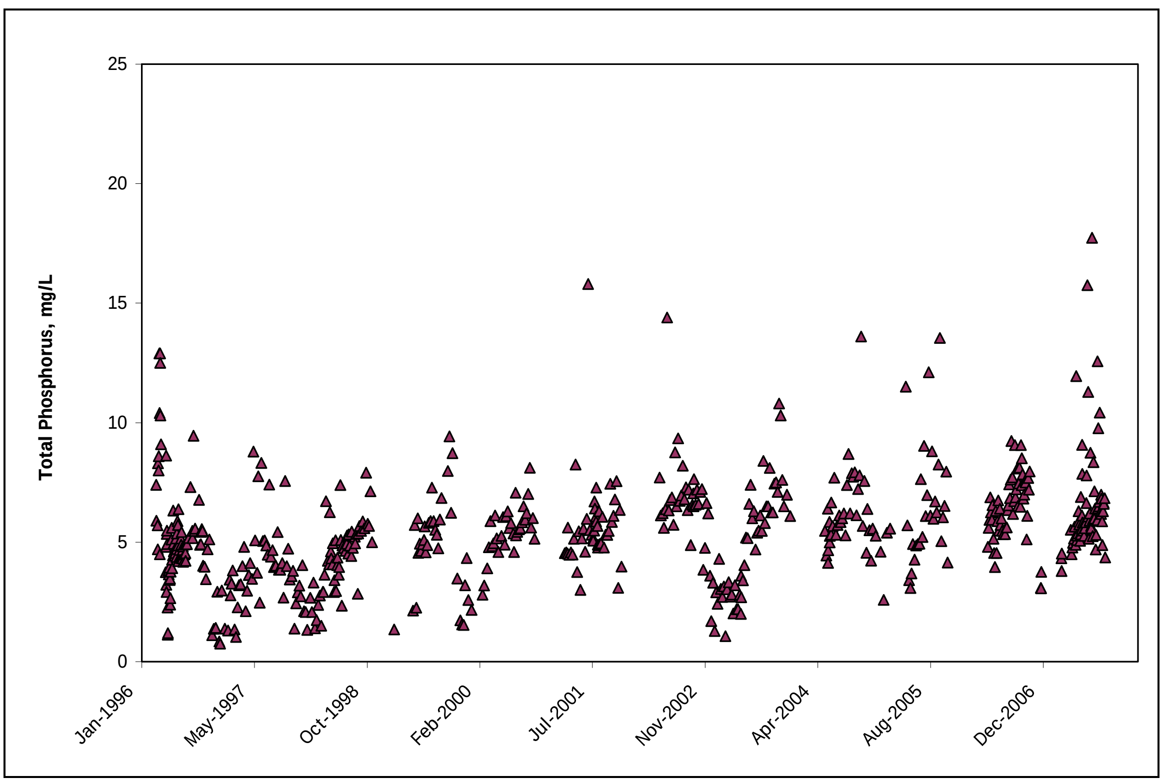


Figure 4-18. Daily Ammonia Loading

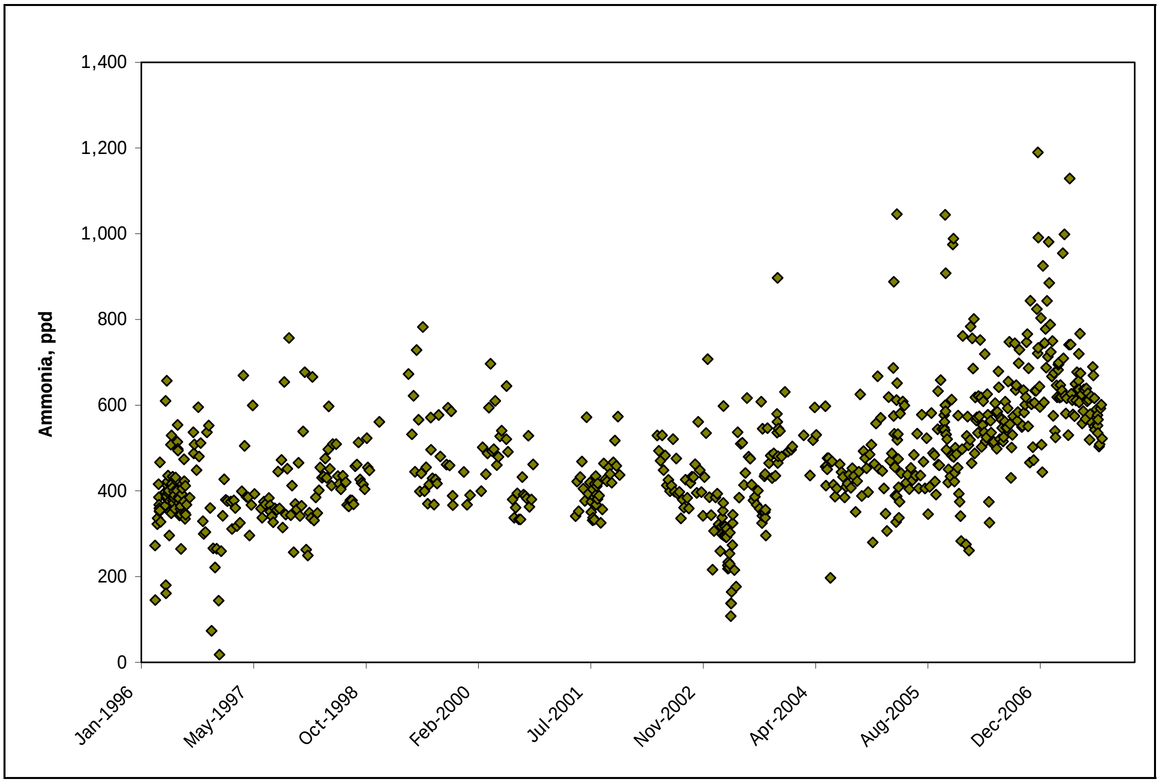


Figure 4-19. Daily Phosphorus Loading

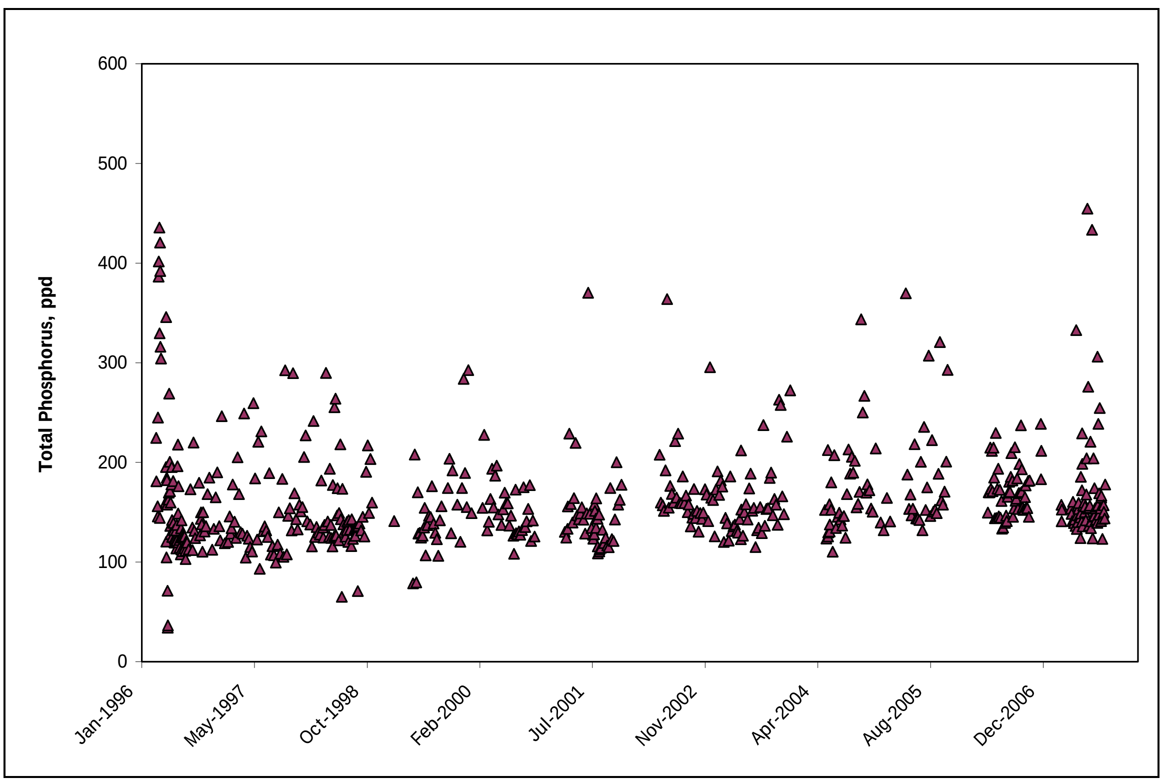


Table 4-5. Nutrient Loading Summary

Parameter	NH_3-N Load, ppd	T-P Load, ppd
Annual Average	490	180
Maximum Month[(a)]	760	270
Maximum Week[(a)]	980	290
Peak Day[(a)]	1,190	450

(a) Maximum month, maximum week and peak day loading were estimated using the recent 5 year data (2003-2007).

FLOW AND LOAD PROJECTIONS

The flow and load projections are based on current flows and loads and anticipated community growth. As provided in *Technical Memorandum Study Area Characteristics, February 2007, and Growth Management and Urbanization Plan (ECO Northwest, 2003),* the build-out population of McMinnville is estimated at 44,055.

Distribution of Average Flows

Sanitary flow generated in the WRF service area comes from a combination of residences, industries, businesses, and schools. Applying the land use information from the *Growth Management and Urbanization Plan,* it is anticipated that at build-out, the commercial/industrial wastewater flow would make up approximately half of the total average flow received at the WRF. This was further validated by reviewing winter water use records (November 2004 through April 2006) from McMinnville Water and Light. Wintertime water use was evaluated because consumptive uses, such as irrigation, are at a minimum during the wet weather season. A summary of the wintertime water use data in comparison to the existing flows is presented in Table 4-6. For the purposes of this comparison, the water used by Cascade Steel was subtracted from the water use total. Cascade Steel uses approximately 0.7 mgd of water and has a separate discharge permit to dispose its process water. The total wintertime water use values are approximately 11 percent lower than the WRF's average summer flow. This is within the expected range of accuracy, and the additional flow to the wastewater collection system may be due to some amount of dry weather groundwater infiltration.

Table 4-6. Wintertime Water Use[a]

Source	Flow, mgd
Commercial/industrial winter water use	1.0
Residential winter water use	1.7
Total winter water use	2.7
Current WRF average summer flow	3.0
Current WRF ADWF	3.3

(a) Based on data from McMinnville Water and Light, 2004 through 2006.

Unit Flow Contributions. Using the information presented in Table 4-6, the unit wastewater flow contributions can be estimated as follows.

- Residential Unit Flow. Assuming that the current residential wastewater flow contribution mirrors the residential water use, the average residential wastewater flow can be estimated at 1.7 mgd, not including dry weather infiltration. Dividing the 1.7-mgd residential flow by the current population of approximately 30,000 gives a unit residential contribution of 57 gallons per capita per day (gpcd). This value falls within the expected range of textbook values for this flow component.
- Commercial/Industrial Unit Flow. Based on the information presented in the *Growth Management and Urbanization Plan*, an equivalent dwelling unit (EDU) can be approximated as 2.6 people. Past planning documents recommended representing commercial/industrial development as 12 EDU/acre. Applying these factors to the developed commercial/industrial land area and the per-capita average flow rate allows for estimation of the commercial/industrial flow component.
- Dry weather infiltration unit flow. The current dry weather infiltration can be estimated as the difference between the ADWF (3.3 mgd) and the total winter water use (2.7 mgd, or 0.6 mgd. Dividing this value by the total current developed acreage of 2,783 acres gives an estimated unit dry weather infiltration of 216 gallons per acre per day (gpad).

Projected Wastewater Flows

The future residential sanitary flow was determined by multiplying the projected build-out population by the observed unit per capita wastewater generation rate. Similarly, the projected commercial/industrial population equivalent was multiplied by the per capita wastewater flow generation rate to obtain the projected commercial/industrial sanitary flow component. The build-out ADWF was estimated by multiplying the build-out developed acreage by the unit dry weather infiltration rate and adding this value to the total sanitary flow. The resulting average flow projections are summarized in Table 4-7.

Other projected average and dry weather build-out flow rates were estimated by applying peaking factors developed through evaluation of existing conditions to the projected build-out ADWF determined in Table 4-7. This basic flow projection technique was used for ASF, AAF, AWWF, MMDWF, MWDWF, and MDDWF.

Projection of the future peak wet weather flows requires additional consideration due to the variability of I/I rates among the existing and future developments. Sewers installed to serve new houses, businesses and commercial units will contribute less I/I compared to existing sewers. This is due to improved construction materials and techniques available. Therefore, future PHF was estimated using current wet weather I/I rates for existing portions of the collection system, while using lower rates in areas of new and rehabilitated developments. For this analysis, a peak hour unit I/I flow for future developments of 2,000 gallons per acre per day (gpad) was used. Additionally, base flow increases due to residential and commercial/industrial components were also considered in the PHF projection. The build-out PHF was estimated at 63 mgd.

Table 4-7. Average Dry Weather Flow Projection for Buildout Conditions

Item	Value
Residential	
Build-out population	44,055
Unit residential flow contribution, gpcd	57
Estimated average residential flow, mgd	2.5
Commercial/Industrial	
Build-out acreage	1,453
EDUs (12 per acre)	17,436
Equivalent population at 2.6 people/EDU	45,330
Unit flow, gpcd	57
Estimated commercial/industrial flow, mgd	2.6
Total Sanitary Flow, mgd	5.1
Dry Weather Infiltration	
Build-out acreage	4,812
Unit flow, gpad	216
Estimated dry weather infiltration, mgd	1.0
Estimated build-out ADWF, mgd	6.1

The MMWWF, MWWWF, and the MDWWF are also sensitive to I/I rates in the collection system. To maintain consistency with the growth of the PHF relative to the AAF, the MMWWF, MWWWF, and the MDWWF are estimated by interpolating between PHF and AAF on a logarithmic flow probability chart such that the recurrence probabilities associated with each of the flows are as follows:

- AAF is exceeded half the time (50% probability).
- MMWWF is exceeded during one month (8.3% probability).
- MWWWF is exceeded during one week (1.92% probability).
- MDWWF is exceeded on one day (0.27% probability).
- PHF is exceeded during one hour (0.011% probability).

Figure 4-20 presents the flow probability chart for build-out and existing conditions. The flow projections are summarized in Table 4-8.

Figure 4-20. Buildout Flow Probability Analysis

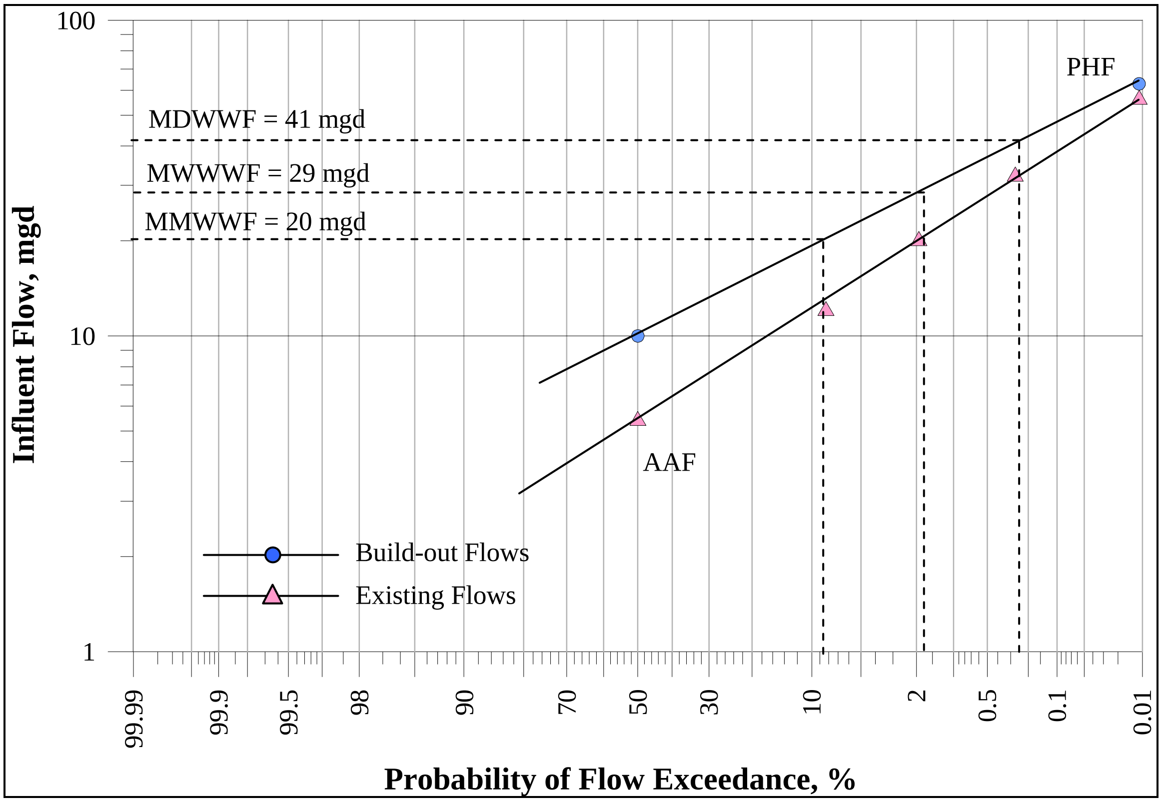


Table 4-8. Flow Projections

Flow Parameter	Build-Out Flow, (2023) mgd
Base Residential Sanitary Flow	2.5
Base Commercial/Industrial Sanitary Flow	2.6
Base Sanitary Flow	5.1
Dry Weather Infiltration	1.0
Average Summer Flow (ASF)	5.6
Average Dry Weather Flow (ADWF)	6.1
Average Annual Flow (AAF)	10.0
Average Wet Weather Flow (AWWF)	14.0
Maximum Month Dry Weather Flow (MMDWF)	11.4
Maximum Week Dry Weather Flow (MWDWF)	13.3
Maximum Day Dry weather Flow (MDDWF)	26
Maximum Month Wet Weather Flow (MMWWF)	20
Maximum Week Wet Weather Flow (MWWWF)	29
Maximum Day Wet Weather Flow (MDWWF)	41
Peak Hour Flow (PHF)	63

Projected Wastewater Loads

The future average sanitary waste load generated in the WRF service area is expected to grow at approximately the same rate as the overall residential and commercial/industrial development. This analysis assumes that the wastewater characteristics will remain the same between existing and build-out conditions. The future loads were established based on the increase in base sanitary flow from at existing conditions (2.7 mgd) to build-out condition (5.1 mgd). As an example, the average annual build-out BOD load was estimated as the current annual average load of 6,100 ppd multiplied by the ratio of build-out to average base sanitary flow, or approximately 1.9. Load projections derived from this analysis are shown in Table 4-9.

Table 4-9. Projected Plant Influent Loading Summary

Wastewater Loading Parameter	Existing	Buildout (2023)
BOD Loads		
Average annual loading, ppd	6,100	11,500
Maximum month, ppd	8,200	15,500
Maximum week, ppd	11,600	21,900
Peak day, ppd	16,800	31,700
TSS Loads		
Average annual loading, ppd	7,600	14,400
Maximum month, ppd	11,300	21,300
Maximum week, ppd	14,400	27,200
Peak day, ppd	33,600	63,500
Ammonia Loads		
Average annual loading, ppd	490	930
Maximum month, ppd	760	1,440
Maximum week, ppd	980	1,850
Peak day, ppd	1,190	2,250
Total Phosphorus Loads		
Average annual loading, ppd	180	340
Maximum month, ppd	270	510
Maximum week, ppd	290	550
Peak day, ppd	450	850

PEAK FLOW RECONCILIATION

As part of the planning process, a collection system model using EPA Storm Water Management Model (SWMM) Version 5.0, Build 5.0.011 was developed to simulate the flow conditions experienced within the service area. The model was refined and calibrated to simulate the existing collection system based on recent sewer rehabilitation efforts, flow monitoring, and historic pump station and treatment facility flow data. This calibrated model was used to estimate the 5-year, 24-hour and 5-year peak hour wet weather flow events for the existing and build-out conditions.

The build-out system model was developed to incorporate additional areas within the planned service area boundary that are currently undeveloped. Table 4-10 presents the preliminary results of the peak wet weather flows anticipated at the WRF during current and build-out conditions based on the modeling efforts, and compares them with the flows estimated using the DEQ methodology. Since the collection system model better represents actual service area characteristics, model flow estimates will be incorporated into this analysis. It is important to note that peak flows from both the DEQ methodology and collection system modeling efforts are based on no I/I reduction through collection system rehabilitation. The potential for I/I reduction is evaluated in the Conveyance System Master Plan.

Table 4-10. Peak Wet Weather Flow Comparison

Description	Existing	Build-out
Collection System Model		
MDWWF, mgd	35.1	45.5
PHF, mgd	43.3	48.9
DEQ Methodology		
MDWWF, mgd	32	41
PHF, mgd	56	63

WASTEWATER CHARACTERISTICS SUMMARY

A summary of the existing and projected flow and load conditions developed in this chapter is presented in Table 4-11.

Table 4-11. Wastewater Characteristics Summary

Description	Existing	Buildout
Wastewater Flows:		
Base Residential Sanitary Flow	1.7	2.5
Base Commercial/Industrial Sanitary Flow	1.0	2.6
Base Sanitary Flow	2.7	5.1
Dry Weather Infiltration	0.6	1.0
Average Summer Flow (ASF)	3.0	5.6
Average Dry Weather Flow (ADWF)	3.3	6.1
Average Annual Flow (AAF)	5.4	10.0
Average Wet Weather Flow (AWWF)	7.5	14.0
Maximum Month Dry Weather Flow (MMDWF)	6.1	11.4
Maximum Week Dry Weather Flow (MWDWF)	7.2	13.3
Maximum Day Dry Weather Flow (MDDWF)	14.4	26.8
Maximum Month Wet Weather Flow (MMWWF)	12.0	20.0
Maximum Week Wet Weather Flow (MWWWF)	20.0	29.0
Maximum Day Wet Weather Flow (MDWWF)	47.6	54.5
Peak Hour Flow (PHF)	52.0	62.0
Wastewater Loads:		
BOD Loads		
Average annual Loading, ppd	6,100	11,500
Maximum month, ppd	8,200	15,500
Maximum week, ppd	11,600	21,900
Peak Day, ppd	16,800	31,700
TSS Loads		
Average annual Loading, ppd	7,600	14,400
Maximum month, ppd	11,300	21,300
Maximum week, ppd	14,400	27,200
Peak Day, ppd	33,600	63,500
Ammonia Loads		
Average annual Loading, ppd	490	930
Maximum month, ppd	760	1,440
Maximum week, ppd	980	1,850
Peak Day, ppd	1,190	2,250
Total Phosphorus Loads		
Average annual Loading, ppd	180	340
Maximum month, ppd	270	510
Maximum week, ppd	290	550
Peak Day, ppd	450	850