SECTION V

EXISTING AND FUTURE WASTELOADS

POPULATION PROJECTIONS

The purpose of this section is to establish the existing population currently served by the sewer system and to estimate the future population for which sewer service must be provided. The population projections will be combined with wastewater loadings for flow, BOD, and SS to estimate the treatment capacity that must be provided to accommodate future growth. For this purpose, data were taken from the 1990 U.S. Census, and the Washington State Office of Financial Management's (OFM) **1995 Population Trends for Washington State**. OFM's projections are based upon the number of building permits issued during the year; this data is tied into population characteristics for the area in order to obtain a population estimate. Table V-1 summarizes the past population and annual growth rates.

Table V-1. Historical Population[1], and Annual Growth Rates[2]

Year	Population	Annual Growth Rate
1910	384	
1920	521	3.1%
1930	1094	7.7%
1940	980	-1.1%
1950	1292	2.8%
1960	1336	0.3%
1970	1622	2.0%
1980	2415	4.1%
1990	2500	0.3%
1991	2592	3.7%
1992	2607	0.6%
1993	2732	4.8%
1994	2860	4.7%
1995	3000	4.9%
1996	3262	8.7%
1997	3507	7.5%
1998	3570	1.8%

Notes:
1. Population data for each turn of the decade (1910 through 1990) is based on US Census data. Population for the years 1991-1998 are OFM estimates.
2. Annual growth rates are average growth rates for the periods listed (1910-1990 are 10 year averages, and 1991-1998 are one year averages).

Due to the success of Woodland's effort to diversify its economy, and because Woodland is only 20 miles north of the expanding Vancouver/Portland area, the population in the City has grown rapidly in the last five years. The recent population growth has been unexpected and the City's growth has been underestimated as documented in the Cowlitz-Wahkiakum Council of Governments' (COG) **Regional Population Forecasts 1990-2015 Report**, May 1993. The average annual population growth has been estimated in the past at 4.4%, with a 1990 population forecasted to be 3,411 by the year 2000. OFM's 1998 population estimate of 3,570 (shown in Table V-1) clearly shows that the City has already exceeded past population projections for the year 2000 by 159 people.

The unexpected population growth requires that the City of Woodland's population forecast be re-adjusted by using updated population estimates. To this end, an analysis of average annual growth rates over various time periods was made to update population forecasts. It is anticipated that it will take up to a maximum of 4 years (to 2003) before construction of the proposed wastewater facility improvements are complete. Therefore, to help ensure newly constructed facilities that have a 20 year life after they are constructed, populations and wasteloads in this report will be projected to the year 2023.

Table V-1 shows that the start of high growth began in 1993 and continued through 1997. In 1996 the annual population growth rate was 8.7%, which is the maximum growth rate the City experienced. In 1998 OFM estimates show a lull in growth which may be reflective upon the moratorium on growth. The average growth rate from 1993 through 1998 is 5.5%/year.

Four growth rates were analyzed based on existing data:

- A 5.5% growth rate averaged from 1993-1998, reflective of peak growth conditions since the economy began to improve.
- A 4.4% growth rate used by COG for planning purposes.

- A 2.9% growth rate averaged from 1970-1998, to show the rapid growth of the 1970's and late 1990's, and the slow growth during the 1980's and early 1990's.
- A 2.2% growth rate average from 1980-1998, which emphasizes the slow growth of the 1980's and early 1990's and the rapid growth of the late 1990's.

Figure V-1 shows Woodland's population projections in 2023 for the four growth rates evaluated. This information, along with the historic growth data in Table V-1 was reviewed with the City Council. Following the discussion of the data and the projections with City Council, a 5.0% annual growth rate was approved by City Council on July 6, 1998. At a 5.0% growth rate, the 2023 population is projected to be 12,089.

The City of Woodland's sewer infrastructure is well established within the Urban Growth Area (UGA) Boundary in accordance with their land-use zoning classifications. Therefore, for purposes of this report, it is assumed that all of the population within the UGA is served by the Woodland's sewer system.

To verify the reasonableness of the year 2023 population projection of 12,089, a comparison was made with an estimate of the ultimate City's residential development capacity within the UGA boundaries based upon the City's Comprehensive Plan. Land-use areas within UGA boundaries were estimated from the land use map in the Comprehensive Plan, and were identified according to land-use zoning classifications from Table IV-2. Maximum build-out densities are identified in the Comprehensive Plan as: 8 household units/acre for low-density residential areas, and 35 household units/acre for high-density residential areas.

Because it is unrealistic to assume maximum build-out, as identified in the Comprehensive Plan, by the year 2023, house counts were performed over already established low density and high density residential areas. Low density residential areas averaged 4.3 homes per acre, and the high residential areas averaged 14 living units per acre (7 buildings per acre at 2 living units per building). For this report, the low residential density land within the City was

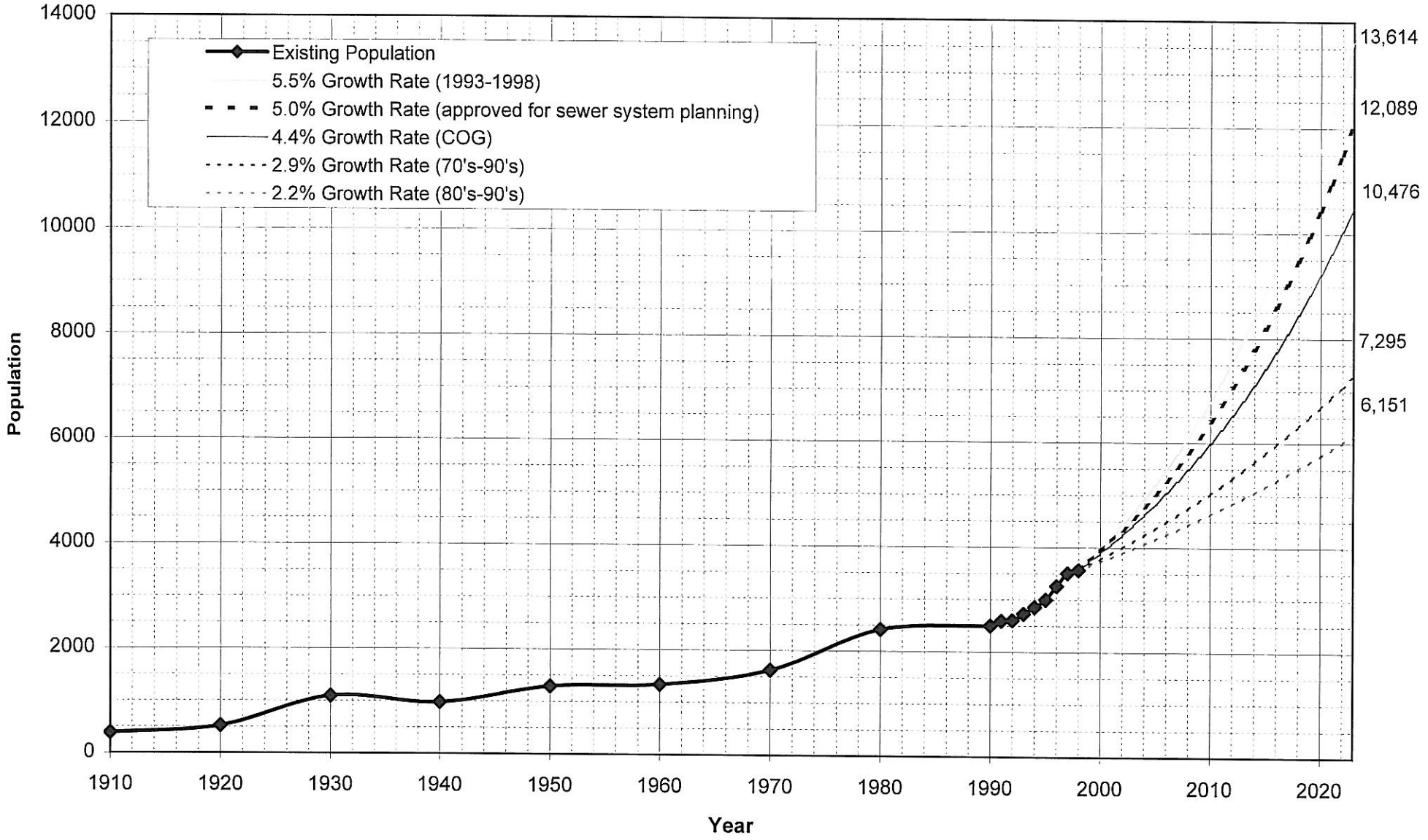

Figure V-1. Historical Population Growth, and Population Forecasts for the City of Woodland.

estimated (by the year 2023) to contain approximately 6 homes per acre, and the high residential density was approximately 25 living units per acre.

Table V-2 presents a comparison of the projected year 2023 population (12,089 people) using the 5.0% growth rate with the maximum, existing, and average residential build-out densities. The Table shows that using estimated existing population densities for low density and high density residential areas, the City will be at 88% of build-out capacity. By using the existing densities, it is assumed that existing residential housing are not destroyed and rebuilt to accommodate more people per acre. Using the maximum build-out densities provided in the Comprehensive Plan, the City will be at 42% of build-out.

Table V-2. Projected (Year 2023) Build-Out Densities, % Build-Out with a Population of 12,089.

Land-Use	Land Area (Acres)	Population (1)	Population (2)	Population (3)
Low Density Residential	722.2	15,022	8,075	11,267
High Density Residential	154.2	14,033	5,613	10,023
Total	*876.4*	*29,055*	*13,688*	*21,290*
% Build-Out	--	*42%*	*88%*	*57%*

(1) Build-Out Using Maximum Residential Densities.
Low Density = 8 homes/Acre; 2.6 persons/home.
High Density = 35 living units/Acre; 2.6 persons/living unit.
(2) Build-Out Using Estimated Existing Residential Densities.
Low Density = 4.3 homes/Acre; 2.6 persons/home.
High Density = 14 living units/Acre; 2.6 persons/living unit.
(3) Build-Out Using Average Residential Densities Between (1) and (2).
Low Density = 6 homes/Acre; 2.6 persons/home.
High Density = 25 living units/Acre; 2.6 persons/living unit.

FLOW

The Woodland WWTP has a Foxboro 2808SABATSA-C series magnetic flowmeter in an 8" pipe located between the secondary clarifier and the chlorine contact basin, which was installed in September 1997 (see Figure IV-8 for a schematic diagram). The effluent flow meter has an existing rated capacity of 1,000 gallons per minute (1.44 MGD) based upon the existing maximum flow-through velocity of the pipe (6.38 fps). The new flow-meter has a maximum

capacity of measuring 5,150 gpm (7.4 MGD) which would carry a flow-through velocity of 32.9 fps. The flow meter is scheduled for yearly calibration and maintenance through Cascade Automation, located in Vancouver, WA. For purposes of this report, it is assumed that daily influent flow is equal to the recorded effluent flow. The old flow meter that was installed prior to September 1997, was a mechanical propeller meter located just before the point of chlorination.

EXISTING FLOWS

The wet weather season is considered to be from November through February (winter months). The dry weather season is from July through October (summer months). Data used for flow analysis was from July, 1996 through the end of June, 1998. Table V-3 provides a summary of influent flow values for July 1996 through the end of June 1998. The per capita flow values are based on weighted averages for the estimated annual population during the flow period.

Table V-3. WWTP Flow Summary from July, 1996 through June, 1998. This Flow Summary is Used to Define Existing Flow Conditions.

Item	Value	Date's of Occurance
Average Annual Flow	0.393 MGD (114 gpcd)	1996-1998
Average Dry Weather Flow	0.356 MGD (105 gpcd)	July-Oct
Average Wet Weather Flow	0.435 MGD (126 gpcd)	Nov-Feb
Maximum Monthly	0.683 MGD (195 gpcd)	Jan-97
Peak Daily Flow	1.208 MGD (370 gpcd)	12/29/96

EXISTING INFILTRATION AND INFLOW (I/I)

Based upon the WWTP flow data, there does not appear to be a significant I/I problem. A comparison of the average dry weather flow with the peak daily flow gives a peaking factor of 3.4. This peaking factor includes unusually high storm events which occurred during the previous two years, and subsequent high groundwater levels which were a result of increased water released from dams upstream by the Army Corp. of Engineers. If these factors are accepted as an "anomaly" for western Washington, then the typical peaking factor for the WWTP would be 1.86 which includes a maximum monthly flow in February 1997 of 0.661 MGD and the average dry weather flow of 0.356 MGD. This is very low I/I and any design

would be inherently conservative since DOE's minimum design peaking factor is 2.5. An estimation of existing average monthly I/I flow was taken as the difference between the average wet weather flow and the average dry weather flow which equals approximately 79,000 gallons per day. An estimation of existing maximum monthly I/I is taken as the difference between the maximum monthly flow and the average dry weather flow which equals about 327,000 gallons per day. The estimate of the peak day I/I, taken to be the peak daily flow minus the average dry weather flow, is about 852,000 gallons per day.

FUTURE FLOWS

Future flows were determined from the values in Table V-3 on a per capita basis and projected to future values by using the projected 2023 population of 12,089. The future projected flows are summarized in Table V-4.

Table V-4. Future Projected Flows for the WWTP in the Year 2023 with a Projected Population of 12,089.

Item	Value	Date's of Occurance
Average Dry Weather Flow	1.28 MGD (105 gpcd)	July-Oct
Average Wet Weather Flow	1.52 MGD (126 gpcd)	Nov-Feb
Maximum Monthly	1.87 MGD (155 gpcd)	
Peak Daily Flow	3.20 MGD (265 gpcd)	

The future average dry season flow was taken to be 105 gallons/capita/day (from existing data) and multiplied by 12,089 people to get approximately 1.28 MGD.

Future average wet weather flow was calculated by taking the existing average wet season flow on a per capita basis (126 gpcd) and multiplying with the future population of 12,089. The future average wet weather flow is approximately 1.52 MGD.

Future maximum monthly flow was estimated by taking the future average dry season flow and adding existing and future maximum monthly I/I. Existing maximum monthly I/I was estimated to be 0.33 MGD. Future additional maximum monthly I/I was estimated as being 30 gallons/capita/day times the increase in population from 1998-2023 (8,519 persons) which

equals about 0.26 MGD. The total future maximum monthly flow is projected to be 1.87 MGD.

Future peak daily flow was estimated by taking the future average dry season flow and adding existing and future peak daily I/I flows. Existing peak I/I was estimated as being 0.85 MGD. The future peak daily I/I was estimated by taking the ratio between the existing peak daily I/I and the existing maximum monthly I/I and applying this ratio to the future maximum monthly I/I. The future peak daily I/I is calculated to be about 0.68 MGD. The total future peak daily flow is estimated to be 2.81 MGD. However, DOE design criteria requires the use of a minimum of 2.5 for a peaking factor on the average dry season flow. By using DOE's peaking factor design, the future peak daily flow would be 3.20 MGD.

COMMERCIAL/INDUSTRIAL SEWER USERS

In order to better understand the impacts of the commercial/industrial users, water-sale records were used to examine the percent of water consumed by each water-user type: residential, commercial/industrial, and other. Table V-5 provides a summary of water sales records from 1995 through 1997.

Table V-5. Water Contributions from 1995-1997.

Water User Classification	1995	1996	1997
Residential	60%	52%	50%
Commercial/industrial	35%	38%	37%
Other	5%	10%	13%
Total	*100%*	*100%*	*100%*

The residential water user classification includes the residential, RV/Mobile Homes, and Multi-Family Homes water user classes delineated by the City of Woodland Water Use Records. The commercial/industrial water user classification includes the Motels, and Commercial water user classes delineated by the City of Woodland Water Use Records. The other water user classification includes the water user categories of Church/school, and City from the City of Woodland Water Use Records. For purposes of this report, the values from 1997 in Table V-5 were taken as being the most reflective of water usage.

Based upon water consumption, it appears that commercial/industrial users could be contributing wastewater discharges of up to 37%. This estimate constitutes the upper bound since obviously there are commercial/industrial users whose services incorporate a portion of the water they consume into their products. If the assumption was made that residential sewer flows were 80 gallons/capita/day (typical range is 70-80 gallons/capita/day), we get a residential wastewater contribution of 0.286 MGD. This is 80% of the existing average dry season flow of 0.356 MGD. If the "other" contribution of flow to the sewer system is also assumed negligible, then a lower bound commercial/industrial wastewater flow contribution of 20% may be estimated.

For purposes of this report, residential flows will be assumed as 80% of the total wasteflow, and commercial, industrial, and institutional will be assumed 20% of the total wasteflow. This assumption is valid, since, the residential wasteflow rate is based on typical household residence consumption and is used widely in all applications. This breakdown of wastewater type is assumed to be applicable toward future, ultimate wasteflows as well.

There are several industries served by the City of Woodland. The most significant industrial discharger to the WWTP is Northwest Pet Products (a dog food manufacturing plant). Commercial users include restaurants, retail stores, and service stations. The most significant commercial discharger to the WWTP is the Oak Tree Restaurant. Based on plant data, there is an extremely large amount of settleable BOD. Settleable BOD is often an indicator of high loads of ground-up organic food wastes. The Oak Tree Restaurant, and the dog food manufacturing plant are known to discharge wastewater high in BOD.

The City of Woodland has collected wastewater data on these two dischargers, and has begun enforcing the City's pre-treatment requirements, as provided in Chapter 13.08 of the City of Woodland Municipal Code Title 13 Water and Sewerage, 1998 (refer to Appendix G).

Northwest Pet Products has an average discharge of 60,000 gal/day, and a 90th percentile BOD concentration of 572 mg/L. The Oak Tree Restaurant has an average discharge of 20,000 gal/day, a 90th percentile BOD concentration of 932 mg/L, and a 90th percentile TSS concentration of 672 mg/L. The calculated BOD loadings for the Northwest Pet Products company, and the Oak Tree Restaurant are 286 lbs/day, and 156 lbs/day, respectively. The calculated TSS loading for the Oak Tree Restaurant is 112 lbs/day. These two discharger loadings total 442 lbs BOD/day, or about 40% of the total existing BOD loading to the WWTP (see below).

BIOCHEMICAL OXYGEN DEMAND (BOD) LOADING

The 90th percentile influent BOD concentration to the WWTP from July, 1996 through the end of June, 1998 is 372 mg/L. Taking this 90th percentile influent BOD concentration and multiplying it by the existing average dry weather flow (0.356 MGD) gives a BOD loading of 1,105 pounds per day, or a total load of 0.31 pounds per capita per day (this load includes all sources of BOD including commercial/industrial users). The future, year 2009, BOD loading was calculated by multiplying the existing 90th percentile BOD concentration of 372 mg/L with the future (year 2009) dry season flow of 0.64 MGD to yield 1,986 lbs/day. This projected future BOD loading rate for year 2009 will be used as the design criteria for Phase I WWTP improvements.

The ultimate (year 2023) BOD loading rate is harder to estimate due to the high amounts of BOD being discharged by Northwest Pet Products, and the Oak Tree Restaurant. Both of these customers are currently exceeding the BOD discharge requirements for the level of pre-treatment required by the City, and are expected to reduce their BOD concentrations in the near future.

Phase II improvements should be designed after a wasteload study has been completed, in 2009, to re-evaluate the BOD loading to the plant after commercial/industrial dischargers have agreed to meet pre-treatment requirements, and/or have agreed to pay higher sewer rates based upon the amount of WWTP BOD capacity they are using. Should the BOD concentration be

reduced before Phase II WWTP improvements are being evaluated, then the WWTP would have additional BOD capacity available for growth from the Phase I improvements.

To obtain a per capita loading rate for residential and "other" users, a back calculation can be made under existing conditions. This per capita loading rate is obtained by subtracting the BOD loads from the known commercial/industrial customers (442 lbs/day) from the total BOD load entering the plant (1,105 lbs/day) and dividing by the existing population (3,570 persons); this load is calculated to be 0.19 lbs BOD/capita/day which correlates well to typical municipal BOD rates of 0.17 -.20 lbs BOD/capita/day.

The City has required that BOD concentrations for both of these customers to be no higher than 300 mg/L. If the assumption is made that Northwest Pet Products, and the Oak Tree Restaurant maintains their BOD concentrations at 300 mg/L, then the combined BOD loading would be 200 lbs/day (based on existing flows). Using this information, an estimate of future BOD influent concentration can be made. This concentration is 290 mg/L, and is used to provide an estimate of the design criteria for year 2023 Phase II improvements. The BOD loading conditions are summarized below.

	Year 1998	Year 2009	Year 2023
BOD loading rates	1,105 lbs/day (@ 372 mg/L)	1,986 lbs/day (@ 372 mg/L)	3,107 lbs/day (@ 291 mg/L)

TOTAL SUSPENDED SOLIDS (TSS) LOAD

The 90th percentile influent TSS concentration to the WWTP is 388 mg/L. TSS loading was calculated by taking the 90th percentile TSS concentration (388 mg/L) and multiplying it by the existing average dry weather flow (0.356 MGD) to yield 1,152 pounds per day, or 0.32 pounds per capita per day (this includes all wastewater customers including commercial/industrial users). The future (year 2009) TSS loading was calculated by multiplying the 90th percentile TSS concentration of 388 mg/L by the future dry season flow of 0.64 MGD which equals 2,071 lbs/day. This loading rate will be used as the design criteria for Phase I WWTP improvements.

A similar analysis can be made with TSS as was made with BOD (above) to obtain a clearer understanding of the sources of TSS received by the plant and the resulting impacts from the City's pre-treatment requirements. Assuming a typical TSS loading rate of 0.19 lbs/capita/day (typical range is 0.18-0.20 lbs/capita/day) for the residential portion of the the wastewater, an estimate of the TSS concentration from Northwest Pet Products can be made; this estimate is calculated to be 723 mg/L.

Along the same lines as the BOD loading discussion above, Northwest Pet Products, and the Oak Tree Restaurant are contributing excessively high TSS loads to the WWTP which, based on concentration, are currently violating the WWTP pre-treatment requirements. Therefore, before Phase II improvements are designed, a TSS wasteload study should be conducted to re-evaluate the TSS loads that will need to be treated in the year 2009. An estimate of the TSS loadings for Phase II improvements are provided below in the TSS loading summary based on the assumption that by the year 2009, Northwest Pet Products, and the Oak Tree Restaurant will not discharge TSS concentrations greater than 300 mg/L. The estimated total influent TSS concentration to the WWTP under these assumptions in year 2023 is 296 mg/L. A summary of the design criteria for TSS loading rates are provided below.

	Year 1998	Year 2009	Year 2023
TSS loading rates	1,152 lbs/day (@ 388 mg/L)	2,071 lbs/day (@ 388 mg/L)	3,160 lbs/day (@ 296 mg/L)

AMMONIA (NH_3) LOAD

Four weekly ammonia samples were collected during June and July of 1998. The 90th percentile concentration of these four ammonia samples was 30 mg/L. Using the 90th percentile, and the existing average dry weather flow, the existing dry weather average NH_3 loading is 89 lbs/day. There is no known available ammonia data for Northwest Pet Products, or the Oak Tree Restaurant. Since there does not seem to be a high influent ammonia load entering the WWTP, there was no need to evaluate the sources of the ammonia to the plant. Therefore, the future ammonia loadings for Phase I and Phase II improvements were both based on an influent ammonia concentration of 30 mg/L.

Future (year 2009) NH_3 loading was calculated by multiplying the 90th percentile ammonia concentration with the future (year 2009) dry season flow; this loading rate calculates to be 160 lbs/day. Similarly, the future (year 2023) ammonia loading rate was determined to be 320 lbs/day. A summary of the ammonia design loading rates are provided below.

	Year 1998	Year 2009	Year 2023
NH_3 loading rates	89 lbs/day (@ 30 mg/L)	160 lbs/day (@ 30 mg/L)	320 lbs/day (@ 30 mg/L)

SUMMARY

Table V-6 provides the existing NPDES Permit criteria for population, flow, and wasteloads for the WWTP; the 1998 (existing conditions) population, wasteflows, and wasteloads; and the projected population, wasteflows, and wasteloads for the year 2009, and 2023.

Table V-6. Comparison of the NPDES Permit Criteria for the WWTP with Existing WWTP Conditions, and Future (Year 2009, and Year 2023) WWTP Wasteflows and Wasteloads.

	Existing Permit Criteria	Existing Conditions (Year 1998)	Phase I WWTP Improvements Design Criteria (Year 2009)	Phase II WWTP Improvements Design Criteria (Year 2023)
Population	4,380	3,570	6,111	12,089
Flow				
ADWF	NA	0.375 MGD**	0.64 MGD	1.28 MGD
AWWF	NA	0.435 MGD	0.77 MGD	1.52 MGD
Average Annual	0.480 MGD	0.405 MGD	0.71 MGD	1.40 MGD
Maximum Monthly	NA	0.683 MGD	1.01 MGD	1.87 MGD
Peak Daily	1.200 MGD	1.208 MGD	1.62 MGD	3.20 MGD
Average Annual Loading				
BOD	800 lbs/day (200 mg/L)	NA	NA	NA
TSS	880 lbs/day (220 mg/L)	NA	NA	NA
NH_3	NA	NA	NA	NA
Dry Weather Loading				
BOD	NA	1,105 lbs/day (@ 372 mg/L)	1,986 lbs/day (@ 372 mg/L)	3,107 lbs/day (291 mg/L)
TSS	NA	1,152 lbs/day (@ 388 mg/L)	2,071 lbs/day (@ 388 mg/L)	3,160 lbs/day (296 mg/L)
NH_3	NA	89 lbs/day (@ 30 mg/L)	160 lbs/day (@ 30 mg/L)	320 lbs/day (30 mg/L)

** ADWF for existing conditions is projected out one year from the existing data to reflect the dry season of 1998.

The information above demonstrates that currently the average annual wastewater flow capacity is about 84% of the permitted capacity. The peak daily flow exceeded the NPDES permit peak day flow criteria by 8,000 gallons, however, this peak daily flow occurred in December of 1996 during an "anomaly" flood storm where the majority of wastewater treatment plants in south west Washington exceeded capacity.

Table V-6 also shows that the WWTP currently exceeds permit criteria for BOD and TSS loads by roughly 38% and 31% when comparing average annual loading criteria with dry weather loading criteria, respectively. However, the evaluation of WWTP performance (see Chapter IV) shows that the plant consistently meets treatment requirements. Even so, the plant does need to be upgraded at this time to meet existing reliability requirements, existing water quality standards, existing sludge treatment requirements, as well as provide increased capacity for future wasteloads

If Northwest Pet Products, and the Oak Tree Restaurant can meet the 300 mg/L BOD concentration, and the 300 mg/L TSS concentration requirements, then some additional capacity will become immediately available to the City. This is also of great benefit since, the need for more treatment capacity would be reduced to meet future demands; thus, greatly reducing capital and operational & maintenance costs. It is also recommended that before Phase II WWTP improvements are evaluated, a wasteload study be conducted to review the preliminary design criteria for the year 2023.