Section 2

Planning, Flows, and Loads

Section 2 presents planning information upon which this GSP is based, including population data, commercial development, and current and projected wastewater flow and load characteristics.

2.1 Historical Population

Historical estimates for the population within Yelm city limits were obtained from OFM for 1930–2010. In 2010, the United States completed a census, which determined the population for Yelm to be 6,848. The census tally for 2010 was substantially higher than the OFM estimate of 5,900. Because the census data are more accurate than OFM estimates, this discrepancy indicates that OFM apparently underestimated the growth rates in Yelm for the period from 2000 to 2010. The U.S. Census data for 2010 are therefore used as the baseline population for this GSP.

Over the last decade, Yelm has been the fastest-growing city in Thurston County and one of the fastest-growing cities in the state. U.S. Census data show that between 2000 and 2010 the population within Yelm city limits more than doubled, and increased at an annual rate of 7.6 percent. Table 2-1 presents Yelm's historical population growth as documented by the U.S. Census and as estimated by the OFM.

The OFM does not provide annual estimates for population within Yelm's UGA. The U.S. Census estimated the 2010 population within the UGA to be 1,353. Compared to the 2000 Census estimate of 1,095, this represents a 2.1 percent annually compounded growth rate.

Table 2-1. Historical Population Growth in Yelm City Limits [a,b]

Year	U.S. Census population estimates for city limits [c]	City population estimates by OFM	Average annual growth (based on OFM estimates) [d]
1930		384	-
1940		378	-0.2%
1950		470	2.2%
1960		479	0.2%
1970		628	2.7%
1980		1,294	7.5%
1990		1,337	0.3%
2000	3,289	3,289	9.4%
2001		3,420	4.0%
2002		3,485	1.9%
2003		3,830	9.9%
2004		4,150	8.4%
2005		4,455	7.3%
2006		4,565	2.5%

Table 2-1. Historical Population Growth in Yelm City Limits [a,b]			
Year	U.S. Census population estimates for city limits [c]	City population estimates by OFM	Average annual growth (based on OFM estimates) [d]
2007		4,845	6.1%
2008		5,150	6.3%
2009		5,625	9.2%
2010	6,848	5,900	4.9%

a. *Provided by Washington Office of Financial Management; includes only population within Yelm city limits.*

b. *Reference: http://www.ofm.wa.gov/pop/april1/finalpop2007.pdf and http://www.ofm.wa.gov/pop/decseries/historicalpop.xls*

c. *Annual compounded growth rate between census years for 2000 and 2010 is 7.6%.*

d. *Linear growth rate between dates shown.*

2.2 Current Service Area Population

Based on the U.S. Census tally, the total population living within Yelm city limits and the UGA in 2010 is 8,201. The 2010 U.S. Census population estimate will be used as the existing population for the City of Yelm and its UGA. However, when evaluating the existing population for the purposes of estimating flows and loads, the GSP will consider only the population served by the City sewer system rather than the entire population within city limits and the UGA. The existing service population consists of the following elements:

1. Population within city limits served by City sewer. Based on mapping data provided by the City of Yelm, a number of parcels within city limits are served by privately owned septic tanks rather than the City's STEP collection system. Estimation of the population determined to be served by the City's STEP collection system and private septic tanks within city limits is documented in a technical memorandum presented in Appendix 2A. Based on City mapping data, 2,125 STEP tanks are installed within city limits. A total of 157 parcels within city limits were determined to contain septic tanks; the population for these parcels is estimated to be 508. The population within city limits served by the STEP system was determined by subtracting the population served by septic tanks from the 2010 U.S. Census population.
2. Population outside city limits served by City sewer. City mapping data show that three STEP tanks are in service outside city limits and within the UGA. These STEP tanks serve an estimated population of approximately eight people. The City does not provide sewer service to any parcels outside the UGA.

The existing service area population, including the population served by City sewer within city limits and the UGA, is summarized in Table 2-2. Developed parcels within the existing service area that are served by City sewer are shown on Figure 1-2. Also shown are the parcels that were determined to be served by septic tanks (not on City sewer).

Table 2-2. Existing Service Area Population					
	(1)	(2)	(3) = (1) - (2)	(4)	(5) = (3) + (4)
Year	Total population within city limits [a]	Population within city limits not served by City sewer [b]	Population within city limits served by City sewer	Population outside city limits served by City sewer [c]	Total population served by City sewer
2010	6,848	508	6,340	8	6,348

a. *Source: 2010 U.S. Census.*

b. *Based on City STEP tank mapping data and Thurston County GIS data, approximately 157 parcels are on septic tanks. Population is based on land density for the census tract each parcel is located on.*

c. *Based on City STEP tank mapping, two residential STEP tanks are installed outside city limits: a single-family home and a duplex. Population is based on 2.5 persons per dwelling unit (the single-family home and duplex are taken to be equivalent to three dwelling units in this calculation). Residents of the UGA that are not served by City sewer are not included in the existing service area population calculation.*

2.3 Population Projections

As previously described in Section 1, two large MPCs are in different stages of development on the west side of Yelm, within city limits. These MPCs, shown in Figure 2-1, make up approximately 40 percent of the area within city limits, with approximately 200 acres in Tahoma Terra and 1,240 acres in the Thurston Highlands. Home construction in Tahoma Terra began in 2007, and the entire development currently has preliminary and final master site plan approval. According to the Community Development Department, more than 400 single-family lots have been created within the Tahoma Terra Community, along with 48 multi-family units. Another 200 single-family lots have been given preliminary subdivision approval. The remaining Tahoma Terra MPC is still subject to additional development review. The 2010 U.S. Census estimates that approximately 656 people were living within the Tahoma Terra Development in 2010. Development of the Thurston Highlands, originally planned to begin in 2007, has not yet begun. At this time, the timing of this development is uncertain.

Because the Thurston Highlands MPC represents such a significant percentage of the total population growth projected for Yelm, the City has elected to consider two separate development scenarios for the sewer planning process: the "without MPC" scenario and "with MPC" scenario. Considering these scenarios separately will allow the City to:

- Create a reliable improvement plan, independent of the timing for the Thurston Highlands development. Final planning and permitting for the Thurston Highlands are not finalized. The level of uncertainty with this potentially large portion of the city's population makes developing accurate projections difficult.
- Determine which improvements are necessary to serve existing customers and which are necessary solely to serve the MPC. This will allow the GSP to develop improvement plans and rate structures in accordance with the City's "growth pays for growth" philosophy.

Because the Tahoma Terra development is already planned and partially permitted, this area is included in the "without MPC" scenario rather than the "with MPC" scenario. This approach will allow the City to differentiate between growth that is already planned and underway in Tahoma Terra versus growth with an uncertain development year in Thurston Highlands. Population forecasts for the two development scenarios are summarized in the following sections. A detailed analysis of service to the Thurston Highlands MPC is included in Section 6 of this GSP.

2.3.1 Population Forecast: "Without MPC" Scenario

The future service area for the "without MPC" scenario, shown in Figure 2-2, is defined as the UGA boundary, minus the area that would be served by the Thurston Highlands MPC.

When developing near-term future projections, the growth rate documented in the census was evaluated. Between the census years of 2000 and 2010, the annual compounded growth rate was 7.6 percent within city limits and 2.1 percent within the UGA. The population forecast developed in this GSP will apply these growth rates from 2010 until 2015. After 2015, it is assumed that growth will stabilize and occur at the lower growth rates projected in the forecasts developed by the TRPC in 2007. The TRPC projections were provided in 5-year increments. Annual growth rates, which were interpolated for each year based on these projections, are shown with the census growth rates in Table 2-3.

Table 2-3. Growth Rates for City of Yelm Population Projections

Period	Source	City	UGA
2010–15	2010 U.S. census data	7.6%	2.1%
2015–20	2007 TRPC Projections	4.0%	5.7%
2020–25	2007 TRPC Projections	2.6%	4.0%
2025–30	2007 TRPC Projections	2.9%	5.9%

Note: Growth rates do not reflect population in the Tahoma Terra or Thurston Highlands communities. Growth rates for these communities were developed separately and are based on an amendment to the TRPC 2007 Buildable Lands Report.

This approach accounts for the increase in recent growth rates, but also develops a plan that is consistent with TRPC's long-term planning for Thurston County. Population estimates assume that the entire population within city limits will be connected to the City sewer by 2020, and the entire population within the UGA will be connected by 2030.

Table 2-4 shows the projected service population for 2020 and 2030. Detailed calculations and assumptions for population projections are included in the technical memorandum in Appendix 2A.

Table 2-4. Future Service Area Sewered Population: "Without MPC" scenario

	(1)	(2)	(3) = (1) + (2)	(4)	(5) = (3) - (4)	(6)	(7)	(8) = (5) + (7)
Year	Population within city limits, not including Tahoma Terra	Population within Tahoma Terra development [a]	Total population within city limits [b]	Population within city limits not served by City sewer [c]	Total population within city limits served by City sewer	Total UGA population	UGA population served by City sewer [d]	Total population served by City sewer
2010	6,192	656	6,848	508	6,340	1,353	8	6,348
2020	10,883	1,785	12,668	0	12,668	1,981	1,308	13,976
2030	14,298	2,575	16,874		16,874	3,220	3,220	20,094

a. *Tahoma Terra population is estimated based on a population of 656 in 2010 and a complete buildout by 2027.*

b. *2010 population data based on 2010 U.S. Census information.*

c. *Assumes that all existing customers served by septic tanks will be served by City sewer by 2020. All development within Tahoma Terra will be served by City sewer.*

d. *Assumes that the entire existing population within the UGA will be connected to City sewer by 2030 as the city expands into the UGA and that eight residential customers are currently served.*

The population projections show that, compared to the 2010 sewered population, the sewered population will more than double by 2020 (120 percent increase) and more than triple by 2030 (217 percent increase).

2.3.2 Population Forecast: "With MPC" Scenario

The population within the Thurston Highlands MPC is projected to develop at the same rate for the Thurston Highlands that was estimated in the 2007 TRPC Buildable Lands Report; however, the initial year of development is assumed to be delayed until 2020. Population associated with the Tahoma Terra development is included in the "without MPC" scenario.

Forecasts show that, by 2020, the population for the "with MPC" scenario is projected to be approximately 1,244 more than the "without MPC" scenario. This equates to a 140 percent increase in sewered population compared to 2010. By 2030, population is calculated to increase by approximately 300 percent.

The future service area for the "with MPC" scenario is shown in Figure 2-3. Table 2-5 shows the projected sewer service population for the "with MPC" scenario.

Table 2-5. Future Service Area Sewered Population: "With MPC" Scenario

	(1)	(2)	(3) = (1) + (2)
Year	Total residential population served by City sewer, not including Thurston Highlands MPC [a]	Future Thurston Highlands MPC population [b,c]	Total residential population served by City sewer
2010	**6,348**	**0**	**6,348**
2020	**13,976**	**1,244**	**15,220**
2030	**20,094**	**5,195**	**25,288**

a. *See Table 2-4.*

b. *Based on the TRPC 2007 Buildable Lands Report and the 2010 Water System Plan Projections; development year delayed until 2020.*

c. *Population of 5,195 for Thurston Highlands represents approximately 40% of buildout population.*

2.4 Projected Commercial Development

Projected commercial development is based on projections developed in the 2010 WSP. The following four primary sources of information were used for projecting commercial and industrial water usage in the Water System Plan:

- A study titled *Yelm Retail and Commercial Development Opportunities* (E.D. Hovee and Co., October 2005)
- A study titled *Yelm Industrial Area Market and Development Assessment* (E.D. Hovee and Co., July 2001)
- The *Draft Thurston Highlands Grading, Drainage, and Utilities Technical Engineering Report* (KPFF 2008)
- E-mail communication with Tami Merriman (Associate Planner, City of Yelm)

The *Yelm Retail and Commercial Development Opportunities* study provides an estimate of commercial development growth potential in Yelm from 2005 to 2030, not including development that will occur within the Thurston Highlands and Tahoma Terra MPCs. The amount of commercial development that will occur within Thurston Highlands is estimated in the *Draft Thurston Highlands Grading, Drainage, and Utilities Technical Engineering Report*. This study estimates the amount of retail and office development for three different development scenarios. The commercial water usage projections developed in this GSP are based on demands projected for the "Preferred Alternative" identified in that report, which will entail the development of 960,000 square feet of commercial space at buildout. Another 120,000 square feet of commercial development is planned for the Tahoma Terra MPC at buildout.

The commercial development projections for the GSP were modified from the WSP in two ways:

- The development associated with the Tahoma Terra community has been included in the existing service area for the "without MPC" scenario. Based on the recent economic slowdown, commercial development in Tahoma Terra that was initially planned for 2010 is now assumed to begin in 2015 and be completed in 2020.
- The development associated with the Thurston Highlands MPC has been assumed to begin in 2020, rather than 2010. This development is evaluated in the "with MPC" scenario.

Future commercial development for the "without MPC" scenario is shown in Table 2-6. Future commercial development for the "with MPC" scenario is included in Table 2-7.

Table 2-6. Commercial Development: "Without MPC" Scenario

Year	(1) Commercial development, not including Tahoma Terra or Thurston Highlands MPC (ft^2)	(2) Commercial development in Tahoma Terra (ft^2)	(3) = (1) + (2) Total commercial development (ft^2)
2010	625,863 [a]	0	625,863
2020	1,296,075	120,000	1,416,075
2030	2,080,000	120,000	2,200,000

a. *Existing commercial development, per City of Yelm.*

Table 2-7. Commercial Development: "With MPC" Scenario

Year	(1) Total commercial development, not including Thurston Highlands (ft^2)	(2) Commercial development in Thurston Highlands (ft^2) [a]	(3) = (1) + (2) Total commercial development (ft^2)
2010	625,863	0	625,863
2020	1,416,075	32,000	1,448,075
2030	2,200,000	352,000	2,552,000

a. *Commercial development for Thurston Highlands identified for the preferred alternative in the DRAFT Thurston Highlands Grading, Drainage, and Utilities Technical Engineering Report, KPFF March 2008. See page 43. Assumes that commercial development completed by 2040 will be 70% of total planned (per Community Development Department and projections developed in the 2010 Water System Plan).*

2.5 Wastewater Flow and Load

Wastewater flow has been increasing at the WRF from 2006 to 2010, consistent with Yelm's steady population growth. The average annual flow has increased by 25 percent over this period; the maximum monthly flow has increased by 17 percent. Over the same period, the population in Yelm has increased by approximately 23 percent (based on OFM population estimates summarized in Table 2-1). The following sections characterize existing flows and loads at the WRF.

2.5.1 Existing Wastewater Flow Characterization

Wastewater flow from 2006–10 is shown in Figure 2-4 and Table 2-8, which show that the average annual flow for the last 3 years was 0.34 mgd. Average day and maximum day flows do not follow a strong seasonal pattern. Peak hour flows are consistently highest on Thanksgiving Day.

Table 2-8. Existing WRF Wastewater Flow Characterization				
Year	Average annual flow (mgd)	Maximum month flow (mgd)	Maximum day flow (mgd)	Peak hour flow (mgd)
2006	0.284	0.314	0.427	NA
2007	0.317	0.329	0.398	0.708
2008	0.329	0.353	0.411	0.756
2009	0.349	0.359	0.436	0.784
2010	0.354	0.366	0.449	0.843
3-year average	0.34	0.36	0.43	

2.5.1.1 Residential Flows

In order to estimate the amount of residential flow treated at the WRF, average winter water use records for the last 3 years were analyzed. Residential use accounted for approximately 75 percent of water demand for the last three winters; residential flows at the WRF were therefore estimated to be 75 percent of the average influent flow. This equates to an average flow of 0.27 mgd and approximately 43 gallons per day (gpd) per person.

An ERU is defined as the flow produced by one average occupied single-family housing unit. Based on U.S. Census data for 2010, there were approximately 2.98 people per each residential housing unit within city limits. Compared to the sewered population of 6,348, this equates to 2,131 ERUs connected and 127.41 gpd/ERU.

2.5.1.2 Non-Residential Flows

Based on winter water use records, commercial wastewater flows were determined to comprise 22 percent of the average influent flow at the WRF, or 0.07 mgd. When compared to commercial development analysis, this flow rate is equivalent to approximately 0.13 gallons per day per square foot (gpd/ft^2) of commercial development (5,660 gpd/acre).

Wastewater flows from schools were determined to comprise 3 percent of the average influent flow at the WRF, or 0.01 mgd. The 2010 WSP estimates a student population of 3,889 within city limits. This equates to approximately 2.6 gpd per student.

2.5.1.3 Infiltration and Inflow

Infiltration and inflow (I/I) is defined as flow entering a system through groundwater (infiltration) and precipitation (inflow). The total flow through a system is therefore the sum of the base wastewater flow, plus the I/I. Infiltration and inflow in the Northwest typically follows a seasonal pattern, with high levels of I/I during the wet winter season and low levels of I/I during the summer.

Yelm's collection system consists entirely of STEP tanks, which pump flow from individual connections to the WRF. Because the entire system is pressurized, it is resistant to I/I. The City's 2011 Inflow and Infiltration Report, prepared in January 2012, does not report any significant I/I in the system. The 2011 I/I Report is included in Appendix 2B.

In 2011, the difference between the maximum month influent flow and minimum month flow was only 0.031 mgd, indicating that wet weather does not have a strong impact on flows at the WRF. Figure 2-5 provides an example of a typical wet weather month's comparison of daily influent flow to rainfall. As shown in the figure, there is no correlation between daily rainfall and influent flow. For this reason, additional flow due to I/I is not included in the flow characterization or flow projections.

2.5.2 Existing Wastewater Load Characterization

The City currently measures total suspended solids (TSS) and biochemical oxygen demand (BOD) to monitor compliance with its NPDES permit. The NPDES permit for the WRF does not require influent ammonia monitoring; however, the City began monthly monitoring of total Kjeldahl nitrogen (TKN) concentrations in March 2012.

Table 2-9 shows wastewater loading over the last 5 years, as measured in the WRF influent.

Table 2-9. Existing WRF Wastewater Load Characterization

Year	Average annual BOD_5 (lb/d)	Maximum month BOD_5 (lb/d)	Average annual TSS (lb/d)	Maximum month TSS (lb/d)
2006	591.7	658.9	133.2	182.0
2007	679.3	707.0	136.3	182.8
2008	696.0	786.6	132.7	155.7
2009	661.8	765.8	155.1	193.4
2010	638.9	689.2	157.9	208.7
3-year average (2008–10)	665.6	747.2	148.6	185.7

The City completed a sampling program to characterize wastewater discharged from commercial customers in October 2011. The commercial customer wastewater characterization sampling plan and results are included in Appendix 2C. Samples were collected from 18 locations. Two samples were taken from each location and were analyzed for the following constituents:

- Fats, oils, and greases (FOG)
- TSS
- TKN
- BOD

Table 2-10 shows the average results for each location sampled.

Table 2-10. Commercial Customer Wastewater Characterization Sampling Results

Location	Business name	Address	5-day BOD (mg/L)	FOG (mg/L)	TSS (mg/L)	TKN (mg/L)
1	Café Elite Coffee Shop	706 Yelm Ave. E B	2,063	27	140	55
2	Puerto Vallarta Restaurant	802 Yelm Ave. W	130	6	83	99
3	Yelm High School	1315 Yelm Ave. W	265	13	150	138
4	McDonald’s	505 Yelm Ave. W	749	95	191	51
5	Yelm Medical Plaza	201 Tahoma Blvd.	270	36	48	100
6	Wal-Mart	17100 Hwy. 507 SE	719	41	126	122
7	Rosemont Retirement Center	215 Killion Rd. NW	175	29	78	41
8	Dairy Queen	1202 Yelm Ave. E Ste. A	1,037	116	221	51

Table 2-10. Commercial Customer Wastewater Characterization Sampling Results						
Location	Business name	Address	5-day BOD (mg/L)	FOG (mg/L)	TSS (mg/L)	TKN (mg/L)
9	Golden Dragon Restaurant	813 Yelm Ave. W	540	13	48	70
10	Frontier Village Cleaners	404 First St. SE	236	27	39	37
11	Safeway	1109 Yelm Ave. E	519	60	117	46
12	Rainier Chevron	16518 Hwy. 507 SE	77	9	166	27
13	Ichiban Teriyaki	506 West Yelm Ave.	245	19	133	42
14	Pizza Hut	1412 Yelm Ave. E Bldg. C	1,126	127	161	75
15	Mariachi Allegre	717 Yelm Ave. E	551	49	68	104
16	Yelm Car Care Center	511 Yelm Ave. W	66	7	120	9
17	Yelm Vet Clinic	1120 Yelm Ave. W	360	133	43	47
18	Kentucky Fried Chicken	1310 Yelm Ave. E	749	58	139	83

Note: Sampling results based on the average of two samples taken at each location.

The results of the sampling were used to characterize loading from potentially high-strength commercial dischargers, such as Yelm High School, restaurants, coffee shops, and grocery stores. Results indicate that restaurants, coffee shops, and fast food chains generally had the highest concentrations of constituents measured.

Sampling data for the commercial dischargers shown in Table 2-10 were compared to plant influent data to estimate loading from residential and low-strength commercial dischargers, such as offices. This estimation was performed using the following calculation steps:

1. Average winter water use in 2010 was evaluated for each sampled commercial customer. Based on this use, a weighted average was generated to estimate the average concentrations from high-strength commercial dischargers. These concentrations are shown in Table 2-11.
2. Influent flow and concentration data at the WRF were obtained from discharge monitoring reports (DMRs) for the analysis period.
3. In order to estimate concentrations for residential and low-strength dischargers, concentrations for high-strength commercial customers were compared to concentrations measured in WRF influent for the analysis period. Concentrations were then weighted based on typical winter water flows determined in an analysis of billing records. This analysis showed that commercial customers that could be considered high-strength dischargers, such as schools, restaurants, coffee shops, grocery stores, and other businesses similar to those sampled, generally account for approximately 3 percent of winter water use. By subtraction, this means that residential customers and low-strength dischargers, such as offices, account for approximately 97 percent of winter water use. These percentages were used to estimate the volume of influent flow contributed by residential and high-strength commercial customers. Concentrations were then evaluated using the following formula:

$$\begin{aligned}&\text{Concentration}_{\text{Sampled Commercial Customers}} \times \text{Estimated Flow}_{\text{Sampled Commercial Customers}}\\ &\underline{+\ \text{Concentration}_{\text{Low Strength Customers}} \times \text{Estimated Flow}_{\text{Low Strength Customers}}}\\ &= \text{Concentration}_{\text{WRF Influent}} \times \text{Estimated Flow}_{\text{WRF Influent}}\end{aligned}$$

Results of the analysis are included in Table 2-11.

Table 2-11. Wastewater Concentrations by Type of Discharger			
	Average WRF influent concentration	Sampled high-strength commercial average concentration	Calculated residential and low-strength commercial average concentration
Parameter	(mg/L)	(mg/L)	(mg/L)
Average BOD	184	515	173
Average TSS	52	110	50
TKN	63	61	63
Average flow (mgd)	0.36	0.01	0.35

Note: Sampling performed October 12–19, 2011.

The results of the commercial sampling showed that, while wastewater discharged from high-strength commercial dischargers is very similar for TKN, BOD in commercial discharge is approximately four times higher than residential discharge, and TSS is approximately twice that for commercial versus residential. Section 10 presents a cost-of-service analysis to evaluate equitable rates for all types of dischargers based on the results of the sampling program.

2.6 Future Projected Flow and Load

This section presents future projected flow and load characteristics, including both residential and non-residential “with MPC” and “without MPC” projections.

2.6.1 Residential Projections: “Without MPC” Scenario

Residential flow projections were based on the calculation of current flow per person and then projected using the population growth summarized in Section 2.3. Residential wastewater loadings were projected to increase proportionally with flow. Table 2-12 shows the projected residential flow and load for the 10- and 20-year planning horizons for the “without MPC” scenario.

Table 2-12. Projected Residential Flow and Load: “Without MPC” Scenario					
Year	Total sewered population, including city limits, Tahoma Terra, and UGA (NOT Thurston Highlands)	Average flow including city limits, Tahoma Terra, and UGA (NOT Thurston Highlands) (mgd)	Average BOD (ppd) [a]	Average TSS (ppd)[b]	Average TKN (ppd)[c]
2010	6,348	0.27	393	114	143
2020	13,976	0.60	865	250	315
2030	20,094	0.86	1,244	360	452

Note: assumes all future growth is served by STEP system.

a. *Based on the average flow and a BOD concentration of 173 mg/L. Sample calculation for 2010: Average BOD ppd = (173 mg/L)*(0.27 mgd)*(3.785 gal/liter*1,000,000 gpd/mgd)/(453,592 mg/pound).*

b. *Based on the average flow and a residential TSS concentration of 50 mg/L.*

c. *Based on the average flow and a residential TKN concentration of 63 mg/L.*

Flow projections were developed assuming expansion of the City's STEP system to serve all additional residential growth. Section 3 of this GSP evaluates alternatives for collection system expansion, including impacts to flow and load projections if an alternative other than STEP system expansion was to be implemented in the future.

2.6.2 Residential Projections: "With MPC" Scenario

Residential projections for the "with MPC" scenario were developed assuming wastewater generated in the MPC is similar to that from the existing service area, in terms of flow rate and of BOD, TSS, and TKN concentrations. Collection system alternatives for the MPC, which take into account differences in wastewater flows and loads associated with each alternative, are evaluated in Section 6. Table 2-13 shows residential flow and load projections for the Thurston Highlands; Table 2-14 shows total residential flows for the Yelm wastewater system for the "with MPC" scenario.

Table 2-13. Projected Residential Flow and Load from Thurston Highlands

Year	Population in Thurston Highlands	Total residential flow from Thurston Highlands (mgd)	Average BOD (ppd)	Average TSS (ppd)	Average TKN (ppd)
2010	**0**	**0.0**	**-**	**-**	**-**
2020	**1,244**	**0.05**	**77**	**23**	**28**
2030	**5,195**	**0.22**	**322**	**93**	**117**

Table 2-14. Projected Residential Flow and Load: "With MPC" Scenario

Year	Total sewered population, including Thurston Highlands	Total residential flow, including Thurston Highlands (mgd)	Average BOD (ppd)	Average TSS (ppd)	Average TKN (ppd)
2010	**6,348**	**0.27**	**393**	**114**	**143**
2020	**15,220**	**0.65**	**942**	**273**	**343**
2030	**25,289**	**1.08**	**1,565**	**453**	**569**

2.6.3 Non-Residential Projections: "Without MPC" Scenario

Non-residential flow projections were developed based on the calculation of current flow per square foot and then projected based on future commercial development summarized in Section 2.4. Based on customer statistics developed by analyzing records of winter water use, flows from potentially high-strength customers, such as schools, restaurants, coffee shops, and grocery stores, account for approximately 45 percent of non-residential flow, while flow from low-strength dischargers, such as office buildings, account for approximately 55 percent of flow. It was assumed that this same ratio would remain relatively consistent as the City's non-residential development continues to grow. Therefore, when projecting commercial loading, 45 percent of the development was considered to have higher-strength concentrations shown in Table 2-11, and 55 percent of the development was assumed to have characteristics of lower-strength dischargers. An example calculation is shown below, using 2010 flow data and the loading concentrations shown in Table 2-11.

*BOD ppd = [(515 mg/L*45%*0.08 mgd)+(173 mg/L*55%*0.08 mgd)]*
[(3.785 gal/liter)(1,000,000 gpd/mgd)/(453,592 mg/pound)]*

Flow projections for schools were based on student population projections developed in the 2010 WSP and an average flow of 2.63 gpd per student. Loadings for schools were then included in non-residential loading projections. Similar to residential projections, non-residential loading was estimated to increase proportionally with flow. Table 2-15 shows the projected non-residential flow and load for the 10- and 20-year planning horizons for the "without MPC" scenario.

Table 2-15. Projected Non-Residential Flow and Load: "Without MPC" Scenario

Year	Total commercial development	Average commercial flow [a]	Total sewered student population	Average school flow [b]	Total non-residential flow	Average BOD (ppd)	Average TSS (ppd)	Average TKN (ppd)
2010	625,863	0.07	3,889	0.01	0.08	215	52	42
2020	1,416,075	0.18	7,706	0.02	0.20	540	128	103
2030	2,200,000	0.28	11,151	0.03	0.31	834	197	159

a. *Based on 0.13 gpd/ft^2.*

b. *Based on 2.6 gpd/student.*

2.6.4 Non-Residential Projections: "With MPC" Scenario

Non-residential projections for the "with MPC" scenario were developed assuming that the MPC non-residential wastewater characteristics in the MPC are similar to those for the existing service area. Collection system alternatives for the MPC, which take into account differences in wastewater flows and loads associated with each alternative, are evaluated in Section 6. Table 2-16 shows non-residential projections for the Thurston Highlands, and Table 2-17 shows total non-residential projections for the "with MPC" scenario.

Table 2-16. Projected Non-Residential Flow and Load from Thurston Highlands

Year	Commercial development in Thurston Highlands (ft^2)	Average non-residential flow from Thurston Highlands (mgd)	Average BOD (ppd)	Average TSS (ppd)	Average TKN (ppd)
2010	--	--	0	0	0
2020	32,000	0.02	12	3	2
2030	352,000	0.06	128	30	24

Table 2-17. Projected Non-Residential Flow and Load: "With MPC" Scenario

Year	Total commercial development (ft^2)	Average non-residential flow (mgd) [a]	Average BOD (ppd)	Average TSS (ppd)	Average TKN (ppd)
2010	625,863	0.08	215	52	42
2020	1,448,075	0.22	552	130	105
2030	2,552,000	0.37	962	227	183

a. *Includes schools.*

2.7 Maximum Month and Maximum Day Projections

Maximum month and maximum day flow projections were determined using peaking factors that compare average flows to maximum flows. Table 2-18 shows peaking factors experienced at the WRF from 2006 to 2010. The average peaking factor for 2008 through 2010 was used to project future maximum day and maximum month flows.

Table 2-18. Flow Peaking Factors

Year	Average flow (mgd)	Maximum month flow (mgd)	Maximum month average flow peaking factor	Maximum day flow	Maximum day average peaking factor
2006	0.28	0.31 (December)	1.10	0.43	1.50
2007	0.32	0.33 (January)	1.04	0.40	1.26
2008	0.33	0.35 (November, December)	1.07	0.41	1.25
2009	0.35	0.36 (January, May)	1.03	0.44	1.25
2010	0.35	0.37 (September)	1.03	0.45	1.27
3-year average			1.05		1.26

In order to evaluate future loadings, historical loading peaking factors were analyzed (Table 2-19). When projecting future loads, it was assumed that maximum day and maximum month loadings would have a constant concentration and would increase proportionally with flow. Maximum day peaking factors are assumed to be equal to peaking factor for flow (1.26).

Table 2-19. Loading Peaking Factors

Year	Average BOD (lb/d)	Maximum month BOD (lb/d)	Maximum month average BOD peaking factor	Average TSS (lb/d)	Maximum month TSS (lb/d)	Maximum month average TSS peaking factor
2006	591.7	658.9	1.11	133	182	1.4
2007	679.3	707.0	1.04	136	183	1.3
2008	696.0	786.6	1.13	133	155	1.2
2009	661.8	765.8	1.16	155	193	1.2
2010	638.9	689.2	1.08	158	209	1.3
3-year average			1.12			1.2

2.8 Summary of Projected Flow and Loading

Future flow and loading projections are summarized in Tables 2-20 to 2-22 and Figures 2-6 to 2-11.

Table 2-20. Projected Flow and Load: "Without MPC" Scenario

Year	Average daily flows for the "without MPC" scenario	Max month flow (mgd)	Max day flow (mgd)	Peak hour flow (mgd)	Average annual BOD_5 (lb/d)	Average annual TSS (lb/d)	Average annual TKN (lb/d)	Maximum month BOD_5 (lb/d)	Maximum month TSS (lb/d)	Maximum month TKN (lb/d)	Maximum day BOD_5 (lb/d)	Maximum day TSS (lb/d)	Maximum day TKN (lb/d)
2010	0.35	0.37	0.45	0.81	608	164	184	682	205	192	763	297	231
2020	0.80	0.83	1.00	1.84	1,405	378	417	1,470	471	436	1,764	683	524
2030	1.16	1.22	1.46	2.69	2,077	557	611	2,172	694	639	2,608	1,005	767

Table 2-21. Projected Flow and Load from Thurston Highlands MPC

Year	Average daily flows	Max month flow (mgd)	Max day flow (mgd)	Peak hour flow (mgd)	Average annual BOD_5 (lb/d)	Average annual TSS (lb/d)	Average annual TKN (lb/d)	Maximum month BOD_5 (lb/d)	Maximum month TSS (lb/d)	Maximum month TKN (lb/d)	Maximum day BOD_5 (lb/d)	Maximum day TSS (lb/d)	Maximum day TKN (lb/d)
2010	0.0	-	-	-	-	-	-	-	-	-	-	-	-
2020	0.05	0.06	0.08	0.13	77	22	28	81	28	29	97	40	35
2030	0.22	0.28	0.36	0.62	322	93	117	336	116	122	404	168	147

Table 2-22. Projected Flow and Load: "With MPC" Scenario

Year	Average daily flows for the "with MPC" scenario	Max month flow (mgd)	Max day flow (mgd)	Peak hour flow (mgd)	Average annual BOD_5 (lb/d)	Average annual TSS (lb/d)	Average annual TKN (lb/d)	Maximum month BOD_5 (lb/d)	Maximum month TSS (lb/d)	Maximum month TKN (lb/d)	Maximum day BOD_5 (lb/d)	Maximum day TSS (lb/d)	Maximum day TKN (lb/d)
2010	0.35	0.37	0.45	0.81	608	164	184	682	205	192	763	297	231
2020	0.85	0.89	1.08	1.97	1,482	400	445	1,550	499	466	1,861	723	559
2030	1.39	1.50	1.82	3.31	2,399	650	728	2,509	810	761	3,011	1,174	914

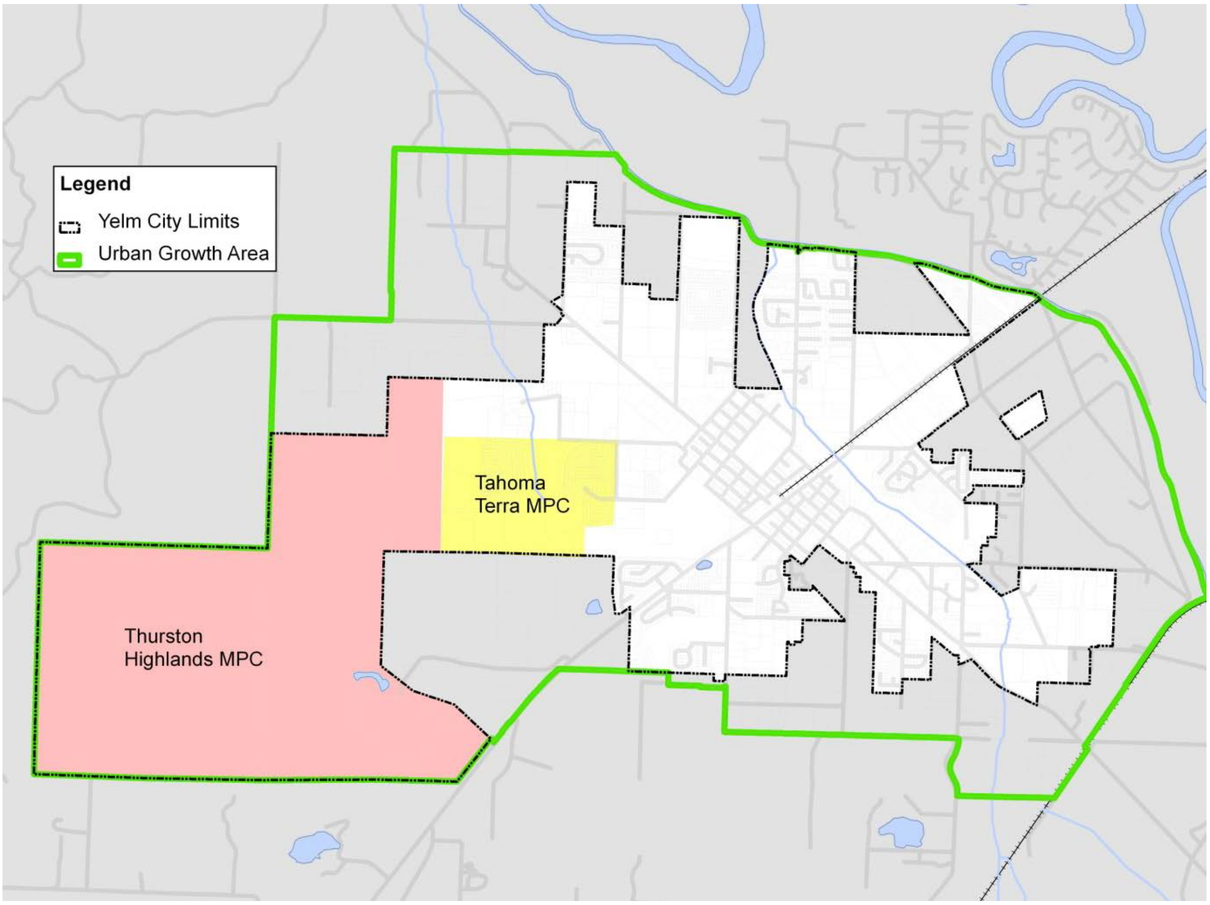

Figure 2-1. Master planned communities

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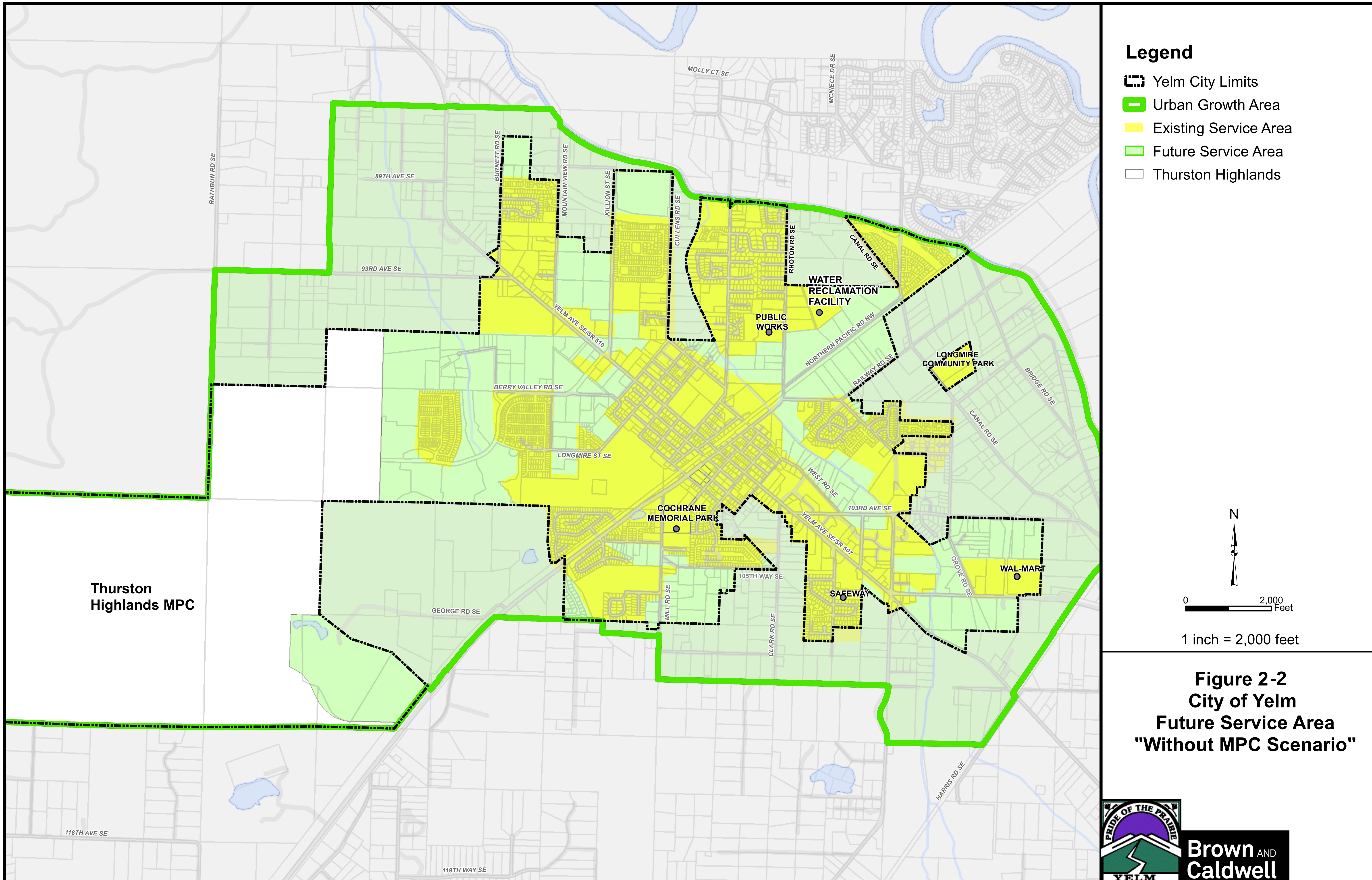

Figure 2-2
City of Yelm
Future Service Area
"Without MPC Scenario"

Brown AND Caldwell

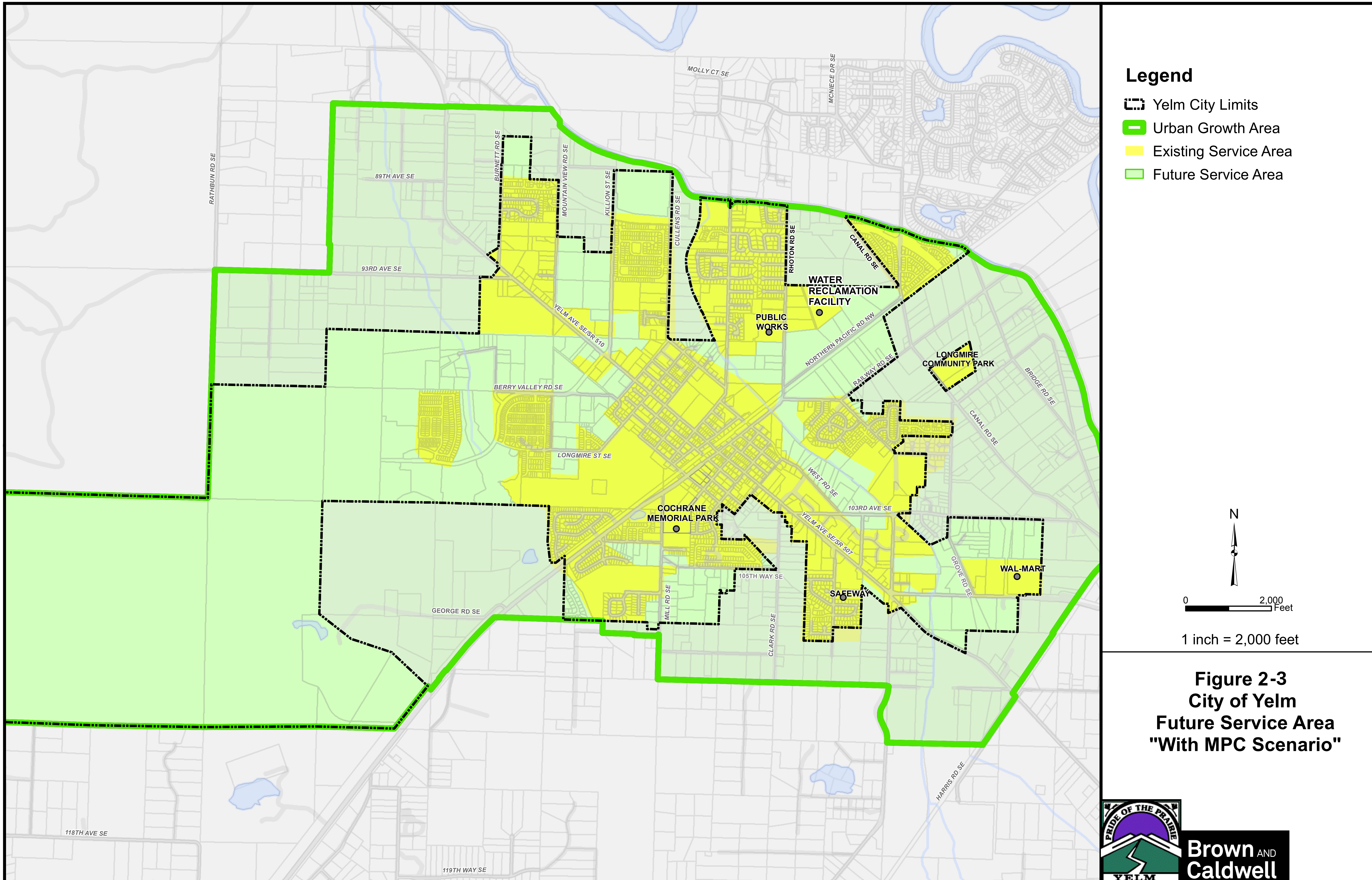

Figure 2-3
City of Yelm
Future Service Area
"With MPC Scenario"

Brown AND Caldwell

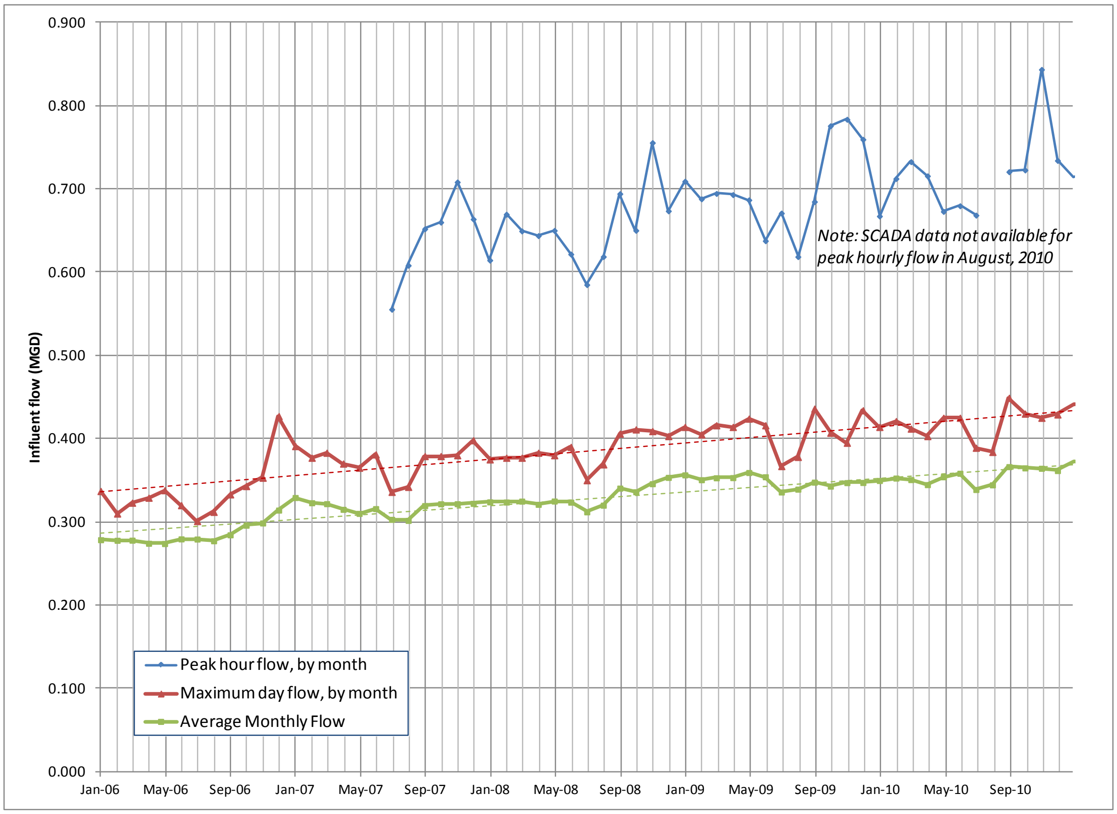

Figure 2-4. Influent flow at the Water Reclamation Facility, 2006–10

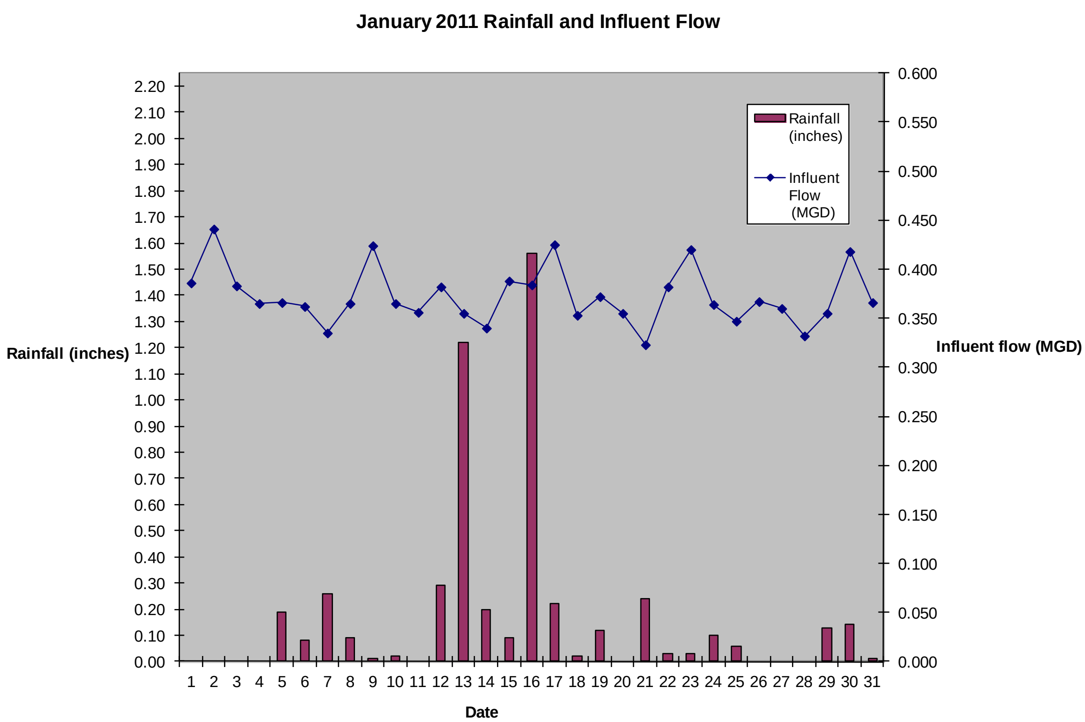

Figure 2-5. Example of daily influent flow compared to rainfall

Source: City of Yelm, 2011 I&I Report

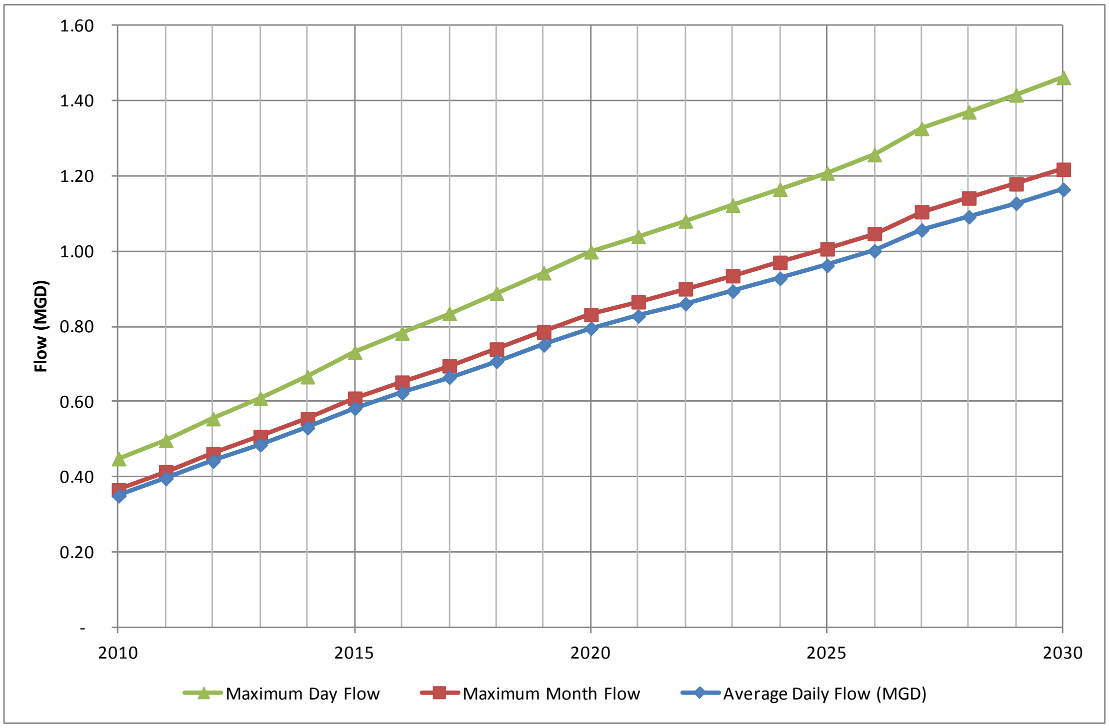

Figure 2-6. Projected flows: "without MPC" scenario

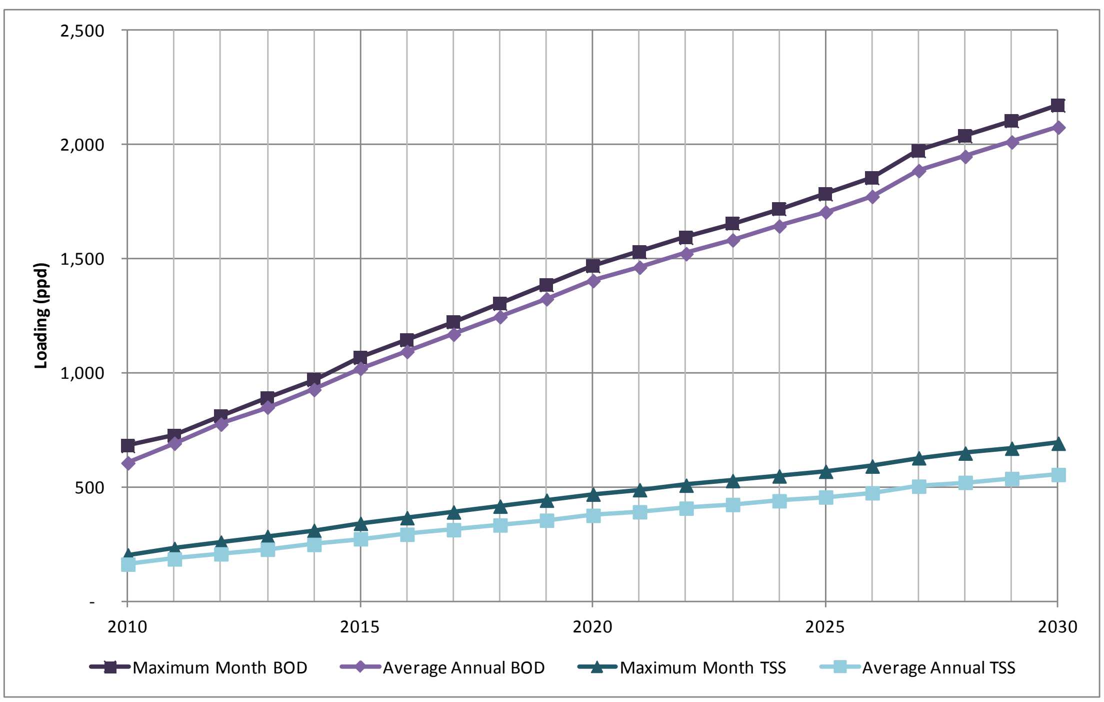

Figure 2-7. Projected BOD and TSS loading: "without MPC" scenario

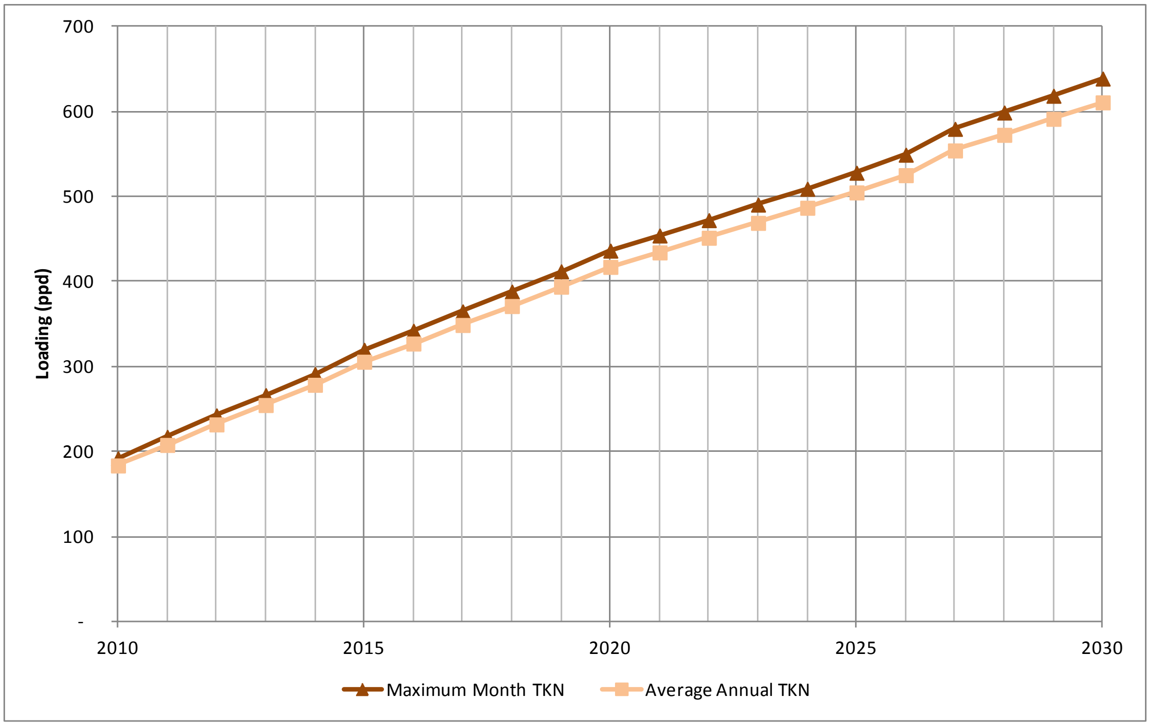

Figure 2-8. Projected TKN loading: “without MPC” scenario

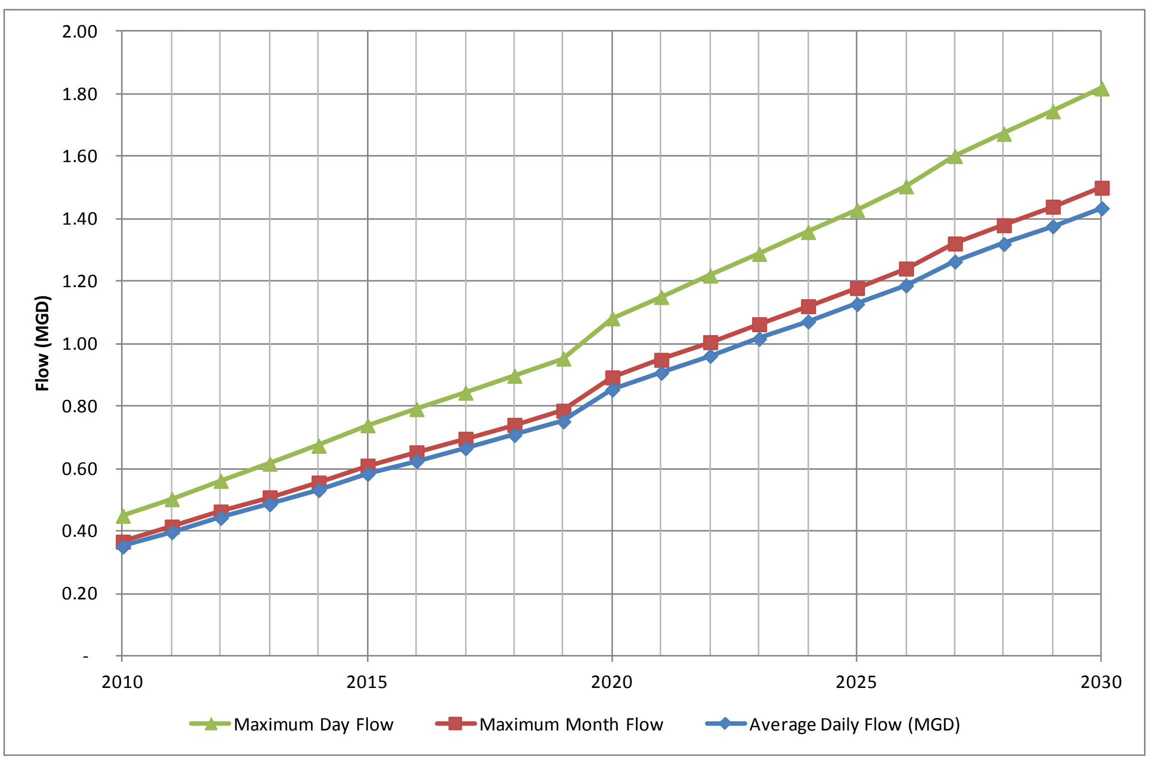

Figure 2-9. Projected flows: “with MPC” scenario

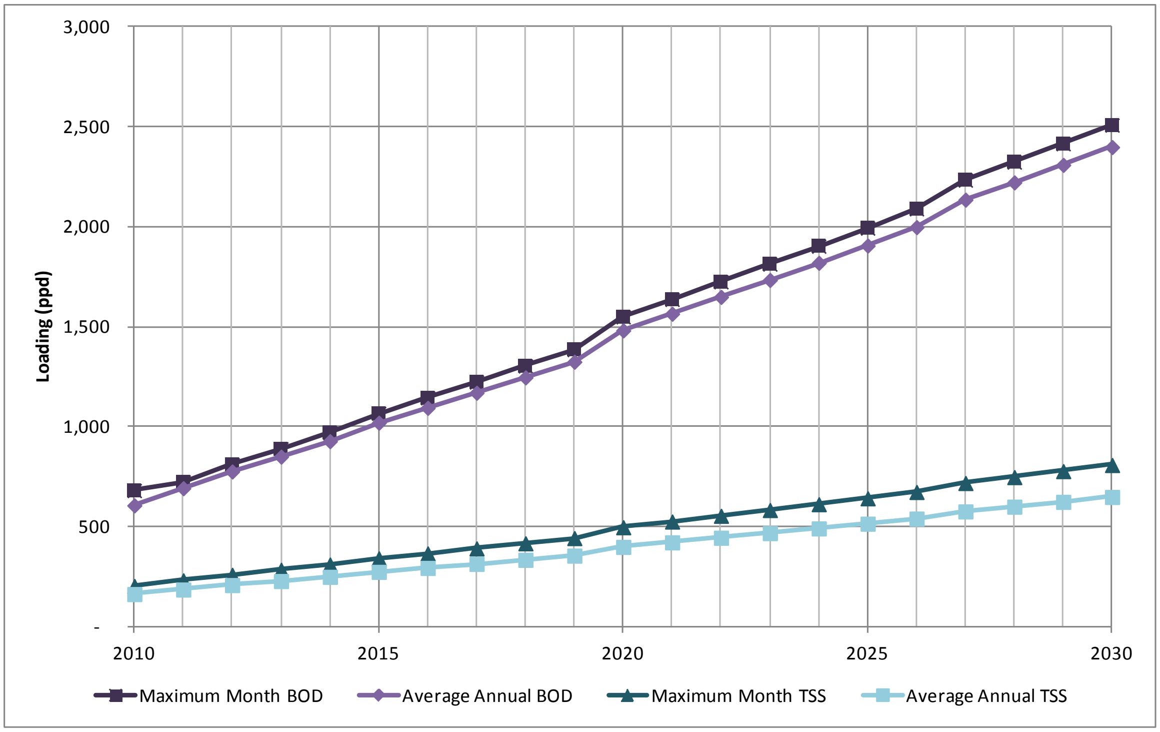

Figure 2-10. Projected BOD and TSS loading: "with MPC" scenario

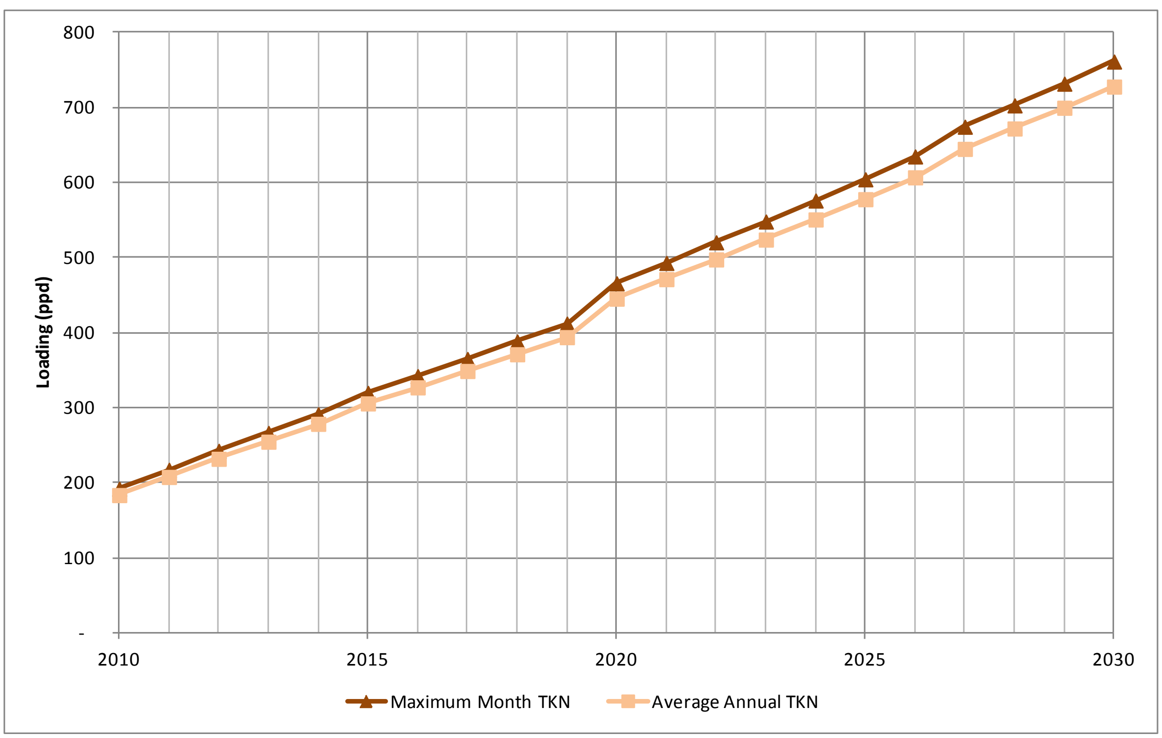

Figure 2-11. Projected TKN loading: "with MPC" scenario