TECHNICAL MEMORANDUM 2.1 – FLOWS AND LOADS PROJECTIONS

NEW Water Facility Plan

B&V PROJECT NO. 402658

PREPARED FOR

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

20 MARCH 2020

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APPENDIX

1 Purpose

Establishing current and future flows and loadings is a critical first step to every planning process for wastewater utilities. Without agreed upon current conditions and future projections at the start of a planning project, it is not possible to effectively develop infrastructure capital improvement plans. The purpose of Technical Memorandum 2.1 (TM 2.1) is to summarize the estimated future flow and loading projections for the Green Bay Metropolitan Sewerage District (NEW Water) Facility Plan. The specific objectives of TM 2.1 are:

1. Complete an evaluation of the past 10 years of data to develop a summary of the existing service area flows and loads including the annual average, maximum month, maximum week, peak day, and peak hour.
2. Categorize flow and loadings for residential, commercial, industrial, and hauled-in contributions under current conditions.
3. Complete an inflow/infiltration evaluation.
4. Review the most recent comprehensive plans from communities and Brown County that are served by NEW Water along with other planning sources within the service area.
5. Develop land use projections, population projections, and resulting flow and load projections for expansions to the existing service area based on methods and results with the Interceptor Master Plan.
6. Prepare 5, 10, 20, and 50-year flow and loads projections.
7. Develop historical and projected peak flow events for use in hydraulic and process modeling. These events will be developed as dynamic hourly data sets to best reflect actual peak flow events experienced at the facilities.
8. Establish key metrics for consideration for sensitivity analysis related to future flows and loads.

2 Background

The Green Bay Metropolitan Sewerage District, operated under the brand name of NEW Water, collects and treats wastewater from 15 communities in a service area encompassing over 285 square miles with a population of approximately 236,845 in 2019. The NEW Water facility is comprised of the Green Bay Facility (GBF) and the De Pere Facility (DPF). NEW Water owns, operates, and maintains approximately 78 miles of interceptor, 1,096 sanitary sewer manholes, 13 lift stations, 29 miles of force mains, 22 permanent metering stations, 4 inverted siphons, and 2 wastewater treatment facilities. NEW Water collects and treats wastewater from the following communities and municipalities:

GBF

- Allouez
- Ashwaubenon
- Bellevue
- Green Bay
- Hobart
- Howard
- Pittsfield
- Pulaski
- Scott
- Suamico
- Dyckesville
- Luxemburg

DPF

- Ashwaubenon
- De Pere
- Hobart
- Lawrence
- Ledgeview
- Rockland (annexed)

The NEW Water treatment facilities receive domestic, commercial, industrial wastewater, and hauled-in waste (HW)/high strength waste (HSW). NEW Water administers an industrial pretreatment program that regulates industrial contributors. The GBF treated an average of 36.6 mgd of total wastewater in 2019 with a liquid treatment train consisting of influent pumping, screening, primary clarification, primary sludge grit removal, activated sludge configured for enhanced biological phosphorus removal (EBPR), secondary clarification, and is disinfected with sodium hypochlorite and dechlorinated with sodium bisulfate. Recycles are not included within the flows and loads coming into the front of the plant as they are included in the process model. The treated effluent is discharged to the Fox River. The solids handling treatment train includes sludge thickening with gravity belt thickeners and a thickening centrifuge followed by anaerobic digestion with co-digestion of high strength waste (HSW), centrifuge dewatering, and ending with solids drying and incineration. Biogas processing includes hydrogen sulfide gas (H_2S) removal, biogas conditioning, siloxane removal, and combined heat and power generation in engine generators with a backup flare. The GBF receives HW, which is screened and discharged to the plant influent and HSW, which is fed to the digesters for additional biogas production. Industrial wastewater flows are pumped to the plant from Proctor & Gamble and Fox River Fiber.

The DPF treated an average of 8.81 mgd in 2019 of wastewater with a treatment train consisting of screening, influent pumping, grit removal, activate sludge configured for enhanced biological phosphorus removal (EBPR), intermediate clarification, final clarification, and tertiary sand filters. The effluent is treated with ultraviolet (UV) disinfection and discharged to the Fox River. An industrial forcemain pumps waste from the Fox River Fiber industrial customer downstream of grit removal. Waste activated sludge (WAS) is pumped to the GBF in a forcemain for biosolids processing. In addition, there is an interplant transfer forcemain to the GBF, which provides some flexibility to send DPF influent to the GBF interceptor system for treatment at the GBF.

The current flow and loadings discussed in this TM were estimated based on data provided by NEW Water. Table 2.1 and Table 2.2 provide the current rated design capacity of the GBF and DPF. This data was obtained from the original design as-built drawings including the *Green Bay Metropolitan Sewerage District Contract 31 South Complex* and the *City of De Pere, De Pere, Wisconsin, Phase II, Expansion of Wastewater Treatment Plant*. Further evaluation of these rated capacities will be completed as part of the Infrastructure Gap Analysis.

Table 2.1. GBF Design Flows and Loadings

INFLUENT PARAMETER	AVERAGE	MAXIMUM MONTHLY	MAXIMUM WEEKLY	MAXIMUM DAILY
Flow (mgd)	32.4	49.2	65.5	96.6
BOD_5 (ppd)	74,660	103,110	126,630	201,390
TSS (ppd)	84,580	89,460	110,360	200,240
NH_3-N (ppd)	5,610	6,555	6,990	12,500

Table 2.2. DPF Design Flows and Loadings

INFLUENT PARAMETER	AVERAGE	DESIGN	PEAK HOUR
Flow (mgd)	9.5	14.2	30
BOD_5 (ppd)	23,500	41,000	41,000
TSS (ppd)	18,400	23,700	28,900

3 Flows and Loadings

3.1 CURRENT FLOW AND LOADINGS

3.1.1 Residential, Commercial, Inflow & Infiltration (I/I), and light industrial (does not include SIUs and Hauled Waste)

Residential and commercial flows (domestic flows) are generated by the public and flow in a diurnal flow that reflects the timing that water is used within a community with peaks in the morning and evening hours. The residential and commercial flows typically correlate well with population and, as a result, the flows and loadings are evaluated and developed into a flow and pound per day per capita value. Domestic flow and loading rates were determined from the historical GBF and DPF daily data from January 2015 to December of 2019. This period was selected because it is a representative snapshot of the data to accurately depict the existing conditions and users within the service area. The domestic flows were calculated by subtracting measured significant industrial users (SIUs) flows and HW (GBF only) volumes from the total observed flow and calculating the average. The minimum 7-day average flow was 15 mgd for the GBF and 4.8 mgd for DPF which were assumed to be the base flow (the minimum flow is assumed to be free from irrigation and I/I related impacts). The average flows and loads for each plant were used to calculate the per capita values for future flow projections for the existing user population (data summarized in Table 3.1.1 and Table 3.1.2).

Table 3.1.1: GBF domestic daily average residential, commercial, I/I, and non-permitted industrial flows and loadings (does not include SIU and hauled waste flows and loads)

YEAR	FLOW (MGD)	PEAK FLOW (MGD)	BOD (PPD)	NH3-N (PPD)	PHOSPHORUS (PPD)	TKN (PPD)	TSS (PPD)
2014	24.4	60.5	32,152	4,982	779	6,582	30,259
2015	21.7	90.5	27,701	4,508	753	6,225	27,699
2016	23.9	55.2	30,354	4,459	776	5,850	28,166
2017	23.6	48.2	28,994	4,139	576	6,081	29,684
2018	24.7	66.6	31,888	3,960	774	5,866	40,986
2019	31.9	84.7	33,482	3,612	869	5,981	44,842

Table 3.1.2: DPF domestic daily average residential, commercial, I/I, and light industrial historical flows and loadings (does not include SIU and hauled waste flows and loads)

YEAR	FLOW (MGD)	PEAK FLOW (MGD)	BOD (PPD)	NH3-N (PPD)	PHOSPHORUS (PPD)	TKN (PPD)	TSS (PPD)
2014	4.71	12.2	14,354	1,224	205	1,560	10,884
2015	5.00	21.5	15,061	1,042	166	1,722	11,396
2016	5.54	15.9	13,641	989	199	1,496	11,692
2017	5.83	12.4	19,466	1,205	223	2,016	14,766
2018	6.69	17.3	22,712	1,442	293	2,568	20,550
2019	8.59	35.7	18,191	1,395	298	2,260	15,565

3.1.2 Significant Industrial Users (SIUs)

The NEW Water treatment facilities receive wastewater from several SIUs. These industries are permitted through NEW Water's Pretreatment Program for flow and loadings. The top 10 contributors (out of 50 total) by volume are listed in Table 3.1.3. The flow comes into the facilities through the raw metro wastewater flow, the dedicated QS2 mill interceptor, the interplant force main, or direct industrial force mains into the plants. At the GBF, Proctor & Gamble flows into the plant upstream of the screens while Fox River Fiber comes into the plant downstream of the primary clarifiers in the primary effluent flumes. Fox River Fiber flows into the DPF downstream of grit removal (with the exception when they are discharging to the gravity interceptor sewer during times of industrial force main outage most significantly during July 2017 to October 2019). For the purpose of this analysis, it was assumed all SIUs are discharging the average flows and loadings daily. To estimate the total pounds per day of loadings, the data for the average day were summed (Table 3.1.4) and are assumed to remain constant for future projections as requested by NEW Water during the flows and loads preliminary meeting on September 9, 2019. Data from 2014 to 2019 were used to calculate the estimates in Table 3.1.3, Table 3.1.4, Table 3.1.5, and Table 3.1.6. The data used for future estimates will come from the year with the largest flows and loads to the plants to account for the Fox River Fiber flow and loading diversion to the municipal pipeline from 2017-2019.

Table 3.1.3: Top 10 SIUs for the NEW Water Pretreatment Program

NO.	COMPANY	PLANT	AVERAGE FLOW FROM 2014-2016 (GPD)	PEAK FLOW (MGD)
1	Procter & Gamble Paper Products Company	GBF	3.43	5.71
2	Fox River Fiber	DPF & GBF	1.11	1.23
3	JBS Green Bay	GBF	1.03	1.27
4	Ahlstrom-Munksjo (formerly Expera)	DPF	0.88	1.11
5	Bay Valley Foods, LLC	GBF	0.58	0.70
6	Green Bay Dressed Beef - Acme	GBF	0.54	0.73
7	Pioneer Metal Finishing	DPF	0.43	0.50
8	Georgia Pacific Consumer Operations, LLC	GBF	0.28	0.33
9	Sanimax USA, LLC.	GBF	0.24	2.03
10	Green Bay Nonwovens, Plant 1	DPF	0.23	0.25

Table 3.1.4: Historical daily average sum of flow and loadings from all SIUs including Fox River Fiber and Proctor & Gamble

	2014	2015	2016	2017	2018
Average Flow (MGD)	14.3	14.7	10.0	12.2	12.5
Peak Flow (MGD)	22.7	23.9	14.7	23.9	20.7
BOD (ppd)	17,536	23,567	19,967	17,940	17,262
NH3 (ppd)	2,201	1,948	2,093	1,856	1,674
Phosphorus (ppd)	414	407	2,870	353	223
TKN (ppd)	3,468	2,803	2,423	2,997	2,322
TSS (ppd)	14,360	13,238	13,372	17,981	14,202

Each treatment plant receives flow from different SIUs (identified in "Plant" column in Table 3.1.3). Table 3.1.5 and Table 3.1.6 include the average day and peak day flow data of all summed treatment plant flow and loadings. The SIUs average flow had historically contributed a maximum of 12.3 mgd to the GBF in 2015 and a maximum of 2.44 mgd in 2015 to the DPF. The average flows and loads were subtracted from the total combined flow to estimate the domestic per capita day values for future flow and loading projections (including Fox River Fiber and Proctor & Gamble for the years with data available).

Table 3.1.5: Total daily flow, max day, and peaking factor for all SIUs flow and loading to GBF

PARAMETER	2014	2015	2016	2017	2018*
Daily Average Flow (mgd)	11.9	12.3	7.9	10.1	10.6
Peak Day Flow (mgd)	18.7	18.4	11.1	20.6	18.2
BOD (ppd)	15,144	21,895	17,866	17,072	16,427
NH3 (ppd)	2,092	1,831	1,881	1,693	1,539
Phosphorus (ppd)	363	333	2,839	300	181
TKN (ppd)	3,307	2,704	2,287	2,835	2,122
TSS (ppd)	13,029	11,440	11,797	16,429	12,563
*No Fox River Fiber Data Available					

Table 3.1.6: Total daily flow, max day, and peaking factor for all SIUs average flow and loading to DPF

PARAMETER	2014	2015	2016	2017	2018*
Daily Average Flow (mgd)	2.44	2.44	2.07	2.09	1.91
Peak Day Flow (mgd)	3.92	5.51	3.61	3.28	2.49
BOD (ppd)	2,392	2,369	2,067	823	810
NH3 (ppd)	109	105	135	109	103
Phosphorus (ppd)	50.7	76.5	28.5	51.8	38.0
TKN (ppd)	160	85	109	101	105
TSS (ppd)	1,331	1,918	1,193	1,397	1,149
*No Fox River Fiber Data Available					

3.1.3 Hauled Waste (HW) to the GBF Head Works

NEW Water's HW Program works with permitted haulers, serves as a waste disposal outlet for septage and industrial wastes. Table 3.1.7 identifies the HW contributors in terms of volume to the GBF. The greatest contributor in 2019 was from residential holding tanks hauled by Kiekhaefer Septic Service, LLC. Table 3.1.8 identifies the BOD loadings by contributor with the greatest being Dean Foods. HW data from January to June 2019 was used for future projections. Average day and maximum day HW flows and loadings were calculated and detailed in Table 3.1.9 and Table 3.1.10. It should be noted that the maximum loadings may not align with the same day as the maximum volumes.

Table 3.1.7: 2019 Total Hauled Waste Volumes to the GBF Headworks

SOURCE OF HAULED WASTE	TOTAL VOLUME IN 2019 (GALLONS)
Residential Holding Tank	1,694,000
Brown County Leachate	1,413,250
Dean Foods	1,025,541
Renards Cheese	644,500
Commercial Holding Tank	586,000
Belgioioso Chase	495,000
Grease	366,075
Okeefe Landfill	342,500
Belgioioso Denmark Langes	335,000
Septic Tank	249,000
Acct #58	135,500
Belgioioso Cheese	120,000
Denmark DAF Sludge	110,000
Porta Potty	60,000
Bay Therm Insulation	30,000
Nhiacha's Butcher Shop	25,000
I View Custom Fabrication	15,000
Acct #56	9,600
Victory Lanes Imports	5,000
Pit Water	4,750
Prefinished Staining	2,500
Grand Total	7,668,216

Table 3.1.8: BOD HW loadings for 2019 to the GBF

SOURCE OF HAULED WASTE	TOTAL BOD IN 2019 (LBS)
Dean Foods	229,077
Grease	24,034
Residential Holding Tank	18,108
Belgioioso Chase	13,399
Denmark DAF Sludge	12,386
Commercial Holding Tank	8,879
Renards Cheese	5,430
Septic Tank	5,228
Belgioioso Denmark Langes	3,348
Brown County Leachate	1,878
Acct #56	1,202
Porta Potty	1,177
Belgioioso Cheese	709
Acct #58	636
Okeefe Landfill	404
Victory Lanes Imports	217
Bay Therm Insulation	95.6
Nhiacha's Butcher Shop	78.3
I View Custom Fabrication	26.1
Pit Water	16.6
Prefinished Staining	6.83
Grand Total	**326,336**

The maximum day loadings of BOD for 2019 was the maximum day of all hauled waste loading days as a result of Foremore Whey, Renards Cheese, Belgiosio Cheese and Denmark DAF sludge all hauled in on the same day. There is a possibility of this occurring again at some point in the future. The increased mass in 2019 may also be a result of those wastes being higher strength. It should be noted the high strength waste from Milk Specialties was not included in the hauled waste that goes to the headworks as this was considered to go to the digester.

Table 3.1.9: HW maximum day flows and loadings

YEAR	VOLUME (GALLONS)	BOD (LBS)	TP (LBS)	TKN (LBS)	TSS (LBS)
2015	503,098	1,614	99	172	3,123
2016	434,000	2,944	64	287	4,836
2017	388,900	2,228	26	268	6,108
2018	463,420	4,387	250	325	6,383
2019	288,206	17,687	281	244	3,679
Average	**415,525**	**5,772**	**144**	**259**	**4,826**

Table 3.1.10: HW average day flows and loadings

YEAR	VOLUME (GALLONS)	BOD (LBS)	TP (LBS)	TKN (LBS)	TSS (LBS)
2015	218,701	254	11	26	436
2016	157,468	238	4	21	275
2017	174,281	293	5	40	389
2018	172,432	454	10	38	542
2019	147,640	985	16	41	483
Average	**174,105**	**456**	**9**	**34**	**432**

HW volumes vary greatly (as shown in Figure 3.1.1), therefore, using the average volume does not fully represent the potential of high-volume days. Additionally, Figure 3.1.2 shows the probability of the HW volume, indicating that over 50% of the time the volume is greater than the average from 2019 (147,640 gallons). As a result of this variability, the maximum average from 2015 to 2019 was used to reserve daily volume in the treatment process for future flows.

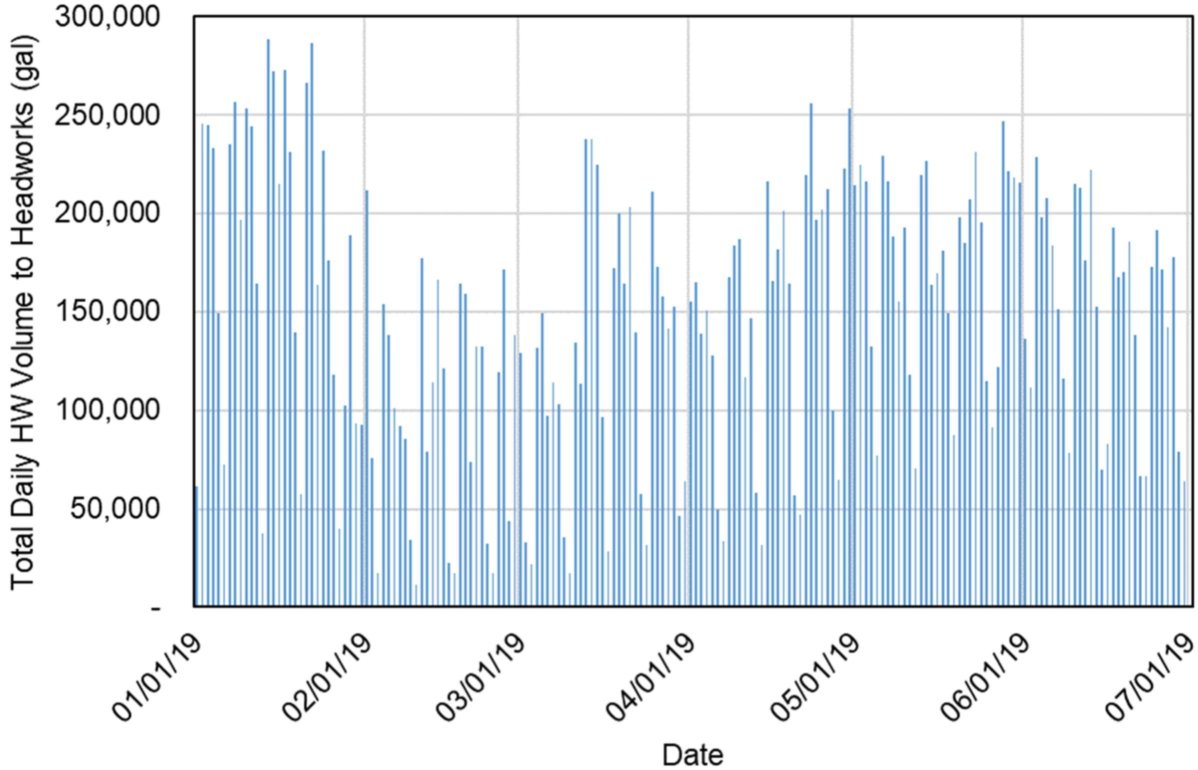


Figure 3.1.1: Total daily volume of HW to GBF headworks is highly variable from day to day.

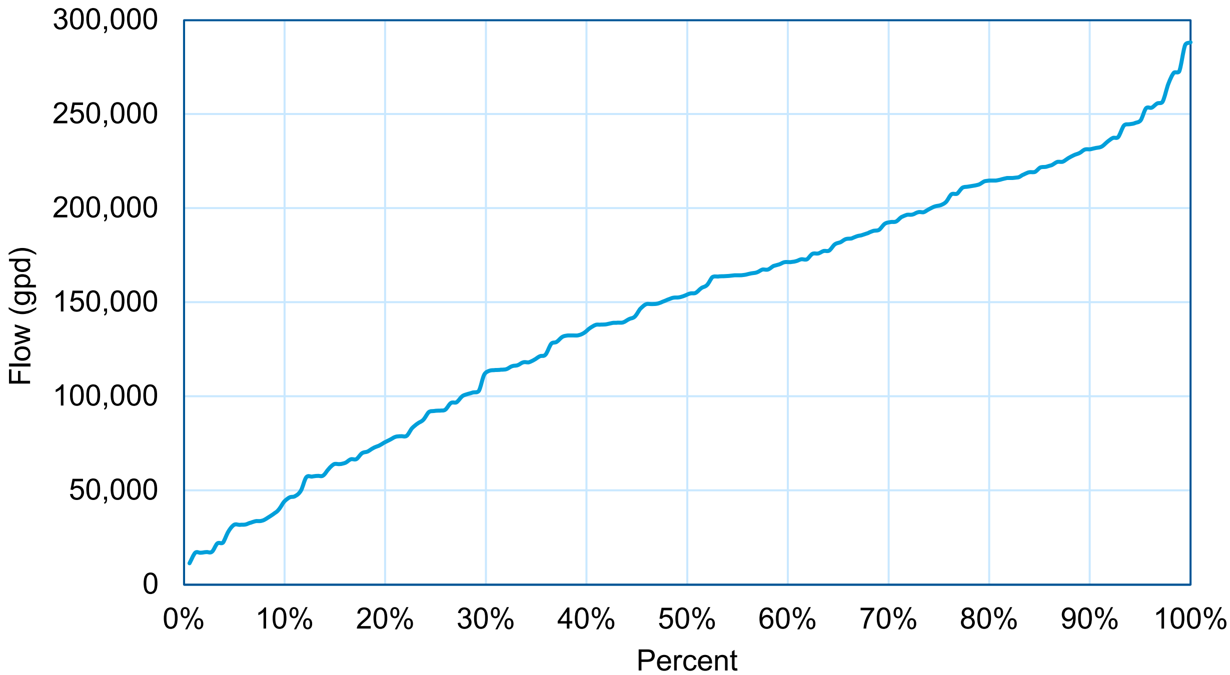


Figure 3.1.2: Total HW daily volumes probability from January to June 2019 shows greater than 50% of flows are above 150,000 gallons per day.

3.1.4 Total Current Flows and Loadings

Historical influent flows and loadings from 2014 through 2019 were analyzed to estimate a value for the current influent flows and loadings to the GBF and DPF including all flows in the combined data provided by the plant. The 2019 historical influent flows and loadings are summarized in Figure 3.1.3 and Table 3.1.11 for the GBF and Figure 3.1.4 and Table 3.1.12 for the DPF. Figures 3.1.3 and 3.1.4 show the approximate flow contributions of each source to show all flows have been accounted for. The figures show approximate values that were determined from HW, SIU, and metro plant data. Therefore, the SIU averages were elevated because the individual industry average daily discharge was summed for each year ensuring the average total possible daily discharge by SIUs. However, not every industry will discharge each day. For each table, the seven-day and 30-day running averages (RA) are estimates of weekly and monthly averages. The 25th and 95th percentiles are probability references. For example, 95% of the flows observed at the GBF were less than 36.8 mgd. The flows and loadings reported in Table 3.1.8 and Table 3.1.9 account for all combined flows and loads into the plant (residential, commercial, industrial, I/I and GBF HW); this includes mill waste and Fox River Fiber Waste).

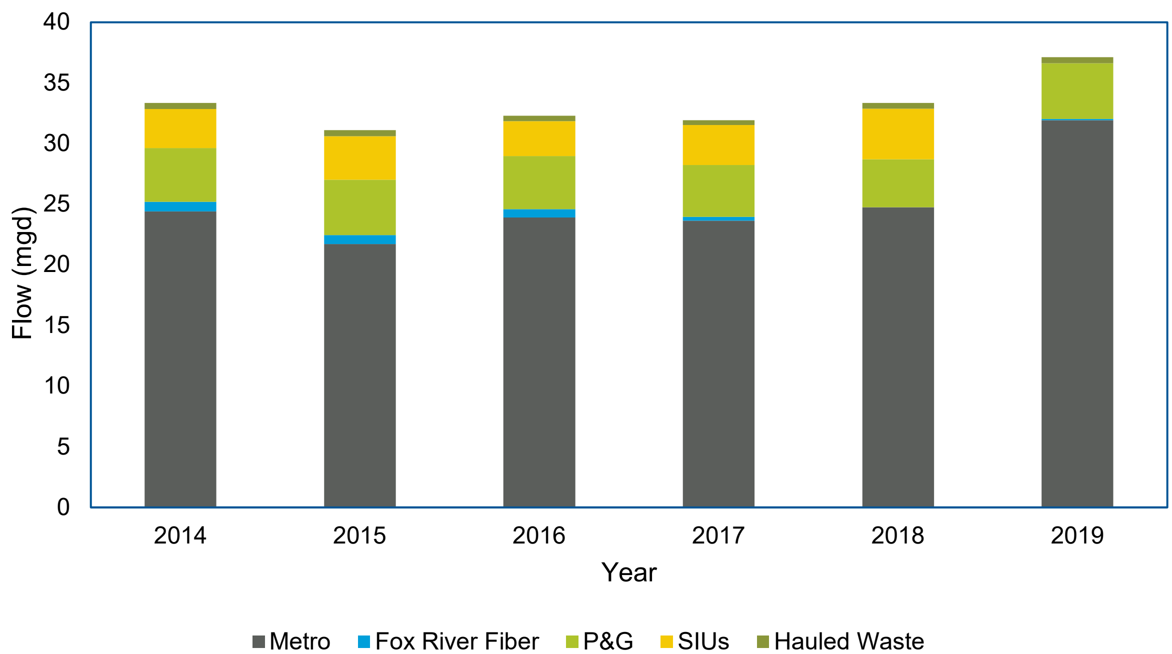


Figure 3.1.3. Summary of sources of contribution to total flow to the GBF.

Table 3.1.11: GBF Historical Combined (2019) Influent Flows and Loadings from plant data

2019	MINIMUM DAY	25TH PERCENTILE	95TH PERCENTILE	AVERAGE	MAXIMUM 30-DAY RA	MAXIMUM 7-DAY RA	MAXIMUM DAY	PEAK HOUR
Flow (mgd)	22.95	30.43	53.20	36.60	49.32	60.91	93.05	136.8 *
BOD_5 (ppd)	13,415	28,117	54,974	35,445	48,807	52,939	94,677	---
TSS (ppd)	9,065	39,063	84,712	50,482	61,925	95,379	224,275	---
NH_3-N (ppd)	255	3,063	4,890	3,699	4,622	6,245	18,483	---
TKN (ppd)	1,363	5,438	7,956	6,162	7,541	9,117	22,612	---
TP (ppd)	48.7	719	1,224	892	1,204	1,533	4,103	---

*Occurred on 4/26/2011. The next highest was 130.1 mgd on 12/14/2015.

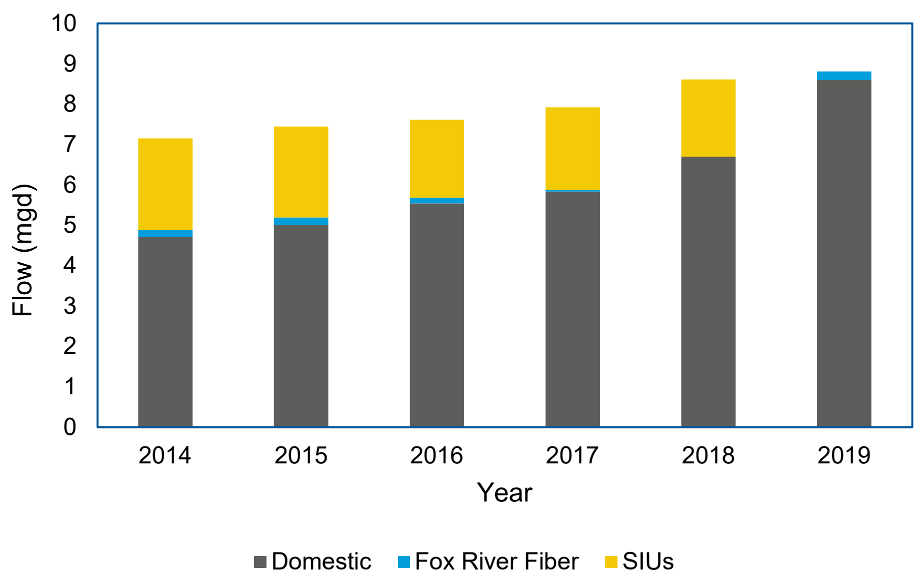


Figure 3.1.4: Summary of sources of contribution to total flow to the DPF. No Fox River Fiber data was available for 2018 and no hauled waste data was available 2019. It should also be noted 2017 Fox River Fiber data is lower as a result of the flow into the metro interceptor.

Table 3.1.2: DPF Historical Combined (2019) Influent Flows and Loadings from plant data

2014-2018	MINIMUM DAY	25TH PERCENTILE DAILY FLOW	95TH PERCENTILE DAILY FLOW	AVERAGE DAILY FLOW	MAXIMUM 30-DAY RA	MAXIMUM 7-DAY RA	MAXIMUM DAY	PEAK HOUR
Flow (mgd)	4.49	7.33	13.2	8.81	12.0	17.1	36.6	53. 4
BOD (ppd)	7,404	15,237	29,414	19,188	26,358	31,342	42,760	---
TSS (ppd)	5,671	12,703	26,925	16,463	29,867	28,732	75135.16	---
NH_3-N (ppd)	641	1,284	2,151	1,559	2,037	2,312	3,451	---
TKN (ppd)	962	1,827	3,504	2,424	3,189	3,612	6,719	---
TP (ppd)	111	275	445	328	416	454	919	---

3.2 FUTURE CONDITIONS

Future flow and loading projections were developed for each of the sources described in current conditions: domestic, industrial, and HW flow. I/I was evaluated to determine if there was excessive flow from I/I during weather events. In addition, new SIUs were summarized (Green Bay Packaging). The information developed in the current flows and loadings was used to develop future flow and loading planning criteria. The following sections describe in detail the stepwise process to estimating future flow and loadings to each of the NEW Water treatment facilities. Additionally, a land use evaluation was conducted to compare the future flow projection methods and this comparison can be found in Appendix A (Table A.1 and Table A.2).

3.2.1 Growth Projections

As mentioned, NEW Water services the City of Green Bay and De Pere, as well as several other communities. Population estimation and projection calculations were completed by obtaining the most recent estimates from the Wisconsin Department of Administration (WDOA) and the United States Census Bureau. The WDOA population estimates are updated on a yearly basis for each community within each county. The WDOA population projections are based upon historical fertility rates, death rates, and migration rates. Those contributions were then weighted based upon the impact of each type of growth or reduction. The most recent WDOA population projections were released in 2013 and have correlated well with the actual population estimates with R^2–values about 0.99 (Figure 3.2.1). Figure 3.2.1 displays population estimates for years 2010 to 2019 and WDOA projections for 2020, 2025, 2030, 2035, and 2040. Data for 2070 was projected based on the linear equation found for the historical estimates and most recent projections from the WDOA.

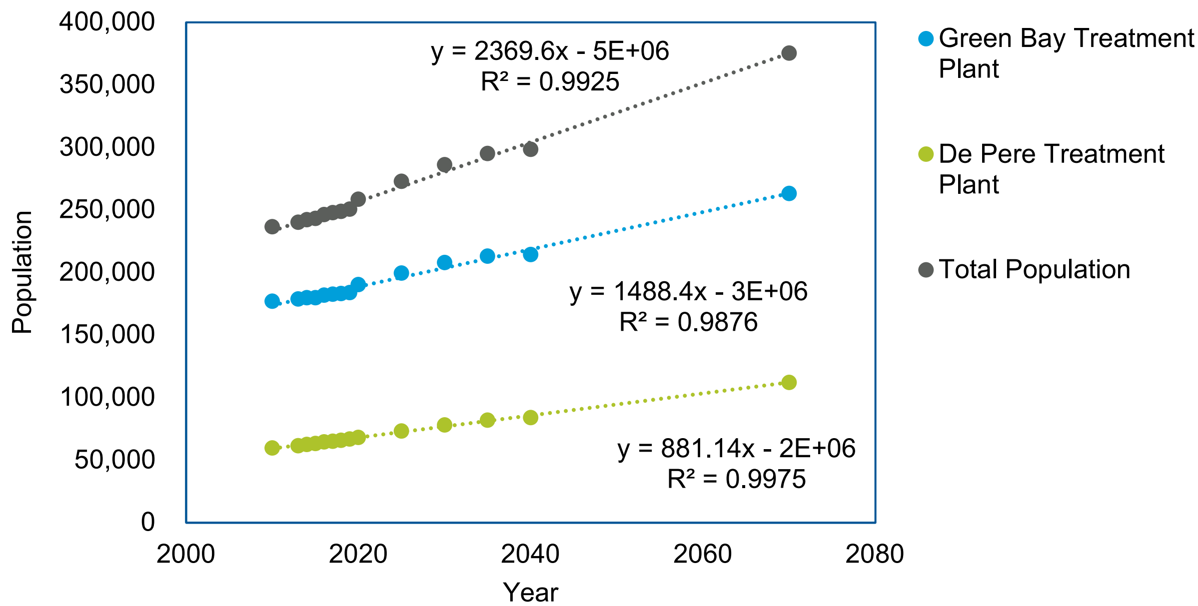


Figure 3.2.1: Population estimates for each NEW Water treatment facility based on WDOA estimates and projections

The WDOA estimates and projected populations were compared with conventional projection equations including the Arithmetic Population Projection method and the Incremental Population Projection method. The U.S. Census Bureau yearly population estimates were used for these calculations. The calculated projections did not correlate well with the actual population growth trends but the WDOA total populations correlated very well with actual recent population estimates, see Figure 3.2.2. As a result, the WDOA projected populations were used for all applicable flow and loading calculations within this Facility Plan for Flow and Load estimates and projections. In addition, in 2015 Brown County produced a 2040 Brown County Sewage Plan and Amendment Process document that reported and used WDOA population projections making the WDOA populations more appropriate.

The 2040 Brown County Sewage Plan and Amendment Process document was the area's most recent comprehensive update of the previous sewage plans. The plan serves as the Sewer Service Area (SSA) planning element of the area's water quality management plan, which covers the NEW Water service area and surface water discharge locations. The 2040 Brown County Sewage Plan and Amendment Process was completed as a requirement of the Federal Clean Water Act, Wisconsin State Statutes Chapter 144.025 and 147.25, and the Wisconsin Administration Code (NR 121). The estimated and projected populations for the communities in the NEW Water service area as reported by the WDOA are provided in Table 3.2.1.

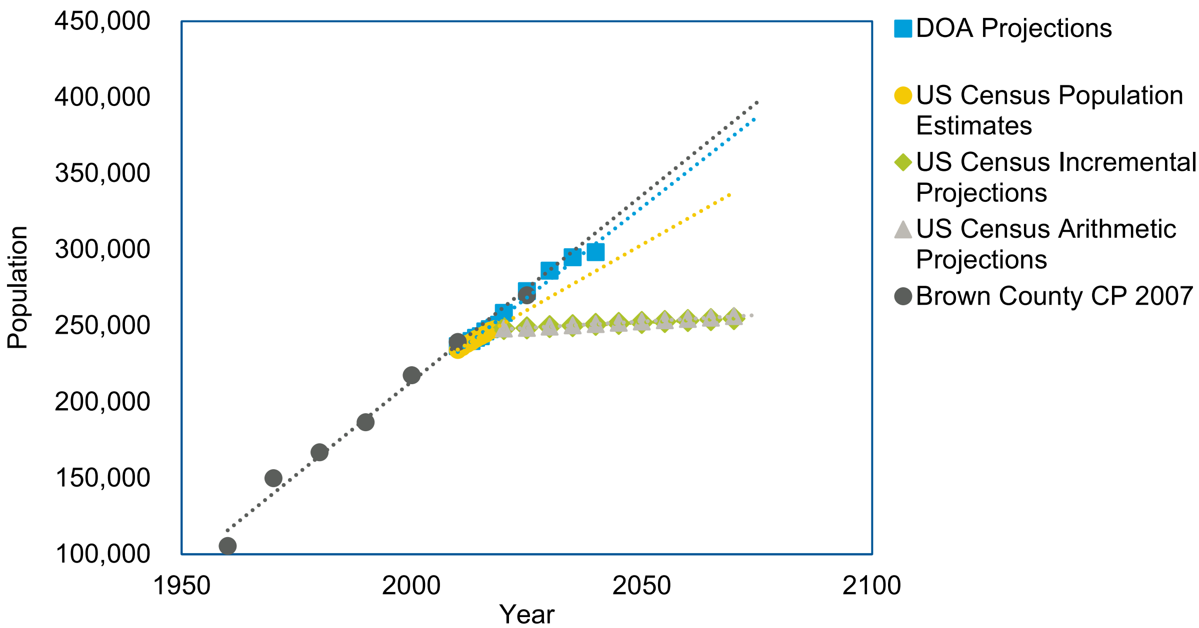


Figure 3.2.2: Population estimates and forecasts for the entire NEW Water service area

Table 3.2.1: Estimated and Projected Populations of Communities Served by NEW Water from WDOA

	CURRENT POPULATION ESTIMATE	PROJECTED POPULATIONS				
Year	**2019**	**2020**	**2025**	**2030**	**2040**	**2070**
Green Bay Treatment Plant Communities Served						
Allouez	13,793	14,030	14,150	14,200	13,600	13,991
Ashwaubenon[1]	6,414	6,582	6,699	6,791	6,627	7,161
Bellevue	15,556	16,480	17,840	19,140	20,780	28,263
City of Green Bay[2]	105,693	108,050	111,200	113,850	113,500	128,616
Town of Green Bay	2,126	2,240	2,385	2,530	2,675	3,490
Hobart[3]	4,704	4,207	4,755	5,297	6,115	9,075
Howard	19,680	21,480	23,820	26,110	29,370	42,895
Pittsfield	2,758	2,815	2,960	3,090	3,190	3,930
Pulaski - Brown Co.[4]	3,408	3,555	3,740	3,915	4,060	5,096
Pulaski - Shawano Co.[4]	216	250	270	295	325	459
Scott	3,658	3,935	4,210	4,470	4,770	6,314
Suamico	12,735	13,180	14,430	15,650	17,290	24,178
Village of Luxemburg	2,612	2,760	2,930	3,090	3,230	4,134
Town of Luxemburg	1,512	1,515	1,565	1,610	1,595	1,798
Total Population	181,072	201,078	210,955	220,038	227,127	279,399
De Pere Treatment Plant Communities Served						
Ashwaubenon[1]	10,466	10,738	10,931	11,079	10,813	11,684
De Pere	24,742	26,260	27,950	29,550	31,280	40581
Hobart[3]	4,895	4,378	4,950	5,513	6,365	9,445
Lawrence	5,690	5,480	6,195	6,900	7,965	11,995
Ledgeview	8,134	8,590	9,710	10,810	12,480	18,951
Rockland[5]	1,846	1,930	2,075	2,210	2,370	3,146
Total Population	55,773	57,377	61,810	66,063	71,273	95,683
Total Overall Population	236,845	258,455	272,765	286,100	298,400	374,417

Notes:

1. Ashwaubenon flow goes to De Pere and Green Bay Plant split 38% to GBF and 62% to DPF.
2. No data provided from the DOA for Dyckesville, Wisconsin as the population is included in Green Bay populations.
3. Hobart flow goes to De Pere and Green Bay Plant split 49% to GBF and 51% to DPF.
4. Pulaski is a community split amongst two counties.
5. Rockland population not served until 2030.

3.2.2 Potential Impacts of the Southern Bridge Project

The Southern Bridge Project was initially recommended in the 1968 Brown County Comprehensive Plan. The completion of the Tier 1 Final Environmental Impact Study and Record Decision is targeted for completion in October of 2020 with potential construction beginning in 2026. This schedule was provided in the Exhibits from the Public Information Meeting on December 11, 2019. Donohue reached out to the Brown County Commission to obtain their current evaluation of projected impacts from the South Bridge Project including the number of households within Brown County (see Appendix B). Brown County kindly provided data (Appendix B) which includes a projected household growth "heat map" showing household growth for each Traffic Analysis Zone (TAZ) on the heat map along with the actual data. The growth projections are from 2017 to 2050 and use WDOA population projections. The bridge is to be constructed within a half-mile corridor surrounding Rockland and Red Maple Roads (see Figure 3.2.3). Figure 3.2.3 identifies the location of the bridge and the surrounding area. The area appears to be mostly residential and farmland with a number of industries, a clinic, a few churches, and some auto related services. Currently, there are two major options for the New Construction Alternative including the Scheuring Road – Heritage Road Arterial Street (red line in Figure 3.2.3) option and the Rockland Road – Red Maple Road Arterial Street (with a US 41 interchange) option (blue line in Figure 3.2.3).

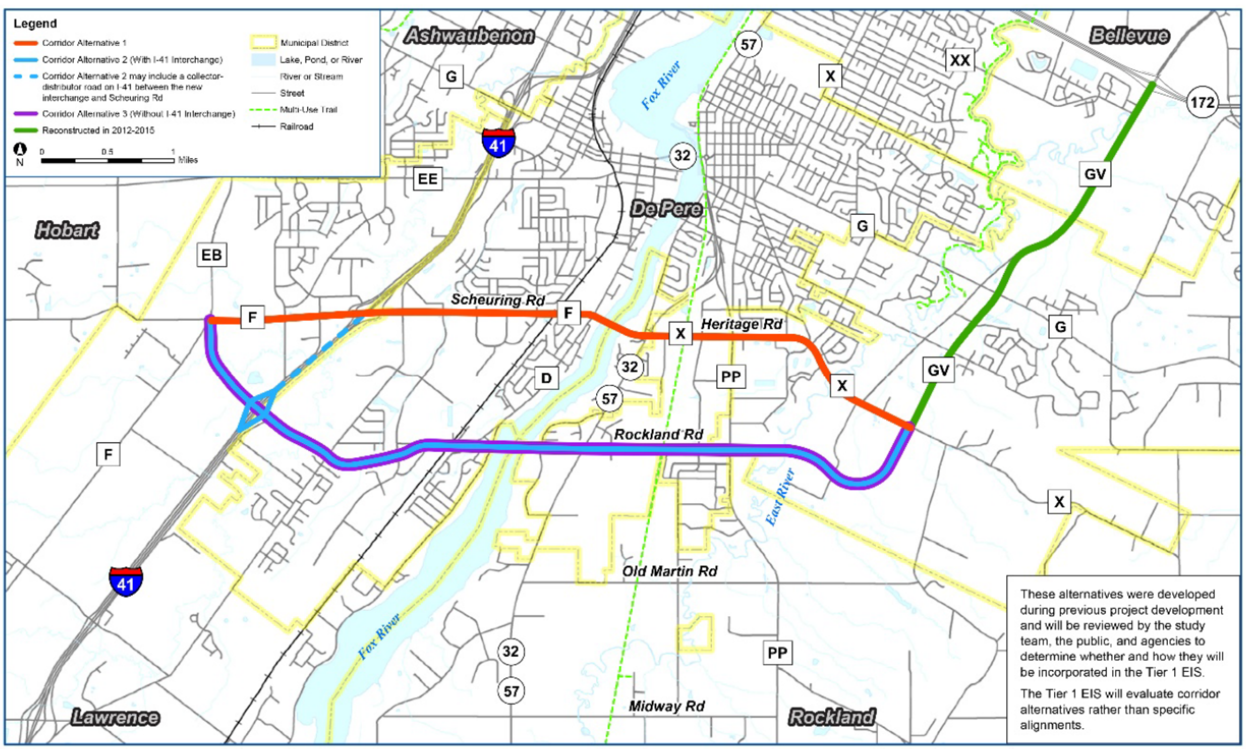


Figure 3.2.3: Southern Bridge Project area alternatives. The bridge location is identified by the red line crossing the river (http://www.public.applications.co.brown.wi.us/Plan/PlanningFolder/Transpotation/Southern%20Bridge%20Project/South%20Bridge%20Connector%20PIM%201%20Handout.pdf).

The data provided by the Brown County Commission included the estimated household growth, this value for 2017 was normalized to the WDOA actual estimated population to determine the number people per household. Using the people per household values, which was determined to be approximately 2.52, the future populations with the Southern Bridge Project were evaluated to determine how much population growth was a result of the bridge construction. From the Brown County Exhibits provided at the Public Information Meeting on December 11, 2019 the estimated completion year is 2032 and thus all population growth was applied to the year after. The growth due to the bridge was estimated to add approximately 14,672 people (815 people per year after 2032) and was found by comparing the population calculated after the bridge was taken into account to the population determined prior to the bridge. The population growth will add approximately 0.061 mgd to the total flow at 75 gpcd. Due to the location of the bridge it was assumed that 100% of the flow will be sent to the DPF.

3.2.3 Future Flows and Loadings

The WDNR requires that future flow and loading estimates account for residential, commercial, industrial, and I/I sources. The following sections outline the development of 5-, 10-, 20, and 50-year flows and loading projections for the GBF and DPF to account for each of these sources.

3.2.3.1 Residential, Commercial, I/I, and Light Industrial Projections

The per capita flow and loadings were determined for the Green Bay and the DPF based upon the WDOA projected populations. The base year (2020) service population projection for the Green Bay treatment plant was 201,078 and 57,377 for the De Pere treatment plant. The unit flows and loads in Table 3.2.2 and Table 3.2.3 were determined using the average gallons per capita day (gpcd) and loadings from historical data and populations. The existing per capita flows of 122 and 102 gpcd are reflective of residential, commercial, I/I, and light industrial (non-permitted). A detailed I/I evaluation is included in Section 3.2.7 of this TM. For future growth, a value of 75 gpcd was used to estimate added future flow. The historical loads were calculated for each year from 2014 to 2017. For comparison, the average 2014-2019 data has been included in Tables 3.2.2 and Table 3.2.3, as there were increased flows from Fox River Fiber into the metro wastewater flow during 2018 to 2019 and increased wet weather flow events. There was increased flow from Fox River Fiber to the metro flow was a result of the industrial force main infrastructure maintenance. The unit loadings used for flow and load projections for each plant were calculated using the average historical loadings from 2019, as these per capita values predicted values that best matched the actual historical and most recent data. For future growth, similar loading production was assumed as historical data.

Table 3.2.2: GBF Per Capita Flows and Loadings (excluding flow from SIUs and HW)

Year	Estimated Population Serviced	Average Influent Plant Flow (GPCD)	Average Influent BOD (PPCD)	Average Influent TSS (PPCD)	Average Influent Ammonia (PPCD)	Average Influent TKN (PPCD)	Average Influent Phosphorus (PPCD)
2014	189,839	93	0.13	0.14	0.016	0.021	0.0031
2015	190,136	77	0.08	0.15	0.014	0.023	0.0029
2016	192,366	109	0.10	0.14	0.014	0.021	0.0033
2017	193,339	94	0.10	0.14	0.013	0.020	0.0029
2018	193,935	93	0.09	0.18	0.012	0.020	0.0031
2019	194,865	130	0.10	0.20	0.011	0.020	0.0036
2014-2019 Average	---	99	0.10	0.16	0.013	0.021	0.0031
2014-2017 Average	---	93	0.10	0.14	0.01	0.02	0.00

Table 3.2.3: DPF Per Capita Flows and Loadings (excluding SIUs and HW)

Year	Estimated Population Serviced	Average Influent Plant Flow (GPCD)	Average Influent BOD (PPCD)	Average Influent TSS (PPCD)	Average Influent Ammonia (PPCD)	Average Influent TKN (PPCD)	Average Influent Phosphorus (PPCD)
2014	50,482	93	0.28	0.22	0.024	0.031	0.0042
2015	51,148	98	0.29	0.22	0.020	0.034	0.0034
2016	52,038	107	0.26	0.22	0.019	0.029	0.0040
2017	52,577	111	0.37	0.28	0.023	0.038	0.0044
2018	53,069	125	0.42	0.39	0.027	0.048	0.0056
2019	53,927	124	0.32	0.27	0.024	0.040	0.0048
2014-2019 Average	---	110	0.33	0.27	0.023	0.037	0.0044
2014 - 2017 Average	---	102	0.30	0.24	0.022	0.033	0.0040

Population growth will likely occur in areas of new development with new construction and new service line resulting in lower I/I contributions to the wastewater flow. For the NEW Water

Interceptor Master Plan (completed in 2018), Donohue & Associates conducted a flow estimate analysis in which the total residential wastewater baseflow including I/I was found to be 75 gpcd (45 gpcd water use and 30 gpcd I/I). This was calculated using historical wastewater flows and metered drinking water data from the NEW Water service area to determine the per capita water use. A value of 75 gpcd was calculated and used for flow projections due to population growth. Furthermore, new service lines resulting in reduced I/I does not affect the per capita loadings, as a result, the per capita loadings from Table 3.2.2 and Table 3.2.3 were assumed for the residential loading projection.

3.2.3.2 New Development SIUs

One new SIU, Green Bay Packaging (GBP), is expected to begin contributing to the GBF flow in 2021. The estimated loading rates were provided by NEW Water from an evaluation completed by Jacobs and are listed in Table 3.2.6. As requested by NEW Water, there is no growth anticipated for SIUs over the planning period; therefore, the future base loading rates have been included as constant values in future flow and loading estimates. However, this will be a parameter that will be considered during the uncertainty analysis to understand potential impacts on unexpected industrial growth.

Table 3.2.6: Green Bay Packaging estimated loading rates to the GBF

	60% PRE-TREATMENT EFFICIENCY
Average Daily Flow (mgd)	2.7
Maximum 7-Day RA (mgd)	3.0
Peak Day Flow (mgd)	3.9
Maximum BOD 7-Day RA (ppd)	13,000
Peak Day BOD (ppd)	17,000
Maximum TSS 7-Day RA (ppd)	3,000
Peak Day TSS (ppd)	3,800
Average Day Phosphorus (ppd)	200
Average Day TKN (ppd)	600

3.2.3.3 Infiltration and Inflow (I/I) and Future Peaking Factors

The flow peaking factors for existing conditions at the Green Bay and De Pere facilities (Table 3.2.4 and Table 3.2.5) were determined based on the maximum average of each time period divided by the average daily value from 2015 to 2020. Peaking factors include all flows into the plant (SIUs, HW, metro, and I/I) but does not include recycles. The data used in this analysis already reflects flows transferred between DPF to GBF which was how the data was prepared by NEW Water. The flow peaking factors are indicative of a system with historical I/I impacts. Therefore, an I/I evaluation was completed as recommended by the Wisconsin Depart of Natural Resources (WDNR) and the Environmental Protection Agency (EPA).

Table 3.2.4: GBF Historical Peaking Factors

PARAMETER	MAXIMUM DAY	MAXIMUM 7-DAY RA (MAXIMUM WEEK)	MAXIMUM 30-DAY RA (MAXIMUM MONTH)	PEAK HOUR
Flow	3.27	2.01	1.63	4.52*
BOD_5	2.65	1.50	1.37	---
TSS	5.28	2.16	1.40	---
NH_3-N	4.42	1.49	1.28	---
TKN	3.46	1.40	1.22	---
TP	4.79	1.79	1.41	---

*Peak hour factor was from a peak hour flow from 2011 (136.8 MGD).
**Peaking factor from (NR) 110.09(2).(j)4.b. for new growth will be 2.5.

Table 3.2.5: DPF Historical Peaking Factors

PARAMETER	MAXIMUM DAY	MAXIMUM 7-DAY RA (MAXIMUM WEEK)	MAXIMUM 30-DAY RA (MAXIMUM MONTH)	PEAK HOUR
Flow	4.55	2.14	1.71	6.64
BOD_5	2.62	1.73	1.49	---
TSS	7.44	2.64	2.04	---
NH_3-N	2.59	1.73	1.53	---
TKN	3.18	1.71	1.51	---
TP	3.21	1.73	1.46	---

*Peak hour was from a peak hour flow from 2015 (53.4 MGD).
**Peaking factor from (NR) 110.09(2).(j)4.b. for new growth will be 2.5.

This I/I evaluation was completed to determine if I/I was excessive within the NEW Water infrastructure. The WDNR and the EPA provide guidance on estimating if excessive I/I is occurring. Flow and precipitation data from 2017, 2018, and from January to June 2019 were analyzed for both infiltration and inflow (Tables 3.2.7 through 3.2.10). For infiltration analysis, flow data collected during the high groundwater periods was used. The average dry weather (ADW) base flow was determined by analyzing a one to two-week period during seasonal high water that was not influenced by rainfall. For the purpose of this analysis, a minimum of seven consecutive dry days was evaluated year-round for the ADW base flow from May 2017 and June 2018. For infiltration analysis, the average wet weather (AWW) flow was estimated from flow data for a one-week period where there was significant rain. In addition, high flow events were analyzed to determine the source of the high flow and include those data points in the infiltration analysis.

The WDNR requires the I/I analysis demonstrate if there is excess I/I occurring within the sewer system. The guidance defines an infiltration threshold criterion for ADW base flow less than or equal to 120 gpcd. The inflow threshold criterion is a maximum daily flow during a storm of less than or equal to 275 gpcd. From the initial evaluation, the infiltration is excessive for the GBF (137 gpcd) and not excessive for the DPF (119 gpcd). However, inflow was excessive with a flow of 473 gpcd for the GBF and 547 for the DPF.

In order to reduce I/I, it is recommended that NEW Water work with its customers to identify and remove unapproved sewer connections and identify sewer sub-basins with high inflow. The next step in those areas may be to perform a Sewer System Evaluation Survey (SSES) to locate and eliminate major I/I sources.

Table 3.2.7: Dry periods of greater than 7 days from 2017 to June of 2019 for the GBF

YEAR	DATES	NUMBER OF DRY DAYS	AVERAGE INFLUENT PLANT FLOW (MGD)*
2017	05/03-05/09	7	31
2018	06/07-06/14	8	21
	06/20-06/30	11	23
Average (mgd)			25
Minimum (mgd)			21
Maximum (mgd)			31
Maximum infiltration baseflow (gpcd)			136.9
*The first two dry day flows are not included in the average influent plant (mgd) average to eliminate possible artificial flow elevation from previous rainfall events.			
**There were no dry periods longer than 6 days in 2019 up to 06/30/2019			

Table 3.2.8: Maximum flow events for infiltrations analysis to the GBF

DATE	DAY PRECIPITATION (IN)	WEEKLY PRECIPITATION (IN)	AVERAGE DAY INFLUENT PLANT FLOW (MGD)
04/20/17	0.97	2.42	53
04/27/17	0.91	3.39	46
05/01/17	0.63	3.13	50
05/02/17	0.03	3.04	43
05/02/18	0.55	4.8	43
05/03/18	0.56	3.83	46
05/04/18	0.83	3.48	72
05/06/18	0.17	2.65	41
05/09/18	0.63	3.23	41
06/18/18	1.71	4.78	48
08/28/18	2.88	5.37	56
09/04/18	2.06	7.31	65
09/05/18	0.40	7.04	51
09/17/18	0.73	6.72	49
10/09/18	0.69	3.65	46
10/08/19	1.42	3.17	48

DATE	DAY PRECIPITATION (IN)	WEEKLY PRECIPITATION (IN)	AVERAGE DAY INFLUENT PLANT FLOW (MGD)
10/10/19	0.79	4.26	59
01/07/19	0.91	1.95	42
03/13/19	0.14	1.38	45
03/14/19	0.40	1.59	87
03/15/19	0.01	1.44	75
03/20/19	0.15	1.55	43
04/17/19	0.89	2.5	47
04/22/19	0.79	3.27	46
04/23/19	0.01	3.18	51
04/25/19	0.24	3.02	40
05/01/19	0.39	2.56	44
05/09/19	0.24	1.78	42
05/27/19	1.43	2.82	51
05/28/19	0.01	2.66	57
Average (mgd)			51
Minimum (mgd)			40
Maximum (mgd)			87
Maximum inflow per capita (gpcd)			473

Table 3.2.9: Dry periods of greater than 7 days from 2017 to June of 2019 for the DPF

YEAR	DATES	NUMBER OF DRY DAYS	AVERAGE INFLUENT PLANT FLOW (MGD)*
2017	05/03-05/09	7	8
2018	06/07-06/14	8	7
	06/20-06/30	11	8
Average (mgd)			8
Minimum (mgd)			7
Maximum (mgd)			8
Maximum infiltration flow per capita (gpcd)			119.1

*The first two dry day flows are not included in the average influent plant (mgd) average to eliminate possible artificial flow elevation from previous rainfall events.

**There were no dry periods longer than 6 days in 2019 up to 06/30/2019

Table 3.2.10: Maximum flow events for infiltrations analysis to the DPF

DATE	DAY PRECIPITATION (IN)	WEEKLY PRECIPITATION (IN)	AVERAGE DAY INFLUENT PLANT FLOW (MGD)
04/20/17	0.97	2.42	14
05/01/17	0.63	3.13	16
05/02/17	0.03	3.04	13
04/13/18	1.53	2.61	14
04/26/18	0.02	4.05	14
05/02/18	0.55	4.8	14
05/03/18	0.56	3.83	15
05/04/18	0.83	3.48	19
05/06/18	0.17	2.65	13
05/09/18	0.63	3.23	14
06/18/18	1.71	4.78	15
08/28/18	2.88	5.37	17
09/04/18	2.06	7.31	17
10/08/18	1.42	3.17	16
10/09/18	0.69	3.65	15
10/10/18	0.79	4.26	19
01/07/19	0.91	1.95	16
03/13/19	0.14	1.38	16
03/14/19	0.4	1.59	37
03/15/19	0.01	1.44	19
03/20/19	0.15	1.55	14
04/17/19	0.89	2.5	14
04/22/19	0.79	3.27	14
04/23/19	0.01	3.18	15
Average (mgd)			16
Minimum (mgd)			13
Maximum (mgd)			37
Overall Minimum (mgd)			4
Maximum inflow per capita (gpcd)			547

Future areas of development should reduce the influence on flow from the occurrence and magnitude of large storm events resulting in reduced I/I and lower peaking factors. Flow growth factors (peaking factors) for future flow due to population growth were adapted from the Wisconsin Administrative Code (NR) 110.09(2).(j)4.b. and were used for new growth flow calculation will be assumed to be 2.5, as noted in Table 3.2.5. The loading peaking factors in Table 3.2.4 and Table 3.2.5 did not change because the per capita loadings are not expected to change with new growth.

3.3 PROJECTED FLOW AND LOADINGS

The projected flows and loadings for 2020, 2025, 2030, 2040, and 2070 are in Table 3.3.1 and Table 3.3.2 for the GBF and the DPF, respectively, using the historical peaking factors calculated and shown in Tables 3.2.4 and 3.2.5 and a new growth peaking factor of 2.5 for all future growth scenarios. In addition, Figure 3.3.1 and Figure 3.3.2 provide a visual summary of the average daily contributions to GBF and DPF, respectively. As mentioned, it is the assumption that all new growth will have lower I/I and thus should have a lower peaking factor (2.5) as provided in NR 110 for new interceptor sewers and sewage outfall designs. The projected flows and loadings include existing residential, commercial, industrial, and hauler flows and loadings and flow and loadings due to future population growth and Green Bay Packaging. HW and SIU flows and loadings were assumed to remain constant for future projections.

Table 3.3.1: GBF future flow and load estimates including residential, commercial, light industrial, SIUS, HW, and I/I

YEAR	INFLUENT PARAMETER	AVERAGE DAY	MAXIMUM 30-DAY RA	MAXIMUM 7-DAY RA	MAXIMUM DAY	PEAK HOUR
2020	Flow (MGD)	38.6	55.3	64.9	96.8	136.8
	BOD (ppd)	42,953	58,845	64,429	113,824	---
	TSS (ppd)	54,551	76,372	117,831	288,031	---
	NH_3-N (ppd)	3,972	5,085	5,919	17,558	---
	TKN (ppd)	6,962	8,494	9,747	24,089	---
	TP (ppd)	1,147	1,618	2,054	5,496	---
2025	Flow (MGD)	42.0	59.8	69.4	101.3	143.0
	BOD (ppd)	60,908	83,443	91,361	161,405	---
	TSS (ppd)	60,316	84,442	130,282	318,466	---
	NH_3-N (ppd)	4,618	5,911	6,881	20,412	---
	TKN (ppd)	7,763	9,471	10,868	26,860	---
	TP (ppd)	1,382	1,949	2,475	6,622	---
2030	Flow (MGD)	42.7	61.5	71.1	103.1	146.3
	BOD (ppd)	61,786	84,647	92,679	163,732	---
	TSS (ppd)	62,122	86,971	134,183	328,003	---
	NH_3-N (ppd)	4,715	6,035	7,025	20,839	---
	TKN (ppd)	7,948	9,696	11,127	27,499	---
	TP (ppd)	1,415	1,995	2,532	6,777	---
2040	Flow (MGD)	43.2	62.8	72.5	104.4	148.8
	BOD (ppd)	62,471	85,586	93,707	165,549	---
	TSS (ppd)	63,532	88,945	137,229	335,448	---
	NH_3-N (ppd)	4,790	6,132	7,138	21,173	---
	TKN (ppd)	8,092	9,872	11,328	27,997	---
	TP (ppd)	1,440	2,030	2,577	6,897	---
2070	Flow (MGD)	47.2	72.6	82.3	114.2	167.7
	BOD (ppd)	67,526	92,510	101,289	178,943	---
	TSS (ppd)	73,927	103,498	159,682	390,335	---
	NH_3-N (ppd)	5,347	6,844	7,967	23,634	---
	TKN (ppd)	9,154	11,168	12,816	31,673	---
	TP (ppd)	1,626	2,292	2,910	7,788	---

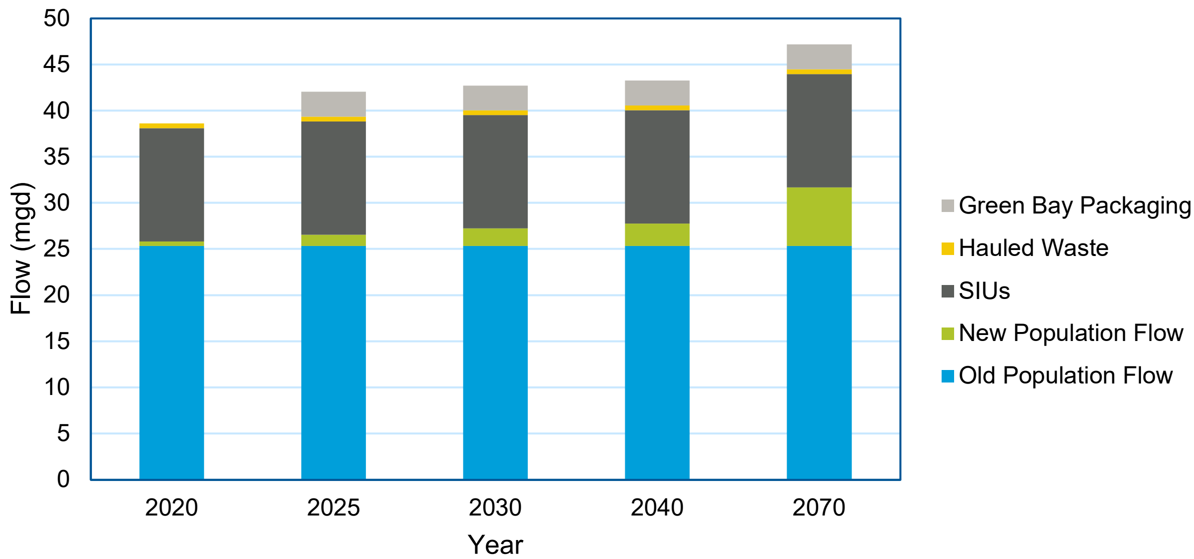


Figure 3.3.1: Relative future average day flow contributions from each source to the GBF.

Table 3.3.2: DPF future flow and load estimates including residential, commercial, light industrial, SIUS, and I/I

YEAR	INFLUENT PARAMETER	AVERAGE DAY	MAXIMUM 30-DAY RA	MAXIMUM 7-DAY RA	MAXIMUM DAY	PEAK HOUR
2020	Flow (MGD)	9.5	14.6	17.5	34.2	53.4
	BOD (ppd)	20,862	31,084	36,091	54,659	---
	TSS (ppd)	17,256	35,203	45,556	81,261	---
	NH_3-N (ppd)	1,479	2,263	2,559	3,830	---
	TKN (ppd)	2,378	3,591	4,066	7,562	---
	TP (ppd)	353	515	610	1,132	---
2025	Flow (MGD)	9.8	15.4	18.4	35.0	54.3
	BOD (ppd)	22,291	33,213	38,563	58,402	---
	TSS (ppd)	18,441	37,620	48,685	86,842	---
	NH_3-N (ppd)	1,585	2,425	2,742	4,105	---
	TKN (ppd)	2,555	3,858	4,369	8,126	---
	TP (ppd)	374	546	647	1,201	---
2030	Flow (MGD)	10.1	16.2	19.2	35.8	55.1
	BOD (ppd)	23,662	35,256	40,935	61,993	---
	TSS (ppd)	19,578	39,939	51,686	92,195	---
	NH_3-N (ppd)	1,687	2,581	2,918	4,369	---
	TKN (ppd)	2,725	4,115	4,660	8,666	---
	TP (ppd)	395	576	683	1,266	---
2040	Flow (MGD)	11.0	18.4	21.4	38.0	57.3
	BOD (ppd)	27,442	40,889	47,475	71,899	---
	TSS (ppd)	22,714	46,336	59,964	106,962	---
	NH_3-N (ppd)	1,968	3,011	3,404	5,097	---
	TKN (ppd)	3,194	4,823	5,462	10,157	---
	TP (ppd)	451	735	780	1,448	---
2070	Flow (MGD)	14.2	26.3	29.3	45.9	65.2
	BOD (ppd)	41,089	61,222	71,084	107,653	---
	TSS (ppd)	34,032	69,426	89,845	160,261	---
	NH_3-N (ppd)	2,982	4,562	5,158	7,723	---
	TKN (ppd)	4,886	7,378	8,355	15,538	---
	TP (ppd)	655	956	1,133	2,102	---

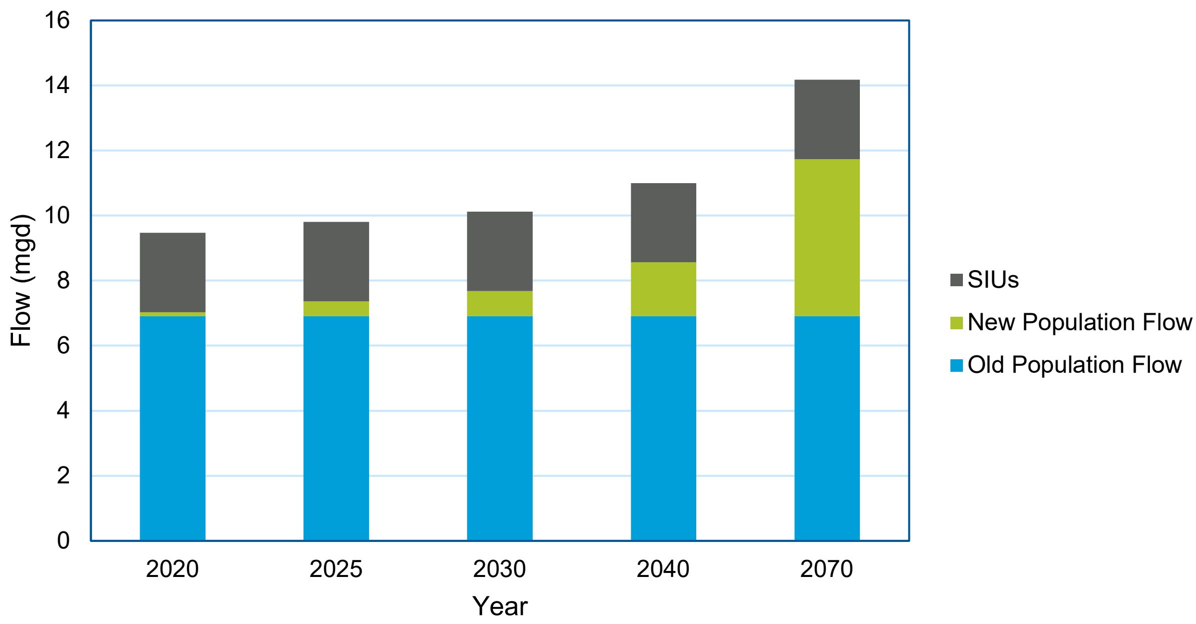


Figure 3.3.2: Relative future average day flow contributions from each source to the DPF.

3.4 SENSITIVITY ANALYSIS

As discussed, the flows and loads are a critical component for establishing infrastructure needs during a facility planning process. The information presented above provides a robust baseline for evaluating infrastructure needs. As part of a sensitivity analysis, ranges of data will be utilized for the following key metrics to understand the bandwidth of potential futures:

- Population growth rate on a per annum basis, with a range of 0 and 1.2% per year
- Specific water production rate for new growth in the GBF and DPF areas, with a range of 65 to 85 gpcd
- SIU growth rate, which will be evaluated in a sensitivity paradigm to understand the impacts of industrial growth of 5, 10, or 15% in a given year

An example of the sensitivity output for future flow projections is shown in Figure 3.4.1 for the GBF and Figure 3.4.2 for the DPF. These results will be discussed in detail at the October 29 workshop, and an finalizes approach to sensitivity analysis will be discussed.

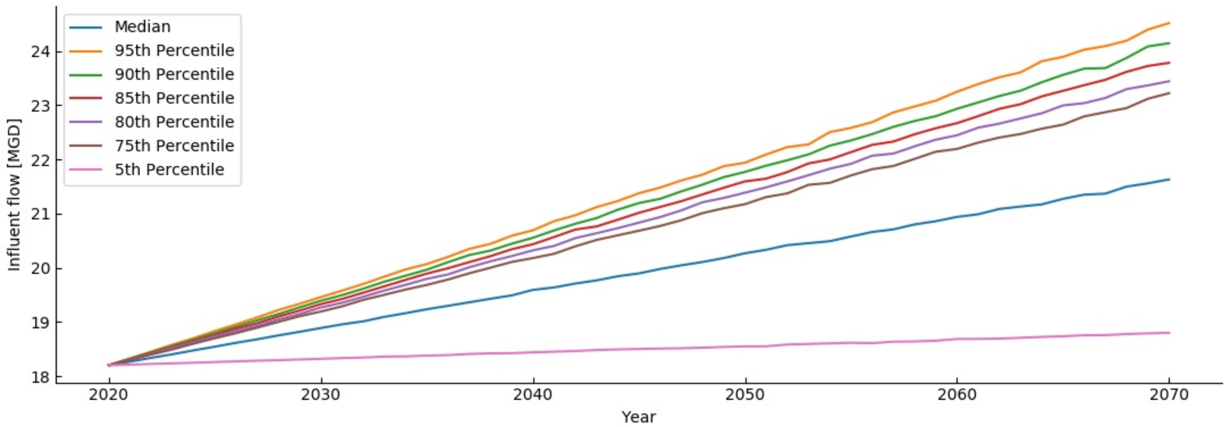


Figure 3.4.1 Sensitivity analysis projection for future metro flows at the GBF

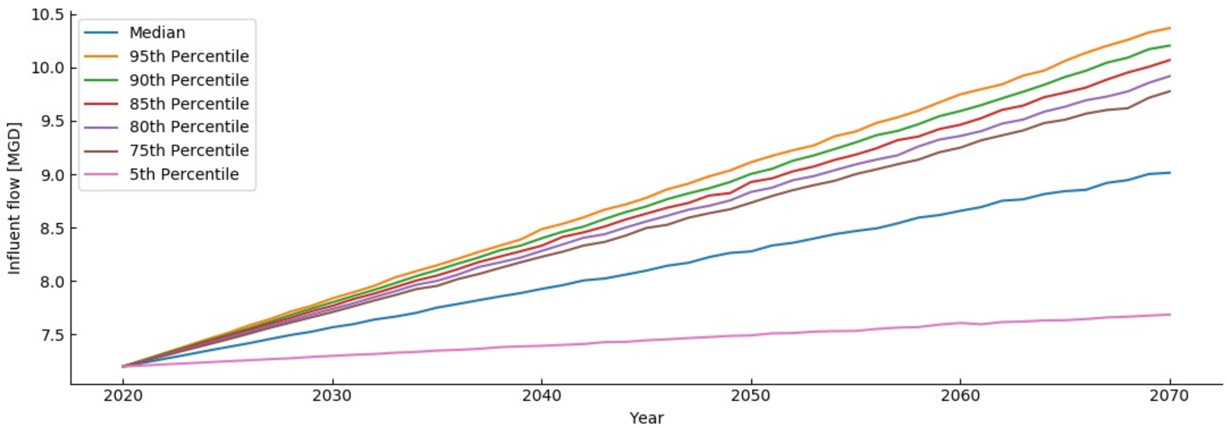


Figure 3.4.2 Sensitivity analysis projection for future metro flows at the DPF

4 Summary

Future flow and loading projections were developed from the summation of the historical per capita day data and expected projections for each of the sources described (domestic, industrial, HW, and I/I). The flow and loading projections represent the design criteria for the future alternative's analysis step of the planning process.

Appendix A

Land Use Alternative

Future flows were estimated using two different methods and then compared: population growth and land use projections. The area approximations and land used evaluation was completed using the 2040 Brown County Sewage Plan, which serves as the area's Sewer Service Area (SSA) plan. The provided future land use data from the 2040 Brown County Sewage Plan was used for all future flow conditions. Flow calculated from population growth and flow from future land use projections (commercial and residential) were compared (Table B.1 and Table B.2). An estimated 580 gallons per acre day was used for commercial land based on previous NEW Water customer allocation calculations that used this baseline commercial contribution (0.0036 cfs/acre with a peaking factor of 4). From residential areas (acres) and measured flow, it was estimated that approximately 727 gallons was generated per residential acre. SIUs flows and loadings were added as a constant flow and load as was done for population growth method. Table B.1 and Table B.2 not only include the future flow for both flow projection methods (population and land use) but also include the percent difference. The difference in flow projections range from 7.6 to 14.8% for the GBF and 6.9 to 18.0% for the DPF. The flow data calculated from the more current population estimates from the WDOA was used for future flow estimates for industrial and commercial flow because it was a larger value. Using the population-based data, it was assumed the ratio of residential and commercial growth would remain constant, populations in residential locations would be accounted for during working hours at commercial or industrial locations, and future population growth and land use change would be sewered.

Table A.1: GBF land use evaluation flow estimates compared to flow based on population estimates

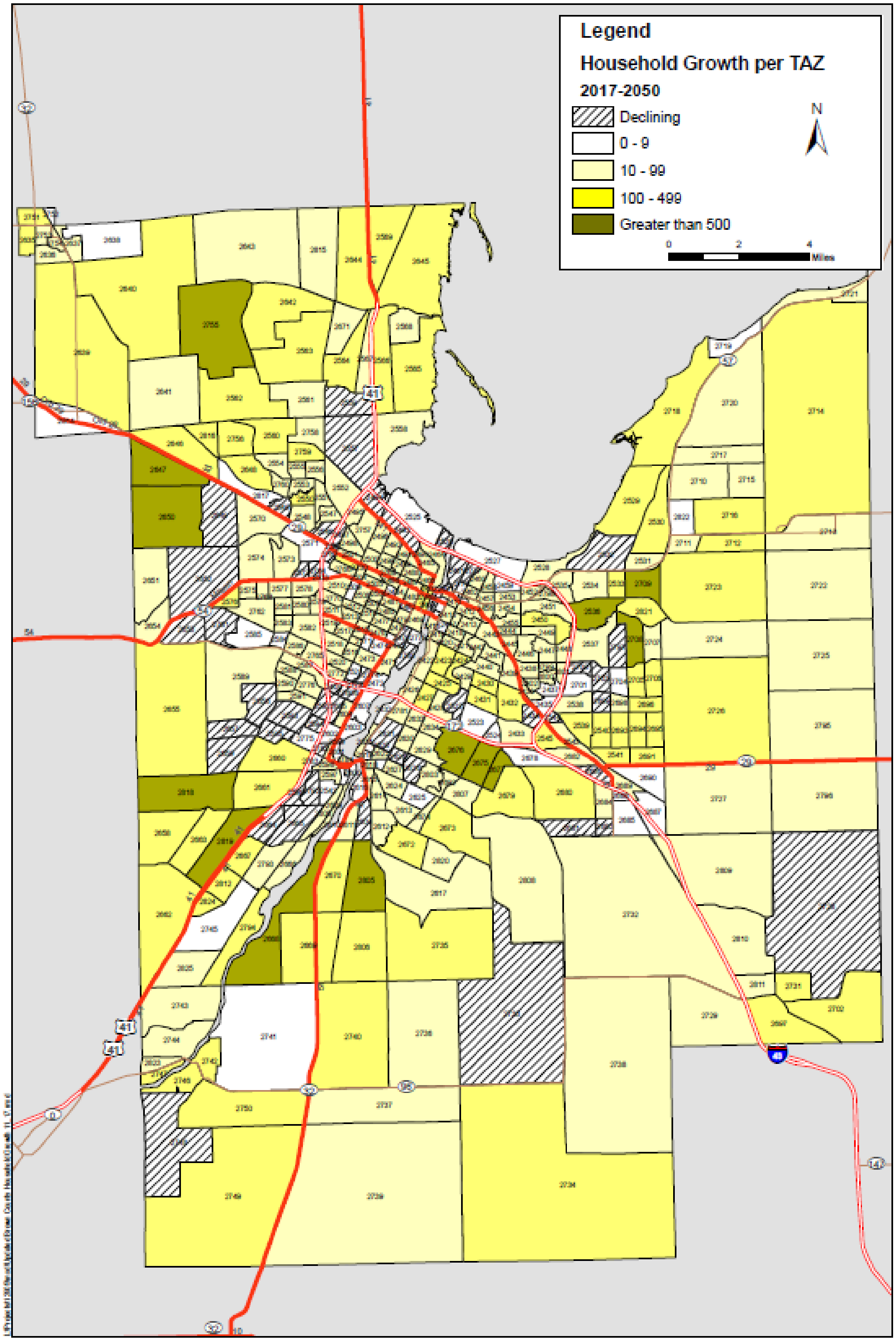
FUTURE FLOW YEAR	AVERAGE DAY FLOW FROM POPULATION (MGD)	LAND USE CALCULATED FLOW (MGD)	PERCENT DIFFERENCE (%)
2020	24.4	21.3	13.6
2025	25.1	21.7	14.8
2030	25.8	22.4	13.8
2040	26.2	23.2	12.2
2070	29.8	27.7	7.6

Table A.2: DPF land use evaluation flow estimates compared to flow based on population estimates

FUTURE FLOW YEAR	AVERAGE DAY FLOW FROM POPULATION (MGD)	LAND USE CALCULATED FLOW (MGD)	PERCENT DIFFERENCE (%)
2020	9.9	8.3	18.0
2025	10.3	8.6	17.5
2030	10.7	9.1	15.9
2040	11.1	9.7	13.4
2070	13.2	12.3	6.9

Appendix B

Brown County Household Growth (2017-2050)



Brown County Household Growth - (2017-2050)

Statewide Travel Demand Model: Year 2050 Update

DRAFT 1 - February 7, 2020

Figure 1