Detroit Water and Sewerage Department

Wastewater Master Plan

DWSD Project No. CS-1314

Preliminary Flow Projections for Alternatives Analysis

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Preliminary Flow Projections for Alternatives Analysis

1. Overview

Prior to analysis of the alternatives as part of the 50-year Wastewater Master Plan for the Detroit Water and Sewerage Department (DWSD), average and peak dry weather flows for the DWSD planning area were projected for the various target years (2000, 2010, 2020, 2030, 2040 and 2050). The planning area includes the Rouge River watershed, Clinton River watershed, and adjoining parts of the Lake St. Clair and Detroit River watersheds and is described in Volume 1. The area includes the existing service area and other areas that are either serviced by other WWTPs, have on-site sewage disposal systems, or are currently not developed.

Peaking factors were used to estimate the peak dry weather flows for the various options and for the various target years. The calculated peaking factors were verified using dry weather flow (DWF) data for the past four years for various meter districts. The projected average and peak DWF will serve as the foundation for analyzing the various treatment or flow management alternatives.

Over the next fifty years, wastewater flows in the DWSD collection will increase due to a number of factors:

- Potential increased service area
- Increased residential population and employment in the existing and new service areas
- Changes in water usage within the service areas
- Changes in the collection system (addition of CSO retention treatment facilities and in-system storage systems)

The estimates of wastewater flows and populations presented in this Technical Memorandum were developed in 2002 and were based on preliminary population estimates and average daily flows from 1997 to 2000. Subsequently, the final wastewater flow projections for the Master Plan were based on final population projections and average daily flows in the year 2001, because flow data was more complete for the year 2001. Therefore, there are some minor differences in the estimates in this Technical Memorandum and other parts of the Master Plan.

2. Approach

Flow analyses were based on GIS files obtained from Camp, Dresser & McKee (CDM). These ESRI Arc View files contained a variety of data consolidated for these analyses. GIS Arc View was used to store data and to calculate existing DWF and future growth

projections. These calculations aided in predicting wastewater flows associated with this growth.

The work in this task was divided into the following sub-tasks:

1. Collect data – Collected pertinent information are:
   - Residential DWF parameter (77 gallons/capita/day)
   - Employee DWF parameter (50 gallons/employee/day)
   - Significant Industrial User (SIU) DWF per sanitary district
   - Updated (2001) SEMCOG population and employee projections for 2000, 2010, 2020, 2030, 2040, and 2050 by Traffic Analysis Zones (TAZ)
   - Existing Sanitary Districts as GIS Arc View theme
   - Dry Weather Inflow/Infiltration (DWI/I) for existing and future conditions based on Greater Detroit Regional Sewer System (GDRSS) meter results.
2. Use GIS Arc View to calculate the DWF for the sanitary districts by area, weighting populations and employees per sanitary district.
3. Summarize total DWF in tabular format for each sanitary district and year.
4. Verify that the DWF predictions are reasonable.
5. Determine DWF for alternative service areas and rerouted flows to other WWTPs for the "Decentralized Treatment" alternative.
6. Prepare a final technical memorandum and presentation materials.

3. Flow Projections

3.1 Calculation Method

TAZs were used as the basis of organization in this study. TAZs are small areas used primarily in transportation planning, and were created from 2000 census blocks (SEMCOG). TAZ data were combined to determine current and future wastewater flows for larger, more measurable areas.

Sewer Districts are the combination of the TAZs that are sewered (not designated as On Site Disposal Systems (OSDS)) and have designated boundaries that are established by legal, political, or ratemaking authorities. Values from TAZs (or portions therein) within these boundaries were consolidated to determine flows from these sewer districts, for both present measurable assessments and future projections. If TAZs were divided by the surrounding boundary, the data within was divided

according to the area percentage within each sewer district (i.e., if 40% of the TAZ area was within a DWSD sewer district, then 40% of the data within that TAZ was also attributed to that particular sewer district).

This study began with population data, both present totals and future projections. Population counts and projections were divided into the number of residents and the number of employees per TAZ unit. Residential population flows were estimated using the City of Detroit average per capita wastewater flow rate of 76 gpd per resident. Employee population flows were estimated using 50 gpd per population unit.

Flow from Significant Industrial Users (SIU) was provided per TAZ based on the Volume 1 of the Wastewater Master Plan. Flow from future SIU was set constant to avoid economic bias.

Dry weather infiltration/inflow (DWI/I) was provided per TAZ by CDM for DWSD service areas, where such wastewater additions have been measured based on GDRSS meter data. Outside the DWSD service areas, representative data were used where available, and estimated for other areas based on data for similar areas. For example, DWI/I was estimated for Warren based on two-year metering data. The DWI/I was divided by the representative tributary area and was applied for Mount Clemens and Pontiac, assuming all three communities were established about the same time, and would be in similar condition.

Total flow was then calculated by adding the provided parameters together, for each TAZ, as follows:

Total Flow = (Resident Population x 77gpcd) + (Employee Population x 50gpcd) + SIU Flow + DWI/I Flow

Based on 2000 population, the average DWF for the existing DWSD metered districts is 568.09 mgd. The flow components are summarized in Figure 1.

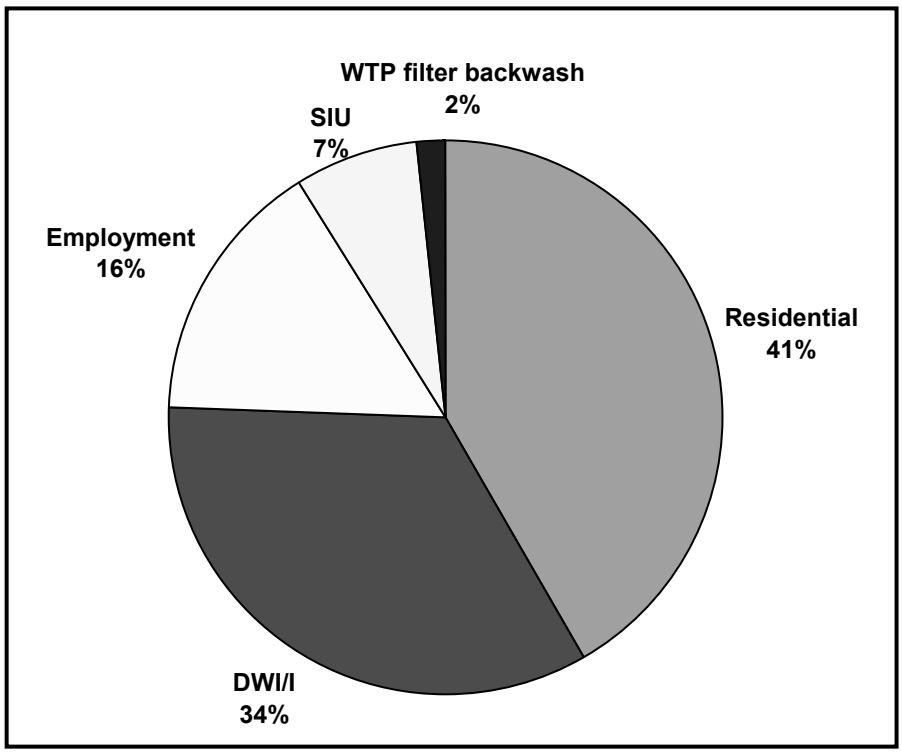

Figure 1. DWSD 2000 ADWF

3.2 Verification of Flow Values

Verification of the calculated average DWF and peaking factors is an important task to ensure confidence in flow projections. The calculated peaking factors and average DWF calculations were compared to flow data for the past four years for various meter districts.

DWSD's daily influent flow data over the last 4 years is shown in Figure 2. A list of all dry weather dates during the past four years was provided by CDM. For this study, a dry weather day was defined based on certain criteria as described in the GDRSS Technical Memorandum 4-13.

Similar analyses were performed for various meter districts as shown in Table 1.

Table 1. Average Dry Weather Flow Calculation vs. Measured Values

Meter	Record	Observed flow (MGD)			Observed Peaking Factor		Average DWF Based on 2000 Population		
		Max hr	Average Day	Max Day	Max Hr	Max Day	Base Flow* (MGD)	Population	Peaking Factor **
E6 and 7 and 8	19 Month/4-yr	242.27	72.32	225.00	3.35	3.11	71.00	517,045	1.76
Troy in E2 District	5 Month	40.44	12.23	24.88	3.31	2.03	13.82	66,826	2.48
E3, Clinton-Oakland , Avon & Dequindre	4-yr	119.33	29.09	51.58	4.10	1.77	37.35	249,612	1.99
E3, Clinton-Oakland , Avon & Dequindre	2yr	56.29	29.18	44.12	1.93	1.51	37.35	249,612	1.71
E4,Clinton-Oakland , W. Utica & Dequindre	4-yr	11.15	1.88	2.97	5.93	1.58	2.14	18,969	3.06
Meter N2	3-yr/4-yr	411.60	76.97	166.45	5.35	2.16	89.15	408,576	1.84
Pontiac WWTP	2-yr		12.40	31.00		2.50	12.21	68,608	2.47
Mt Clemens WWTP	Interim Report		3.83				3.44	17,331	3.11
Warren WWTP	Interim Report		23.18				22.97	137,575	2.20
DWSD WWMP***	1998-2001	961.00	553.63	800.70			568.09	3,105,417	1.31

* Base flow calculation based on the following criteria:
Residential DWF parameter: 77 gallons/capita/day
Employee DWF parameter: 50 gallons/employee/day
No change in SIU or DWI/I flow for year 2000-2050
**Based on ASCE Curve A
Peak Factor = 5 /P^(1/6), P is population in thousand
*** Use a factor of 1.31 for DWSD service area regardless of # of population
Peak Factor for Max Day= 800.7/568.09=1.41
Based on 99% percentile
Peak Factor for Max Day= 748.62/568.09=1.32

3.3 Average Dry Weather Flows

Average DWF for the DWSD planning area was projected for the various target years (2000, 2010, 2020, 2030, 2040 and 2050). As shown in Figure 3, the planning area includes the existing service area and other areas that are either served by other WWTPs, have OSDS, or are currently not developed. Figure 4 shows the planning area. Table 2 includes the projected average DWF for the year 2000 through 2050 for the entire planning area, and Table 3 for the existing metered areas. Figures 5 and 6 provide the flow per community for the years 2000 and 2050.

All dry weather flow from the Western Townships Utilities Authority (WTUA) will be directed to the Ypsilanti Community Utilities Authority (YCUA) when the expanded plant starts up in early in 2006. The current YCUA contract with WTUA is to treat up to 8 mgd of dry weather flow. WTUA includes Canton, Northville and Plymouth Townships, as well as any cities within those townships as shown in Figure 4.

Table 2. Projected Average Dry Weather Flows

Description	Flow (MGD)					
	2000	2010	2020	2030	2040	2050
Existing Sewer Service Area (including WTP filter backwash)	568.09	554.07	555.03	555.59	558.70	561.16
Tri-County Planning, Remaining Unsewered Area in Wayne, Oakland and Macomb Counties	17.15	18.60	22.32	26.12	28.18	29.78
Mt Clemens, Warren and Pontiac Existing Service Areas	38.49	39.03	39.20	39.06	39.33	39.62
Tri-County WWTP, Existing Service Areas of other WWTP Providers in Macomb, Oakland & Wayne County	15.81	17.72	18.83	19.60	20.11	20.54
Remaining Planning, Remaining Unsewered Area in the Planning Area Outside Tri-County	19.62	20.56	21.43	22.21	22.86	23.45
Remaining WWTP, Existing Service Areas of other WWTP Providers in the Planning Area Outside Tri-County	11.83	32.89	35.31	36.67	37.81	38.72
Planning Area Served by Wayne County WWTP, Remaining Portion of Service Area of Wayne County Downriver System	12.30	12.63	12.91	13.25	13.71	14.11
OSDS, Areas Currently Planned for On-Site Sewage Disposal	27.12	27.94	28.84	29.78	30.63	31.35
Grand Total	**710.41**	**723.44**	**733.87**	**742.28**	**751.34**	**758.74**

Assumptions:

Residential DWF parameter:	76 gallons/capita/day
Employee DWF parameter:	50 gallons/employee/day
WTP filter backwash	9.00 MGD For the Existing Service Area for year 2000-2050
No change in SIU or DWI/I flow for year 2000-2050	
No change in Employment Population for year 2000-2050	
As of 2006 all average dry weather flow from WTUA will be directed to YCUA WWTP	

Abbreviation:

DWF	Dry Weather Flow
DWI/I	Dry Weather Inflow/Infiltration
OSDS	On Site Disposal System
Remaining Planning	Planning area outside the Tri-County not including communities with their own WWTP
Remaining WWTP	Communities with their own WWTP outside the Tri-County area
SIU	Significant Industrial Users
Tri-County Planning	Planning area in the Tri-County not including communities with their own WWTP
Tri-County WWTP	Communities with their own WWTP in the Tri-County
WTP	Water Treatment Plant
WTUA	Western Townships Utilities Authority
YCUA	Ypsilanti Community Utilities Authority

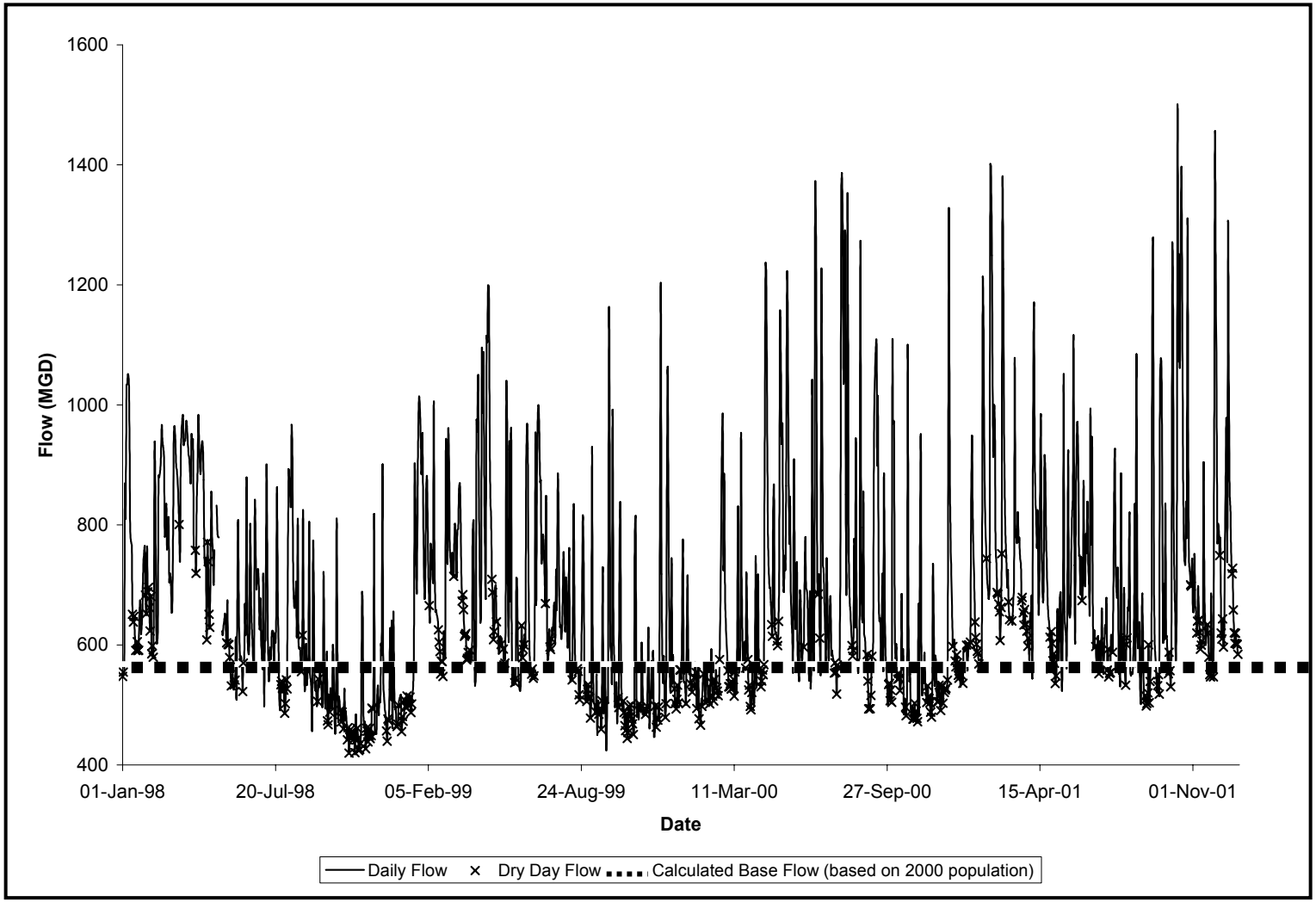

Figure 2. 1998-2001 DWSD WWTP Influent Record (excluding recycled flow)

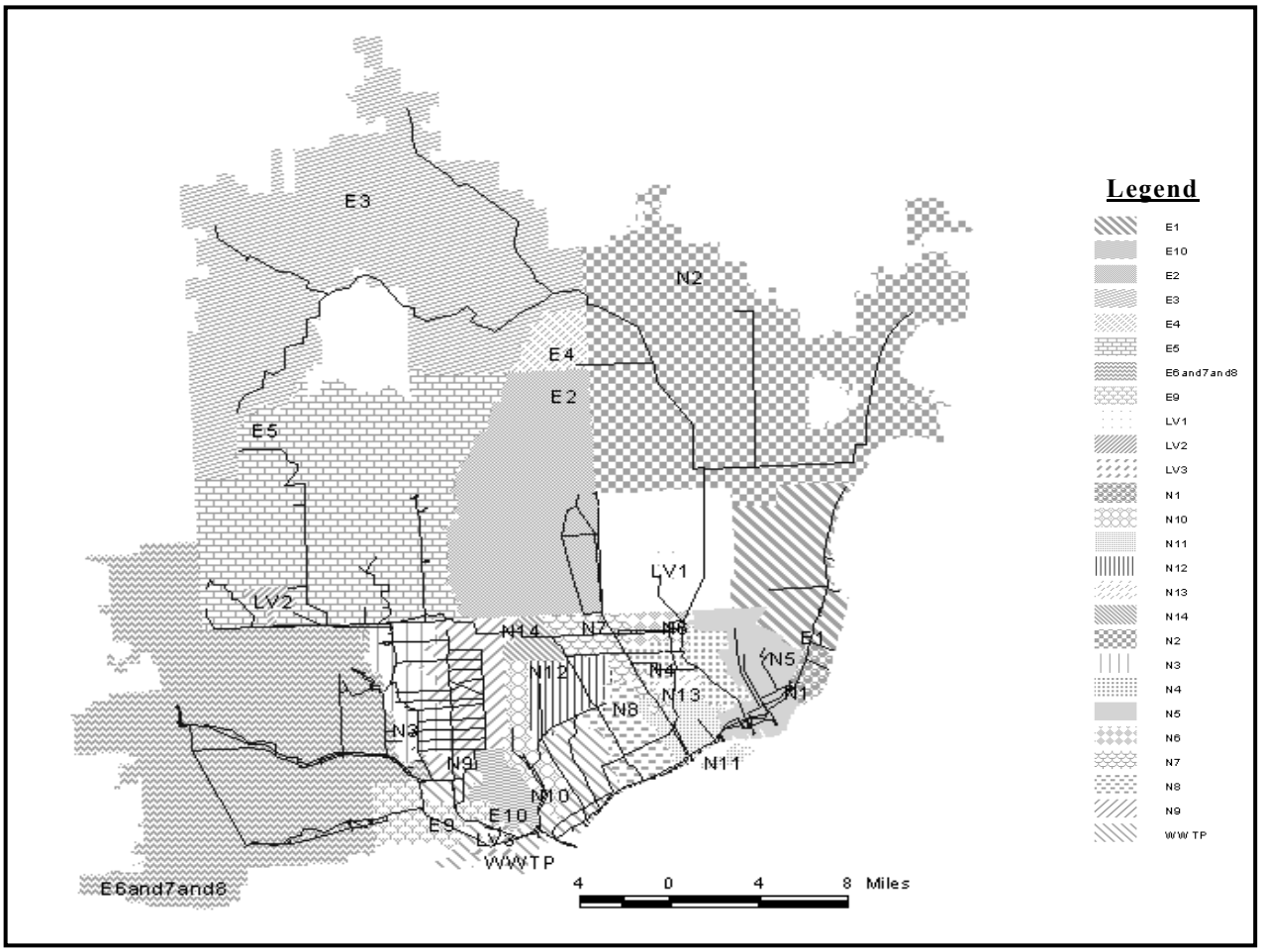

Figure 3. Existing Meter District Boundaries

Table 3. Projected Flow Per Existing Meter District

Meter District ID	Description	Flow (MGD)					
		2000	2010	2020	2030	2040	2050
E1	Kerby P.S.	21.67	20.97	20.53	20.15	20.20	20.28
E10	Dearborn, Miller Rd. P.S.	8.55	8.75	8.95	9.14	9.22	9.28
E2	S.E. Oakland, 8 Mile & Dequindre	45.92	45.09	44.35	43.52	43.56	43.63
E3	Clinton-Oakland , Avon & Dequindre	37.35	39.70	41.41	42.41	43.32	44.10
E4	Clinton-Oakland , W. Utica & Dequindre	2.14	2.21	2.23	2.22	2.25	2.27
E5	Evergreen-Farmington, 8 Mile & Southfield	46.87	47.49	47.68	47.41	47.69	47.97
E6and7and8*	Rouge Valley/North Huron Valley	71.00	56.47	56.64	56.35	56.92	57.50
E9	Dearborn, Greenfield P.S.	11.00	11.10	11.15	11.08	11.09	11.10
LV1	Centerline	1.23	1.18	1.15	1.14	1.15	1.16
LV2	Farmington	1.15	1.12	1.11	1.11	1.11	1.11
LV3	Melvindale	1.77	1.72	1.68	1.67	1.67	1.67
N1	Fox Creek Enclosure @ Kercherval	5.51	5.46	5.43	5.41	5.41	5.41
N10	Oakwood @ Reisener	20.02	19.78	19.57	19.48	19.43	19.35
N11	DRI @ Dubois and Franklin	14.79	14.31	14.03	13.89	13.85	13.76
N12	Weatherby @ Majestic	13.92	13.07	12.39	12.03	11.93	11.76
N13	Meldrum-Canfield	2.35	2.37	2.34	2.34	2.34	2.33
N14	First-Hamilton Upstream	5.66	5.48	5.39	5.46	5.47	5.48
N2	NI-EA @ Iowa	50.87	54.41	57.13	59.50	61.27	62.81
N3	NWI @ Evergreen	19.52	19.12	19.01	19.04	19.05	19.07
N4	Conner Creek Forebay	15.56	15.23	15.06	14.96	14.93	14.83
N5	DRI @ Jeffersonian Apts.	31.09	30.47	30.38	30.38	30.31	30.16
N6	Conner @ Mt. Olivet	7.30	7.09	7.04	7.00	6.95	6.88
N7	Mt. Elliot @ Palmer	15.21	14.87	14.78	14.78	14.76	14.72
N8	DRI @ 12th	27.71	28.01	27.91	27.91	27.77	27.75
N9	Hubbell-Southfield	25.25	24.00	23.44	23.32	23.29	23.24
WWTP	Wastewater Treatment Plant	55.70	55.60	55.23	54.89	54.75	54.54
Grand Total (including WTP Backwash Data)		568.09	554.07	555.03	555.59	558.70	561.16

* As of 2006 all average dry weather flow from WTUA will be directed to YCUA WWTP

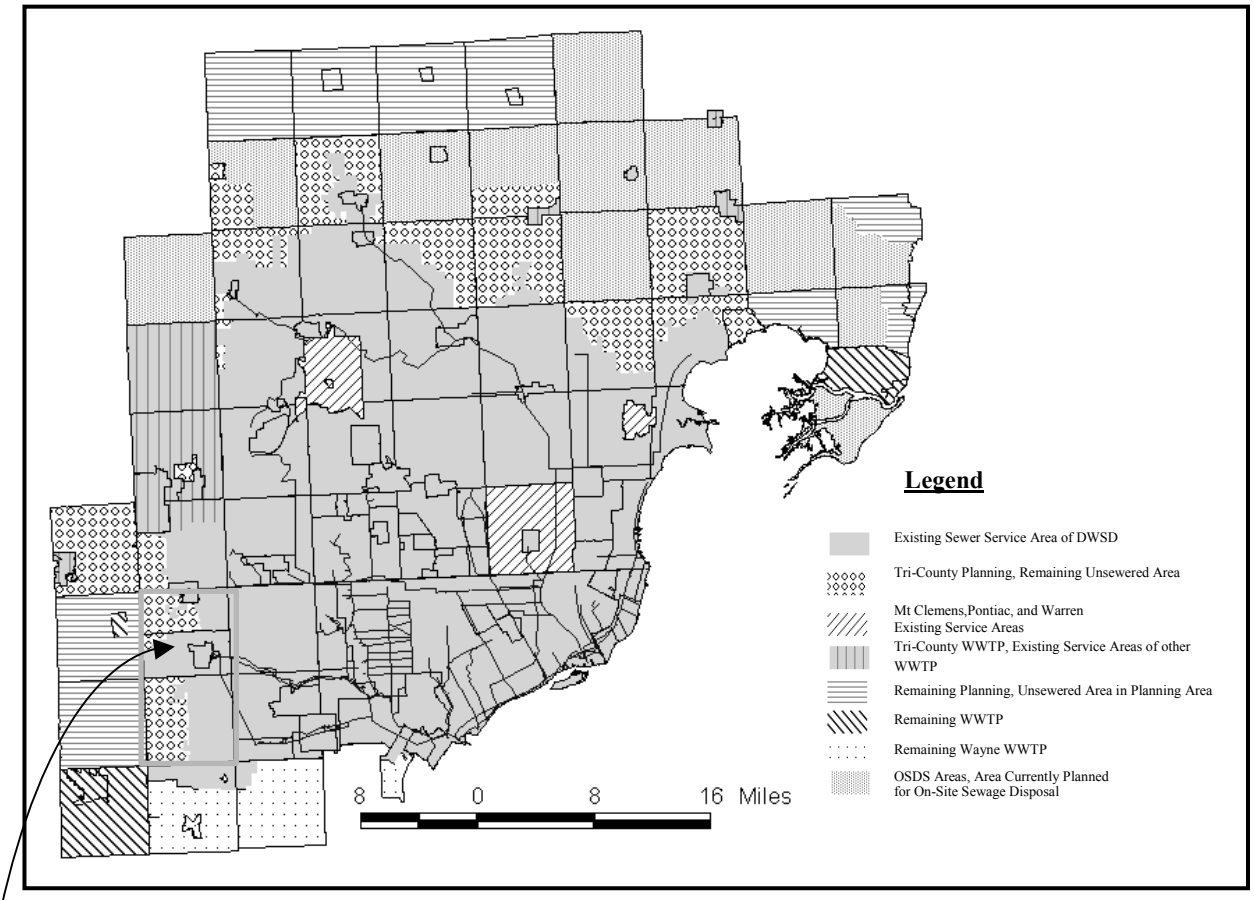

Figure 4. DWSD Planning Area

As of 2005, YCUA WWTP will serve this area.

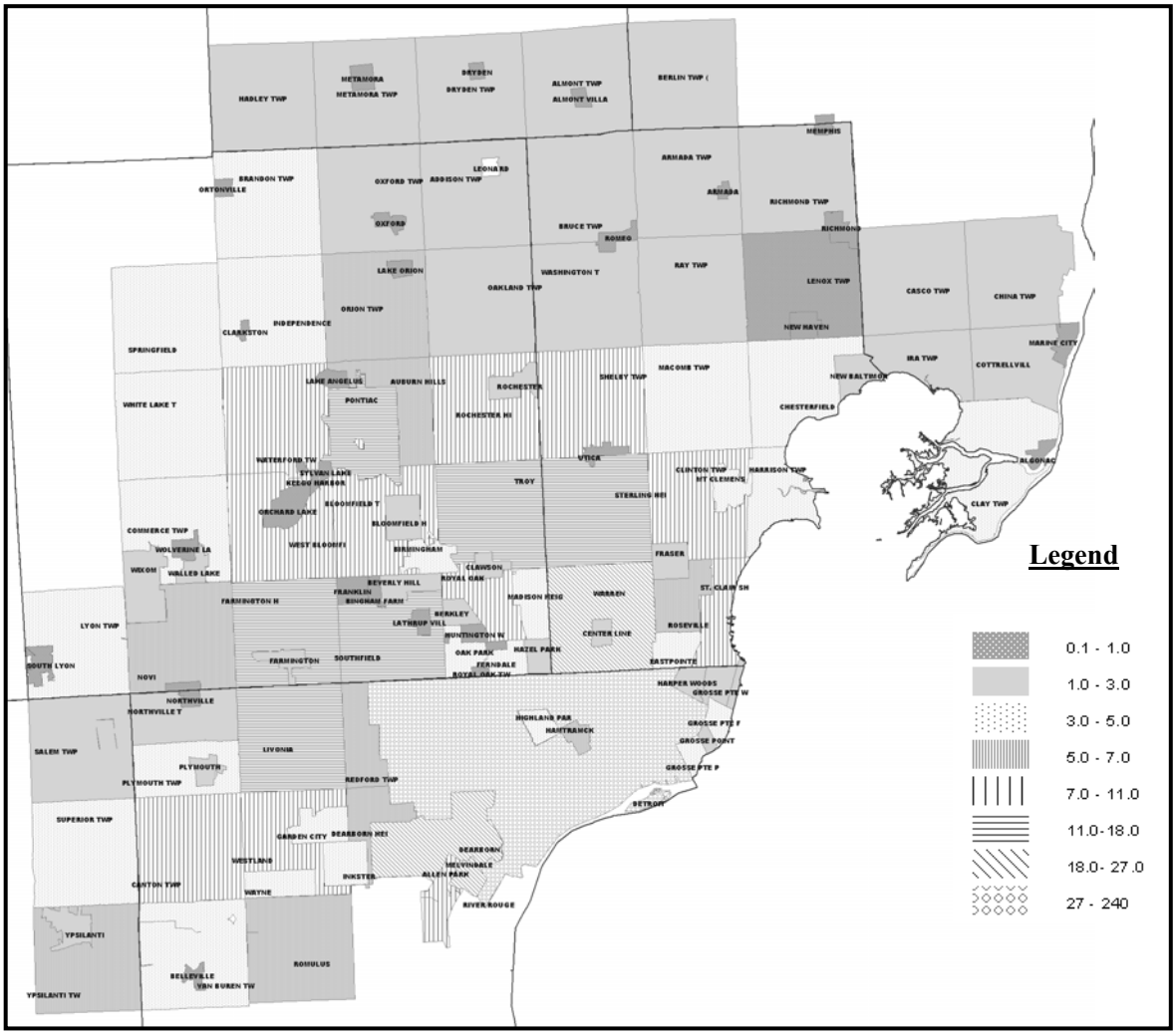

Figure 5. 2000 Dry Weather Flow (mgd) by Community

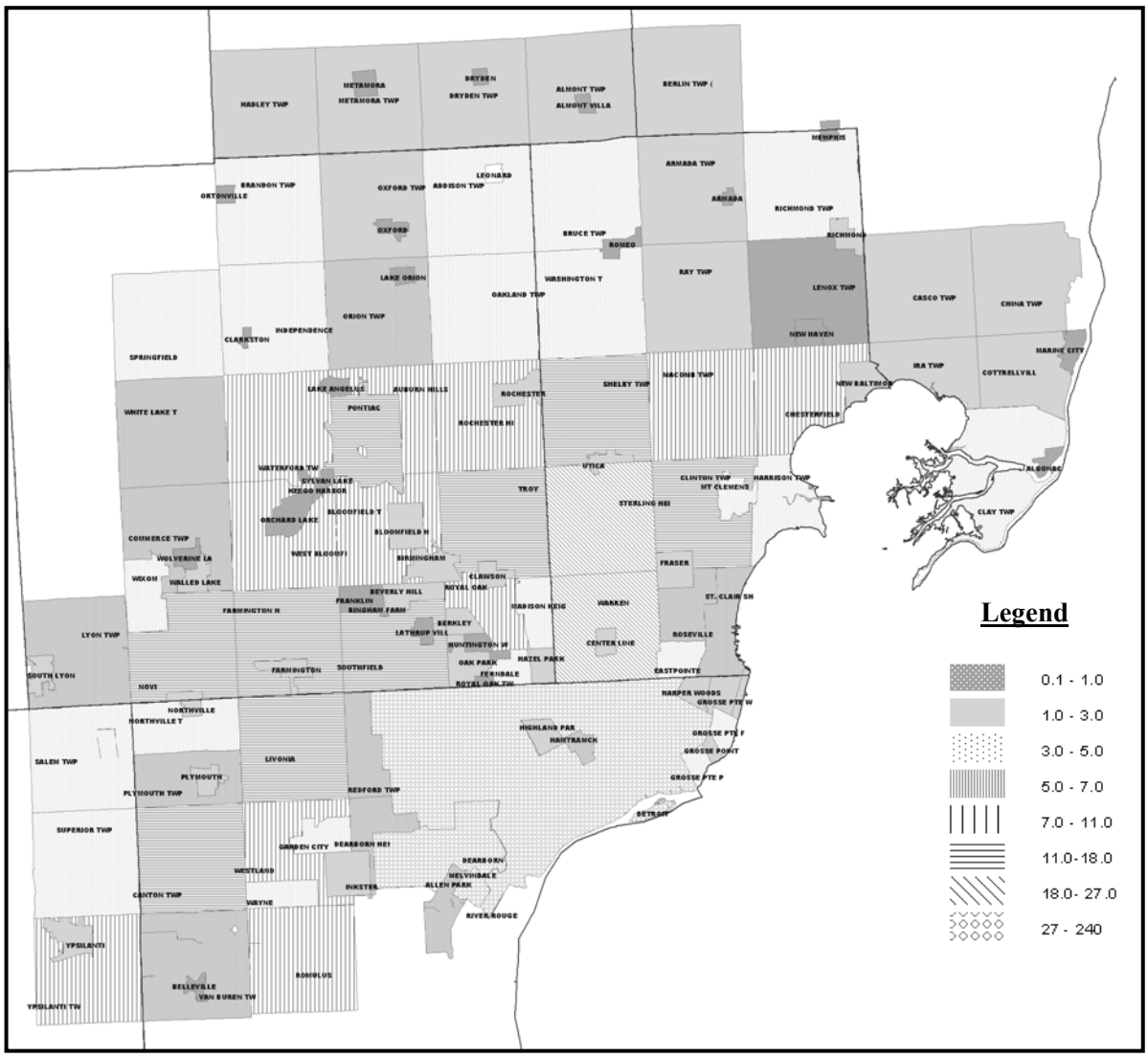

Figure 6. 2050 Dry Weather Flow (mgd) by Community

3.4 Peak Flow Factors

Peaking factors were used to estimate the peak dry weather flows for the various options and for the various target years. The estimated peaking factors for various meter districts in Table 1 are plotted in Figure 7. These values were compared to the DWSD practice as recommended in the National Sanitation Foundation (NSF) study "Sewerage and Drainage Problems and Administrative Affair", Ten State Standards for wastewater facilities design, and the American Society of Civil Engineers (ASCE) study "Design and Construction of sanitary and storm Sewers".

Based on Figure 7, it is recommended to use a constant number of 3.5 for maximum peak hourly flow factor. The maximum-day peaking factor was based on ASCE curve "A" that predicts the peaking factor as a function of population. The relationship is as follows:

Peaking Factor = 5 /P^(1/6), P is population in thousand

It is important to recognize that these curves and all published empirical peaking factor/population relationships are developed for a much smaller planning area than DWSD's. To determine the peaking factors for DWSD's service area, the 4-year records presented in Figure 2 were analyzed.

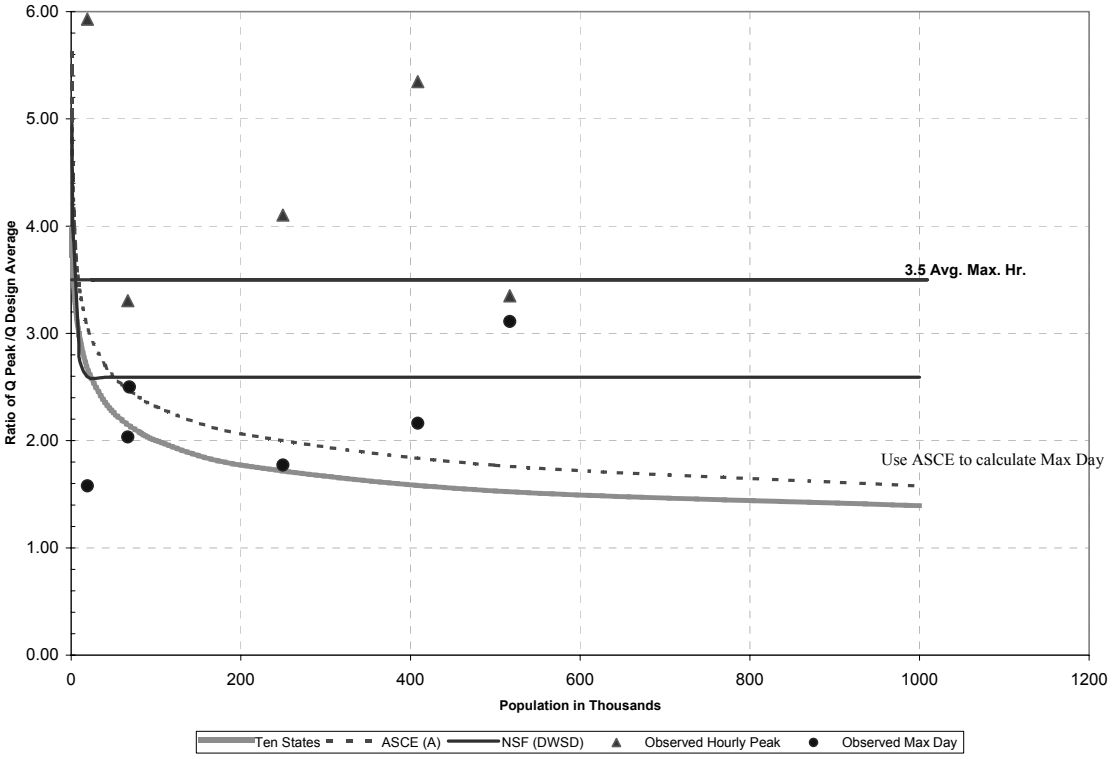

Figure 7. Peak Flow Factors

Figure 8 is a cumulative distribution plot of the 1998-2001 DWSD influent plant record. From Figure 8, the 100% percentile maximum dry weather day flow is 800.7 mgd, and the 99% percentile maximum dry weather day flow is 748.62 mgd. Taking the calculated average DWF of 568.09 mgd, the maximum day to average day ratios are 1.41 and 1.32 for 100% and 99% percentile, respectively (see Table 4). Based on 2000 population data, using ASCE curve "A" the predicted peaking factor was 1.31. For analysis of future flows for DWSD, a value of 1.31 is recommended for the maximum day flow factor. For smaller sub-areas such as Pontiac or Warren, use of the ASCE Curve "A" is recommended.

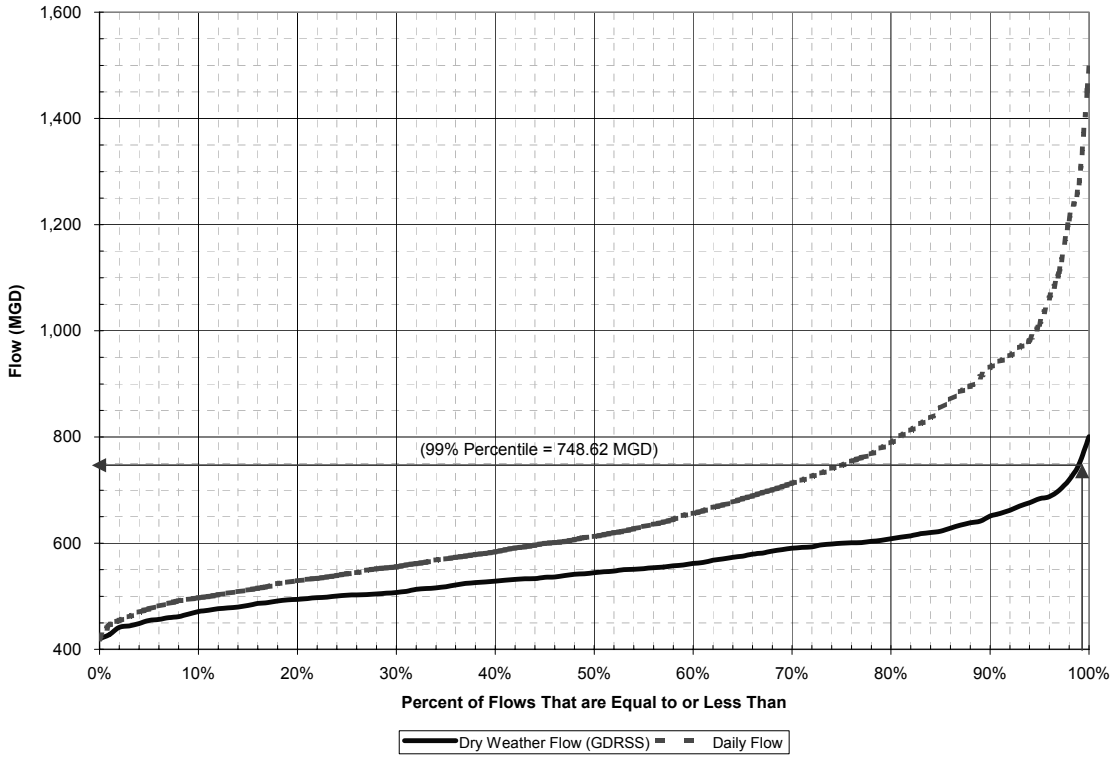

Figure 8. DWSD WWTP Influent Flow Analysis

Table 4. Calculation of Maximum Day Dry Weather Peak Flow Factor for DWSD

Year	Flow (MGD)	
1998	Maximum Day	800.70
	Average Day	536.51
	Minimum Day	419.92
	Max. Day Peak Factor	1.49
1999	Maximum Day	714.23
	Average Day	540.40
	Minimum Day	444.26
	Max. Day Peak Factor	1.32
2000	Maximum Day	684.77
	Average Day	536.24
	Minimum Day	466.29
	Max. Day Peak Factor	1.28
2001	Maximum Day	752.15
	Average Day	604.32
	Minimum Day	498.38
	Max. Day Peak Factor	1.24

4-year Max. Day (100% percentile)	800.70
4-year Max. Day (99% percentile)	748.62
Calculated Base Flow (2000 population)	568.09
Max Day Peak Factor (100% percentile)	1.41
Max Day Peak Factor (99% percentile)	1.32
DWSD 2000 Service Area Population	3,105,417
Peak Factor Based on 2000 Population*	1.31

* Based on ASCE Curve A
Peak Factor = 5/P^(1/6), P is population in thousand

Recommend using a factor of 1.31 for DWSD service area regardless of population #

Table 5. Projected/ Maximum Day Dry Weather Flows

Geography	Average Flow (MGD)		Population		Peaking Factor*		Max Daily Flow (MGD)	
	2000	2050	2000	2050	2000	2050	2000	2050
Existing Sewer Service Area (including WTP filter backwash)	568.09	561.16	3,105,417	3,012,886	1.31	1.31	744.20	735.12
Tri-County Planning, Remaining Unsewered Area in Wayne, Oakland and Macomb Counties	17.15	29.78	118,707	270,111	2.26	1.97	38.76	58.67
Mt Clemens, Warren and Pontiac Existing Service Areas	38.49	39.62	222,816	229,183	2.03	2.02	78.13	80.04
Tri-County WWTP, Existing Service Areas of other WWTP Providers in Macomb, Oakland & Wayne County	15.81	20.54	106,235	153,340	2.30	2.16	36.36	44.36
Remaining Planning, Remaining Unsewered Area in the Planning Area Outside Tri-County	19.62	23.45	41,569	81,265	2.69	2.40	52.79	56.27
WWTP Providers in the Planning Area Outside Tri-County***	11.83	38.72	84,884	311,225	2.39	1.92	28.27	74.35
Remaining Portion of Service Area of Wayne County Downriver System	12.30	14.11	65,531	75,279	2.49	2.43	30.62	34.30
OSDS, Areas Currently Planned for On-Site Sewage Disposal	27.12	31.35	54,862	100,329	2.57	2.32	69.70	72.73
Grand Total**	710.41	758.74	3,800,020	4,233,619	1.31	1.31	930.64	993.95

* Peak Factor = 5 /P^(1/6), P is population in thousand

** Use 1.31 for max. day peak factor regadless of population #

***As of 2006 all average dry weather flow from WTUA will be directed to YCUA WWTP

3.5 Flow Projection for Alternatives

Average and peak dry weather flows for the alternatives of expanding Pontiac, Mount Clemens, Warren WWTP's and a new WWTP were projected for the target years 2000 and 2050. These results are documented in Tables 7,8 and 9 in the next section and in the Technical Feasibility of Satellite Treatment Memorandum.

3.6 Sensitivity Analysis

DWF's were calculated using a parameter of 76 gallons/capita/day. Assuming the use rate was reduced to 65 gpcd by year 2050 due to using water saving fixtures, the reductions in DWF would be as follow:

Average DWF (MGD) Using 77 gpcd	
Existing Sewer Service Area	561.16
Tri County (not including OSDS or area served by Wayne County WWTP)	651.11
Average DWF (MGD) Using 65 gpcd	
Existing Sewer Service Area	528.02
Tri County (not including OSDS or area served by Wayne County WWTP)	610.79
Reduction	
Existing Sewer Service Area	33.14
Tri County (not including OSDS or area served by Wayne County WWTP)	40.32

4. Evaluation of Available Secondary Treatment

The peak secondary treatment capacity is 930 mgd, which includes 100 mgd recycle flow. Under normal dry weather flow conditions, all the primary effluent receives secondary treatment. Under wet weather conditions, primary effluent in excess of 930 mgd will be discharged to the outfall after chlorine disinfection.

Table 6 evaluates the available secondary treatment at DWSD for the various incremental planning areas for two maximum-day peaking factors of 1.31 (recommended value) and 1.41 (based on 100-percentile maximum dry weather day flow). The excess secondary treatment was calculated by subtracting 100 mgd for recycle flow from the established capacity of 930 mgd and projected dry weather flow. This analysis does not account for any additional secondary capacity that may be necessary to treat wet weather flow or additional dewatered flows from CSO or SSO basins. From Table 6, by year 2050 and assuming no change in DWSD's existing meter district boundary and a peaking factor of 1.31, the plant will have excess secondary capacity of 94.88 mgd. By year 2050 and assuming DWSD provides secondary treatment to the entire planning area with a peaking factor of 1.31, an additional 163.95 mgd in secondary capacity would be needed.

Table 7 evaluates the available secondary treatment at DWSD due to the expansion of the Pontiac WWTP. Providing additional treatment at Pontiac (Option 3 of the Pontiac WWTP expansion) of 45.01 mgd for average day and 86.28 for maximum day would result in a decrease at DWSD of 45.01 mgd for average day and 58.96 mgd for maximum day.

Similarly, reduction due to diversions of flow to the Warren and Mount Clemens WWTP's are shown in Table 8. The impacts of diversion to new WWTP's in the Clinton River Watershed are shown in Table 9.

Table 6. Evaluation of the Available Secondary Treatment for the DWSD Planning Area

Available Secondary Treatment Using a Peak Factor of 1.31

Geography	Average Flow (MGD)		Population		Peaking Factor	Max Daily Flow (MGD)		Available Secondary Treatment* for Max Day	
	2000	2050	2000	2050		2000	2050	2000	2050**
Existing Sewer Service Area	568.09	561.16	3,105,417	3,012,886	1.31	744.20	735.12	85.80	94.88
Existing Sewer Service Area+Tri-County Planning	585.24	590.95	3,224,124	3,282,997	1.31	766.67	774.14	63.33	55.86
Tri County (not including area served by Wayne County WWTP)	639.54	651.11	3,553,175	3,665,520	1.31	837.80	852.95	-7.80	-22.95
All - OSDS - area served by Wayne County WWTP	670.99	713.28	3,679,628	4,058,011	1.31	879.00	934.39	-49.00	-104.39
All	710.41	758.74	3,800,020	4,233,619	1.31	930.64	993.95	-100.64	-163.95

Available Secondary Treatment Using a Peak Factor of 1.41.

Geography	Average Flow (MGD)		Population		Peaking Factor	Max Daily Flow (MGD)		Available Secondary Treatment* for Max Day	
	2000	2050	2000	2050		2000	2050	2000	2050**
Existing Sewer Service Area	568.09	561.16	3,105,417	3,012,886	1.41	801.01	791.24	28.99	38.76
Existing Sewer Service Area+Tri-County Planning	585.24	590.95	3,224,124	3,282,997	1.41	825.19	833.23	4.81	-3.23
Tri County (not including area served by Wayne County WWTP)	639.54	651.11	3,553,175	3,665,520	1.41	901.75	918.06	-71.75	-88.06
All - OSDS - area served by Wayne County WWTP	670.99	713.28	3,679,628	4,058,011	1.41	946.10	1005.72	-116.10	-175.72
All	710.41	758.74	3,800,020	4,233,619	1.41	1001.68	1069.82	-171.68	-239.82

*Assume 930 MGD -100 MGD (recycle Flow) -Option Flow
**As of 2006 all average dry weather flow from WTUA will be directed to YCUA WWTP

Table 7. Evaluation of the Available Secondary Treatment at DWSD Due to the Expansion of Pontiac WWTP

Pontiac WWTP Flows:

Description	Population		Maximum Day Peaking Factor*		Flow (MGD)			
					2000		2050	
	2000	2050	2000	2050	Average	Max Day	Average	Max Day
Pontiac Existing Flow	68,608	80,970	2.47	2.40	12.21	30.17	13.85	33.31
Option 1	145,449	164,837	2.18	2.14	18.43	40.19	21.10	45.07
Option 1 Total Flow to Pontiac	214,058	245,807	2.04	2.00	30.64	62.64	34.96	69.84
Option 2	189,457	233,726	2.09	2.01	25.33	52.84	30.78	62.01
Option 2 Total Flow to Pontiac	258,065	314,695	1.98	1.92	37.53	74.38	44.63	85.57
Option 3	257,386	314,788	1.98	1.92	37.26	73.86	45.01	86.28
Option 3 Total Flow to Pontiac	325,994	395,757	1.91	1.85	49.47	94.28	58.86	108.62

Detroit WWTP Flows:

Description	Population		Maximum Day Peaking Factor**		Flow (MGD)			
					2000		2050***	
	2000	2050	2000	2050	Average	Max Day	Average	Max Day
Scenario 1: DWSD Existing Service Area	3,105,417	3,012,886	1.31	1.31	568.09	744.20	561.16	735.12
Scenario 2: DWSD Existing Service Area + Planning Area (not including OSDS or area served by other WWTP)	3,224,124	3,282,997	1.31	1.31	585.24	766.67	590.95	774.14
Scenario 1 - Pontiac option 3	2,848,031	2,698,099	1.31	1.31	530.83	695.39	516.16	676.16
Decrease in Flow to DWSD					37.26	48.81	45.01	58.96
Scenario 2 - Pontiac option 3	2,966,738	2,968,209	1.31	1.31	547.99	717.86	545.94	715.18
Decrease in Flow to DWSD					37.26	48.81	45.01	58.96

*Peak Factor = 5 /P^(1/6), P is population in thousands
** Use a factor of 1.31 for DWSD service area regardless of population
***As of 2006 all average dry weather flow from WTUA will be directed to YCUA WWTP

Table 8. Evaluation of the Available Secondary Treatment at DWSD Due to the Expansion of Warren and Mt Clemens WWTP

Warren and Mt Clemens WWTP Flows:

Description	Population		Maximum Day Peaking Factor*		Flow (MGD)			
					2000		2050	
	2000	2050	2000	2050	Average	Max Day	Average	Max Day
Warren Expanded Flow								
Option 1	66,826	64,520	2.48	2.50	13.82	34.30	14.00	35.00
Mt Clemens Expanded Flow								
Option 1	54,120	106,528	2.57	2.30	6.81	17.52	11.25	25.80
Option 2	163,011	342,277	2.14	1.89	20.38	43.60	35.90	67.90
Option 3	308,409	500,534	1.92	1.77	37.02	71.21	54.02	95.90

Detroit WWTP Flows:

Description	Population		Maximum Day Peaking Factor**		Flow (MGD)			
					2000		2050***	
	2000	2050	2000	2050	Average	Max Day	Average	Max Day
Scenario 1: DWSD Existing Service Area	3,105,417	3,012,886	1.31	1.31	568.09	744.20	561.16	735.12
Scenario 2: DWSD Existing Service Area + Planning Area (not including OSDS or area served by other WWTP)	3,224,124	3,282,997	1.31	1.31	585.24	766.67	590.95	774.14
Scenario 1 - Warren option 1	3,038,591	2,948,366	1.31	1.31	554.27	726.10	547.16	716.78
Decrease in Flow to DWSD					13.82	18.10	14.00	18.34
Scenario 2 - Warren Option1	3,157,298	3,218,477	1.31	1.31	571.42	748.57	576.95	755.80
Decrease in Flow to DWSD					13.82	18.10	14.00	18.34
Scenario 1 - Mt Clemens option 3	2,730,182	2,447,832	1.31	1.31	531.07	695.71	507.14	664.35
Decrease in Flow to DWSD					37.02	48.50	54.02	70.77
Scenario 2 - Mt Clemens option 3	2,915,715	2,782,463	1.31	1.31	548.23	718.18	536.92	703.37
Decrease in Flow to DWSD					37.02	48.50	54.02	70.77

*Peak Factor = 5 /P^(1/6), P is population in thousands

** Use a factor of 1.31 for DWSD service area regardless of population

***As of 2006 all average dry weather flow from WTUA will be directed to YCUA WWTP

Table 9. Evaluation of the Available Secondary Treatment at DWSD Due to a New WWTP's in Clinton River Watershed

New WWTP Flows:

Description	Population		Maximum Day Peaking Factor*		Flow (MGD)			
					2000		2050	
	2000	2050	2000	2050	Average	Max Day	Average	Max Day
Option 1 - Oakland University Area	145,449	164,837	2.18	2.14	18.43	40.19	21.10	45.07
Option 2 - Ford Motor Company Proving Grounds Area	305,805	405,735	1.93	1.84	44.73	86.17	56.31	103.48
Option 3 - East of Macomb/Oakland Area (South of M59)	350,554	451,689	1.88	1.81	50.14	94.40	62.20	112.28

Detroit WWTP Flows:

Description	Population		Maximum Day Peaking Factor**		Flow (MGD)			
					2000		2050***	
	2000	2050	2000	2050	Average	Max Day	Average	Max Day
Scenario 1: DWSD Existing Service Area	3,105,417	3,012,886	1.31	1.31	568.09	744.20	561.16	735.12
Scenario 2: DWSD Existing Service Area + Planning Area (not including OSDS or area served by other WWTP)	3,224,124	3,282,997	1.31	1.31	585.24	766.67	590.95	774.14
Scenario 2 - Option 1	3,078,675	3,118,160	1.31	1.31	566.81	742.52	569.84	746.49
Decrease in Flow to DWSD					18.43	24.15	21.10	27.65
Scenario 2 - Option 2	2,918,319	2,877,262	1.31	1.31	540.51	708.07	534.63	700.37
Decrease in Flow to DWSD					44.73	58.60	56.31	73.77
Scenario 2 - Option 3	2,873,570	2,831,308	1.31	1.31	535.11	700.99	528.74	692.66
Decrease in Flow to DWSD					50.14	65.68	62.20	81.48

*Peak Factor = 5 /P^(1/6), P is population in thousand
** Use a factor of 1.31 for DWSD service area regardless of population
***As of 2006 all average dry weather flow from WTUA will be directed to YCUA WWTP