Detroit Water and Sewerage Department

Wastewater Master Plan

DWSD Project No. CS-1314

Flow Management – Distribution of DWI/I Reductions

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Author: CDM

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Flow Management – Distribution of DWI/I Reductions

1. Introduction

The DWSD Wastewater Master Plan has made estimates of the flow generated by the City of Detroit and each of its customers. These flows have been categorized as being sourced from residential, industrial and commercial, and significant industrial sources. Estimates have also been made of the amount of the Dry Weather flow that comes from Inflow and Infiltration (DWI/I) sources. This component of flow is important because when it is reduced, there can be an increase in the amount of flow that can be treated from other residential, commercial and industrial customers.

An important element of the WWMP is to use Flow Management to better control these DWI/I sources to accommodate the anticipated growth of customers that will use the DWSD system for treatment of their wastewater flows. Flow Management refers to controlling the amount of extraneous flows that find their way into the collection system, which reduces the available capacity to provide treatment of non-I/I sources. Currently, the average dry weather flows that the DWSD WWTP treats is on the order of 605 MGD. Of this, about 251 MGD has been estimated as coming from DWI/I sources.

These DWI/I flows can come from leaking cracks and joints in sewer pipes, leaks in manholes and similar structures, and drainage around houses that enter through foundation footing drains that may be connected to sanitary collection systems. In combined systems, there are additional dry weather inflow sources that can include river inflow through backwater gates. In all cases, the groundwater supplies the water that enters these systems. This groundwater can be replenished through rainfall, but can also come from water distribution systems. Water distribution systems can contribute to the dry weather flows seen in combined systems through the use of hydrant flushing, fire fighting, and water main leaks as the drainage from these uses would flow to the combined sewer inlets and increase the dry weather flows.

This technical memorandum evaluates a number of approaches that can be used to allocate a reduction in the overall DWI/I loading to the DWSD WWTP by 20%, or about 50 MGD. The approaches address the distribution of the DWI/I between the first tier customers and look at how to best allocate the 50 MGD reduction to the different customers in ways that that both account for their prior DWI/I reduction efforts through flow management and also reflects the opportunities to reduce these flows because of the types of collection systems employed.

Table 1 presents the First Tier Customers, the tributary areas each has, and the estimated DWI/I calculated to be generated by each of these customers. Note that some customers are entirely served by sanitary sewers, others entirely by combined sewer systems, and others have a mix of those two sewer system types.

First Tier Customer	Type	Total Area (ac)	Combined (ac)	Separate (ac)	Metered DWF	DWI/I (MGD)	DWI/I (in)
Allen Park	Sanitary	1,716	0	1,716	1.7	0.28	2.20
Centerline	Sanitary	1,031	0	1,031	1.2	0.06	0.76
City of Detroit	Combined	82,555	82,555	0	296	185	30.15
Clinton-Oakland	Sanitary	75,822	0	75,822	31.3	3.2	0.56
Dearborn	Mixed	14,823	10,000	4,823	22.1	6.6	5.95
Dearborn Heights Dist 2	Sanitary	17	17	0	0.07	0.04	31.82
Evergreen-Farmington	Mixed	62,681	3,850	58,831	43	7.4	1.58
Farmington	Sanitary	1,376	0	1,376	1.4	0.41	4.02
Grosse Pointe	Mixed	684	271	413	1.7	0.92	18.05
Grosse Pointe Farms	Mixed	1,384	1,337	48	2.9	1.9	18.05
Grosse Pointe Park	Sanitary	1,283	0	1,283	1.4	0.34	3.54
Hamtramck	Combined	1,347	1,347	0	5.0	2.9	28.57
Harper Woods	Storm	188	188	0	0.84	0.70	50.03
Highland Park	Combined	1,870	1,870	0	3.4	1.7	12.12
Macomb	Sanitary	84,248	0	84,248	51	12	1.97
Melvindale	Sanitary	1,757	0	1,757	1.6	0.36	2.75
N.E. Wayne	Mixed	20,410	8,106	12,304	25	7.6	5.03
North Huron/Rouge Val	Mixed	98,063	6,155	91,908	68	10	1.40
Redford Township	Combined	49	49	0	0.08	0.05	13.64
S.E. Oakland	Sanitary	42,146	22,997	19,149	47	8.6	2.76
Wayne Co Area 6	Combined	81	81	0	0.16	0.08	13.64
Totals		493,529	138,822	354,707	605	251	6.83

Table 1. First Tier Customer Information

In this table the community DWI/I has been shown both as MGD and as inches of DWI/I over the tributary area. The second method is important because the Southeast Michigan area receives an average of about 33 inches of rainfall annually. In general, about 10 to 15 inches of this rainfall finds its way to the groundwater table and can, in turn, find its way into collection systems. Therefore, if the DWI/I values shown in this table exceed 10-15 inches, it is likely that other sources contribute to these flows. These can include flows from the water distribution system with uses that discharge into the collection system.

2. Alternative Allocation Approaches

Three alternative approaches are provided in the following sections to assign responsibility for reducing the DWI/I generated in the collection system. Each of these approaches has advantages and disadvantages that are also discussed. Estimates of the DWI/I goals for each of the communities are provided below.

2.1 Proportional Reduction Approach

The first approach that could be taken would assign responsibility for reducing DWI/I based on proportionality. Customers would be required to reduce DWI/I by an equal percentage to their overall contribution of DWI/I. Since the overall

reduction goal is 20%, this approach would require each customer to reduce their DWI/I by that same 20%. Following is a description of the advantages and disadvantages of this approach:

Advantages:

- Simple to calculate required reductions
- Applies uniformly to all customers
- Requires all customers to reduce DWI/I
- Every community is asked to contribute to the overall flow management solution

Disadvantages:

- Differences of DWI/I inherent in collection system types not accounted for
- Impacts of soils or geography not accounted for
- Customers who are already engaged in active flow management programs do not receive credit for work completed
- Flows identified by this approach may not be the most economical to remove

2.2 General Standard Approach

A second approach is to develop a standard limit in terms of the acceptable level of DWI/I that a community can accept in their collection system. This approach could be based on factors such as the flow per unit of tributary area or based on flow per inch-mile of installed pipeline. Once a standard is developed, this would be applied uniformly to all communities. Those that have DWI/I flows that are less than the standard allowed have no further responsibility for reducing flows within their community. Those communities with flows that exceed the standard are obligated to reduce DWI/I flows until they achieve the standard. Following is a description of the advantages and disadvantages of this approach:

Advantages:

- Acknowledges communities that have worked to remove DWI/I
- Can easily calculate required reductions
- Standard applied uniformly to all customers

Disadvantages:

- Differences of DWI/I inherent in collection system types not accounted for

- Impacts of soils or geography not accounted for
- Flows identified for removal may not be the most economical to remove

2.3 System Standard Approach

A third approach would develop different DWI/I standards that are applied to different collection system types. This approach recognizes that there are fundamental differences in how sanitary and combined collection systems operate and that the amount of DWI/I that enters these systems varies. These different standards would acknowledge these differences and require that all customers and the City of Detroit manage their DWI/I flows in their collection systems to within the standards that are set.

An issue that must be dealt with is how to set these standards to provide goals that ensure that there is good flow management of the DWI/I flows generated in these collection systems while at the same time not placing an economic burden on certain types of customers for the majority of the work. Following is a description of the advantages and disadvantages of this approach:

Advantages:

- Acknowledges communities that have worked to remove DWI/I
- Required reduction for each community can be calculated
- Recognizes differences in collection system performance
- Requires flow management work within different types of collection systems
- Cost effectiveness of removal factored into standards set

Disadvantages:

- Impacts of soils or geography not accounted for
- Flows identified for removal may not be the most economical to remove in some cases

3. Recommended Approach

3.1 Comparison of Approaches

To select the approach, the different approaches have been compared. The following Table 2 shows the application of these three different approaches to the First Tier Customers provided in Table 1.

- Approach 1 - For these calculations, the assumption for the first approach was that a 20% reduction in DWI/I would be required for each customer.

- Approach 2 - For the second approach, the standard was set so that the overall goal of a 50-MGD reduction was achieved. To accomplish this, the goal of 22.2 in/yr (1,650 gpd/ac) was found to provide the needed reduction. This approach is shown graphically in Figure 1.

- Approach 3 - For the final approach, two separate standards were set so that the goal of 50-MGD DWI/I reduction would be achieved. In this case, the standard for the sanitary collection systems was set at 1.0 in/yr (75 gpd/ac) and the standard for the combined areas set at 23.5 in/yr (1,750) gpd/ac). This approach is shown graphically in Figure 3.

Table 2. Reduction by Approach

				Prop. Standard		General Standard		System Type Standard			
First Tier Customer	Metered DWF	DWI/I (MGD)	DWI/I (in)	MGD		MGD		MGD	Comb.	Sep.	
Allen Park	1.7	0.28	2.20	0.06	0%	0	0%	.15	.	.15	0%
Centerline	1.2	0.06	0.76	0.01	0%	0	0%	.	.	.	0%
City of Detroit	296	185	30.15	36.9	74%	49	98%	40.8	40.8	.	82%
Clinton-Oakland	31.3	3.2	0.56	0.63	1%	0	0%	.	.	.	0%
Dearborn	22.1	6.6	5.95	1.31	3%	0	0%	.	.	.	0%
Dearborn Heights Dist 2	0.07	0.04	31.82	0.01	0%	0	0%	.01	.01	.	0.02%
Evergreen-Farmington	43	7.4	1.58	1.47	3%	0	0%	.	.	.	0%
Farmington	1.4	0.41	4.02	0.08	0%	0	0%	.31	.	.31	0.6%
Grosse Pointe	1.7	0.92	18.05	0.18	0%	0	0%	.41	.38	.03	0.8%
Grosse Pointe Farms	2.9	1.9	18.05	0.37	1%	0	0%	.	.	.004	0.0%
Grosse Pointe Park	1.4	0.34	3.54	0.07	0%	0	0%	.24	.	.24	0.5%
Hamtramck	5.0	2.9	28.57	0.57	1%	0.6	1.3%	.51	.51		1.0%
Harper Woods	0.84	0.70	50.03	0.14	0%	0.4	0.8%	.37	.37	.	0.7%
Highland Park	3.4	1.7	12.12	0.34	1%	0	0%	.	.	.	0%
Macomb	51	12	1.97	2.46	5%	0	0%	6.1	.	6.1	12%
Melvindale	1.6	0.36	2.75	0.07	0%	0	0%	.23	.	.23	0.5%
N.E. Wayne	25	7.6	5.03	1.52	3%	0	0%	.92	.	.92	1.8%
North Huron/Rouge Val	68	10	1.40	2.04	4%	0	0%	.	.	.	0%
Redford Township	0.08	0.05	13.64	0.01	0%	0	0%	.	.	.	0%
S.E. Oakland	47	8.6	2.76	1.72	3%	0	0%	.	.	.	0%
Wayne Co Area 6	0.16	0.08	13.64	0.02	0%	0	0%	.	.	.	0%
Totals	605	251	6.83	50		50		50	42	8	

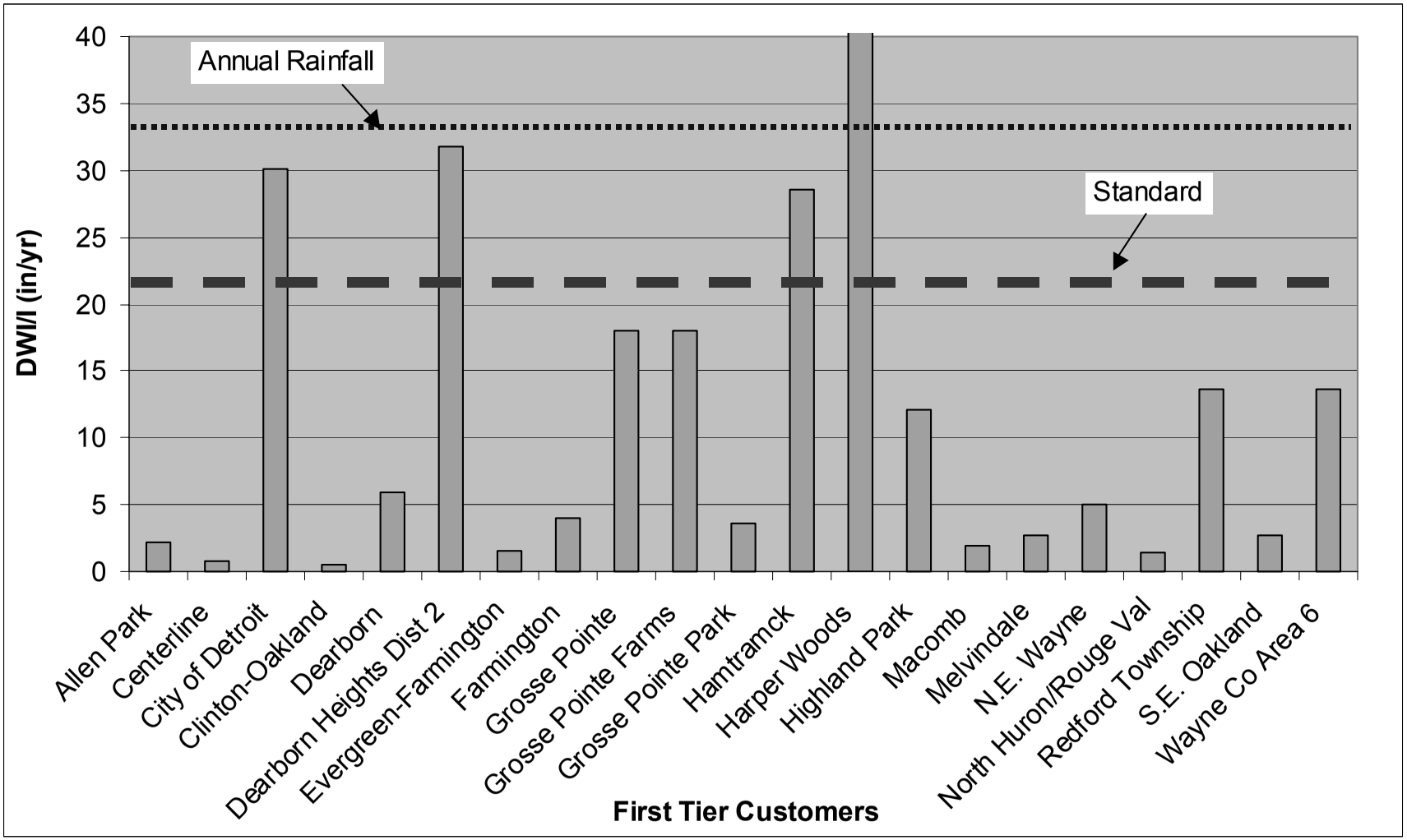

Figure 1 – General Standard Approach

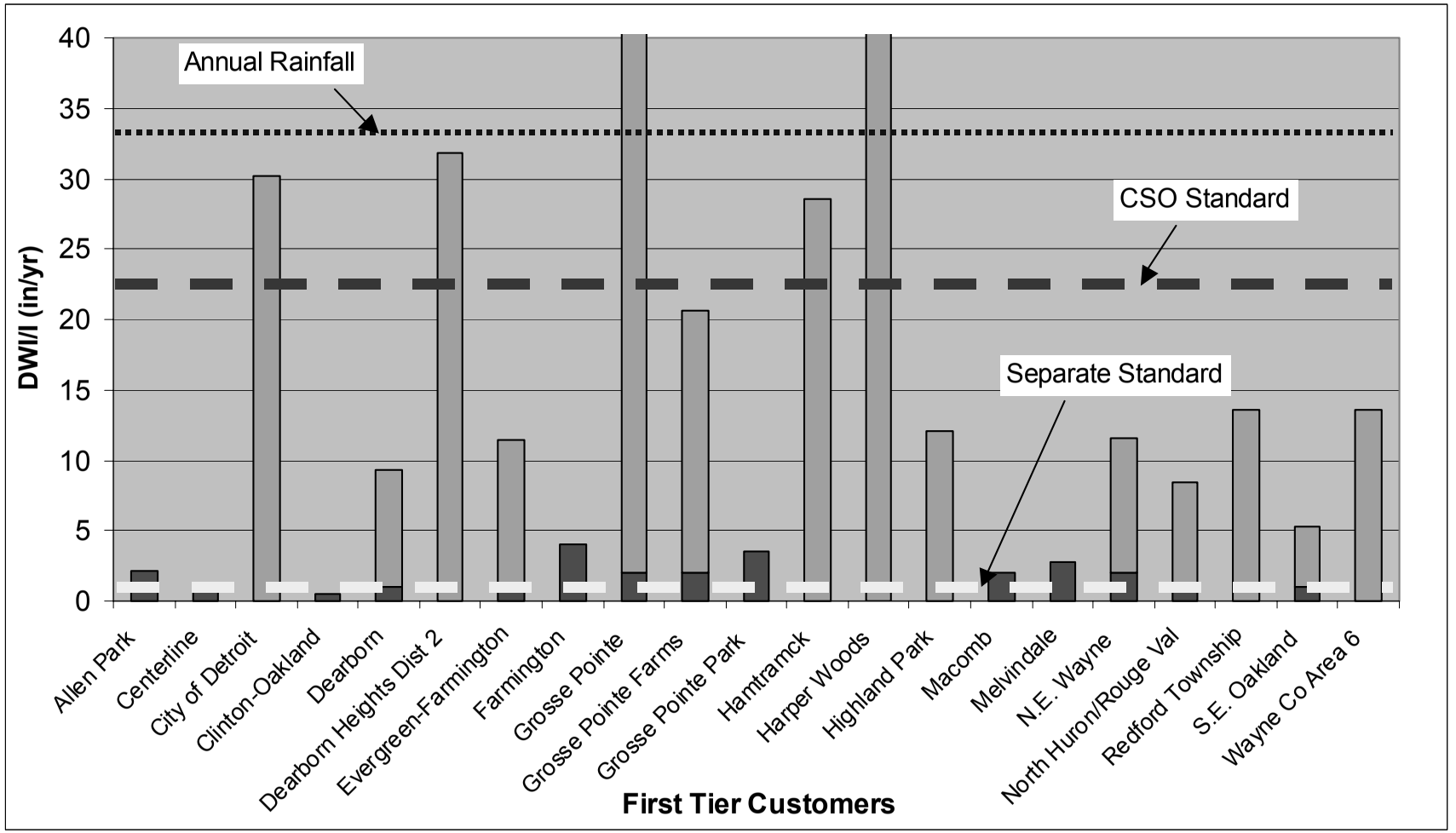

Figure 2 – System Standard Approach

3.2 Description of Selected Approach

For the purpose of Flow Management in the DWSD collection system, it is recommended that Approach 3, the System Standard Approach be taken. This approach recognizes that there are differences in the acceptable DWI/I depending on whether the community is served by separate or combined sewers. Since different standards are applied to these different types of communities, there is recognition for those that have already invested in reducing the amount of DWI/I in their collection systems.

3.3 Recommended Reductions

The recommended reductions in terms of flows are provided in the final set of columns in Table 2. This table shows the reduction in terms of MGD of DWI/I that would be expected. In cases where First Tier Customers have both separate and combined systems, the amount of DWI/I reduction by system type is shown. The final column shows the percentage of the overall 50 MGD DWI/I reduction goal that each community has responsibility for.