Detroit Water and Sewerage Department

Wastewater Master Plan

DWSD Project No. CS-1314

Expanded Treatment Facilities within the City of Detroit

Technical Memorandum
Original Date: August 9, 2001
Revision Date: May 31, 2003
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Expanded Treatment Facilities within the City of Detroit

One of the alternatives being examined as part of the 50-year Wastewater Master Plan for the Detroit Water and Sewerage Department (DWSD) is the possibility of expanding treatment capacity within the City of Detroit. This alternative explores the option of expanding the current DWSD Wastewater Treatment Plant (WWTP) located at 9300 West Jefferson Avenue in Detroit and the option of constructing a new WWTP within the City of Detroit.

The estimates of wastewater flows presented in this technical memorandum were developed in 2002 and were based on 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.

1. Expanded Central Treatment

An option to handle the anticipated increases in dry-weather flow is to expand the firm capacity of the current DWSD WWTP located on West Jefferson. This evaluation is based in part on the Review of Detroit Wastewater Treatment Plant technical memorandum.

1.1 Current Dry-Weather System Capacity

The CH2M Hill report included estimates of the current installed/rated and firm capacities of the various parts of the wastewater treatment system. These estimates were determined prior to the implementation of ongoing improvements and capacity expansions being performed under the PC-744 project that is discussed in Section 2.3. The estimates of the current installed/rated and firm capacities from the above-referenced technical memorandum are summarized below.

1.1.1 Raw Wastewater Pumping

Raw wastewater entering the DWSD facility goes through one of two pumping stations. The normal dry weather well elevation is 76 feet. Based on that elevation, Pump Station 1 includes eight pumps with a total rated capacity of 1,124 mgd (953 mgd firm capacity, where firm capacity assumes the largest unit is out of service). Pump Station 2 includes seven pumps with a total rated capacity of 581 mgd (498 mgd firm capacity). The total installed dry-weather rated capacity is therefore 1,705 mgd, 1,451 mgd firm capacity. Allowing 100 mgd of in-plant recycle flow, the net firm capacity for raw wastewater pumping is 1,351 mgd.

1.1.2 Primary Clarification

Water from the two pump stations passes through bar screens, grit chambers, and ferric chloride addition to the primary clarifiers. There are twelve rectangular clarifiers. Each clarifier is rated for 90 mgd. There are also four circular clarifiers,

each rated for 180 mgd. The total installed capacity is thus 1,800 mgd. Taking one of the 180 mgd clarifiers out of service, plus allowing 100 mgd for in-plant recycle flows, leaves a net firm capacity of 1,520 mgd.

1.1.3 Intermediate Lift Pumps

Following the primary clarifiers, the water passes to the secondary treatment system, via two intermediate lift stations (ILS). Station One transfers water to aeration decks 1 and 2. The station has two pumps, each officially rated for 300 mgd, but practically limited to 260 mgd due to hydraulic considerations at the downstream aeration deck. Station Two has three pumps, with each rated for 350 mgd. Two of the pumps transfer water to aeration decks 3 and 4, while the other can send water to decks 2, 3, and 4. This gives a total practical rated capacity of 1,570 mgd. Allowing for one of the 260 mgd and one of the 350 mgd pumps being out of service, and allowing 100 mgd for in-plant recycle flows, leaves a net firm capacity of 860 mgd.

1.1.4 Aeration Decks

There are presently four aeration decks, one conventional deck using air and three using high-purity oxygen. The air deck (deck 1) has a capacity of 150 mgd. Each pure oxygen deck (decks 2, 3, and 4) has a capacity of 350 mgd, resulting in a total installed capacity of 1,200 mgd. Assuming the 150 mgd aeration deck is out of service, and allowing 100 mgd for in-plant recycle flows, leaves a net firm capacity of 950 mgd.

1.1.5 Secondary Clarifiers

Water from the aeration decks is transferred to one of 25 circular clarifiers, each with a design capacity of 40.4 mgd for a total rated capacity of 1,010 mgd. Because of the unusually large number of clarifiers, the estimate for firm capacity assumed two clarifiers out of service. Also allowing for 100 mgd of in-plant recycle flow, the net firm capacity of the secondary clarifiers is 830 mgd.

1.1.6 Summary of Current Capacity

The current treatment capacity of the DWSD facility is summarized in the table below. It can be seen in Table 1 that the overall treatment capacity is limited by the secondary clarifiers, as the firm dry weather treatment capacity is 830 mgd, after 100 mgd of in-plant recycle flow is allowed.

Table 1. June 2002 Dry Weather Unit Operation Capacities

Unit	Current Installed Capacity mgd	Recycle Allowance mgd	Backup/Down Allowance mgd	Current Net Firm Capacity mgd
Raw WW pumping	1,705	100	254	1,351
Primary Clarifiers	1,800	100	180	1,520
Intermediate Lift Pumps	1,570	100	610	860
Aeration Decks	1,200	100	150	950
Secondary Clarifiers	1,010	100	80.8	830

1.2 Current Wet-Weather Capacity

The wet-weather capacity matches the dry-weather capacity, except for the raw wastewater pumping stations. As the typical elevation in the incoming wet well under wet weather conditions is 85 feet, the rated capacity of the pumps is increased compared to the dry weather capacity. Based on that elevation, the rated wet weather capacity of the eight Pump Station 1 pumps is 1,330 mgd (1,129 mgd firm). The rated wet weather capacity of the seven Pump Station 2 pumps is 623 mgd (534 mgd firm). The total wet weather rating of the raw pumping stations is 1,953 mgd (1,663 mgd firm). Assuming 100 mgd of in-plant recycle flow to the head of the plant, the net wet weather capacity is 1,563 mgd.

During wet weather operations, all flow up to the raw limit (approximately 1.5 billion gallons per day) is treated in the primary clarifiers; then, all flow in excess of the secondary treatment capacity (930 mgd if recycles are held elsewhere) is chlorinated and blended with secondary treatment effluent for final discharge.

The capacities under wet weather conditions are summarized in Table 2.

Table 2. June 2002 Wet Weather Unit Operation Capacities

Unit	Current Installed Capacity (mgd)	Recycle Allowance (mgd)	Backup/Down Allowance (mgd)	Current Net Firm Capacity (mgd)
Raw WW pumping	1,953	100	290	1,563
Primary Clarifiers	1,800	100	180	1,520
Intermediate Lift Pumps	1,570	100	610	860
Aeration Decks	1,200	100	150	950
Secondary Clarifiers	1,010	100	80.8	**830**

1.3 Post PC-744 Capacities

In 2001, DWSD implemented contract PC-744 WWTP Rehabilitation and Upgrade Program. In this program, selected pieces of equipment in the facility will be upgraded with the goal of ensuring future compliance with applicable regulations. Two contracts covering activities related to PC-744 are PC-740, in which the raw wastewater pump station and primary clarifiers are being upgraded, and CS-1289/PC-751, in which the intermediate lift stations and aeration decks are being upgraded. The contracts all call for analysis and upgrade to be applied as appropriate to the raw wastewater pumping, primary clarifiers, intermediate pumping, aeration decks, secondary clarifiers, chlorination, and the outfall. The result will generally be increases in the firm capacity of the various parts of the plant. The proposed and planned upgrades are described below.

1.3.1 Raw Wastewater Pumping

Under PC-744/740, an eighth pump is scheduled for addition to Pump Station 2. With that, the total firm wet weather capacity will be 1,752 mgd. This contract also includes a provisionary allowance for upgrades to the existing raw wastewater pumps. This pump upgrading work should result in a capacity in excess of 1,800 mgd. Allowing 100 mgd of in-plant recycle flow, the net raw wet weather capacity will be at least 1,700 mgd.

1.3.2 Primary Clarifiers

Under PC-744/740, two new clarifiers each rated at 180 mgd are to be installed. Added to the currently installed 1,800 mgd capacity, the new installed capacity will be 2,160 mgd. Allowing for one 180 mgd circular and two 90 mgd rectangular clarifiers to be out of service, and allowing 100 mgd of in-plant recycle flow, the new net firm primary capacity will be 1,700 mgd.

1.3.3 Intermediate Lift Stations

Under PC-751, the two 260 mgd pumps in Lift Station 1 will be replaced with 365 mgd pumps. This will bring the total installed capacity to 1,780 mgd. Allowing one of the 365 mgd pumps and one of the 350 mgd pumps in Lift Station 2 to be out of service, and allowing for 100 mgd of in-plant recycle flow, results in a net firm capacity of 950 mgd.

1.3.4 Aeration Decks

Under contract DWP-1005, the air-based aeration deck will be converted to pure oxygen. This will bring the deck up to 350 mgd capacity. Following that improvement, the total installed capacity will be 1,400 mgd for the aeration decks. After allowing for one deck to be out of service and allowing for 100 mgd of in-plant recycle flow, the net firm capacity will be 950 mgd.

1.3.5 Secondary Clarifiers

There are no plans to install improvements for the secondary clarifiers. Thus, the firm net secondary clarifier capacity will remain at 830 mgd.

The capacity of the various operations following implementation of the planned improvements is summarized in Table 3.

Table 3. Expected Capacity of DWSD Operations Following Upgrades

	Post PC-744 Installed (mgd)	Recycle Allowance (mgd)	Backup/ Down Allowance (mgd)	Net Post PC-744 Firm Capacity (mgd)
Raw WW pumping (Wet Weather)	2,042	100	290	1,700*
Primary Clarifier	2,160	100	360	1,700
Intermediate Lift Pump	1,780	100	730	950
Aeration Decks	1,400	100	350	950
Secondary Clarifiers	1,010	100	80.8	**830**

After pump upgrades are completed the raw wastewater net pumping capacity should be at least 1,700 mgd; however, the exact post-PC744 capacity is not known.

1.4 Conclusions

The overall capacity of the wastewater treatment plant is set by the capacity of the most limited unit operation. As shown above, that unit operation includes the secondary clarifiers, with a firm capacity of 830 mgd, i.e., 930 mgd less 100 mgd recycle. That limitation cannot readily be increased due to the following considerations:

- The firm capacity is based on the assumption that only 2 of 25 clarifiers are out of service; based on experience, that assumption is not particularly conservative.
- The clarifiers are currently operating above the suggested 10 State Standards for surface loading rate. Each clarifier has a surface area of 31,416 square feet. The suggested design peak overflow rate is 1000-1200 gal/d-ft2, which would yield flows per clarifier of 31 to 38 mgd, compared to the current rated flow of 40.4 mgd/clarifier. Plant stress tests have demonstrated that that flow produces acceptable effluent, but higher flows could result in the plant not meeting discharge criteria.
- The assumption of 100 mgd of in-plant recycle flow (which reduces the net available treatment capacity), at 10% of the total plant flow, is reasonably conservative, and provides the plant operators with some flexibility.

While it would be logical to suggest increasing the number of secondary clarifiers, such an increase is not practical given the footprint of the facility. There is no space available for additional clarifiers.

The conclusion of this analysis is that the overall capacity of the plant is 830 mgd of raw flow can receive secondary treatment. This capacity cannot be increased without expanding to adjacent properties or significantly increasing the complexity of operations. After process upgrades, the primary system will be able to handle up to 1,700 mgd of raw flow, with flow exceeding 830 mgd being chlorinated and discharged.

2. Construction of a New Plant Within the City of Detroit

One of the options being examined as part of the 50-year Wastewater Master Plan for the Detroit Water and Sewerage Department (DWSD) is the possibility of building a new wastewater treatment plant within the City of Detroit. The Detroit River was the watershed considered to accept the discharge from a new wastewater plant with the City of Detroit. Information regarding the details of the design criteria and costing for the treatment plants sizes discussed in this report can be found in the 'Technical Feasibility of Satellite Treatment' Technical Memorandum.

2.1 Site Selection Criteria

The potential sites within the City of Detroit were screened using the following engineering and environmental constraints that would affect the construction or operation of a wastewater treatment plant:

- Only sites that were identified as Agricultural\Rural Residential, Commercial, Industrial, or Other by the GIS were selected for further investigation.
- Sites that were not within two miles of the current DWSD interceptors in the City of Detroit were eliminated.
- Sites where the nearby interceptor could not provide an estimated 2050 average flow greater than 20 MGD were eliminated.
- Sites that were not within one mile of the Detroit River were eliminated.
- Sites had to be of sufficient area to accommodate the proposed facility and an appropriate buffer. For this study, the minimum area considered was 50 acres.
- The elevation of the sites should allow efficient conveyance of sewage to the plant and conveyance of treated effluent to the receiving water.
- Sites should have adequate vehicle access to and from major roadways.
- Sites should not have steep slopes.
- Sites should not be long and narrow in shape.
- Sites should not be in the vicinity of state parks, active airport operations, transmission towers, cemeteries, and conservation areas.

The site at Conner Creek was chosen since it met the above criteria. The current and projected 20-year land use of the site is 'commercial'. An area designated 'medium/high density residential housing' surrounds the site (see Figure 1). The site is located near the Conner, Freud, and Fairview Pump Stations of the current DWSD interceptor system. These pump stations could provide flow to the potential WWTP. The Conner Creek site is located northwest of the site where the Conner Creek combined sewer overflow (CSO) basin is being constructed.

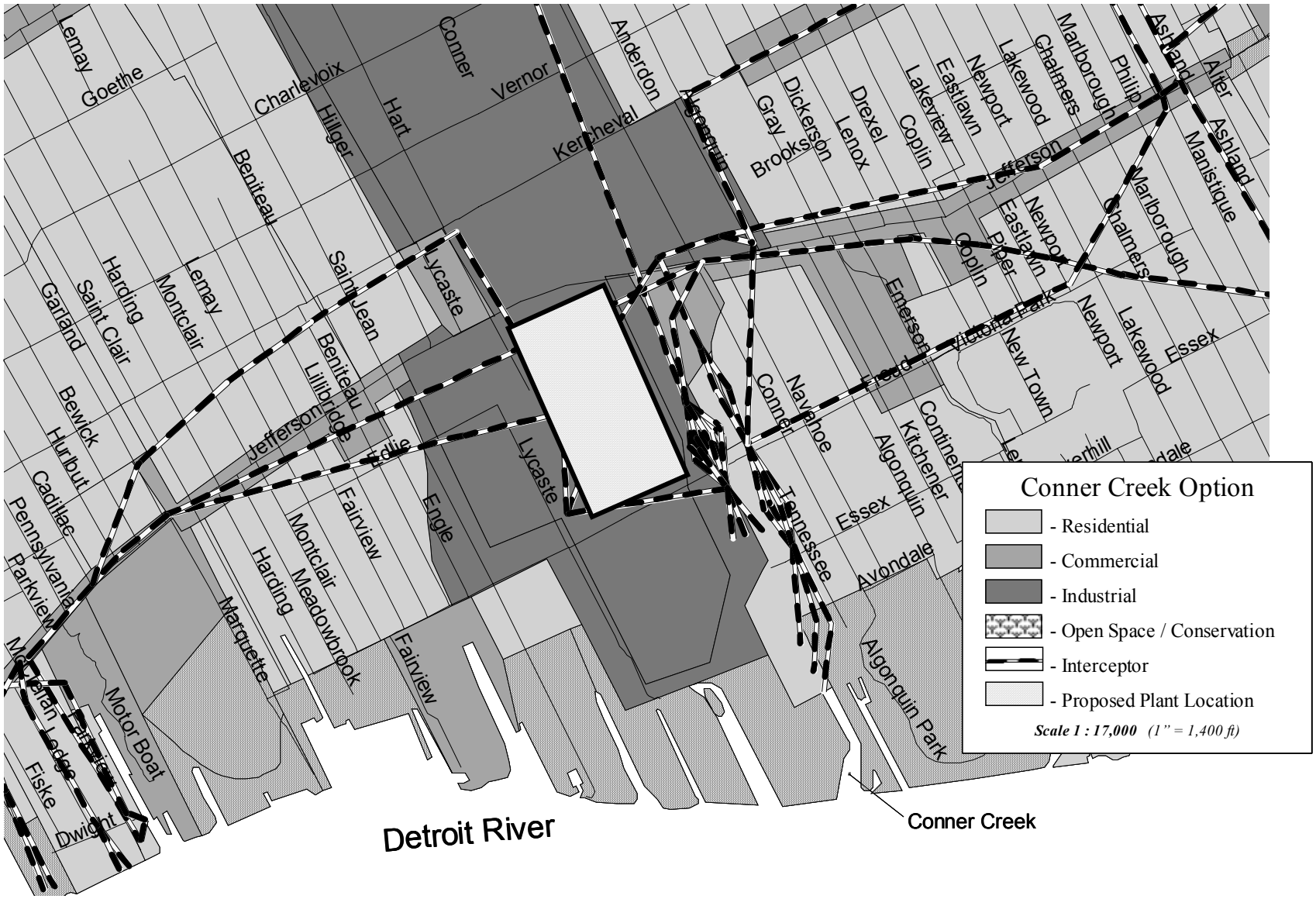

Figure 1. Surrounding Land Use and Location of Conner Creek Site

2.2 New Wastewater Treatment Plant at Conner Creek

The discharge limits from the Conner Creek WWTP are expected to be equivalent to secondary treatment standards. Secondary limits could be granted if the plant discharged to the Detroit River, which is approximately 4,500 ft. from the proposed site. Approximately 50 acres are available for a new wastewater treatment plant. Table 4 shows the two plant flows that were considered for the Conner Creek location.

Table 4. New Wastewater Treatment Plant Capacity Options

Option	Average Plant Capacity (mgd)	Maximum Plant Capacity (mgd)
1	100	175
2	125	200

Table 5 shows the ratios of maximum daily to average daily flow used for the two new wastewater treatment plant options:

Table 5. Peaking Factors

Option	Maximum Daily Flow / Average Daily Flow
1	1.75
2	1.60

The same ratios were used to calculate the peak hourly flow. The system would be designed such that flow in the interceptor exceeding the maximum design flow would travel past the new plant and be treated at the existing DWSD Wastewater Treatment Plant.

Based on information contained in the DWSD Long Term CSO report, a maximum average daily flow of 125 mgd was calculated by the Greater Detroit Regional Sewer System (GDRSS) model at the Fairview Pump Station. The Fairview Pump Station is downstream of the Conner Creek site and provides a good estimate for the dry weather flows to be expected in the Conner Creek area. The maximum flow of 200 mgd was estimated based on diurnal fluctuations associated with the daily flows and the projected population growth. Additional capacity could also provide for flow diversion within the collection system to route additional dry weather flow to this site.

2.2.1 Influent

The influent concentration to the new plant was assumed to be similar to the current wastewater quality received at the DWSD Wastewater Treatment Plant.

Table 6 shows the influent design concentrations used.

Table 6. Design Influent Concentrations

Parameter	Concentration	Unit
BOD5 (Five Day Biochemical Oxygen Demand)	92	mg/L
TSS (Total Suspended Solids)	141	mg/L
Ammonia Nitrogen	n/a	mg/L
Total Phosphorus	3.1	mg/L

2.2.2 Treatment Process

Treatment at the new plant would consist of screening, grit removal, primary settling, conventional activated sludge, final settling, and ultraviolet disinfection. Solids would be treated, dewatered, and disposed of in a landfill. All treatment processes were designed to conform to Ten States Standards. Figure 2 shows a process layout for this site.

Table 7 details the approximate sizes for the major treatment processes for the three options including an equalization basin.

Table 7. New Wastewater Treatment Plant Process Sizes

Treatment Process	Option 1 100 mgd	Option 2 125 mgd
Primary Treatment		
Screening	Two – 18 ft. wide	Two – 20 ft. wide
Grit Removal	66 ft. x 66 ft. x 15 ft. deep	71 ft. x 71 ft. x 15 ft. deep
Primary Settling	14 – 100 ft. diameter tanks	14 – 110 ft. diameter tanks
Secondary Treatment		
Aeration	14 – 50 ft. x 150 ft. x 15 ft. swd	14 – 55 ft. x 165 ft. x 15 ft. swd
Secondary Settling	14 – 116 ft. diameter tanks	14 – 124 ft. diameter tanks
Disinfection		
UV Disinfection	130 ft. x 60 ft.	130 ft. x 60 ft.
Solids Treatment		
Centrifuge Feed Tanks	4 cells – 73 ft. x 73 ft. x 10 ft. each	4 cells – 80 ft. x 80 ft. x 10 ft. each
Sludge Dewatering / Storage Basins	4 cells – 49 ft. x 49 ft. x 10 ft. each	4 cells –54 ft. x 54 ft. x 10 ft. each

2.2.3 Discharge Limits and Effluent Quality

Table 8 shows what the expected discharge quality from the expanded plant would be.

Table 8. Expected Effluent Quality

	Effluent Concentration (mg/L)	Expected NPDES Limits Monthly/Daily (mg/L)
CBOD5 (Five Day Carbonaceous Biochemical Oxygen Demand)	<20	25/40
TSS (Total Suspended Solids)	<25	30/45
Ammonia Nitrogen	n/a	n/a
Total Phosphorus	<1	1/--

2.2.4 NPDES Permit for a Potential Conner Creek WWTP

The potential Conner Creek WWTP would be discharging at a point where there is no current WWTP discharge; therefore, a NPDES permit application would need to be filed with the MDEQ. The NPDES permit application would need to be filed irrespective of whether the site would be considered a new permitted point of discharge or another discharge point to be added to the current DWSD NPDES permit. An antidegradation statement would need to be filed with the NPDES permit application to identify the social or economic development and the benefits to the community/industry that would be foregone if the new or increased loading of pollutants were not allowed.

Once the application is received, MDEQ staff will make preliminary determinations on the application, including a proposal to issue or deny the discharge described in the application.

If conditions are satisfactory to continue with permit application processing, MDEQ will:

- Propose water quality based effluent limitations.
- Propose a schedule of compliance for meeting the proposed effluent limitations (if applicable).
- Any other restrictions deemed necessary by the MDEQ.

MDEQ will then place the proposed permit and associated limitations on public notice. The public notice will include:

- A description of the activities generating the proposed discharge.
- The name of the waterway the discharge is proposed to enter.

- A statement of MDEQ's tentative determination to issue or deny the proposed permit application.

Since the discharge from the potential Conner Creek WWTP would be greater than 500,000 gallons per day, MDEQ is required to prepare a fact sheet. The fact sheet contains:

- A sketch of the proposed discharge location.
- A quantitative description of the proposed discharge including average daily flow and average discharge (pounds/day) of any pollutants subject to limitation by MDEQ.
- A description of the water quality standards.
- Effluent limitations.
- Mixing zone description.
- Uses for which the receiving water has been classified.

The permit application will remain on public notice for thirty days. During this time, any interested parties may submit views regarding the application and/or MDEQ's tentative determination. At some time following the thirty-day comment period, MDEQ may then issue a NPDES permit, valid for up to a five-year period.

The MDEQ has divided the State of Michigan into watersheds. All of the discharges within a watershed are required to renew their permits at the same time. Therefore, the initial permit may be required to be renewed prior to five years.

2.2.5 Land Availability

The area proposed for the Conner Creek Wastewater Treatment Plant consists of 50 acres. The maximum average design flow that can be accommodated at the site is 125 mgd.

2.2.6 Conveyance System Description and Cost

The wastewater would be supplied to the planned Conner Creek wastewater treatment plant from the Conner Creek and Freud Street pump stations. These pump stations are located on or very close to the planned site. Therefore, no conveyance system would need to be established for the Conner Creek site.

2.2.7 Cost Summary

Table 9 summarizes the cost associated with the various new wastewater treatment plant site options.

Table 9. Wastewater Treatment Plant Discharging to Detroit River Cost Summary

Costs	Option 1 - 100 mgd	Option 2 - 125 mgd
Capital (Million $)	256.3	297.3
Annual O&M (Million $)	27.5	33.4
Conveyance (Million $)	0	0
Capital and Conveyance Cost per gallon ($/gal.)	2.56	2.38

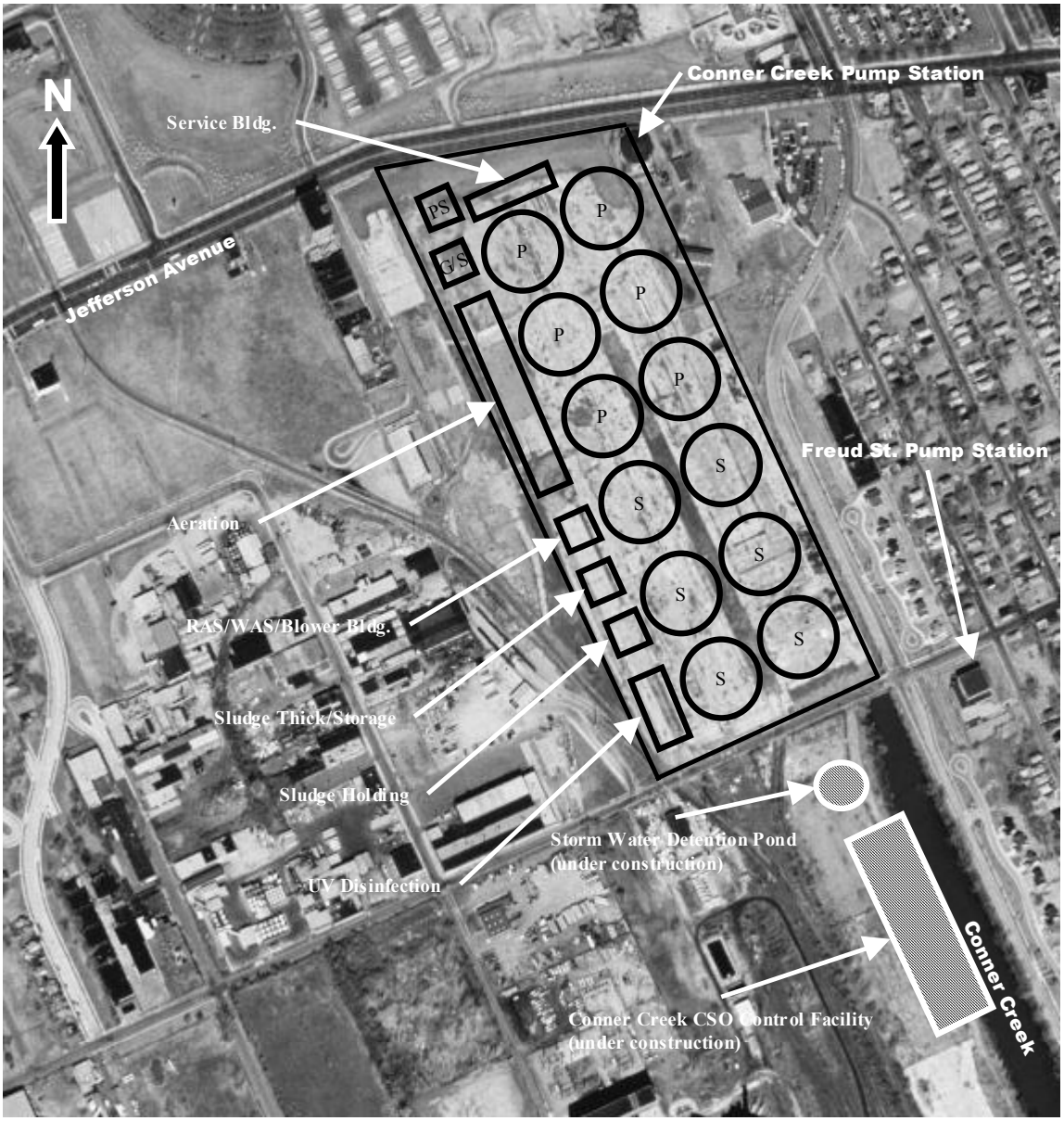

Figure 2. Generic Layout for new wastewater treatment plant within the City of Detroit discharging to the Detroit River

Appendix A and Appendix B

Sizing Based on Ten State Standards and Reliability Criteria

Assumptions:	Average Flow	125	mgd
	Peaking Factor (Peak Hourly)	1.6	
	Maximum Day Peaking Factor	1.6	
	Influent BOD	92	mg/L
	Influent TSS	141	mg/L
	Influent Ammonia-N	n/a	mg/L
	Influent Total P	3.1	mg/L
	Effluent BOD	25	mg/L
	Effluent TSS	30	mg/L
	Effluent Ammonia-N	n/a	mg/L
	Effluent Total P	1	mg/L
	Reliability Class (1,2,3)	1	
	Most facilities are Class 1		
	Peak Hourly Flow at Headworks	200	mgd
	Peak Hourly Flow Rest of Plant	200	
	Maximum Day Flow	200	mgd
	Peak Hourly Flow to be Equalized	200	mgd

Calculations:

Preliminary Treatment

Coarse Bar Screen

Approach velocity greater than 1.25 ft/sec, less than 3 ft/sec at average flow

Selected approach velocity	2	ft/sec		
Selected angle from horizontal	30	degrees		
Channel Area	96.7	sf		
Channel Length and Width	10	ft, if square		
Bar Screen Dimensions	20	ft by	10	ft

Reliability Criteria Class I requires that one backup unit be provided

Raw Sewage Pumping Station

Minimum of 2 pumps capable of pumping peak hourly flow

Number of Pumps	2	minimum
Size of Pumps	200	mgd each

Grit Chamber

Detention time of 3 to 5 minutes at peak hourly flow
Air rate of 3 to 8 cfm/ft of tank length

Number of units (exclude bypass)	1	
Selected detention time	4	minutes
Selected air rate	5	cfm/ft
Selected depth	15	ft
Volume	555,556	gal
Rounded volume	555,600	gal
Volume	74,267	cf
Rounded volume	75,000	cf
Length and width	70.7	ft, if square
Rounded legth and width	71	ft, if square
Air rate	355	cfm

Retention Basin

No retention basin needed.
Flow that exceeds the peak hourly flow will be treated at the existing DWSD WWTP.

Primary Clarifiers

Minimum depth is 10 ft. SWD

Surface Overflow Rates	Design Ave. Flow		Design Peak Hourly Flow
No WAS	1000	gpd/sf	1500 to 3000 gpd/sf
Accepts WAS			1200 gpd/sf

Tank receives WAS?	n	(y or n)			
Selected Design Peak Hourly Flow	2,000	gpd/sf			
Waste Activated Sludge	0	mgd			
Recycle Streams	6.00	mgd	at	250	mg/L (Est. BOD)
Diameter	110			800	mg/L (Est. TSS)

Surface area	131,000	sf at design average flow
	103,000	sf at peak hourly flow
Controlling surface area	131,000	sf
Round surface area	131,000	sf
Number of clarifiers	13.78	
Rounded number of clarifiers	14	

Reliability criteria

With largest unit out of service, should be able to treat 50 percent of the total design flow

Capable flow treatment	247.1	mgd
50% of design flow	103	mgd
	OK	

Secondary Treatment

Conventional Activated Sludge

Aeration Tank Organic Loading	40	lb./day/1000 cf
Freeboard Requirements: 18 in. for diffusers		
3 ft. for surface aerators		

Assumed BOD percent removal in primary clar.	30	percent
WAS BOD Concentration	3000	mg/L
Side Water Depth	15	ft
Number of Basins	14	
Length to width ratio	3	

BOD Loading to Aeration Basins	75,867	lb./day
Rounded	75,900	lb./day
Total Volume of Basins	1,897,500	cf
Rounded	1,900,000	cf
Area	126,667	sf
Length	164.8	
Rounded	165	ft each
Width	54.9	
Rounded	55	ft each

Aeration

lb. O2/hp hr	2	

Oxygen requirements	174,202	lb. oxygen at peak hour conditions
Horsepower	3,629	hp
Rounded	3,630	hp

Reliability criteria will be met as long as there are a minimum of 2 equally sized basins

RAS Pumps

RAS pumps must be able to pump between 0.15 and 1.0 times the design average flow

0.15 * Qave	18.8	mgd
1.0 * Qave	125.0	mgd

Minimum of one backup pump required

WAS Pumps

Minimum of 25 percent of average flow

0.25 * Qave	31.3	mgd

Minimum of one backup pump required

Secondary Clarifiers

Overflow rate at Design Peak Hourly Flow	1,200	gpd/sf
Peak Solids Loading Rate	50	lb./day/sf
Minimum side water depth is 12 ft		
Assumed MLSS	3,000	mg/L
Number of clarifiers	14	
Surface area	166,667	sf, based on surface overflow rate
	162,572	sf, based on solids loading rate
Controlling	166,667	sf
Rounded	166,700	sf
Diameter	123.1	ft
Rounded	124	ft
Reliability Criteria		
Treatable Flow	188.4	mgd
75% of design flow	150.0	mgd
	OK	

Tertiary Filters

Not needed. Only meeting secondary treatment standards.

Chlorine Disinfection

Requires 15 minutes of detention time at peak hourly flow
One backup unit required

Assumed depth	10	ft.
Number of tanks	6	
Volume required	2,083,333	gal.
	278,502	cf
Rounded	278,600	cf
Surface area	27,860	sf, total

Need to provide 15 minutes storage with one unit out of service

Require 6 units with area of	5,572	sf each
If square	74.6	
Rounded	75	ft

Ultraviolet Disinfection

Peak Flow	200	mgd
Transmittance	65	percent
Dose	32,500	uW-sec/cm2

Outfall

Discharge directly to Detroit River
Assume minimum necessary slope

Length of Pipe	4500	ft
Diameter of Pipe	?	in.

Sludge Handling

Primary and Secondary Sludge Handled Separately
Primary Sludge

Assumed solids removal	60	percent
Assumed percent solids	4	percent
Mass Solids for Primary Sludge	112,174	lb./day
Flow for Primary Sludge	336,375	gpd

Secondary Sludge

Chemical Sludge

Assumed Iron Dose Dose:	3	mg Fe/mg P
Assumed Non-Chemical P Removal	0.01	lb./ P removed per lb. BOD removed

Assumed 2 lb. FSS produced for each lb. Iron removed

P removed prior to chemical	759	lb./day
	0.7	mg/L
Iron needed to remove 2.35 mg/L P	7,416	lb. Fe/day
Solids Produced	14,832	lb./day solids
Rounded	14,840	lb./day solids

Waste Activated Sludge

Assumed 1 lb. WAS produced per lb. BOD removed

Assume WAS is	0.8	percent solids
Mass Solids from WAS	75,867	lb./day
Total Secondary Sludge	90,707	lb./day
	1,360,002	gpd

Gravity Belt Thickener Storage

Only secondary sludge undergoes gravity belt thickener storage

Number of Gravity Feed Storage Days	2	days
Storage Volume	2,720,004	gallons
	363,613	cf
Rounded	363,700	cf

Centrifuge

Both primary and secondary sludge are centrifuged

Number of Centrifuge Storage Days	4	days			
Gravity Belt Thickened Solids	8	percent			
Days of Centrifuge Operation	5	days/week			
Hours of Operation per Day	8	hrs/day			
Primary Sludge Flow to Centrifuge	336,375	gpd at	4	percent solids	
Secondary Sludge Flow to Centrifuge	136,000	gpd at	8	percent solids	
Total Flow to Centrifuge	472,375	gpd			
Rounded	472,400	gpd			
Centrifuge Storage	1,889,600	gallons			
	252,603	cf			
Rounded	252,700	cf			6317.5
					79.4827
Centrifuge Size	1,378	gpm			
Rounded	1,380	gpm			

Landfill Storage

Assumed	7	days			
Centrifuged Sludge	20	percent			
Flow to Storage Tank	121,675	gpd			
Rounded	121,700	gpd			
Storage Volume	851,726	gallons			
	113,859	cf			
Rounded	113,900	cf			2847.5
					53.36197

New WWTP at Connor Creek Option 1 – 100 MGD

Cost Summary

Layout Name	Project ($)	Oper. ($/yr)	Maint. ($/yr)	Mat. ($/yr)	Chem. ($/yr)	Energy ($/yr)	Amort. ($/yr)
Connor Creek Option 1	$287,000,000	$5,680,000	$1,820,000	$15,800,000	$1,250,000	$2,960,000	$7,780,000

Process Summary

Process	Construction ($)	Oper. ($/yr)	Maint. ($/yr)	Mat. ($/yr)	Chem. ($/yr)	Energy ($/yr)	Amort. ($/yr)
Influent Pump Station	$7,030,000	$280,000	$191,000	$49,200	$0	$96,200	$616,000
Preliminary Treatment	$2,570,000	$695,000	$257,000	$0	$0	$10,800	$216,000
Primary Clarification	$9,770,000	$210,000	$116,000	$97,700	$0	$2,630	$859,000
Intermediate Process Pumping	$4,580,000	$110,000	$84,700	$32,100	$0	$534,000	$0
Complete Mix Activated Sludge	$21,800,000	$446,000	$311,000	$224,000	$0	$1,740,000	$1,620,000
Iron Feed System	$205,000	$50,500	$0	$4,110	$0	$0	$17,200
Coagulation - Flocculation	$19,700,000	$728,000	$290,000	$197,000	$1,220,000	$68,400	$1,710,000
Secondary Clarifier	$13,700,000	$251,000	$139,000	$137,000	$0	$3,130	$1,190,000
Ultra-Violet Disinfection	$8,270,000	$0	$129,000	$82,700	$33,500	$313,000	$675,000
Post Aeration	$455,000	$52,800	$30,400	$4,900	$0	$38,800	$40,000
Blower System	$6,370,000	$0	$0	$0	$0	$0	$535,000
Gravity Thickening	$723,000	$72,100	$43,500	$7,230	$0	$1,060	$64,900
Centrifugation	$15,000,000	$1,410,000	$226,000	$768,000	$0	$150,000	$0
Hauling and Land Filling	$2,360,000	$285,000	$0	$14,200,000	$0	$0	$222,000
Other Direct Costs	$174,000,000	$0	$0	$0	$0	$0	$0

Design Output Data

Description	Value	Units
Administration Hours	12800	hrs/yr
Laboratory Labor Hours	8150	hrs/yr
Estimated Land for Construction Requirement	74.	acres
Estimate Administration Labor Cost	$642,000	$/yr
Estimated Laboratory Labor Cost	$448,000	$/yr
Mobilization	$3,270,000	$
Site Preparation	$3,290,000	$
Site Electrical	$8,960,000	$
Yard Piping	$21,300,000	$
Effluent Pumping	$2,000,000	$
Instrumentation and Control	$8,960,000	$
Lab and Administration Buildings	$6,000,000	$
non-Ocean Outfall	$0	$
Total Other Direct Costs	$58,300,000	$

Total Unit Process Construction Cost	$112,000,000	$
Profit	$0	$
Total Construction Costs (w/ Profit)	$171,000,000	$

Miscellaneous Costs	$17,100,000	$
Legal Costs	$0	$
Engineering Design Fee	$34,200,000	$
Inspection Costs	$0	$
Contingency	$34,200,000	$
Technical	$0	$
Total Indirect Costs	$85,400,000	$

Total Cost of Land	$0	$
Interest during Construction	$30,700,000	$

PROJECT SUMMARY

Total Annual Labor Costs	$7,490,000	$/yr
Total Annual O&M Costs	$27,500,000	$/yr
Total Annual Amortization Costs	$7,780,000	$/yr
Total Project Cost	$287,000,000	$

Conveyance Cost

There are no conveyance costs associated with this option.

New WWTP along Detroit River - Conner Creek - Option 2 – 125.0 MGD

Cost Summary

Layout Name	Project ($)	Oper. ($/yr)	Maint. ($/yr)	Mat. ($/yr)	Chem. ($/yr)	Energy ($/yr)	Amort. ($/yr)
Connor Creek Option 2	$333,000,000	$6,590,000	$2,090,000	$19,600,000	$1,560,000	$3,580,000	$8,950,000

Process Summary

Process	Construction ($)	Oper. ($/yr)	Maint. ($/yr)	Mat. ($/yr)	Chem. ($/yr)	Energy ($/yr)	Amort. ($/yr)
Influent Pump Station	$7,650,000	$344,000	$230,000	$53,600	$0	$100,000	$668,000
Preliminary Treatment	$2,800,000	$845,000	$308,000	$0	$0	$12,000	$235,000
Primary Clarification	$11,300,000	$236,000	$131,000	$113,000	$0	$2,940	$995,000
Intermediate Process Pumping	$5,340,000	$138,000	$104,000	$37,400	$0	$667,000	$0
Complete Mix Activated Sludge	$25,300,000	$508,000	$361,000	$246,000	$0	$2,130,000	$1,860,000
Iron Feed System	$225,000	$57,100	$0	$4,510	$0	$0	$18,900
Coagulation - Flocculation	$24,100,000	$728,000	$294,000	$241,000	$1,520,000	$85,500	$2,090,000
Secondary Clarifier	$15,200,000	$272,000	$152,000	$152,000	$0	$3,380	$1,330,000
Ultra-Violet Disinfection	$8,620,000	$0	$145,000	$86,200	$37,300	$348,000	$719,000
Post Aeration	$554,000	$54,800	$32,900	$5,640	$0	$48,500	$48,900
Blower System	$7,670,000	$0	$0	$0	$0	$0	$643,000
Gravity Thickening	$845,000	$85,600	$50,700	$8,450	$0	$1,140	$75,700
Centrifugation	$17,900,000	$1,710,000	$277,000	$961,000	$0	$185,000	$0
Hauling and Land Filling	$2,950,000	$356,000	$0	$17,700,000	$0	$0	$279,000
Other Direct Costs	$202,000,000	$0	$0	$0	$0	$0	$0

Design Output Data

Description	Value	Units
Administration Hours	15300	hrs/yr
Laboratory Labor Hours	9000	hrs/yr
Estimated Land for Construction Requirement	87.	acres
Estimate Administration Labor Cost	$764,000	$/yr
Estimated Laboratory Labor Cost	$495,000	$/yr
Mobilization	$3,810,000	$
Site Preparation	$3,740,000	$
Site Electrical	$10,500,000	$
Yard Piping	$24,900,000	$
Effluent Pumping	$2,000,000	$
Instrumentation and Control	$10,500,000	$
Lab and Administration Buildings	$6,830,000	$
non-Ocean Outfall	$0	$
Total Other Direct Costs	$67,700,000	$

Total Unit Process Construction Cost	$131,000,000	$
Profit	$0	$
Total Construction Costs (w/ Profit)	$198,000,000	$

Miscellaneous Costs	$19,800,000	$
Legal Costs	$0	$
Engineering Design Fee	$39,700,000	$
Inspection Costs	$0	$
Contingency	$39,700,000	$
Technical	$0	$
Total Indirect Costs	$99,100,000	$

Total Cost of Land	$0	$
Interest during Construction	$35,700,000	$

PROJECT SUMMARY

Total Annual Labor Costs	$8,680,000	$/yr
Total Annual O&M Costs	$33,400,000	$/yr
Total Annual Amortization Costs	$8,950,000	$/yr
Total Project Cost	$333,000,000	$

Conveyance Cost

There are no conveyance costs associated with this option.