Detroit Water and Sewerage Department

Wastewater Master Plan
Volume 2

Critical Facilities and Flow Management

CDM Camp Dresser & McKee

Draft — June 25 . 2003

Detroit Water and Sewerage Department

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Technical Memoranda*

The Following Technical Memoranda were used in the preparation of *Critical Facilities and Flow Management,* Volume 2 of the Detroit Water and Sewerage Department's Wastewater Master Plan.

- *Review of Large Treatment and Collection Systems*
- *Review of Detroit Wastewater Treatment Plant*
- *Interceptors and Trunk Sewers*
- *Lateral Sewers and Connector Sewers*
- *Wastewater Facility Inventory: Pump Stations and Meters*
- *Review of Collection System Regulators and Outfalls*
- *Onsite Sewage Disposal Systems in the City of Detroit*
- *Soil Suitability for Onsite Sewage Disposal Systems*
- *Industrial Waste Control Division, Ordinance 34-96*
- *Physical Inspection of Lateral and Connector Sewers*
- *Flow Management-Distribution of DWI/I Reductions*
- *Dry Weather Flow from Footing Drains and Service Connections*

*Technical Memoranda are available on the CD that accompanies this report

Executive Summary

General

This is Volume 2 of the Detroit Water and Sewerage Department (DWSD) Wastewater Master Plan. This report on *Critical Facilities and Flow Management* has two principal objectives:

- Identification of the critical facilities of the DWSD's regional wastewater system in the Planning Area and an assessment of their physical condition to handle expected flows to 2050. The Planning Area is shown in Figure 1.
- Evaluation of the feasibility of managing capacity and flows by using methods such as I/ I reduction, limits on wet weather flows, and operational protocols for handling wet weather flows.

Critical Facilities

The purpose of the analysis of the critical facilities in the DWSD system is to establish a baseline of information on the physical condition and the capacity of the system. This information was used to develop the capital improvement plan. Emerging practice in wastewater utilities is to perform an extensive assessment and inventory of physical assets. New environmental regulations (CMOM — capacity, maintenance, operations and management of sewer systems) and accounting standards (General Accounting Standards Bureau GASB—34) set forth requirements for developing inventories and assessing the condition and service life of wastewater facilities.

Critical facilities have been classified in eight groups for this Master Plan:

- Regional Transport and Treatment
- Major Transport
- Metering and Instrumentation
- Wholesale Customer Collection and Conveyance
- Wholesale Customer Wet Weather Control
- Detroit Collection and Conveyance
- Detroit CSO Control
- Facilities on Private Property

Regional Transport and Treatment

Regional transport and treatment facilities include the Wastewater Treatment Plant, Pump Station 1, Pump Station 2, the Detroit River Interceptor, the Oakwood Interceptor, the Northwest Interceptor, and the North Interceptor-East Arm. These facilities are called "common use" facilities under DWSD's sewer rate allocation. The Wastewater Master Plan project has assembled information on the condition and ongoing capital improvements to these facilities.

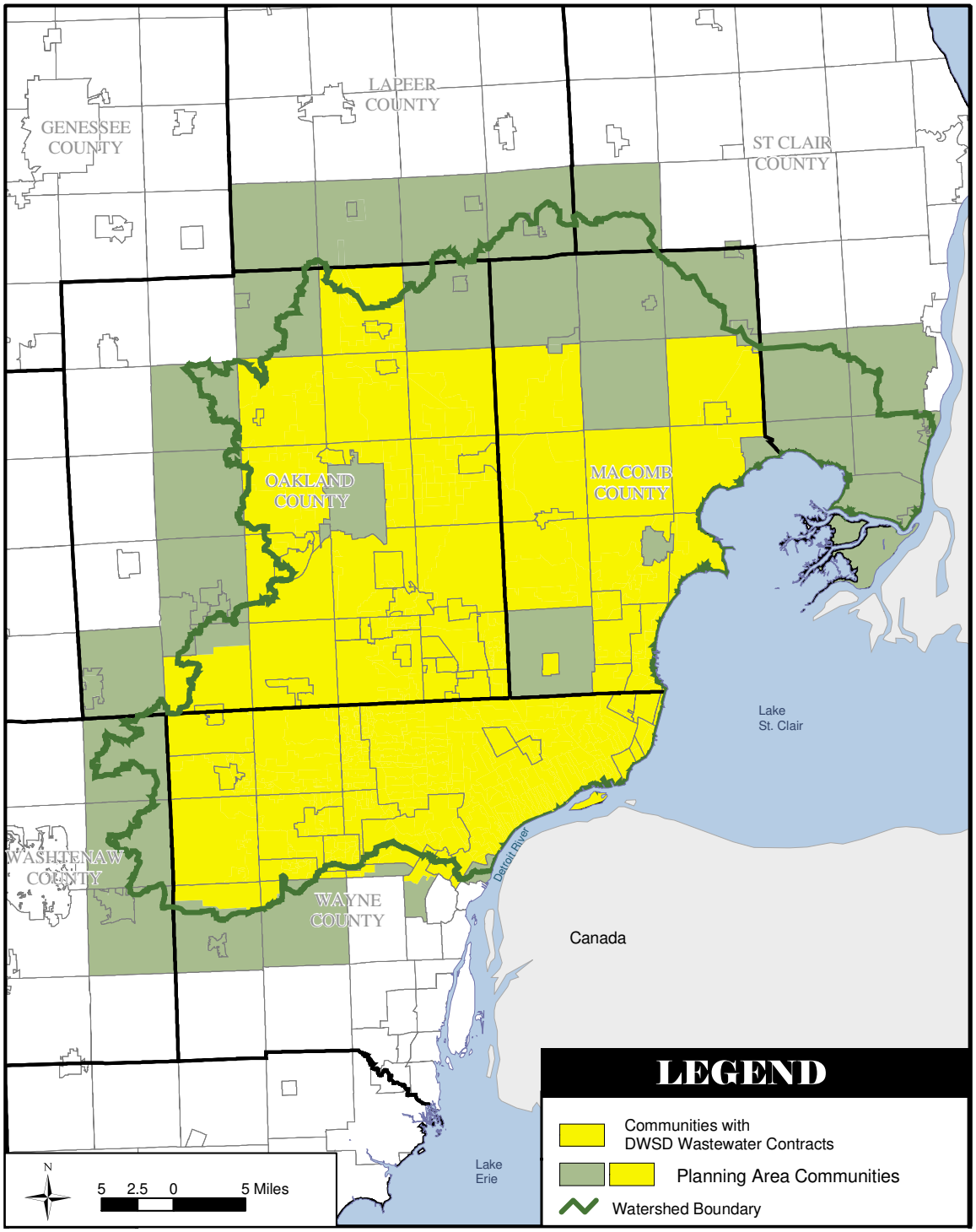
The Wastewater Treatment Plant is currently being upgraded to a permitted primary capacity of 1,700 mgd and a permitted secondary capacity of 930 mgd. The plant is the largest sewage treat-

Table 1: World's Largest Wastewater Facilities

Plant Location	Peak Hour Capacity* (MGD)
Detroit	1700
Montreal	1618
Paris/Acheres 1-4	1598
Chicago/Stickney	1440
Sau Paulo/Barueri	1438
Los Angeles/Hyperion WWTP	1100/1400
Hong Kong	913
Washington DC	900
Mexico City/lago de Texcoco	799
London/Beckton	730
Massachusetts/Deer Island	700
Beijing/Gaobeidian	695
Emscher/'Emscher Mouth'	684
Minn.-St. Paul/Metropolitan	650
Rio de Janeiro	639
Athens/Psyttalia Island	616
Chicago/Northside	450
Chicago/Calumet	430
Simmering, Vienna/Main	410
Tokyo/Morigasaki	406

*Plants outside the U.S. are sized in terms of peak hour flow. Plants within the U.S. are sized in terms of peak hour capacity.

Figure 1: DWSD Wastewater Planning Area



ment plant in the world in terms of capacity (Table 1). The permitted primary treatment capacity includes an allowance for 100 mgd of in-plant recycle flow. This recycle flow is conservative because recent flow monitoring has revealed an average recycle flow of 30-70 mgd. The secondary capacity for flow entering the plant is approximately 830 mgd if a similar allowance for 100 mgd of recycle flow .

The DWSD's Wastewater Treatment Plant has adequate capacity to meet existing permit requirements. However, major capital improvements of the plant, such as the one currently being implemented by PC-744 (WWTP Rehabilitation and Upgrade Program), are required to ensure its long term compliance with the NPDES permit. The current WWTP's NPDES permit took effect on October 1, 1997, and expired on October 1, 2002. Currently, the WWTP is permitted to treat up to 1,520 mgd raw wastewater (or 1,620 mgd total in-plant flow which includes the 100 mgd in-plant recycle flow), through primary treatment and 930 mgd through secondary treatment. Raw wastewater is the wastewater flow entering the treatment plant from the collection system minus treatment plant recycle flow. By January 1, 2004, the primary treatment capacity will increase to 1,700 mgd (raw, excluding the recycle flow).

There are four liquid treatment processes that will receive major upgrades under DWSD Project PC-744 to meet future permit requirements. The facilities are as follows:

- Raw wastewater pump stations
- Primary clarifiers
- Intermediate lift stations
- Aeration decks

The two raw wastewater pump stations (PS-1 and PS-2) have a combined firm capacity (assuming one or more of the largest units out of service, see report for detailed discussions on specific unit processes) of 1,663 mgd. This is sufficient for handling the current permitted wet weather primary treatment flow of 1,520 mgd (raw), but not the near-term permitted wet weather flow of 1,700 mgd (raw), until the completion of PC-744. The existing permit requires the installation of an additional pump at PS-2 by January 1, 2004.

The primary clarifiers provide a firm capacity of 1,520 mgd (raw) and meet the current permit requirement. The permit requires the construction of two new 180 mgd circular primary clarifiers for a firm capacity of 1,700 mgd (raw) by January 1, 2004.

The two intermediate lift stations provide a total firm capacity of 930 mgd which satisfies the current permit requirement. However, the two pumps in Lift Station 1 each have a much lower capacity (260 mgd/ pump) than each of the three pumps (350 mgd/ pump) in Lift Station 2. The capacity difference between the pumps would create a flow imbalance to the aeration decks should one pump from both lift stations be inoperable. Two new larger pumps at 365 mgd/ pump will be installed at Lift Station No. 1 to address the flow imbalance issue by February 2004.

The four aeration decks provide a firm capacity (only air deck is allowed out of service) of 1,050 mgd that satisfies the permit requirement. The secondary treatment capacity calculation assumes three aeration decks in operation. One of the decks is an air aeration deck while the other three decks are oxygen aeration decks. The air aeration deck has a much lower treatment capacity (150 mgd) than the oxygen aeration decks (350 mgd/ deck) meaning that all three oxygen aeration decks must be in service during wet weather events to provide the required treatment capacity. The air aeration deck will be converted to an oxygen aeration deck by February 2004 under PC-744.

The current solids handling and disposal mechanism at the Detroit WWTP consists of four main

unit processes:

- Complex A and B Gravity Thickening
- Complex I and II Dewatering and Cake Conveyance
- Complex I and II Incineration and Landfilling of Ash
- Lime Mixing Facility

Complex A's six gravity thickeners receive primary sludge from the rectangular and circular primary clarifiers. Complex B's six gravity thickeners receive waste-activated sludge (WAS) from the secondary clarifiers. The thickeners at both complexes serve to thicken the sludge prior to dewatering and provide sludge storage during high solids loading periods or during periods of major emergency shutdowns at the dewatering complexes. Combined, Complex A and B have a firm sludge thickening capacity of at least 500 dtpd, with 880 dt storage capacity. At the completion of PC-744, the total peak thickening capacity is expected to be at 940 dtpd.

Per the Solids Master Plan in the Needs Assessment Study (PC-744), the peak wet weather solid loadings to the WWTP is going to increase significantly in the future. The study estimates that a firm solids processing capacity of 940 dtpd is needed, due to increased future loads, increased primary treatment capacity, a series of peak wet weather events, and projected dewatering loads from CSO facilities.

DWSD has begun exploring alternatives in two key areas of improvements to meet its future solids processing needs. The first area of improvement is replacing the belt filter presses with centrifuges. When DWSD completes CS-1290 in 2004, there will be 10 centrifuges in the C-II Lower Level dewatering complex, 10 BFPs in the C-I dewatering complex, and 12 BFPs in the C-II Upper Level dewatering complex.

The second area of improvement is investigating the replacement of on-site incineration technology with a new, off-site process called Minergy. Minergy technology recycles the wastewater sludge into environmentally inert products. Per the DWSD Plan for Long-Term Measures to Ensure Compliance with Permit Requirements report in 2000, once Minergy has successfully operated for a time sufficient to establish reliability and credibility, DWSD may change the incinerators to "standby" mode. DWSD intends to maintain a backup plan even if the Minergy process is selected in the future per the same report.

Common Use Interceptors

An interceptor is a large sewer that receives flow from a number of trunk sewers and transports the flow to the wastewater treatment plant. These sewers do not connect to homes, buildings or streets. Detroit's system drains to three main interceptors: the Detroit River Interceptor (DRI), the North Interceptor - East Arm (NI-EA) and the Oakwood Northwest Interceptor (ONWI). The characteristics of the interceptors are described in Table 2.

The interceptors are generally in sound structural condition based on the findings of previous studies. Available information has been assembled on profile drawings depicting the location of problems such as adverse slope, sedimentation, corrosion and cracking of pipe walls. The Detroit River Interceptor was constructed in three major stages from 1927 to 1936. The materials of construction were concrete and brick. The North Interceptor - East Arm was constructed from 1969 to 1976. The material of construction was reinforced concrete. The Oakwood North West Interceptor was constructed from 1928 to 1950. The material of construction was reinforced concrete. A number of different construction materials have been used for the interceptors. The majority of Detroit's large sewers are constructed of concrete. A few older sections of the DRI are multi-ring brick sewers. Deeper sewers were most often installed using

Table 2: Characteristics of DWSD Common Use Interceptors

Name	Year of Construction	Diameter Range	Invert Depth Range (feet)	Capacity Range (cfs)	Material of Construction	Length (feet)
Detroit River Interceptor (DRI)	1927, 1935, 1936	8'-0" - 16'-0"	17 - 43	126 - 1400	Concrete, Brick	66,500
North Interceptor - East Arm (NIEA)	1969, 1973, 1976	12'-0" - 17'-6"	32 - 73	341 - 454	Reinforced Concrete	79,400
Oakwood-Northwest Interceptor (ONWI)	1928, 1931, 1950	6'-3" - 12'-9"	12 - 80	169 - 521	Concrete	86.800

pre-cast concrete liners in tunnels. Further, cast-in-place reinforced concrete was employed during the construction of some box sections and structures, such as outfalls and dams.

Major Transport

The DWSD-owned regional sewer system includes six suburban interceptors and three pumping stations that convey wastewater from Macomb County and portions of Oakland County. These six pipelines and three pumping stations are not in the category of Regional Transport and Treatment Facilities because they do not serve all users of the system, just those users in Macomb County and in the Clinton-Oakland District of Oakland County.Table 3 presents characteristics of the six major pipelines serving Macomb County and the Clinton-Oakland District of Oakland County.

The Lakeshore Interceptor was constructed in 1972 from reinforced concrete. The 11-foot diameter sewer provides transport of wastewater for the eastern portion of Macomb County. It extends from 21-Mile Road southward for approximately 36,000 feet where it empties into the 15-Mile Interceptor. The Clintondale Pump Station discharges into the south end of this interceptor and the Chesterfield Interceptor feeds into the north end.

The Oakland Arm was constructed in two major construction contracts from 1970 to 1972. This nine-foot diameter, approximately 57,600-foot long sewer provides transport of wastewater for portions of Macomb and Oakland County. It ultimately discharges into the Northeast Sewage Pumping Station in Detroit.

The Edison Corridor was constructed in 1969 from concrete. This 12-foot 9-inch diameter sewer provides transport of wastewater for a portion of Macomb County. The capacity of this 41,300-foot long sewer is 823 cfs.

Table 3: Characteristics of DWSD Suburban Interceptors

Trunk Sewer	Year Constructed	Diameter Range	Invert Depth Range (ft)	Capacity Range (cfs)	Material of Construction	Length (feet)
Lakeshore Interceptor	1972	11'-0"	46 - 54	230	Rein. Concrete	36,000
Garfield/Romeo Interceptor	1973, 1974, 1999	7'-0" - 11'-0"	28 - 66	107 - 246	Concrete	32,500
Oakland Arm	1970, 1972	8'-0" - 9'-6"	16 - 62	288 - 350	Concrete	57,600
Avon Arm	1974	3'-0" - 4'-0"	10 - 41	14 - 31	Concrete	14,100
15 Mile Rd. Interceptor	1973, 1974, 1975, 1984	5'-0" - 11'-0"	12 - 68	32 - 274	Rein. Concrete	36,400
Edison Corridor	1969	12'-9"	60 - 108	213 - 555	Concrete	41,300

The Garfield/Romeo Interceptor was constructed in three major construction contracts from 1973 to 1999. The material of construction was concrete. The 7- to 11-foot diameter sewer provides transport of wastewater for a portion of Macomb County. The Romeo Arm extends from 15 Mile north along Hayes to 18 Mile Road. This sewer crosses the Price Brook, Eaton, Healy Brook and Nims Drains. The force-main portion of this sewer, which extends north from 18 Mile, and the Garfield Pump Station are being replaced by the construction of a large gravity sewer. Construction on this new Garfield Interceptor was completed in 2003. It has a capacity of 161 cfs.

The 15-Mile Road Interceptor was constructed in four major construction contracts from 1973 to 1984. The material of construction was reinforced concrete. This 5- to 11-foot diameter sewer provides transport of wastewater for a portion of Macomb County. This sewer is approximately 36,500 feet long.

The Avon Arm was constructed in 1974 from concrete. The 3- to 4-foot diameter concrete sewer providing wastewater transport for portions of Macomb and Oakland counties is approximately 14,000 feet long.

Metering and Instrumentation

DWSD maintains 65 major meters throughout its service area. Of these, 56 are important billing or flow-monitoring meters, seven are meters at the Wastewater Treatment Plant measuring incoming flow and two are meters that measure effluent flow from the plant. Through the CS-1249 project, CDM is monitoring, maintaining, and evaluating these meters as part of an ongoing program to upgrade the billing system.

Meter types include parshall flumes, ultrasonic, magmeter, transit time, and weir installations.

DWSD is constructing a new region-wide instrumentation and control system under project PC-713. These facilities will be new and they will be completed in 2007. The proposed capital improvement plan of November 2002 will address long-term employment of this system from 2007 to 2050.

Detroit Collection and Conveyance

The collection system was constructed over a period of 140 years as Detroit grew from a settlement to a metropolitan area. The principal materials of construction were crock (a type of vitrified clay pipe), polyvinyl chloride pipe (PVC), clay, reinforced concrete pipe (RCP), concrete cylinder pipe (CCP), and brick. Wood boxes formerly used for transport have all been replaced. Figure 2 shows current sewer type and length in the DWSD system. Figure 3 breaks this down by construction material.

The construction standard for public sewers installed from 1836 to 1910 was brick. Until 1892,

Figure 2: Estimated Sewer Type and Length in DWSD System

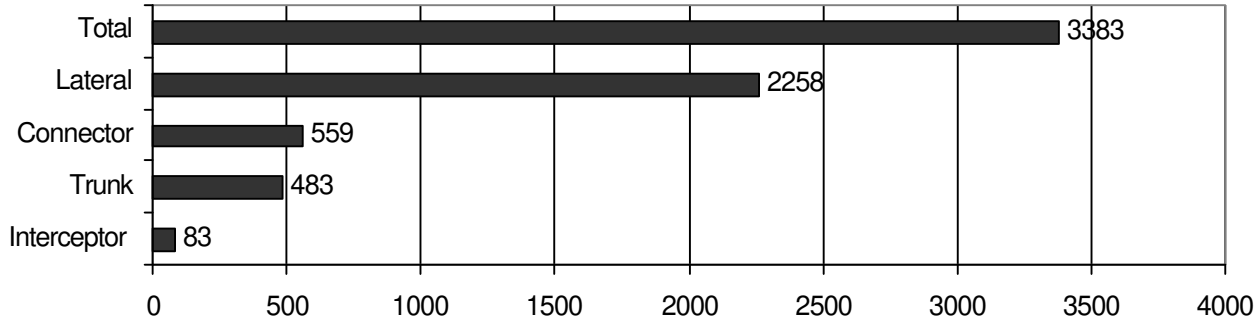
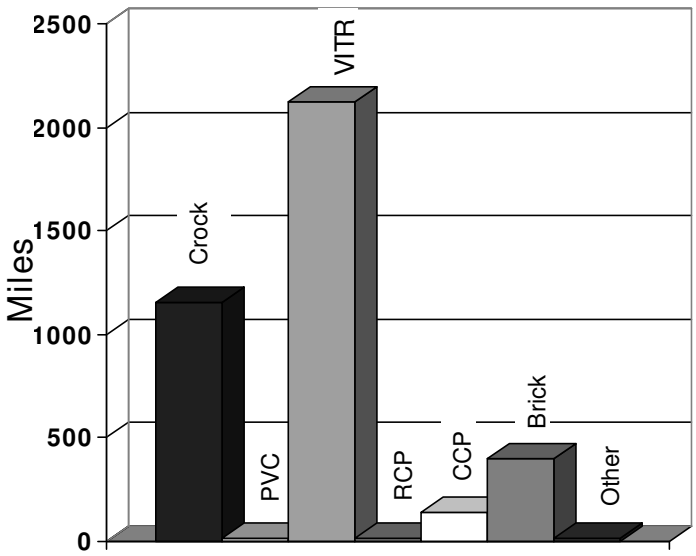


Figure 3: Detroit Sewer Materials and Length in Miles



Material	Length (miles)
Glazed VCP	941
PVC	12
VCP	1887
RCP	12
CCP	138
Brick	393

laterals were also constructed of brick. The first public sewer was constructed in 1836, when Savoyard Creek, which flowed from Cadillac Square to the foot of First Street was enclosed.

Many sewers were constructed before streets were in place so the sewers were built in long reaches with few manholes. In 1892 a change of materials for small lateral sewers was made. "Crock" (glazed the vitrified clay) pipe was introduced and manholes and lampholes were provided for lateral sewers. In the following 20 years, the wastewater collection and transportation system expanded rapidly as extensive areas were annexed into Detroit. Through 1920, most of the public sewers were constructed of brick and were less than seven feet in diameter. In 1926, when the interceptor concept was implemented, monolithic concrete construction was introduced and quickly became the standard for large sewers. Concrete pipe gradually superseded crock pipe. By 1930 it represented half of new lateral construction.

In the early 1930s, the Federal Emergency Administration of Public Works (FEAPW) administered a program of public sewer cleaning and repair of older sewers. Interceptor and wastewater treatment plant construction was underway in the years 1935 through 1940. In 1940 the Detroit River Interceptor, part of the Oakwood-Northwest Interceptor, and the original Detroit primary Wastewater Treatment Plant were completed.

The Detroit collection system was expanded to the present city limits by 1951. Construction continued under the combined sewer relief program during this period. By 1975, lateral sewer construction had been completed in the last undeveloped areas and in the inner-city urban renewal and rehabilitation areas. Short lateral sections and replacement sewers were constructed as needed. Table 4 shows lateral sewer conditions. Figure 4 shows the age of Detroit sewers. Figure 5 shows

Table 4: Lateral Sewer Segment Conditions

	North		West		East		Central		Total	Percent of Total
Segments inspected	166		178		165		128		637	100%
Excellent	9	5.4%	7	3.9%	16	9.7%	6	4.7%	38	6.0%
Good	74	44.6%	95	53.4%	105	63.6%	67	52.3%	342	53.8%
Fair	63	38.0%	48	27.0%	30	18.2%	32	25.0%	174	27.3%
Needs Investigation	20	12.0%	28	15.7%	19	11.5%	20	15.6%	87	13.7%

Figure 4: Age of Detroit Sewers

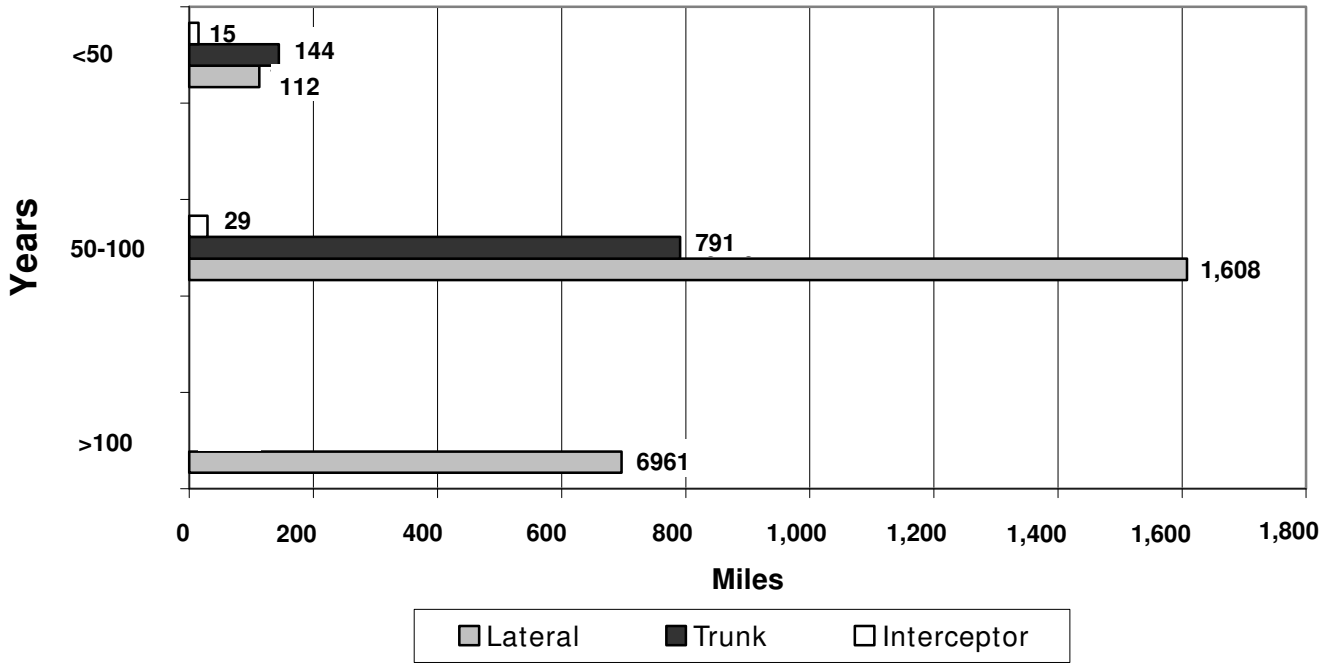
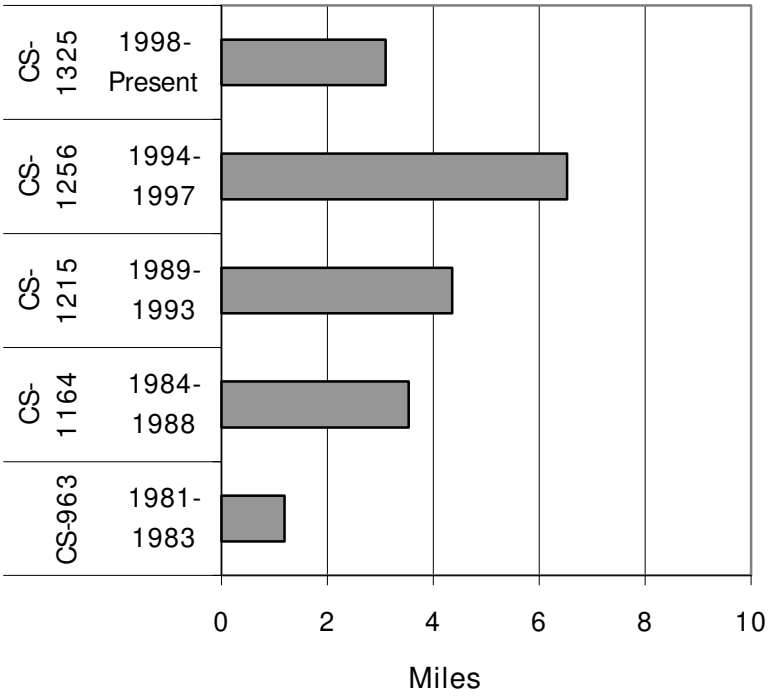


Figure 5: Miles of CIPP Pipe Installed in Detroit Since 1981



the amount of cured in place pipe (CIPP) pipe installed in in Detroit over the last 21 years. CIPP is rehabilitated pipe. It is not new pipe.

The information in this report was derived from a variety of sources: TV tapes, information from the paper files of previous TV inspections, construction drawings, sewer maps, WOTS (Work Order Tracking System), existing DWSD computerized sewer maps, previous studies, personal interviews and personal observation. The recommendations in this report are derived from the findings under past and current conditions and are intended to help develop an effective management approach to maintaining continuous, uninterrupted sewer service to the citizens and establishments of the City of Detroit.

Detroit CSO Control Facilities

CSO facilities include outfalls, regulators, and CSO basins. DWSD operates three CSO basins that were constructed between 1995 and 1998, and

two screening and disinfection facilities completed in 2001. Other facilities are under construction, or soon will be constructed. A total of 190 regulator structures have been identified, and a total of 81 CSO outfalls have been identified. A number of inspections have been made during recent projects and these have been used to assess the condition of the structures. In general, because of DWSD's long term CSO program, the CSO facilities are in good to excellent condition. Facilities in good condition are those with functioning components and with no repairs required.

Facilities on Private Property

Facilities on private property include on-site sewage disposal systems and service connection pipes. These facilities have been included as critical facilities because of their number – over 1.5 million service connections to the DWSD regional system and about 134,000 on-site sewage disposal systems in the septage service area. Individual property owners have a major role in accountability for regional wastewater service costs. Proper installation and maintenance of these facilities can keep public costs for wastewater collection and treatment at a minimum.

A review was made of the conservation soil maps of four counties (Oakland, Macomb, St. Clair and Lapeer) to determine soil suitability for OSDS. Soils were rated suitable, marginal, unsuitable and unclassified.

Suitable soil is generally soil that is well-drained, sandy soil or soil that has a permeability of less than 60 minutes per inch and a seasonal high water table two feet or more below the ground surface.

Marginal soil is generally soil that is somewhat poorly drained with a seasonal high water table one to two feet below the ground surface and soil permeability of 60 to 300 minutes per inch.

Unsuitable soil is soil that is poorly to very poorly drained with a seasonal high water table of less than one foot below the ground surface or is soil that is highly impermeable (permeability greater than 300 minutes per inch).

Unclassified soil is soil that was not mapped. This includes landfills, made land, filled land and other categories.

In the planning area, there are 15 communities that will continue to rely on OSDS that have 75 percent or more of the soils classified as marginal or unsuitable for on-site sewage disposal (OSDS). Development in these areas will require "engineered" or alternative sewage systems. Some types of alternative OSDS being used for marginal or unsuitable soil are mound systems, sand filters and aerobic treatment units. These systems often cost $10,000 or more. They also require regular maintenance or they will malfunction, resulting in expensive repairs and environmental contamination.

Along with soil suitability problems, several other factors such as regulatory issues, residential concerns, growth, and public health and safety issues will result in dramatic decreases in land disposal of septage. This will increase the amount of septage pumped into the DWSD system in the future. Details on this issue are presented in the technical memorandum *Soil Suitability for On-Site Sewage Disposal Systems* on the CD that accompanies this report.

By 2050, over 140,000 people living in communities that now rely on OSDS may need DWSD sewer service.

Service connections connect homes and businesses to the public sewers. Collectively they make up a major component of conveyance. They are estimated to exceed the total length of publicly owned sewers within the DWSD service area. Table 5 shows the length in miles of service connections in the DWSD Service Area.

Capacity Management

Capacity management in the context of this master plan includes the reduction of I/ I and the optimization of wet weather flow routing to maximize the use of available capacity. At present, dry weather flows at the treatment plant are an estimated 40 percent infiltration and inflow. The Volume 1 *Report on Planning Criteria* established that dry weather infiltration/ inflow is about 242 mgd based on 2001 flow data. Future dry weather sanitary flows due to new growth are expected to be about 25 mgd after new residents and employment are added to the planning area by 2050.

There is significant opportunity to reduce dry weather infiltration and inflow and several target areas have been identified to reduce dry weather I/ I at a pace that equals or exceeds the rate of growth in flows from new development and population increases in the service area.

Table 5: Miles of Service Connections in DWSD Service Area

	Detroit	Suburbs
Constructed before 1945	1,536	352
Constructed 1946-1975	2,679	8,613
Constructed after 1976	71	3,121

1. Introduction

1.1 Purpose and Objectives of this Report

This *Report on Critical Facilities and Flow Management* has two principal objectives:

- Identification of the critical facilities of the DWSD's regional wastewater system and an assessment of their physical condition to handle expected flows to the year 2050.
- Evaluation of the feasibility of managing capacity and flows by using methods such as I/ I reduction, limits on wet weather flows, and operational protocols for handling wet weather flows.

1.2 Technical Memoranda

There are detailed technical memoranda on specific subjects that substantiate the information in this volume. These are presented on the CD bound at the back of this report. The complete list of technical memoranda appears in the table of contents.

2. Critical Facilities

2.1 Identification of Critical Facilities

Critical facilities have been classified into eight groups for this Master Plan:

- Regional Transport and Treatment
- Major Transport
- Metering
- Wholesale Customer Collection and Conveyance
- Wholesale Customer Wet Weather Control
- Detroit Collection and Conveyance
- Detroit CSO Control
- Facilities on Private Property

The eight groups are important for three reasons:

- **First, these groups are important from the standpoint of future cost allocation**. For example, regional transport and treatment facilities are "common-use" facilities, and the DWSD's rate methodologies provide for a sharing of cost for common-use facilities among all users. As another example, costs for construction and maintenance of facilities on private property are paid for only by the respective property owners. Approximately one half of the length of the collection system is made up of service connection pipes on private property. Therefore, from a Master Planning perspective, the standards of construction and maintenance of these private facilities are very important elements of a cost-effective regional solution for the next 50 years.
- **Second, these groups establish the importance of wet weather flow facilities**. Both DWSD and its wholesale customers have large infrastructures to manage wet weather flow, and the remaining CSO investments now under NPDES permit and the potential SSO infrastructure will create even larger facilities. Wet weather flows generally govern the physical capacity of the collection, transport and treatment system. However, dry weather flows provide the revenue to build and maintain these facilities.
- **Third, these groups include the full range of accountability.** Accountability for cost-effective wastewater service collectively lies with the regional treatment provider, DWSD, its first-tier wholesale customers, the second-tier wholesale customers and then to the individual property owners in the city and the suburbs who generate wastewater.

2.2 Methods of Assessment

2.2.1 Review of Available Information

The purpose of the analysis of the critical facilities in the DWSD system is to establish a baseline of information on the physical condition and the capacity of the system. This information is used to develop the capital improvement plan. Emerging practice in wastewater utilities is to perform an extensive assessment and inventory of physical assets. New environmental regulations (CMOM — capacity, maintenance, operations and management of sewer systems) and accounting standards (General Accounting Standards Bureau GASB—34) set forth requirements for developing inventories and assessing the condition and service life of wastewater facilities. A number of data collection tools have been created to this end during the development of the Master Plan.

These tools will provide DWSD with a comprehensive summary of interceptor and trunk sewer assets. The key tools that have been produced are: sewer profiles, detailing major elements; spreadsheets, containing the detailed information used to develop the profiles; and summaries of construction and inspection information consolidated from a number of reports previously completed

for the DWSD.

The assessments presented in this chapter have been compiled from a wide variety of sources, including previous reports, the results of concurrent studies by others, interviews and discussions with DWSD staff and wholesale customer staff, data from sewer inspection records, and data from the city's Work Order Tracking System (WOTS). All sources are cited in the list of references to this report.

A comprehensive search was conducted to obtain assessment data for the trunk and interceptor sewers. The information that was obtained has been summarized and bound in notebooks, along with reference material. Information regarding construction history, inspection history, current and future use, pumping stations, special structures, system hydraulics, and emergency management and redundancy is included and will be transmitted to the DWSD at the end of the Master Planning effort.

The material gathered from available sources has been reviewed with a team of senior DWSD engineers familiar with the construction and maintenance of the Detroit sewer system. This team – the Pipeline Team – met several times in 2001 and early 2002 and has provided comments on portions of the material presented in this report. The Pipeline Team has continued to meet and review the findings of the Master Plan. A complete description of the Pipeline Team is presented in the technical memorandum *Interceptors and Trunk Sewers* that accompanies this report.

2.2.2 New Sewer Inspections

Having completed the review of existing sources of information documented herein, the Master Plan team implemented a TV inspection program for Detroit lateral sewers in 2002.

The inspections of lateral sewers were planned based on knowledge and techniques developed by DWSD under the *Long Term CSO Control Plan for the Detroit and Rouge Rivers*. In developing that plan, some pilot inspections were undertaken using raft-mounted video cameras. Approximately 10,000 linear feet of large sewers were inspected from 1994 to 1996. The sewers were found to be in generally good condition. It was further recommended by the *Long Term Control Plan* that DWSD inspect 4,000 feet per year of the following major sewers: DRI, Oakwood Northwest, First-Hamilton, Mt. Elliott, Edison Corridor and Oakland Arm. Sewer grades are defined on page 2-25.

Further inspection of trunk sewers and interceptors is recommended in Volume 4 of this Master Plan, *Capital Improvement Program*.

2.3 Regional Transport and Treatment

2.3.1 Common Use Interceptors

An interceptor is a large sewer that receives flow from a number of trunk sewers and transports the flow to the wastewater treatment plant. These sewers do not connect to homes, buildings or streets. Detroit's system drains to three main interceptors: the Detroit River Interceptor (DRI), the North Interceptor - East Arm (NI-EA) and the Oakwood Northwest Interceptor (ONWI).

This section examines construction history, inspection history, current and future use, system hydraulics, and emergency management.

Interceptor Profiles

Profile drawings were prepared for the three interceptors. These are shown on Figures 2.3.1, 2.3.2 , 2.3.3 and 2.3.4 on the following pages. The profiles show the sewer elevation profile, major street intersections, major connections with other sewers, dates of construction, and materials of construction. In addition to the interceptor pro-

Figure 2.2: Detroit River Interceptor

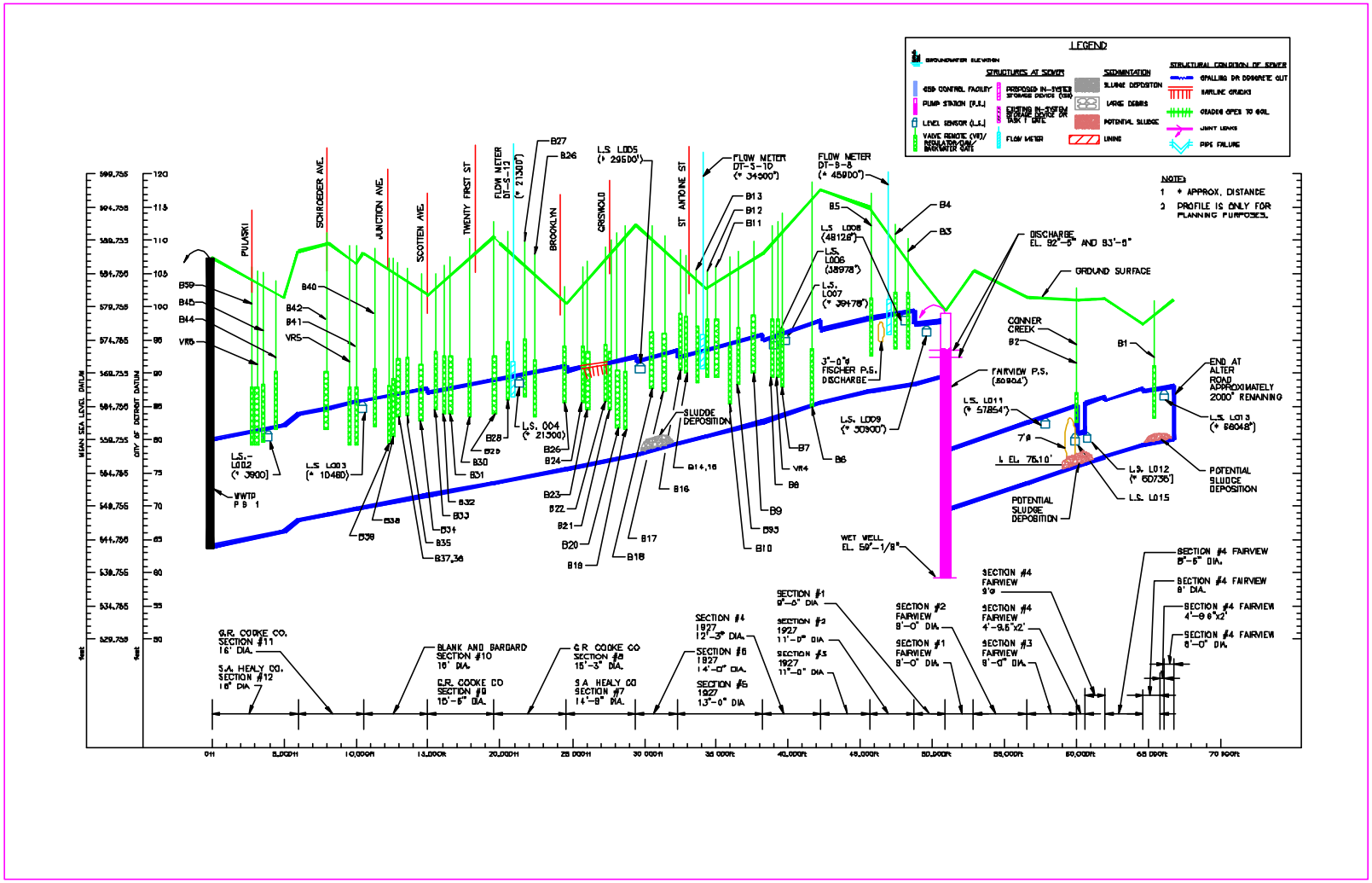


Figure 2.3: North Interceptor—East Arm

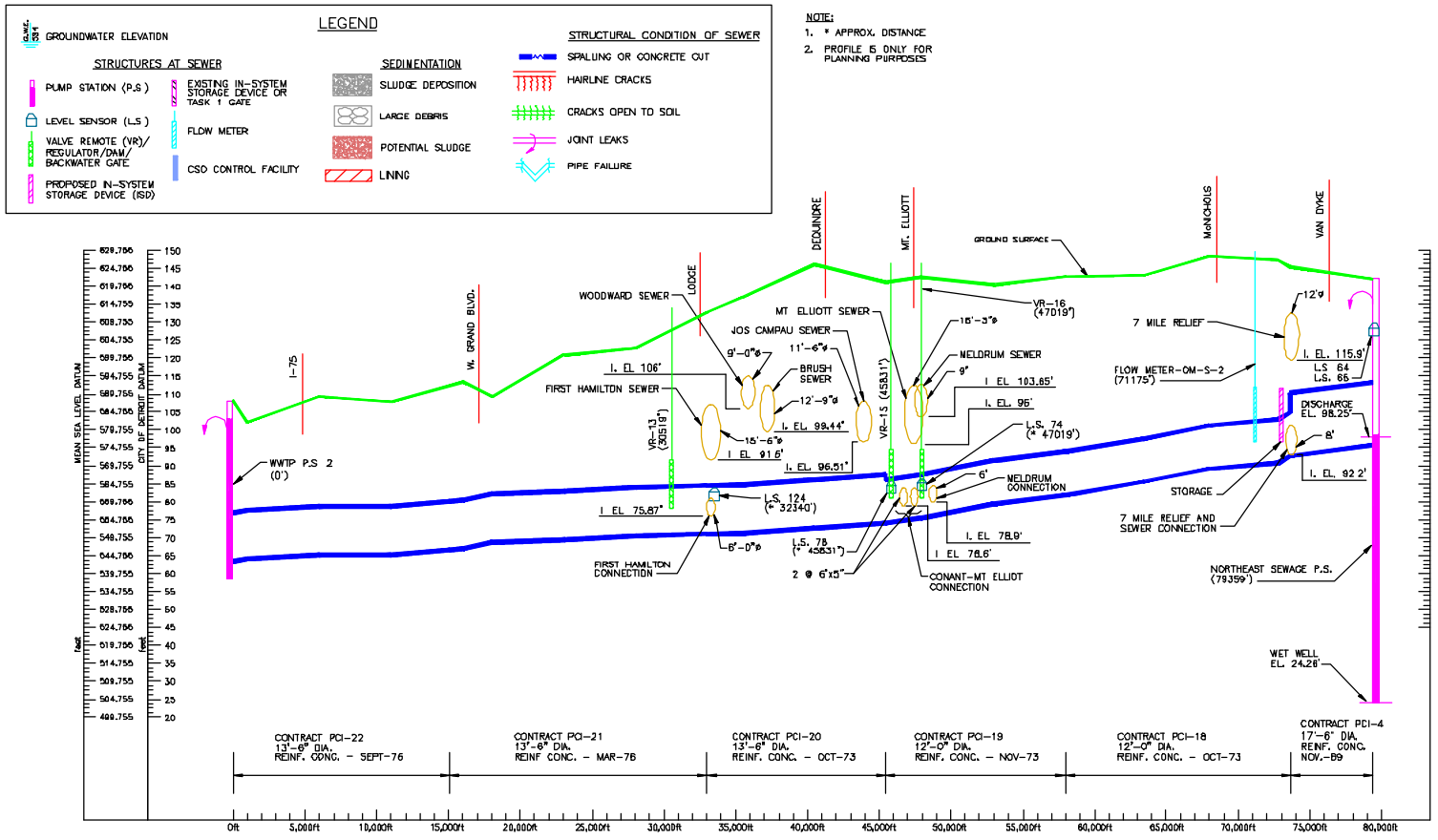


Figure 2.4: Oakwood-Northwest: WWTP to Evergreen

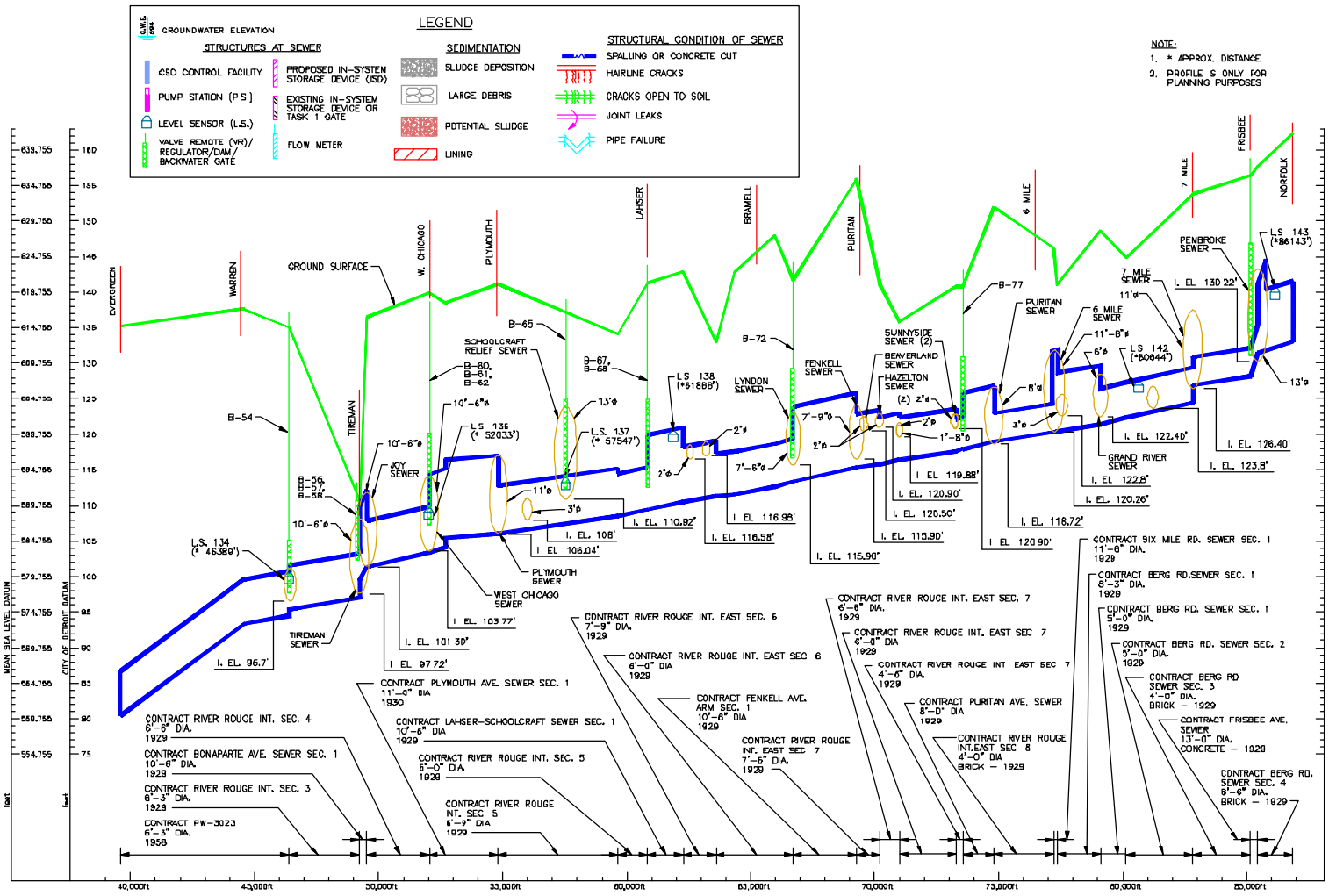


Figure 2.5: Oakwood-Northwest: Evergreen to Norfolk

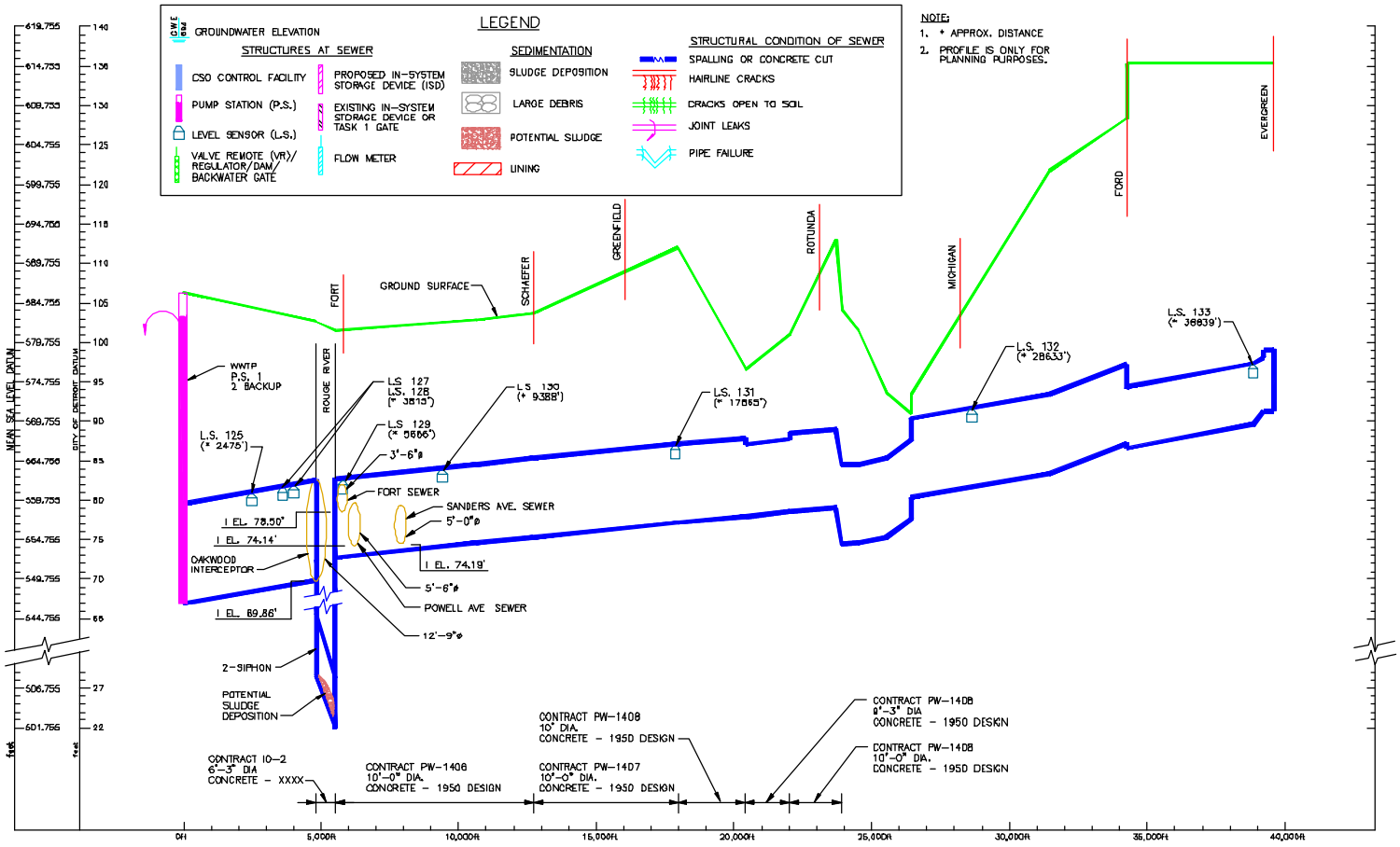
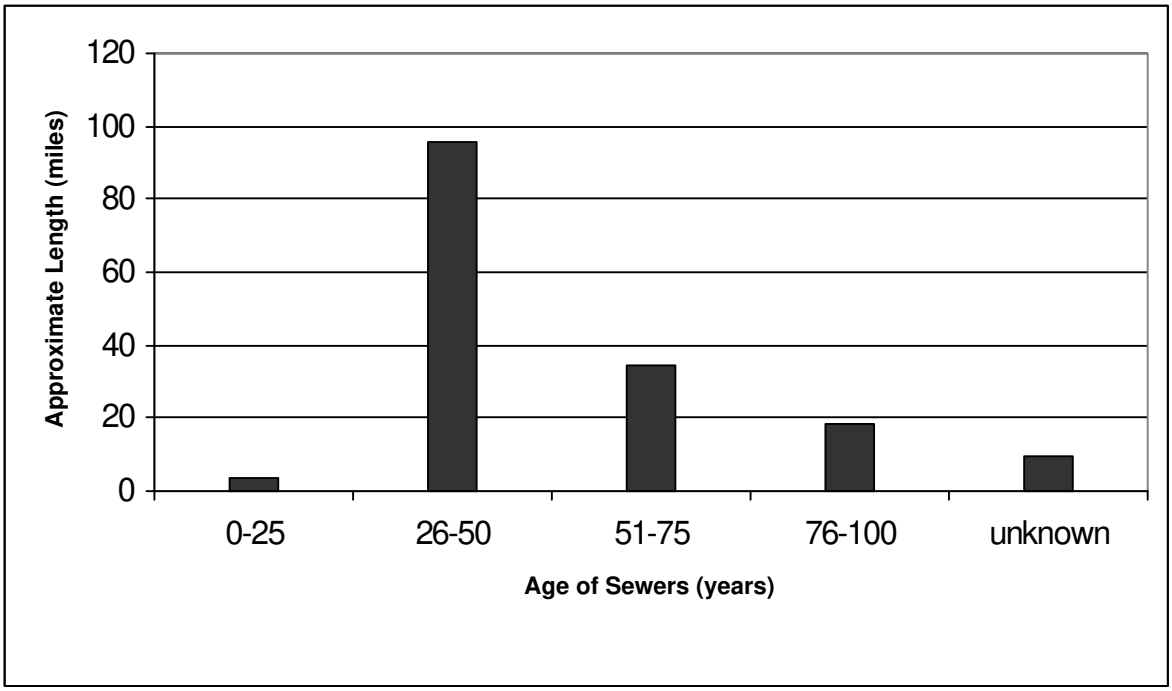


Figure 2.5: Age of Major DWSD Interceptors & Trunk Sewers (as of 2002)



files, spreadsheets detailing attributes, obtained from as-built drawings, have also been prepared. These are included in the technical memorandum *Interceptors and Trunk Sewers* that accompanies this report.

The capacities of the large sewers vary considerably. Due to the complexity of the collection system, the theoretical capacities have limited application in the evaluation of flow management alternatives for the collection system. A capacity analysis is included in Volume 3 of this Master Plan, *Wastewater Service Alternatives*.

Interceptor Construction

The Detroit River Interceptor was constructed in three major stages from 1927 to 1936. The materials of construction were concrete and brick. The North Interceptor - East Arm was constructed from 1969 to 1976. The material of construction was reinforced concrete. The Oakwood Northwest Interceptor was constructed from 1928 to 1950. The material of construction was reinforced concrete. A number of different construction materials have been used for the interceptors. The majority of Detroit's large sewers are constructed of concrete. A few older sections of the DRI are multi-ring brick sewers. Deeper sewers were most often installed using pre-cast concrete liners in tunnels. Further, cast-in-place reinforced concrete was employed during the construction of some box sections and structures, such as outfalls and dams.

Figure 2.5 illustrates the approximate length of major trunk and interceptor sewers built by 25-year segments. The figure summarizes age information on three interceptors, six major pipelines in Macomb County and 16 trunk sewers in Detroit. This figure can be used in future planning efforts to estimate the length of sewer that will reach the end of its useful life over each of the next five decades.

Analysis

Table 2.1 shows a summary of the major charac-

Table 2.1: Characteristics of DWSD Common Use Interceptors

Name	Year of Construction	Diameter Range	Invert Depth Range (feet)	Capacity Range (cfs)	Material of Construction	Length (feet)
Detroit River Interceptor (DRI)	1927, 1935, 1936	8'-0" - 16'-0"	17 - 43	126 - 1400	Concrete, Brick	66,500
North Interceptor - East Arm (NIEA)	1969, 1973, 1976	12'-0" - 17'-6"	32 - 73	341 - 454	Reinforced Concrete	79,400
Oakwood-Northwest Interceptor (ONWI)	1928, 1931, 1950	6'-3" - 12'-9"	12 - 80	169 - 521	Concrete	86,800

teristics of the three regional interceptors. Additional detail is presented in the Technical Memorandum *Interceptors and Trunk Sewers* that accompanies this report.

Estimates of sediment deposits and structural improvement needs were prepared based on a review of existing inspection records and facility condition reports. An assessment of sediment deposits was made for each of the interceptors and trunk sewers where information was available. Information regarding sludge deposition and structural conditions of the sewers was derived from the CS-1158 report, published in 1996, plus a series of internal DWSD memoranda from 2001 that describe suspected sludge deposition and structural improvement needs.

Preliminary recommendations for cleaning and a routine inspection program were based on the information collected. Information regarding sediment build-up in the sewers has been shown on the profiles. Recommendations for a sedimentation management program and physical inspection of the system are presented in Volume 4 of this Master Plan, *Capital Improvement Program.*

Inspections and Maintenance

A systematic inspection and maintenance program is not currently in place for interceptor sewers. A systematic inspection program is warranted due to the age of the large pipelines in the DWSD system. Maintenance requirements for large pipelines can be determined based on systematic inspection.

Due to the logistic and safety issues in accessing large, deep sewers that are in active service, inspections are difficult and costly. The DWSD has crews that inspect larger sewers (greater than four foot diameter) in walk-through inspections where they can be safely entered. The crews cannot safely inspect a number of trunk and interceptor sewers due to size and/ or high dry weather flows.

Under the *Long Term CSO Control Plan for the Detroit and Rouge Rivers,* some pilot inspections were undertaken using raft-mounted video cameras. Approximately 10,000 linear feet of large sewers were inspected. The sewers were found to be in generally good condition.

Considering the difficulty in determining the useful life of large sewers, DWSD should consider an inspection program to assess the existing conditions in interceptors sewers and develop a long-term inspection program that can be used to monitor the condition of the pipelines as they age. It can be expected that an inspection of 10 to 25 percent of the system will provide a comprehensive understanding of existing conditions.

A regular maintenance program for interceptors should not be approached in the same manner as maintenance of collector sewers. Typically, periodic maintenance of collector sewers involves cleaning, and in some cases, televising sewer lines to identify areas which would benefit from preventative maintenance.

The effort required to clean large pipelines on a periodic basis, is not warranted, based the potential benefits. In lieu of periodic cleaning, a program of "planned maintenance" is recommended. Maintenance activities will typically fall into two categories: removal of sludge and debris and limited repairs.

Most of the larger pipelines do not have redundancy in the case of failure. As part of the proposed capital improvement plan, this Master Plan recommends projects that provide DWSD with contingency capability for potential pipeline failures.

2.3.2 Septage Receiving Facilities

In 2000, DWSD estimated that about 15 million gallons of septage (12 percent of the state estimate) was deposited in the Detroit system. Septage accounts for about .01 percent of the flow at the Detroit Wastewater Treatment Plant.

DWSD requires that haulers provide analytical testing of their septage twice a year. In addition DWSD also collects samples from haulers' trucks on an unannounced basis.

There are currently four septage disposal sites tributary to the DWSD wastewater system, three in Oakland County and one in Wayne County. Locations and hours of operation of these sites are shown in Table 2.2.

Table 2.2 — Septage Receiving Stations in the DWSD Service Area

Plant	Hours	Loads/ Day
Detroit Wastewater Treatment Plant 9300 W. Jefferson, Detroit	24 hours/day, all year	10
Oakland County 22440 Eight Mile Road, Southfield	8 a.m.-4 p.m., Mon Fri., Sat. 9- 4 p.m	10-12
Oakland County 1155 Cesar Chavez, Pontiac	24 hours/day, all year	20
S.E. Oakland County 29132 Stephenson, Madison Heights	7:30 a.m.- 3:30 p.m. Mon.-Fri.	1

The Oakland County Drain Office sends monthly payments of septage treatment token sales to DWSD. The statement identifies haulers and the number of tokens each purchased. Oakland County collects a fee for each token sold based on tanker size. Total charges range from 4.8 cents per gallon for a 500-gallon tanker to 2.4 cents per gallon for an 8,000-gallon tanker.

DWSD also sells tickets at the first floor DWSD office, 735 Randolph, Detroit. The rate for disposal is $10 for every 500 gallons or 2 cents per gallon. Gallons are determined by truck capacity.

Detroit Wastewater Treatment Plant, 9300 W. Jefferson, Detroit: Septage trucks are weighed upon entrance and directed to an uncovered manhole. After the septage is dumped, the truck is weighed again and the hauler must provide payment tickets. A second manhole is provided as a back up for dumping septage. In warm-weather months, up to 10 haulers dump sewage at the plant daily. No clean-up hose is provided.

Pontiac Septage Disposal Facility, 1155 Cesar Chavez, Pontiac: This site, opened in March 2002, consists of a concrete road, drying bed for catch basin cleaning waste, video surveillance, fence, dumpster pad, four openings for septage dumping, two frost-proof hydrants for water, card-activated gate and automatic gate for exiting. Sewer openings are on either side of a concrete island that has two water spigots. To dispose of a load of septage, the hauler enters a coded card into the entrance gate slot, drives forward to a sewer opening, places the hose from the truck in the sewer, opens the valve on the truck and dumps the load. There are cleanup hoses. Four haulers can use the facility simultaneously.

Southeastern Oakland County, 29132 Ste-

phenson Highway, Madison Heights: This site is fenced, has a paved circular drive, an offset in the drive with a sloped concrete pad and sewer opening, video cameras and water spigot. The sewer lead connects to a combined sewer 15 feet wide. To dispose of a load of septage, the hauler puts tokens in a can, signs the register and drives to the offset. Cleanup hoses are available.

Oakland County Water Building, 22440 Eight Mile Road, Southfield: This site has a paved road, token box, gate, video camera and concrete pad sloping to a sewer. To dispose of septage, the hauler drives in off of Eight Mile Road, backs onto the grass, pulls forward to the token box, and deposits a token. The gate raises and the hauler pulls forward to put the hose from the truck into the sewer opening. There is no hose for washing down the area.

Detailed information is included in the technical memorandum *Septage Transport and Disposal to the Detroit Wastewater System* on the CD that accompanies this report.

2.3.3 Wastewater Treatment Facilities

Introduction

The Detroit Water and Sewerage Department (DWSD) owns and operates the largest single-site wastewater treatment plant (WWTP) in the world as measured by peak capacity. (See Table 1, on Page *3* of the *Executive Summary)*. It is currently being upgraded to a permitted primary capacity of 1,700 mgd and a permitted secondary capacity of 930 mgd. Thus, the secondary treatment capacity for flow entering the plant is approximately 830 mgd. The plant treated an average of 724 million gallons per day (mgd) of wastewater in 2001. The plant went into service in 1940 and used primary treatment to remove approximately 60 percent of pollutants. In the 1970s, secondary treatment facilities were added to provide a higher degree of treatment. The combination of primary and secondary treatment removes more than 85 percent of incoming pollutants, exceeding federal and state requirements.

The Detroit Wastewater Treatment Plant is currently a conventional treatment plant consisting of primary and secondary treatment. Raw wastewater containing domestic wastewater, industrial wastewater and storm water collects at three interceptors and is pumped to the WWTP. Pickle liquor or ferric chloride is added near or at the pump stations for phosphorus removal. Wastewater then flows through screens to remove coarse solids and then through grit chambers to remove sand, gravel and other heavy solid materials. A polymer is added either directly to or after the grit chambers to aid in solids removal in the primary clarifiers. The primary clarifiers remove settleable solids. Wastewater is then pumped to the aeration decks by the intermediate lift stations. The microorganisms in the aeration decks biologically treat the wastewater to convert the colloidal and dissolved organic matters into various gases and into cell tissue (settleable biomass). The secondary clarifiers settle out those solids. Finally, the treated wastewater is disinfected with chlorine. Dechlorination of the wastewater occurs before discharge through one of the outfalls. Solids from the primary and secondary clarifiers are further processed by gravity thickening, dewatering, incineration or lime-mixing, and landfill disposal of stabilized dewatered sludge and ash.

Further details of the information presented here can be found in the technical memorandum *Review of Detroit WWTP* on the CD that accompanies this report.

Liquid Treatment Processes

Although the WWTP meets existing permit requirements, the the PC-744 project is being performed to meet future requirements. The current WWTP's NPDES permit took effect on October 1, 1997, and expired on October 1, 2002. Currently,

Table 2.3 Liquid Treatment Capacity and Unit Availability (2002)

Facility	Firm Capacity	Unit Availability
Raw Wastewater Pump Stations	1,663 mgd	Largest pump from both PS-1 and PS-2 out of service
Primary Clarifiers	1,620 mgd	One circular or two rectangular clarifiers out of service
Intermediate Lift Pumps	960 mgd	Three pumps in service, largest pump out of service
Aeration Decks	1,050 mgd	Air aeration deck out of service
Secondary Clarifiers	930 mgd	Two secondary clarifiers out of service
Chlorination	64 tpd	Unknown
Dechlorination	45.6 tpd	Two of 14 evaporators and sulfonators out of service. Evaporators and sulfonators operating at 80% of maximum flow of 9,500 lbs/day/evaporator and sulfonator

the WWTP is permitted to treat up to 1,520 mgd (raw) wastewater through primary treatment and 930 mgd through secondary treatment.

There are four processes that require major upgrades under PC-744 to meet future permit requirements (See Tables 2.3 and 2.4):

- Raw wastewater pump stations
- Primary clarifiers
- Intermediate lift stations
- Aeration decks

The two raw wastewater pump stations (PS-1 and PS-2) have a combined firm capacity of 1,663 mgd. This is sufficient for handling the current permitted wet weather primary treatment flow of 1,520 mgd (raw), but not the future permitted wet weather flow of 1,700 mgd (raw). The existing permit requires the installation of an additional pump at PS-2 by January 1, 2004 when the new permit takes effect.

The primary clarifiers provide a firm capacity of 1,520 mgd (raw) and meet the current permit requirement. The permit requires the construction of two new 180 mgd circular primary clarifiers for a firm capacity of 1,700 mgd by January 1, 2004 when the new permit takes effect.

The two intermediate lift stations provide a total firm capacity of 930 mgd that satisfies the current permit requirement. However, the two pumps in Lift Station 1 each have a much lower capacity (260 mgd/ pump) than each of the three pumps (350 mgd/ pump) in Lift Station 2. The capacity difference between the pumps would create a flow imbalance to the aeration decks should one pump from both lift stations be inoperable. Two new larger pumps at 365 mgd/ pump will be installed at Lift Station No. 1 to address this potential imbalance issue by February 2004.

The four aeration decks provide a firm capacity (only one air deck is allowed out of service) of 1,050 mgd. This satisfies the permit requirement. The secondary treatment capacity calculation assumes three aeration decks in operation. One of the decks is an air aeration deck while the other three decks are oxygen aeration decks. The air aeration deck has a much lower treatment capacity (150 mgd) than the oxygen aeration decks (350 mgd/ deck) meaning that all three oxygen aeration decks must be in service during wet weather events to provide the required treatment capacity. The air aeration deck will be converted to an oxygen aeration deck by February 2004 under PC-744.

Solids Treatment Processes

- The current solids handling and disposal mechanism at the Detroit WWTP consists of four main unit processes:
- Complex A and B gravity thickening
- Belt filter presses dewatering and cake convey-

Table 2.4 Liquid Treatment Capacity & Unit Availability (2006)

Facility	DWSD Firm Capacity	Unit Availability
Raw Wastewater Pump Stations	1,800 mgd	Largest pump from both PS-1 and PS-2 out of service (assumes no improvement in PS-2 pumping capacity)
Primary Clarifiers	1,800 mgd	One circular or two rectangular clarifiers out of service
Intermediate Lift Pumps	1,050 mgd	Three pumps in service, largest pump out of service
Aeration Decks	1,050 mgd	One aeration deck out of service
Secondary Clarifiers	930 mgd	Two secondary clarifiers out of service
Chlorination	64 tpd	Unknown
Dechlorination	45.6 tpd	Two of 14 evaporators and sulfonators out of service. Evaporators and sulfonators operating at 80% of maximum flow of 9,500 lbs/day/evaporator and sulfonator

ance

- Incineration and landfilling of ash
- Lime-mixing facility

Investigation of the future peak wet weather solids loads under PC-744 indicates a significant increase of loadings to the WWTP. It was estimated that DWSD requires a firm solids processing capacity of 940 dtpd. This was based upon future loads, increased primary treatment capacity, a series of peak wet weather events, and projected dewatering loads from CSO facilities.

DWSD has begun exploring improvement alternatives in two key areas to meet its future solids processing needs. The first is replacing the belt filter presses (BFP) with centrifuges. When DWSD completes CS-1290 there will be 10 centrifuges in the C-II Lower Level dewatering complex, 10 BFPs in the C-I dewatering complex, and 12 BFPs in the C-II Upper Level dewatering complex.

The second area of improvement is the possible replacement of on-site incineration technology with a new, off-site process called Minergy. Minergy technology recycles the wastewater sludge into environmentally inert products. This would result in eventually operating the incinerators only in "standby" mode.

Preliminary Evaluation of Long-Term Issues

Firm Capacity

Firm capacity is typically defined as the number of units that could be reliably expected to be in service. Some firm capacity definitions refer to the capacity of an area with the largest unit out of service. DWSD has defined firm capacity as the number of units that can reliably be expected to be in service to treat wet weather flows. DWSD performed a unit availability analysis to determine the firm capacities of the different liquid treatment and solids handling processes. Firm capacities in this report are based on DWSD's unit availability analysis unless otherwise specified.

Liquid Treatment

The existing primary treatment firm capacity is 1,520 mgd (raw, or 1,620 mgd if including 100 mgd in-plant recycle flow), and the existing secondary treatment firm capacity is 930 mgd based on the Needs Assessment Study and the Long Term CSO Control Plan. The limiting processes are the clarifiers at both primary and secondary treatment, per the Long Term CSO Control Plan (DWSD, 1996). Once PC-744 is complete the primary treatment firm capacity will be 1,700 mgd

(raw, or 1,800 mgd if including the 100 mgd in-plant recycle flow), and the secondary treatment firm capacity will be 930 mgd. The long-term limiting facilities are still the primary and secondary clarifiers (Long Term CSO Control Plan). The firm primary treatment capacity will increase from 1,520 mgd (raw) to 1,700 mgd (raw) by constructing two additional circular clarifiers. Per DWSD staff and DWP, once constructed, there will be no space available for additional primary clarifiers or additional secondary clarifiers. New chlorination and dechlorination facilities are undergoing construction.

Solids Handling

The existing firm capacity of the solids handling system is about 675 dry tons per day (dtpd) based on evaluating the data provided in the PC–744 Needs Assessment Study Revision 2 (2001). The firm capacity of solids handling depends on the number of filter presses and centrifuges in operation at the time firm capacity is established. The data clearly indicates that the dewatered sludge disposal through incineration or lime mixing is the limiting process for solids handling processes. A slightly different firm capacity of 630 dtpd was reported by the WWTP Dynamic Modeling team (Appendix E of the *Needs Assessment Report, Revision 2, 2001*). This was due to a higher capacity unit was used for the Complex II incinerators by the Modeling team (NAS used 72 dtpd and Modeling team used 61 dtpd). Staff from the Detroit Wastewater Partners (DWP) provided a rough estimate between 700 to 800 dtpd.

The 1996 DWSD Long-Term CSO Control study reported a firm capacity of 552 dtpd for the solids handling facilities. This number does not include the capacity of the lime mixing facilities and a different unit availability was assumed for major processes.

DWSD's Solids Master Plan in the NAS determined that a firm solids processing capacity of 940 dtpd for a period of up to two weeks is necessary. The post PC-744 firm capacity of the gravity thickening and dewatering will both reach the 940 dtpd goal. PC-744 will realize a higher firm capacity of 1,163 dtpd for the dewatering processes in anticipating the likely replacement of the C-II upper level BFPs in early 2011.

DWSD has yet to make the final decision on the use of incinerators or off-site Minergy process for its long term solids disposal plan.

2.4 Major Transport Facilities

The Detroit regional sewer system includes six suburban interceptors and three pumping stations that convey wastewater from Macomb County and portions of Oakland County. These six pipelines and three pumping stations are not in the category of Regional Transport and Treatment Facilities because they do not serve all users of the wastewater system, just those users in Macomb County and in the Clinton-Oakland District of Oakland County.

The Lakeshore Interceptor was constructed in 1972 from reinforced concrete. The 11-foot diameter sewer provides transport of wastewater for the eastern portion of Macomb County. It extends from 21-Mile Road southward for approximately 36,000 feet where it empties into the 15-Mile Interceptor. The Clintondale Pump Station discharges into the Lakeshore Interceptor near the south end and the Chesterfield Interceptor feeds into the upstream (north) end.

The Oakland Arm was constructed in two major construction contracts from 1970 to 1972. This 8– to 9.5-foot diameter, approximately 57,500-foot long metered sewer provides transport of wastewater for portions of Macomb and Oakland counties.

The Edison Corridor was constructed in 1969 from concrete. This 12-foot 9-inch diameter sewer

Table 2.5: Characteristics of DWSD Suburban Interceptors

Trunk Sewer	Year Constructed	Diameter Range	Invert Depth Range (ft)	Capacity Range (cfs)	Material of Construction	Length (feet)
Lakeshore Interceptor	1972	11'-0"	46 - 54	230	Rein. Concrete	23,000
Garfield/Romeo Interceptor	1973, 1974, 1999	7'-0" - 11'-0"	28 - 66	107 - 246	Concrete	32,500
Oakland Arm	1970, 1972	8'-0" - 9'-6"	16 - 62	288 - 350	Concrete	57,600
Avon Arm	1974	3'-0" - 4'-0"	10 - 41	14 - 31	Concrete	14,100
15 Mile Rd. Interceptor	1973, 1974, 1975, 1984	5'-0" - 11'-0"	12 - 68	32 - 274	Rein. Concrete	36,400
Edison Corridor	1969	12'-9"	60 - 108	213 - 555	Concrete	41,300

provides transport of wastewater for a portion of Macomb County. The capacity of this 41,300-foot long sewer is 823 cfs.

The Garfield/Romeo Interceptor was constructed in three major construction contracts from 1973 to 1999. The material of construction was concrete. The 7- to 11-foot diameter sewer provides transport of wastewater for a portion of Macomb County. The Romeo Arm extends from 15 Mile north along Hayes to 18 Mile Road. This sewer crosses the Price Brook, Eaton, Healy Brook and Nims Drains. The force-main portion of this sewer, which extends north from 18 Mile, and the Garfield Pump Station are being replaced by the construction of a large gravity sewer. Construction of this new Garfield Interceptor was completed in 2003. It has a capacity of 161 cfs.

The 15-Mile Road Interceptor was constructed in four major construction contracts from 1973 to 1984. The material of construction was reinforced concrete. This 5- to 11-foot diameter sewer provides transport of wastewater for a portion of Macomb County. This sewer is approximately 36,500 feet long.

The Avon Arm was constructed in 1974 from concrete. The 3- to 4-foot diameter metered sewer provides wastewater transport for portions of Macomb and Oakland counties. It is approximately 14,000 feet long.

Table 2.5 presents characteristics of the six major pipelines serving Macomb County and the Clinton-Oakland District of Oakland County. Table 2.6 presents a synopsis of the condition of these pipelines based on past inspection information. Profiles of these pipelines and additional information on the physical condition are presented in the technical memorandum *Interceptors and Trunk Sewers* that accompanies this report.

Major Pumping Stations

Table 2.7 presents characteristics of the three major pumping stations operated by DWSD and serving Macomb County and the Clinton-Oakland District of Oakland County.

Table 2.6: Sediment Deposits and Structural Needs

Trunk Sewer	Sediment Deposition	Spalling or Concrete Damage
Lakeshore Interceptor	*	*
Garfield/Romeo Interceptor	1,300'@12"	600'
Oakland Arm	*	*
Avon Arm	*	*
15 Mile Rd. Interceptor	2,600'@10-20"	*
Edison Corridor	1,750'@10"	

*No data indicating sediment or structural problems

Table 2.7: Characteristics of Major Suburban Pump Stations

Name	Location	Function	Sanitary Capacity		No. of Pumps
			Design	Maximum Installed	
Clintondale	3475 Union Lake Road, Mt. Clemens	Sanitary	80 cfs 52 mgd	120 cfs 78 mgd	3
Garfield	16650 21 Mile Road, Macomb Twp.	Sanitary—Closed in 2002	18 cfs 11.8 mgd	27 cfs 17.7 mgd	3
Northeast	11000 E. Eight Mile, Detroit	Sanitary	250 cfs 162 mgd	400 cfs 259 mgd	3

The Northeast Pump Station is located in Detroit, but serves Macomb County and the Clinton-Oakland Sewer District in Oakland County. It currently has a design capacity of 162 mgd, but a new pump, scheduled to be installed in 2004, will increase its design capacity to 259 mgd.

The condition and service life of these three pumping stations are further discussed in section 2.8.4 along with the other pumping stations that service the City of Detroit.

2.5 Pump Stations and Meters

2.5.1 Pump Stations

Detroit Water and Sewerage Department (DWSD) currently operates 14 pump stations. It also operates seven package stations on Belle Isle. One, Lighthouse Point, has a capacity less than one million gallons per day. It also operates seven package stations on Belle Isle. Figure 2.7 shows the location of these pump stations.

In December 2001, the Detroit Wastewater Partners, under contract to DWSD, conducted an inventory and evaluation of assets in the DWSD system. Included in this *Asset Audit Report* was an inventory of pump stations. The purpose of the asset audit is to assess the current and projected operational status of all significant system components, their state of repair, and their projected maintenance and replacement status.

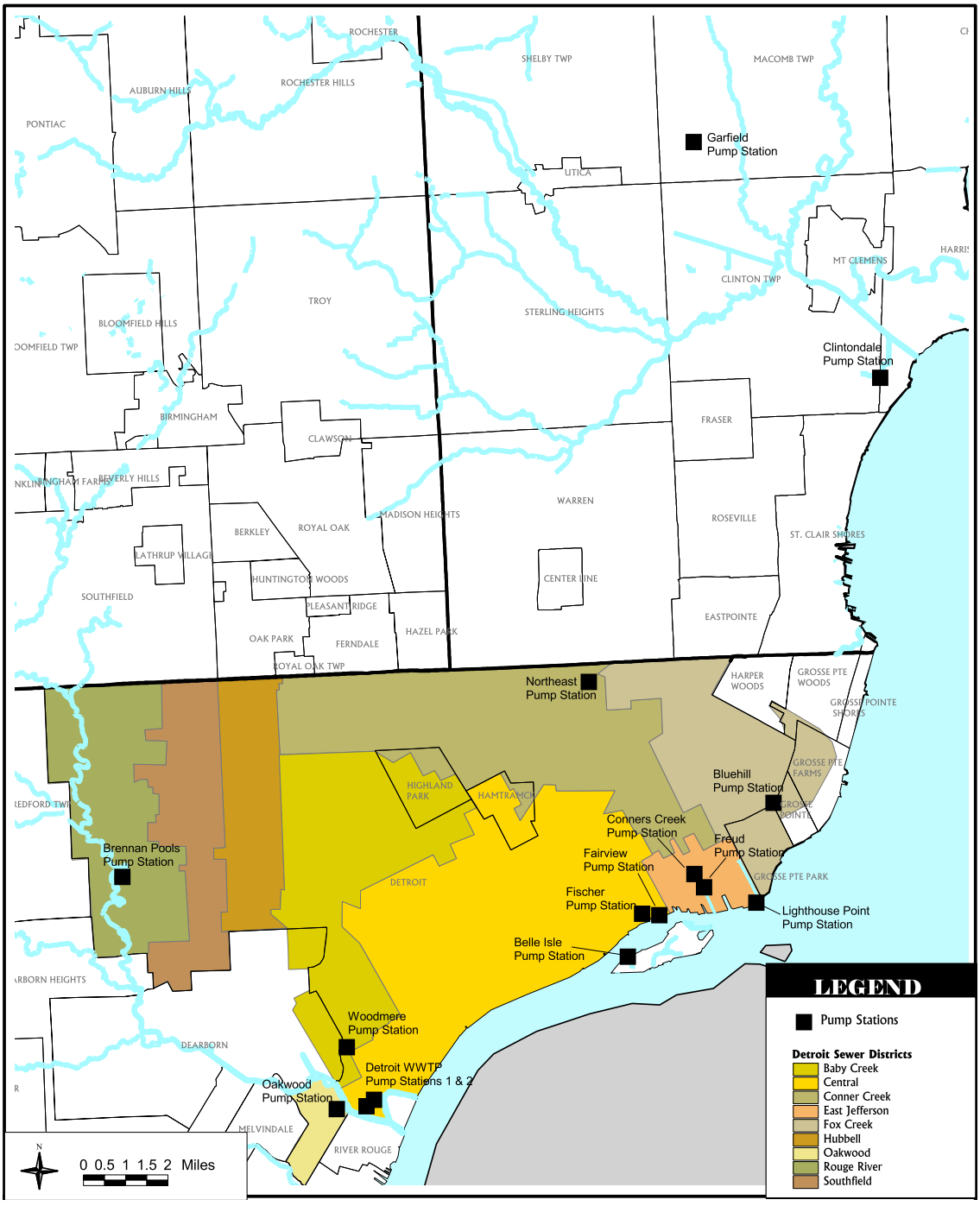
Age is a critical characteristic for assessing the need for replacement. Figure 2.6 shows a summary of the age distribution of pump station assets found in the *Asset Audit Report*. Full details of each pump station can be found in the technical memorandum *Wastewater Facility Inventory: Pump Stations and Meters* on the CD that accompanies this report.

A large proportion of the assets found during the inventory are older than 20 years. The significance of the age of the item varies with the type of system evaluated. While most electrical and mechanical components will have a recommended maximum life of 20 years, building components often typically last longer.

DWSD has already recognized the need for rehabilitation and replacement of critical pump station facilities and has been rehabilitating and replacing pump station components through its contracts. All pump stations except Brennon Pools have had either major pump rebuilds or rehabilitation contracts planned or underway in the past few years.

The *Asset Audit Report* evaluated the condition of each item in the pump stations and gave it a score. From the scores, each item was categorized by the size and complexity of the repair or rehabilitation,

Figure 2.7: DWSD-Owned Pump Stations in Service Area



and the time frame, as follows:

Size and Complexity:

- Light: Major maintenance and/ or light restoration
- Medium: Recommended rehabilitation and/ or medium restoration
- Major: Replacement and/ or major restoration

Time Frame:

- Immediate: Less than one year
- Short Term: Less than five years
- Long Term: Less than 10 years

The recommended rehabilitation/ repair/ replacement items are categorized according to mechanical, electrical, and structural/ building repairs, as follows:

Type of Rehabilitation/Repair/Replacement:

- Mechanical: Pumps, compressors, diminutors, boilers, furnaces, water heaters
- Electrical: Pump motors, generators, transformers, electrical panels
- Structural/ Building: Structural repairs on building and wet well, and mechanical fixed building items such as HVAC components, cranes, etc.

Table 2.9 shows the results of this analysis. The overall distribution of these results is shown in Table 2.8.

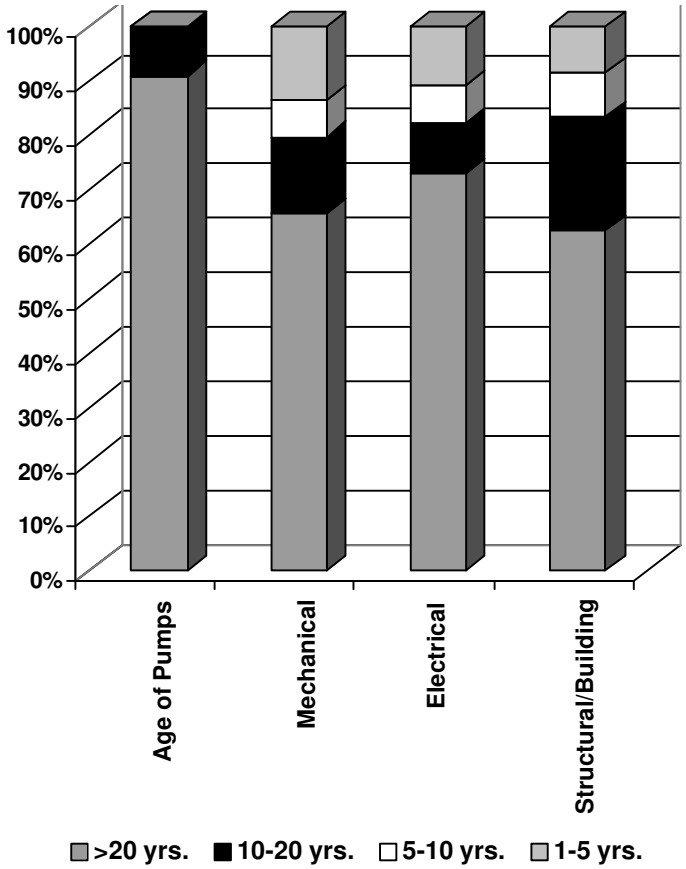
The *Asset Audit* identified a number of repairs that require immediate attention. A large proportion of the repairs are major projects. Also, a large number of mechanical and electrical components need to be rehabilitated, as opposed to structural/ building items. Further details on pump stations and meters can be found in the technical memorandum Wastewater Facility Inventory: *Pump Stations and Meters* on the CD which accompanies this Master Plan.

Table 2.8: Distribution of Pump Station Conditions

Analysis	Category	% of Total
Size/Complexity of Repair	Light	37
	Medium	22
	Major	41
Time Frame	Immediate	41
	Short Term	33
	Long Term	27
Type of Repair	Mechanical	42
	Electrical	37
	Structural/Building	21

Source: PC 744 Audit Report

Figure 2.6 Age Distribution of Pump Station Assets (2001)



Source: PC 744 Audit Report

Figure 2.8: DWSD Meters in Service Area

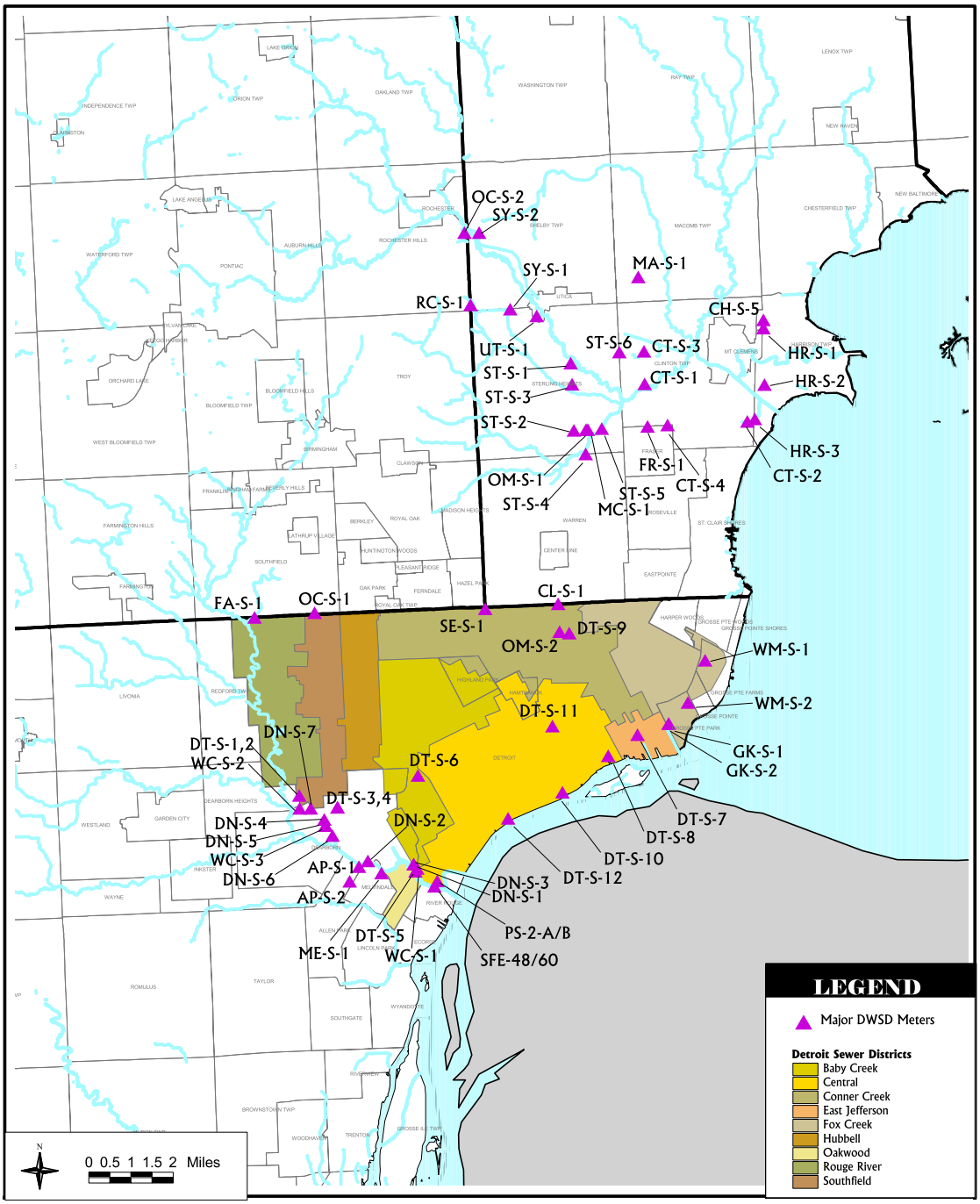


Table 2.9 Pump Station Repair Condition

Pump Station	Repair Type	Number of Items by Repair Category									Total	Total Items by Pump Station
		Mechanical			Electrical			Structural/Building				
		Immed.	ST	LT	Immed.	ST	LT	Immed.	ST	LT		
Belle Isle(Main and 7 Package Stations)	Light	0	5	0	1	0	0	0	0	0	6	
	Medium	3	6	0	0	0	0	0	2	1	12	46
	Major	5	1	5	0	0	8	4	0	5	28	
Bluehill	Light	0	4	0	4	0	0	0	0	0	8	
	Medium	5	0	1	2	4	0	2	1	0	15	32
	Major	1	1	0	0	0	5	1	1	0	9	
Brennan Pools	Light	0	1	0	0	0	0	0	0	0	1	
	Medium	1	1	0	0	3	1	0	0	0	6	9
	Major	1	0	0	0	0	0	0	1	0	2	
Clintondale	Light	2	1	0	0	0	0	0	0	0	3	
	Medium	1	0	0	0	4	0	1	0	0	6	12
	Major	0	1	0	0	0	0	0	1	1	3	
Conner Creek	Light	8	0	0	8	4	0	2	0	0	22	
	Medium	0	0	0	0	0	0	0	0	0	0	36
	Major	1	0	1	1	5	6	0	0	0	14	
Fairview	Light	0	0	0	0	0	0	1	0	0	1	
	Medium	0	3	0	0	0	0	1	3	1	8	25
	Major	2	0	8	0	0	4	0	0	2	16	
Fischer	Light	3	1	0	1	0	0	0	0	0	5	
	Medium	2	0	0	0	0	0	1	1	0	4	11
	Major	1	0	0	0	0	1	0	0	0	2	
Freud	Light	3	11	0	10	0	0	0	1	0	25	
	Medium	2	1	0	0	0	0	1	0	0	4	48
	Major	4	0	1	1		9	2	1	1	19	
Lighthouse Point	Light	1	0	0	0	0	0	0	0	0	1	
	Medium	0	0	0	0	0	0	0	0	0	0	4
	Major	2	0	0	1	0	0	0	0	0	3	
Northeast	Light	1	2	0	2	2	0	1	5	0	13	
	Medium	2	1	0	2	0	0	2	0	2	9	34
	Major	2	2	1	2	0	0	0	0	5	12	
Oakwood	Light	5	0	0	0	9	0	3	1	0	18	
	Medium	2	0	0	0	0	0	0	2	0	4	31
	Major	1	0	3	0	0	2	1	0	2	9	
Woodmere	Light	5	0	0	0	5	0	1	1	0	12	
	Medium	0	0	0	0	0	0	2	0	0	2	24
	Major	0	0	2	0	3	5	0	0	0	10	
	TOTAL	**66**	**42**	**22**	**35**	**39**	**41**	**26**	**21**	**20**	**312**	**312**

Source: PC 744 Audit Report

2.5.2 Meters and Instrumentation

DWSD maintains 65 major meters throughout its service area. Of these, 56 are important billing or flow-monitoring meters, seven are meters at the Wastewater Treatment Plant measuring incoming flow and two are meters at the plant that measure effluent flow. The locations of these meters are shown in Figure 2.8. A listing and description of these meters is found in Table 2.10 on the following pages.

Through the CS-1249 project (Greater Detroit Regional Sewer System Phase #3), CDM is monitoring, maintaining, and evaluating these meters as part of an ongoing program to upgrade the billing system. The list in Table 2.10 is derived from information gathered during this project.

Meter types are listed in the table and include parshall flumes, ultrasonic, magmeter, transit time, and weir installations.

DWSD is constructing a new region-wide instrumentation and control system under project PC-713. These facilities will be completed in 2007.

Table 2.10 Meters in the DWSD System

DWSD Meter No.	Meter Type	Community/District Served	Age in 2002 (Years)	GDRSS Condition Notes
AP-S-1	Transit Time	Allen Park	1	Interference causes scatter in velocity path readings, likely from entrained air (drop manhole upstream of meter).
AP-S-2	Magmeter	Allen Park	1	No significant issues.
CH-S-5	Parshall Flume	Chesterfield, Lenox, New Haven	11	No significant issues.
CL-S-1	Magmeter	Center Line	39	Meter cabinet hit by car. Meter reinstalled 7/16/01.
CT-S-1	Parshall Flume	Clinton Township (Oakland-Macomb Interceptor)	29	No significant issues.
CT-S-2	Parshall Flume	Clinton Township	27	Replaced failed Miltronic on 8/30/01.
CT-S-3	Parshall Flume	Clinton Township	26	No significant issues.
CT-S-4	Parshall Flume	Clinton Township	25	No significant issues.
DN-S-1	Parshall Flume	Dearborn: East	43	Gate controlling flow to pump station is not fully closed so flow goes through P.S. and flume. New downlooker installed.
DN-S-2	Magmeter	Dearborn: West	39	2 phone line failures in 2001 - repairs made 10/2/01.
DN-S-3	Herschell Hollow Crest Weir	Dearborn: East	43	Gate controlling flow to pump station is not fully closed so flow goes through P.S. and flume. New downlooker installed.
DN-S-4	Magmeter	Dearborn: North Central	1	No significant issues.
DN-S-5	Magmeter	Dearborn: North Central	1	7/01 - Telog failed and was replaced. Backwater problems during rain events.
DN-S-6	Parshall Flume	Dearborn: North Central	22	Flume clogged - cleaned on 10/2/01 and 1/21/02. Data gaps due to power disconnects.
DN-S-7	Parshall Flume	Dearborn: North Central	17	Data gap, reprogrammed Telog 10/15/01. Flume clogged - cleaned on 12/15/01.

Table 2.10 Meters in the DWSD System (continued)

DWSD Meter No.	Meter Type	Community/District Served	Age in 2002 (Years)	GDRSS Condition Notes
DT-S-1_2*	Transit Time	Rouge	6	Electronic board repaired 11/01.
DT-S-10*	Transit Time	Central City	5	Clocks needed resetting. No other significant issues.
DT-S-11*	Transit Time	Central City/Conner Creek	6	Enclosure needs replacement. Flow & level discrepancies between Accusonic & Telog.
DT-S-12*	Transit Time	Central City	6	No significant issues.
DT-S-3_4*	Transit Time	Hubbell/Southfield	6	No significant issues.
DT-S-3_4*	Transit Time	Hubbell/Southfield	6	No significant issues other than sediment interference.
DT-S-5*	Transit Time	Baby Creek	6	No significant issues. Flow & level discrepancies between Accusonic & Telog.
DT-S-6*	Transit Time	Baby Creek	6	Transducer and new barrier installed in 2001.
DT-S-7*	Transit Time	Conner Creek	5	No significant issues other than level discrepancies from downlooker interference.
DT-S-8*	Transit Time	East Side/Grosse Pointe Park/Milk River	6	No significant issues. Flow & level discrepancies between Accusonic & Telog.
DT-S-9*	Transit Time	Conner Creek	4	No significant issues.
FA-S-1	Parshall Flume	City of Farmington	45	No significant issues.
FR-S-1	Parshall Flume	Fraser	29	No significant issues.
GK-S-1	Parshall Flume	Grosse Pointe Park	40	No significant issues.
GK-S-2	Venturi	Grosse Pointe Park	57	No significant issues.
HR-S-1	Parshall Flume	Harrison Township	28	No significant issues.
HR-S-2	Parshall Flume	Harrison Township	28	No significant issues.
HR-S-3	Parshall Flume	Harrison Township	27	No significant issues.
MA-S-1	Magmeter	Macomb Township	26	No significant issues.
MC-S-1*	Transit Time	Macomb Sanitary District	1	New, no significant issues other than sediment buildup near or above velocity path 1.
ME-S-1	Magmeter	Melvindale	10	Incorrect scaling on Telog. Scale corrected 11/13/01 and data corrected .
OC-S-1	Ultrasonic	Evergreen-Farmington Sanitary District	10	New totalizer installed and other repairs made in 2001.
OC-S-2	Parshall Flume	Clinton-Oakland Sanitary District	30	Improper hydraulic conditions - being redesigned.

*Indicates flow-monitoring meter. All others are billing meters.

Table 2.10 Meters in the DWSD System (continued)

DWSD Meter No.	Meter Type	Community/District Served	Age in 2002 (Years)	GDRSS Condition Notes
OM-S-1*	Transit Time	Clinton-Oakland Sanitary District/Macomb Sanitary District	1	New.
OM-S-2*	Transit Time	Clinton-Oakland Sanitary District/Macomb Sanitary District	5	No significant issues.
RC-S-1	Parshall Flume	Rochester Hills	29	No significant issues.
SE-S-1	Magmeter	Southeast Oakland Sanitary District	38	No significant issues.
ST-S-1	Parshall Flume	Sterling Heights	?	No significant issues other than calibration.
ST-S-2	Parshall Flume	Sterling Heights	?	No significant issues.
ST-S-3	Parshall Flume	Sterling Heights	?	No significant issues.
ST-S-4	Parshall Flume	Sterling Heights	?	No significant issues.
ST-S-5	Parshall Flume	Sterling Heights	29	No significant issues.
ST-S-6	Parshall Flume	Sterling Heights	26	No significant issues.
SY-S-1	Parshall Flume	Shelby Township	28	No significant issues.
SY-S-2	Ultrasonic	Shelby Township	20	Temporary Sigma meter installed (5/2/01) upstream. Ave flow 0.79cfs, max 1.47cfs.
UT-S-1	Parshall Flume	Utica	29	No significant issues.
WC-S-1	Multi-Path Transit Time	Wayne County Rouge Valley Sanitary District	5	No significant issues.
WC-S-2	Single-Path Ultrasonic	Wayne County Rouge Valley Sanitary District	11	Wayne County planning to replace meter.
WC-S-3	Single-Path Ultrasonic	Wayne County Rouge Valley Sanitary District	11	Inaccurate readings observed. Wayne County planning to replace meter.
WM-S-1	Magmeter	Northeast Wayne County	40	Meter readings off 2-3% - awaiting ABB report. No other problems.
WM-S-2*	Transit Time	Grosse Pointe/Grosse Pointe Farms	6	No significant issues.
WWTP		Central City/Oakwood		

*Indicates flow-monitoring meter. All others are billing meters.

2.6 Wholesale Customer Collection and Conveyance Facilities

A detailed review of the facilities owned and operated by the wholesale customers of DWSD is beyond the scope of this Master Plan. However, an overview is presented below of the major elements of the wholesale customer systems that are critical in delivering flow to the DWSD system.

Wayne County owns and operates 93 miles of interceptors tributary to the DWSD regional sewer system. The Wayne County interceptors vary in size from 24 to 78 inches in diameter. The county has 27 inverted siphons within its collection and conveyance system and there are three billing meters and 25 non-billing meters. Wayne County also owns one section of the Northwest Interceptor, the reach along Ford Road from Evergreen Road to Southfield Road.

Macomb County Wastewater Disposal District owns and operates the Chesterfield Interceptor and the Lenox Pump Station. The Chesterfield Interceptor is a two foot diameter reinforced concrete sewer that extends northward from the Lakeshore Interceptor for approximately 13,000 feet. The Lenox Pump Station has two flow meters and a capacity of 2.6 cfs. DWSD operates two pump stations that serve Macomb County; Clintondale Pump Station, 80 cfs capacity with ultimate capacity of 120 cfs, and Northeast Pump Station, with a capacity of 300 cfs. The Garfield Pump Station will be abandoned when the Garfield Interceptor is completed in August 2002.

Oakland County operates three sewer districts that serve portions of Oakland County.

- The Clinton-Oakland District: In this district are the Elizabeth Lake Pump Station, Paint Creek Interceptor and the Clinton-Oakland Interceptor. In addition, the new Oakland Avenue Septage Unloading Facility is in this district.
- The Evergreen-Farmington District: In this district are the Murwood Pump Station, Evergreen Interceptor, Farmington Interceptor, Lathrup Village Retention Basin, Walnut Lake Pump Station, Eight Mile and Evergreen emergency overflow structure, the septage receiving station at Eight Mile Road and the Birmingham, Bloomfield and Acacia Park Retention Basins.
- The Southeast Oakland Disposal District: In this district are the Dequindre Interceptor, George W. Kuhn Retention Basin, North Arm Interceptor, 12 Towns Drains and the septage receiving station at the George W. Kuhn Retention Basin.

The City of Farmington Sewer District serves the City of Farmington. The major facility in this district is the Farmington Equalization Basin.

Additional information on facilities in each district can be found on the technical memorandum *Descriptions of Sewer Districts* on the CD which accompanies this Master Plan.

2.7 Wholesale Customer Wet Weather Control

There are substantial wet weather control facilities that are owned an operated by DWSD's suburban customers. These facilities are critical in managing regional wet weather flows and protecting water quality.

Wayne County owns and operates a number of wet weather flow facilities. Lift Station 1 located in Dearborn Heights on Hines Parkway Drive just west of Evergreen Road was completed in 1999 to pump flows from the Middle Rouge Interceptors (Middle Rouge Relief Interceptor and the Middle Rouge Parkway Interceptor Extension) into the Northwest Interceptor during periods of high wet weather flow when the hydraulic grade line in the Northwest Interceptor precludes gravity discharge of the county's contract capacity to the Northwest Interceptor.

Wayne County has 20 combined sewer overflow regulators and a 2.2 million-gallon storage basin

on the Inkster Arm. The county is a co-permittee on three CSO storage/ treatment basins. These three facilities were constructed within the last five years.

Table 2.11 on the following page describes CSO facilities and equalization basins in the DWSD Service Area.

Table 2.11: Wholesale Customer Wet Weather Flow Control Facilities

Location	Operating Authority	Storage Capacity (MG)	Basin type
Oakland County			
Acacia Park	Oakland Co. Drain Commissioner	4	CSO
Birmingham	Oakland Co. Drain Commissioner	5.5	CSO
Bloomfield Village	Oakland Co. Drain Commissioner	10	CSO
George W. Kuhn (Twelve Towns)	Oakland Co. Drain Commissioner	62	CSO
Lathrup Village	City of Lathrup Village	3	Equalization
Farmington	City of Farmington	3.2	Equalization
Wayne County			
Redford Township	Wayne Co. Dept. of Environment	1.7	CSO
Inkster	Wayne Co. Dept. of Environment	2 (plus 1.1 MG first flush)	CSO
Dearborn Heights	Wayne Co. Dept. of Environment	2.7	CSO
Milk River	Inter-County Drainage Board (Wayne-Macomb Counties)	19	CSO
Livonia	City of Livonia	2.2	Equalization
Wayne	City of Wayne	2.3	Equalization
Middle Rouge	Western Townships Utility Authority (Northville & Plymouth Twps., Plymouth, Canton)	7.8	Equalization
Lower Rouge	Western Townships Utility Authority (Canton)	5.5	Equalization
Macomb County			
Martin	Southeast Macomb Sanitary District	8.6	CSO
Chapaton	Southeast Macomb Sanitary District	28	CSO

2.8 Detroit Collection & Conveyance

Detroit is served by wastewater collection and transport facilities that include various kinds of pipeline, such as service connections, lateral sewers, trunk sewers and interceptor sewers along with pumping stations, control structures, and outfalls. The wastewater flow is picked up at the service connection, flows through the lateral, trunk and interceptor sewers (where it is joined by suburban flow) ultimately arriving at the Detroit Wastewater Treatment Plant.

The collection system serving Detroit is primarily combined sewers and consists of over 3,800 miles of public lateral and trunk sewers in four maintenance districts. Catch basins connected directly to the collection system drain over 4,000 miles of streets and alleys. Nearly two-thirds of the city's service area is drained by gravity under non-storm conditions. The remaining third requires pumping.

Detailed information on the Detroit collection system can be found on the technical memorandum *Lateral and Connector Sewers* on the CD which accompanies this report.

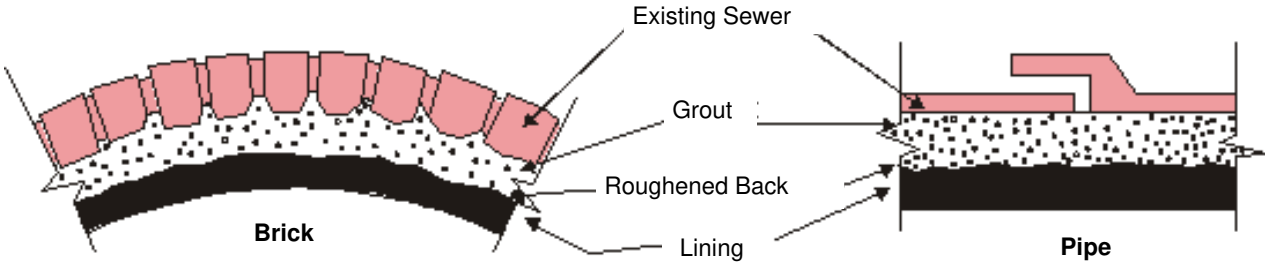
2.8.1 Construction Material History

The collection system was constructed over a period of 140 years as Detroit grew from a settlement to a metropolitan area. The purpose of this section is to review the sizes, shapes and material types of the sewers in the City of Detroit. The principle material types we will be discussing include: brick, stone, vitrified clay, glazed vitrified clay, monolithic concrete, and reinforced concrete sewers.

The construction standard for public sewers installed from 1836 to 1910 was brick. Figure 2.9 shows a cross section of a typical brick sewer. Until 1892, laterals were also constructed of brick. The first public sewer was constructed in 1836, when Savoyard Creek, which flowed from Cadillac Square to the foot of First Street was enclosed. This arch sewer was constructed of stone and brick (3'-6" x 4'-6") and is still used for the greater portion of the original length. Sixty-six percent (129 miles) of the public sewers built through 1910 are egg-shaped in cross section. Until 1885, a non-standard oval shaped egg section was popular. After 1885, a standard egg section was adopted. Repairs generally consisted of restoration of the cross section and lining the interior with a second ring of brick. Later, public sewers were built of two-ring brick. The largest ones were built of three-ring brick.

The laterals were mostly 15" x 20" egg-shaped conduits with some 18" x 24" in size. Many sewers were constructed before streets were in place so the sewers were built in long reaches with few manholes. Junctions and connections to the public

Figure 2.9: Cross Sections Showing Installation of Lining Materials in Sewers



sewers were constructed by angling and dropping the line of construction to the grade of the public sewer. In 1892 a change of materials for small lateral sewers was made. Glazed vitrified clay (glazed VCP or "crock") pipe was introduced and manholes and lampholes were provided for lateral sewers. Lampholes were built of glazed VCP set vertically as a tee and were located at the ends of the line and at changes of direction and grade to provide a means of inspection, ventilation, and flushing.

In the following 20 years, the wastewater collection and transportation system expanded rapidly as extensive areas were annexed into Detroit. Through 1920, most of the public sewers were constructed of brick and were less than seven feet in diameter. In 1926, when the interceptor concept was implemented, monolithic concrete construction was introduced and quickly became the standard for large sewers.

Laterals were constructed using such refinements as "pounded" backfill in the main streets; 25 to 30 foot drop manholes with a water cushion at the entry to the public sewers; and concrete encasement under trolley tracks and around lateral angles and drops. Concrete pipe gradually superseded glazed VCP pipe. By 1930 it represented half of new lateral construction.

Conner Creek and Fox Creek were enclosed in 1929 and 1930 respectively, with flow diverted to the DRI upstream of Fairview Pumping Station. By 1930, parts of the East and West Jefferson Avenue Relief Sewers had been completed to intercept and convey storm flow generated on the east side of Detroit to the Conner Creek Pumping Station.

In the early 1930s, the Federal Emergency Administration of Public Works (FEAPW) administered a program of public sewer cleaning and repair of older sewers. This program generally consisted of restoration of cross sections, lining interiors with an additional ring of brick, grouting cracks, and rebuilding old sewers having timber inverts. Work at outfalls was coordinated by the Detroit Department of Public Works (DPW) in conjunction with the construction of sewer overflow regulator chambers for the DRI.

Interceptor and wastewater treatment plant construction were underway in the years 1935 through 1940. In 1940 the Detroit River Interceptor, the Oakwood-Northwest Interceptor, and the original Detroit primary wastewater treatment plant were completed.

The Depression and World War II limited public sewer construction between 1930 and 1945. Some lateral sewer manhole construction along problem reaches of laterals was accomplished with the aid of WPA or PWA funding. Short lateral relief sections were constructed as needed. The major combined sewer relief program was introduced in 1945 and has continued to date. Typically, homes constructed after 1945 were connected to laterals installed 20 to 25 years earlier.

The Detroit collection system was expanded to the present city limits by 1951. Construction continued under the combined sewer relief program during this period. A minimal amount of construction was by the open-cut method. Reinforced concrete pipe was also jacked into place for smaller sizes. Brick was used for special sections in smaller sewers or where connections to existing sewers were made.

By 1975, lateral sewer construction had been completed in the last undeveloped areas and in the inner-city urban renewal and rehabilitation areas. Short lateral sections and replacement sewers were constructed as needed.

2.8.2 Data Sources for Condition Assessment

The information in this report was derived from review of previously compiled TV tapes, extracting information from the paper files of previous

Figure 2.10: Detroit Sewer System Districts

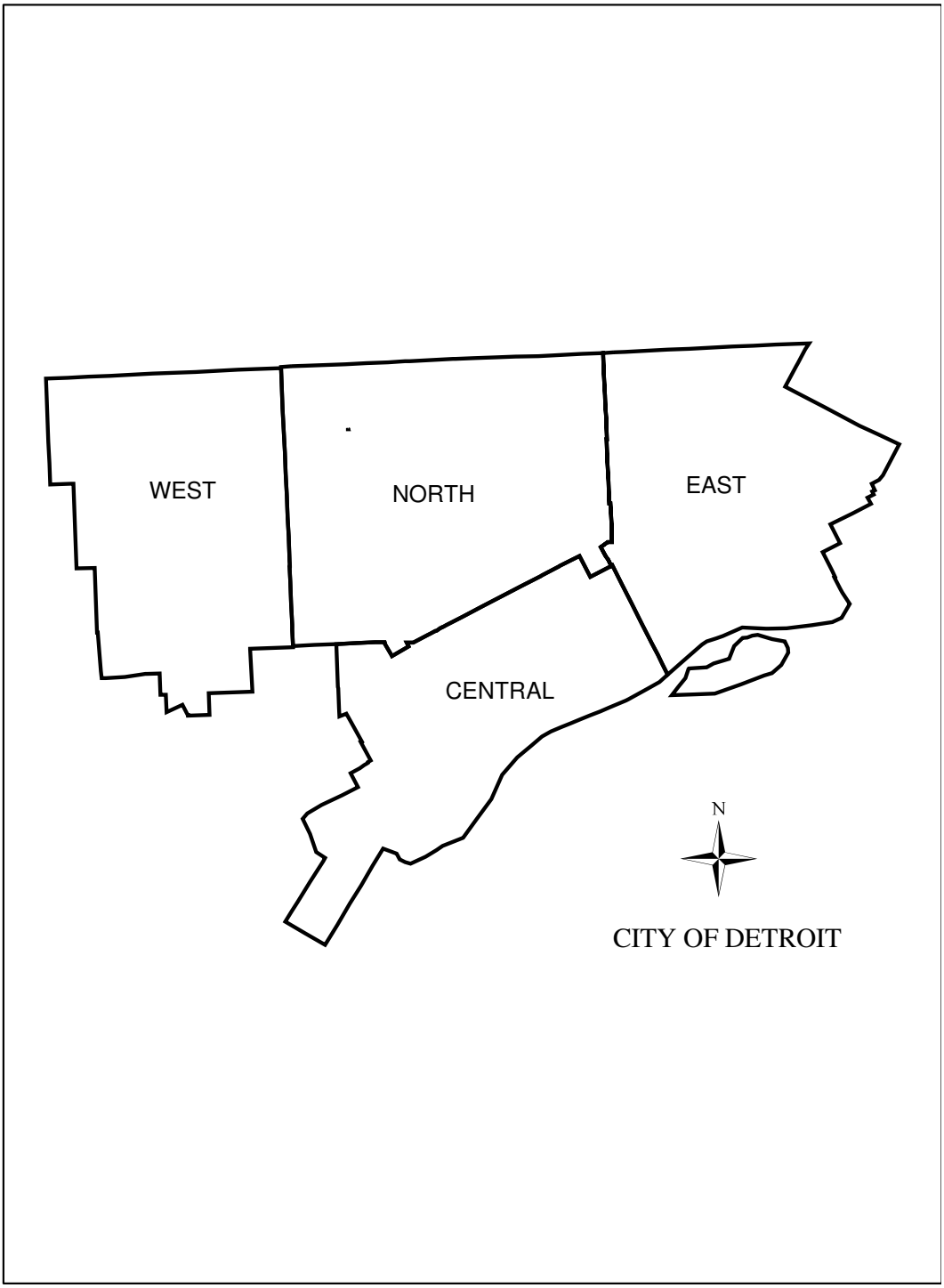


Figure 2.11: Detroit Sewer System West District

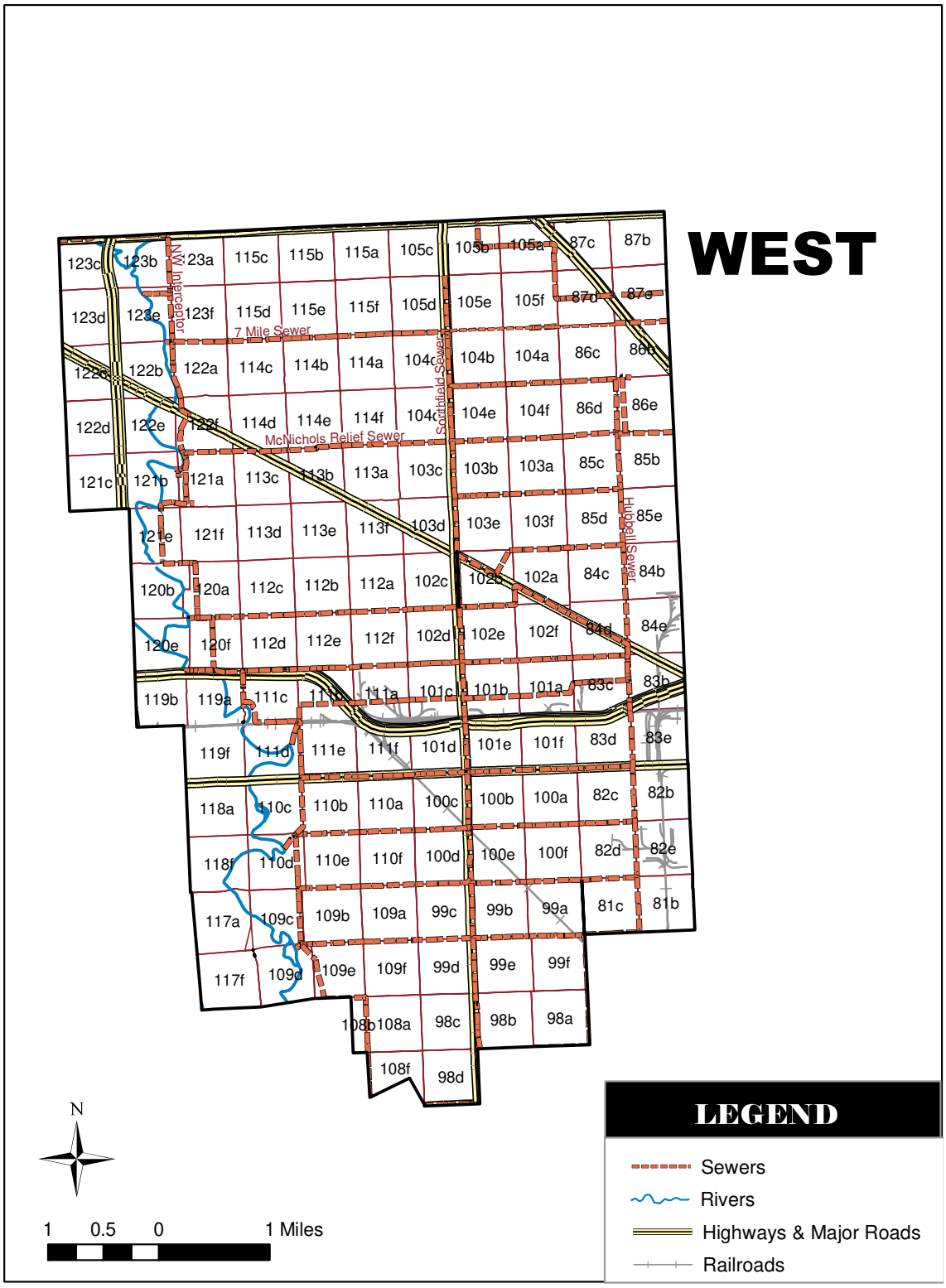


Figure 2.12: Detroit Sewer System North District

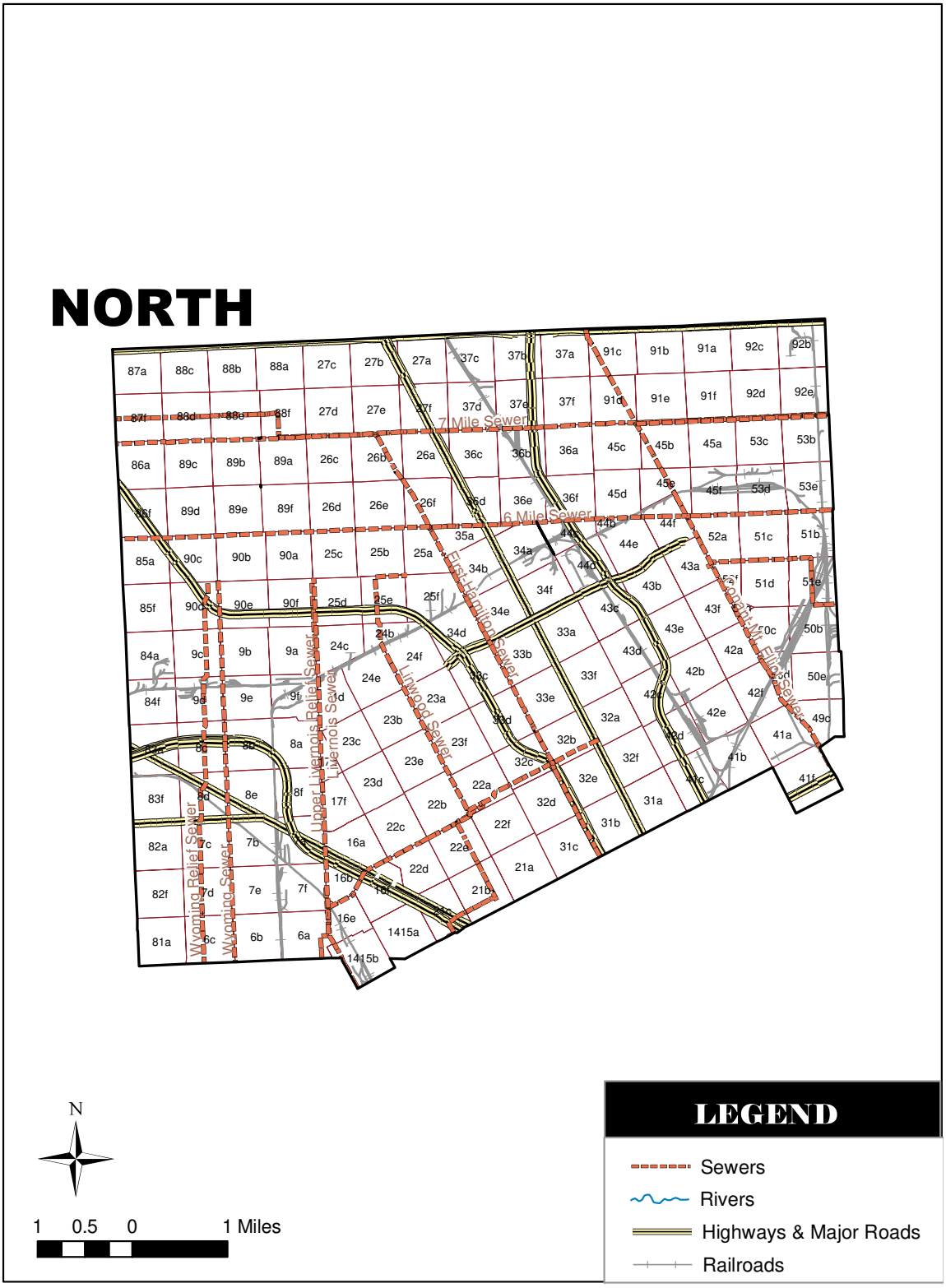


Figure 2.13: Detroit Sewer System East District

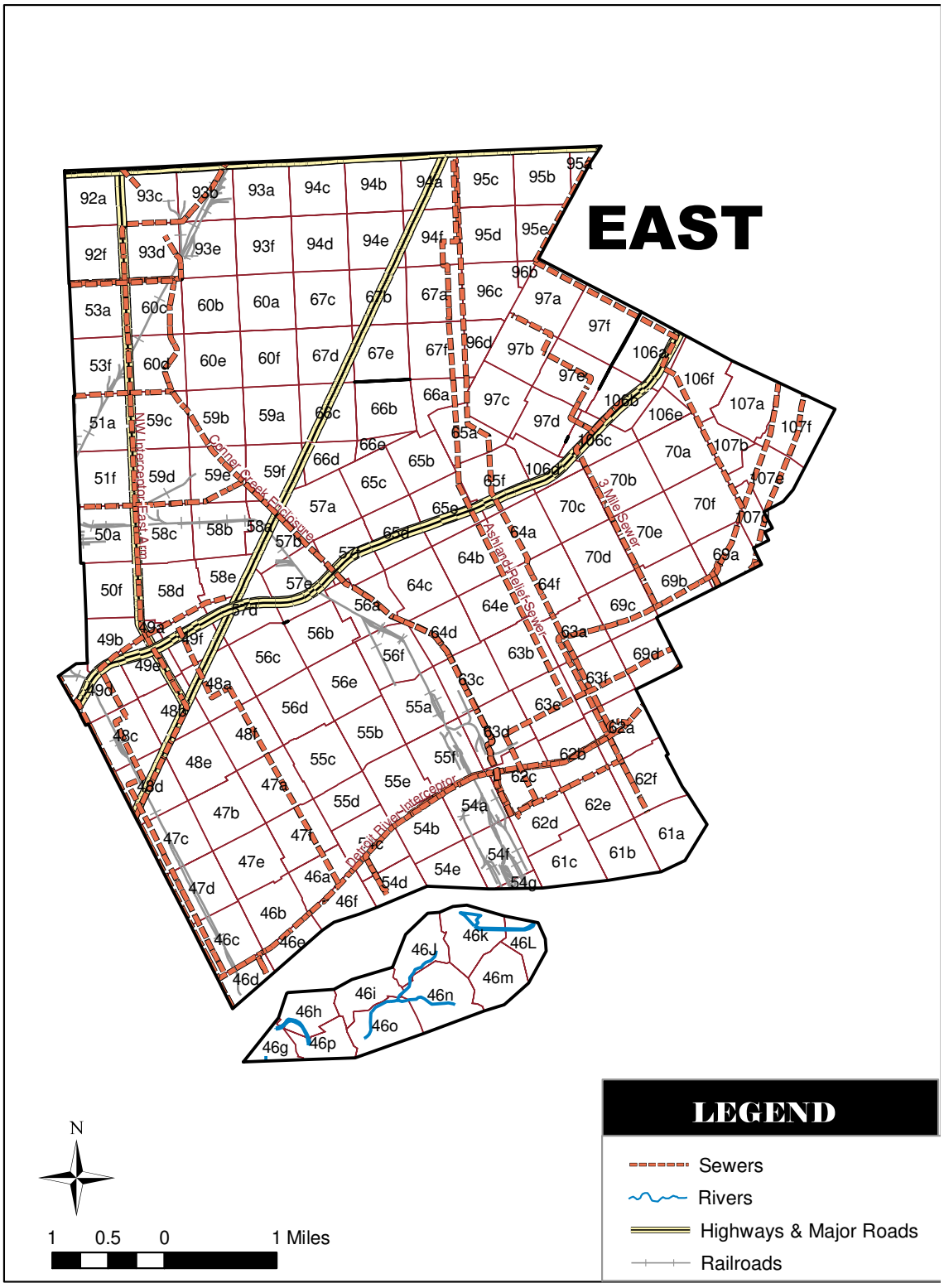
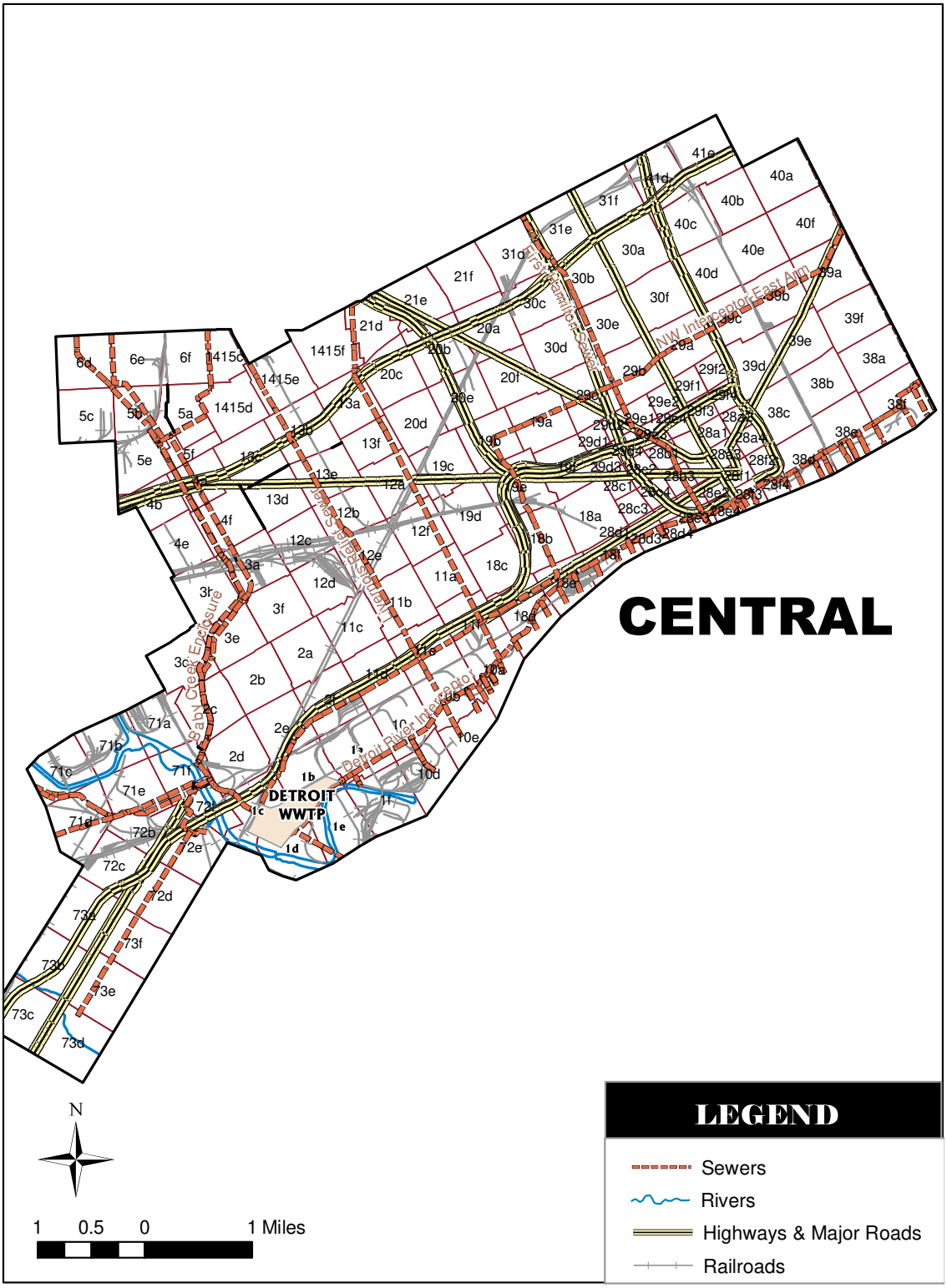


Figure 2.14: Detroit Sewer System Central District



TV inspections, reviewing construction drawings, reviewing sewer maps, extracting data from the WOTS (Work Order Tracking System), excerpts from the existing DWSD computerized sewer maps, excerpts from previous studies, interviews and field observation. The basis for the recommendations in this report are derived from the findings under past and current conditions and are intended to help develop an effective management approach to maintaining continuous, uninterrupted sewer service to the citizens and establishments of the City of Detroit for the existing sewer system.

The existing map records for the Detroit sewer collection system are divided into the four Maintenance Districts shown in Figure 2.10. Individual districts are shown in Figures 2.11 to 2.14. A representative group of map pages were selected for analysis, identified and targeted for the data collection. They were picked at random and provide a good cross-section of the conditions of the lateral sewer system.

2.8.3 Sewer System Terminology

The following terms are defined:

Service Connection — A pipe that carries the wastewater flow from a customer facility to a point where it is joined to the public sewer system. This joining may be in the form of a manufactured plumbing piece (such as a Y or a T), or a custom-made opening in the public sewer main where the customer's pipe penetrates the lateral sewer.

Lateral Sewer — A sewer that collects flows from home and business service connections and transports it to a trunk sewer. Lateral sewers have few or no other common sewers tributary to them. There are over 2,200 miles of lateral sewers in the city's collection system.

Connector Sewer — A pipe that connects more than one lateral sewer to a trunk sewer, a pipe that connects one region of lateral sewers to another, or one region of lateral sewers to a trunk sewer. These pipes are generally 24" to 48" diameter in size and are considered as intermediate transports to the trunk sewer system.

Trunk Sewer — A sewer that receives flow from lateral and connector sewers and sends the flow to an interceptor. These sewers have limited service connections.

Interceptor Sewer — A large diameter, deep sewer that receives flow from a number of trunk sewers and transports the flow to the WWTP. Service connections to these sewers are not typical. There are three interceptor sewers (typically called the "common use" interceptors) serving Detroit: the Detroit River Interceptor (DRI), the North Interceptor - East Arm (NI-EA) and the Oakwood Northwest Interceptor (ONWI).

Combined Sewer — A sewer that carries both wastewater and storm water flows. Combined sewers are found primarily in older, urban systems in the Northeast and upper Midwest of the United States. Combined sewer systems were built up until the 1950s.

Force Main — A pressurized pipeline carrying wastewater pumped by a sewage pump station. Typically sewage flows by gravity to a pump station and is then transported through a force main to another, higher location.

Outfall — The sewer pipe where a combined sewer discharges into a lake or river. Detroit has 32 outfalls on the Rouge River and 46 outfalls on the Detroit River. Combined sewage is discharged through these outfalls during heavy rains to prevent backups in residential basements or on streets. Each outfall is listed in the NPDES discharge permit issued to the City of Detroit.

Separate Sanitary Sewer — A sewer that carries sanitary and permitted industrial wastes but is not designed to carry storm water flows. Minor quantities of ground water, storm water and surface

water can enter a sanitary sewer unintentionally through defects in the pipeline.

Sewer Separation — Replacing a combined sewer with a separate sanitary sewer pipe and a storm sewer pipe. The sanitary sewer pipe flow is transported to the wastewater treatment plant and storm sewer flow is discharged directly to a drain or river, without treatment.

Sewer Condition Grades — Sewer condition grades developed for the Master Plan are divided into four categories:

Excellent: Pipe is clean, fully functional, structurally sound, properly aligned, service connections intact, and without evidence of corrosion or cracking. These pipes could still have their full useful life.

Good: Pipe is free of obstacles and noticeably clean but may show occasional signs of slight cracking. No open joints are evident and most sections are properly aligned. Service connections are reasonably intact, and little or no evidence of corrosion appears. These pipes may have 75 percent of their functional life remaining.

Fair: Pipe will need to be inspected again in 10 years and has less than 50 percent of its useful life remaining. Minor to moderate infiltration is occurring. Some evidence of corrosion may be seen on pipe walls. Occasional cracks have opened enough to allow roots to penetrate. An occasional dip in the pipe may be allowing sedimentation to build, slightly reducing capacity.

Needs Investigation: Structural cracks appear in two of every three sections of pipe. Some cracks and joints are noticeably allowing exfiltration and infiltration. These pipes need to be placed on an annual watch and replacement/ repair will be needed in 10 to 20 years. An occasional obstruction may be reducing the pipe's capacity significantly. Occasional pieces of pipe may be missing. Corrosion is so severe that the core of the pipe wall is visible. Collapse is inevitable and attempting to perform maintenance cleaning could further impede the ability to restore service flow. Repair/ replacement needs to be planned immediately.

Sewer types and lengths in the DWSD system are shown in Figure 2.15.

2.8.4 Assessment

Table 2.12 shows the conditions of lateral sewer gleaned from records reviewed in the DWSD field engineering office. The Master Plan team has evaluated conditions based on inspections of records for over 1,200 sewers in the last 15 years.

2.8.5 Typical Sewer Problems

Sewers are damaged and flow is disrupted for a variety of reasons. Typical reasons are discussed here and shown in Table 2.13.

Figure 2.15: Estimated Sewer Type and Length in DWSD System

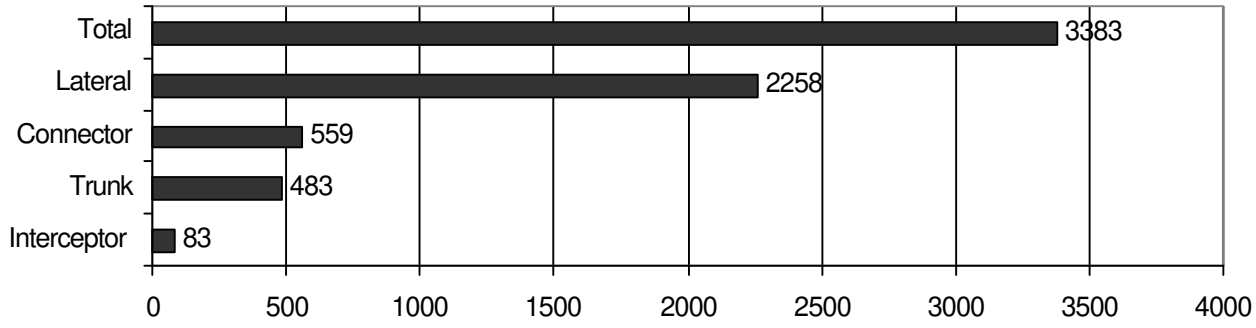


Table 2.12: Lateral Sewer Segment Conditions

	North		West		East		Central		Total	Percent of Total
Segments inspected	166		178		165		128		637	100%
Excellent	9	5.40%	7	3.90%	16	9.70%	6	4.70%	38	6.00%
Good	74	44.60%	95	53.40%	105	63.60%	67	52.30%	342	53.80%
Fair	63	38.00%	48	27.00%	30	18.20%	32	25.00%	174	27.30%
Needs Investigation	20	12.00%	28	15.70%	19	11.50%	20	15.60%	87	13.70%

Roots

The lateral sewers located near terraces and in alleys or vacated alleys appear to be affected by tree roots that have entered through cracks and joints, more than any other lateral sewers. Deeper (more than 15 feet deep) lateral sewers did not have as many root problems.

Off-Set Joints

If the pipe sections are not properly seated, the alignment of the pipe from one section to another can change. These alignment changes at pipe joints or "off-sets" are sometimes caused by ground freezing and thawing, vibration from nearby construction, or effects from a leaking sewer that changes the stability of the backfill in the pipe's trench.

Sedimentation

Sedimentation is a buildup of material in the inverts of sewers. It is most often caused by grit — the heavy suspended inorganic matter present in water or wastewater, such as sand, gravel, cinders — heavy organic matter or soil entering the pipe through cracks or open joints.

Corrosion

Corrosion is the deterioration of sewers through chemical action or mechanical abrasion. Samples of concrete from a Detroit sewer more than 50 years old revealed that deterioration was occurring. The presence of iron oxide and calcium hydroxide through the material indicated the acid nature of the wastewater had corroded the pipe. Also, inspection of a 54-inch elliptical sewer showed a strong presence of acidic activity on the iron frame and lid, suggesting the presence of hy-

Table 2.13: Typical Sewer Pipe Problems in Detroit

Problem	Causes
Root Growth	Roots penetrating through pipe joints and broken pipe sections.
Off-Set Joints	Ground movement and pipe joints cause debris buildup.
Sedimentation	Broken pipe allows soil to be washed into pipe.
Corrosion	Corrosion or breakdown erode of pipe structure. "Bottomless" Pipe.
Obsolete Material	Orangeberg Pipe is a discontinued product due to poor performances and design life. Pipe crumbles during normal cleaning.
Infiltration	Groundwater penetrates pipe joints and cracks.
Exfiltration	Effluent escapes pipe to contaminate surrounding soil.
Structural Cracks	Material fatigue, changes in support of the backfill around pipe.
Undersized Sewers	Sewers inadequately sized to carry current flows.
Grease	Grease build-up on sewer walls attaches itself to other debris causing blockage.
Odor	Sewer gases.
Adverse Soil Conditions	Improper or disturbed pipe bedding creates excessive soil pressure, causing infiltration of fine soils. Pipe can also bend or collapse due to inadequate bedding support.
Utility Interference	Installation of utilities can disturb existing sewers. For example, directional drilling errors can damage sewers.

drogen sulfide. This could cause the lid to rust to the frame, preventing access.

Obsolete Material

Obsolete Material refers to pipe products that are discontinued due to poor performance or improper design. One example is Orangeberg Pipe which is a trade name for a discontinued brand of pipe that has a tendency to crumble during cleaning, well before the useful life of normal pipe material.

Infiltration

Infiltration is the excessive flow of groundwater into sewers through leaking joints, cracks, or deteriorated manholes or other structures. Footing drains connected to the sanitary or combined sewers can also be a major source of infiltration.

Exfiltration

Exfiltration is sewage that escapes from sewer pipes through open joints or cracks. It can cause environmental and health hazards if it reaches ground surface or a watercourse. In many instances in Detroit, exfiltration has mixed with the fine aggregate making a slurry type soil material that can flow back into the sewer creating a potential blockage.

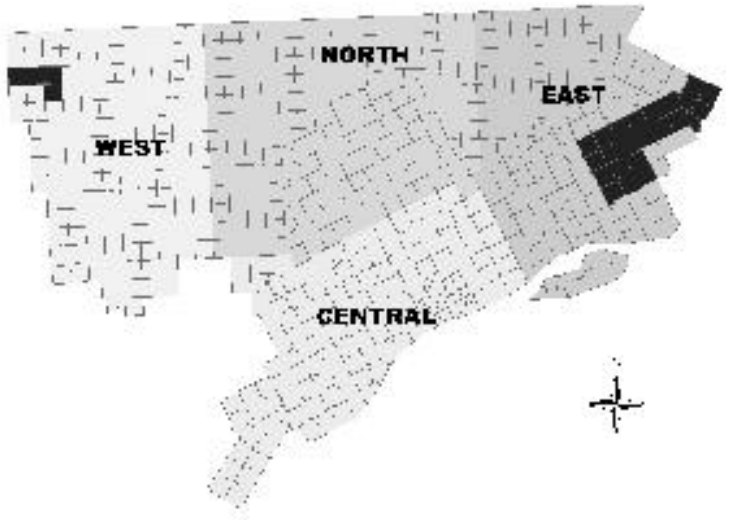
Structural Cracks

Structural Cracks are imperfections in sewer pipe structural integrity that can allow infiltration, and in severe cases lead to complete collapse of the conduit. In older sewers, longitudinal "stress" cracks are seen at the top or on the side of the pipe wall.

Undersized Sewers

Undersized Sewers are pipes whose hydraulic capacity is less than the flows that they are required to carry. Sewers may have been undersized due to original design or due to additional service area being added that was not planned for. The darkest portions of Figure 2.16 show districts in Detroit where undersized sewers are a problem.

Figure 2.16: Undersized Sewer Areas in Detroit



Grease

Grease is often generated as a byproduct from food preparation establishments. If it is not trapped before it enters the public sewers, it will often lodge against pipe walls or other debris potentially creating a solid obstruction to the wastewater flow.

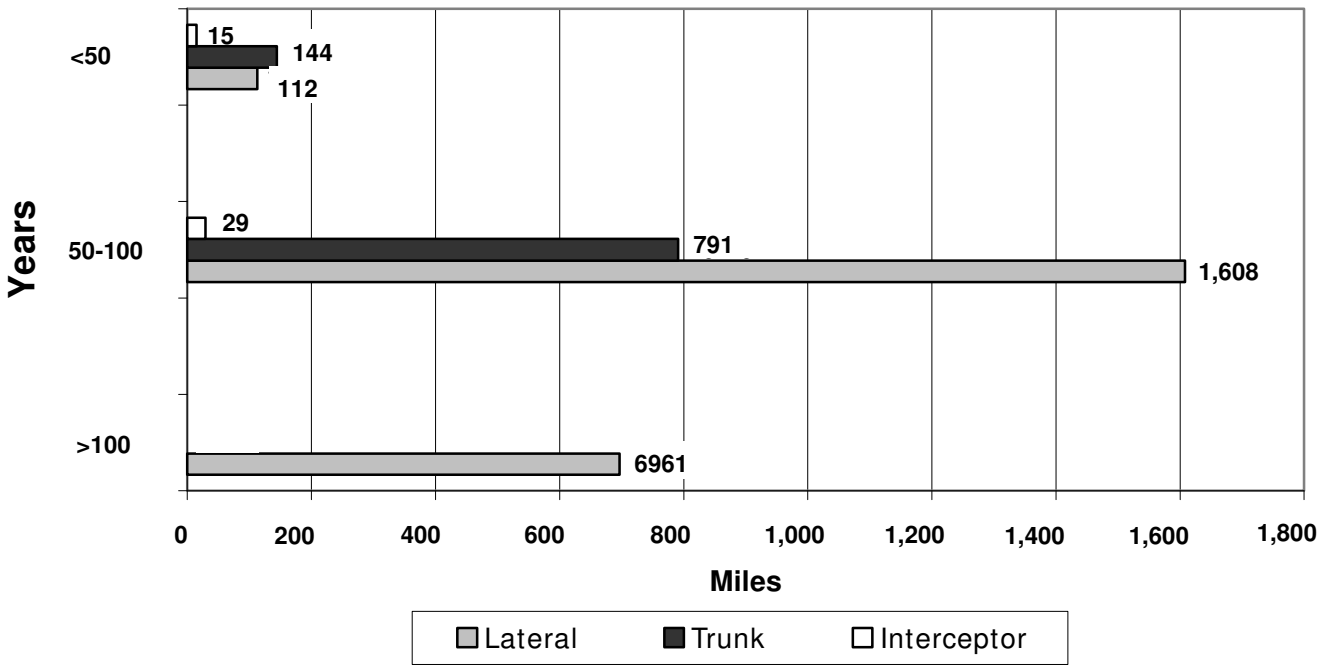
Odor

Odor is commonly found where there is venting of gas through existing openings in the public or private system. The sewer gas is most often found where debris can build up and begin to decompose, or where obstructions allow liquid sewage to remain stagnant and begin to turn septic.

Adverse Soil Conditions

Adverse soil conditions present problems in some areas of Detroit. Poor soil conditions can create extreme pressures on sewers, leading to cracking or collapse. Also, in areas where fine soil surrounds the sewer pipes, the soil material migrates its way

Figure 2.17: Age of Detroit Sewers



into sewer cracks. Crews have observed this often in the VCP that has commonly been used for the last 70 years in the system.

Utility Interference

Utility Interference is the damage to or intrusion of sewers by other utility conduits. Locator information for all utilities is required before below-grade excavating or directional boring can occur. Lack of information and poor contractor practices have led to small utility leads being placed through the sewer pipe. The exposed infiltrating utility pipe becomes a trap for debris that moves through the sewer system.

2.8.6 Age of Sewers

The data used to compile this sewer structures age report was derived from the DWSD complete Sewers 2 shape file provided by the IT Department and a manual listing of sewer segments provided by the DWSD Engineering Division. Segments were sorted and listed by address and then by age. The compiled report produced approximately 46,000 records of which approximately 8,000 had no age information attached. All 46,000 records were analyzed and the age information was estimated to give an overall picture of what the ages of the sewers are in Detroit as shown in Figure 2.17.

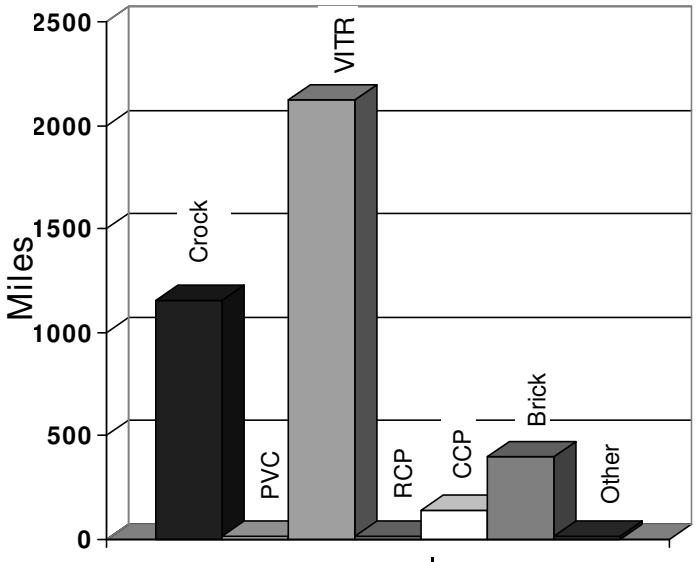
2.8.7 Sewer Construction Material

The sewer system is made up of several different types of pipe material. Material types changed in popularity as the years went by and technology changed. The approximate quantities of each type of material used in the Detroit sewer system are described here and shown in Figure 2.18.

Cast Iron — A small portion of the sewer system in Detroit is made up of cast iron pipe, and appears to have installation dates prior to 1930. This material is subject to corrosion and may be more vulnerable to failure

Glazed Vitrified Clay Pipe — This pipe with the

Figure 3: Detroit Sewer Materials and Length in Miles



Material	Length (miles)
Glazed VCP	941
PVC	12
VCP	1887
RCP	12
CCP	138
Brick	393

smooth surface was commonly referred to as a "crock." It was designed to be placed spigot into bell on a solid base and when properly backfilled, could withstand sewage flow conditions quite well. One of the weaknesses of crock sewers is that they are brittle and when service connections are made, construction is done nearby, or cleaning machinery passed through, they are prone to cracking, chipping or breaking.

PVC — Polyvinyl chloride piping is durable and light-weight. It is joined by a glue-bonding process making it the most water-tight pipe material available. This material is smooth and offers good transfer of wastewater flow.

Vitrified Clay Pipe (VCP) — This material has been a proven product for sewers for many years. It comes in short lengths to make it manageable and is easy to fit together by section. It is brittle so care must be used in handling and placing the pipe.

Concrete (CCP) — Various types of concrete are used for storm drains, culverts, storm sewer and sanitary sewers.

Reinforced Concrete (RCP) — Formed concrete pipe with steel reinforcing material embedded in its walls for strength is popular for large-diameter pipes.

Brick — Almost every public sewer installed from 1836 to 1910 was constructed using bricks. Until 1892, laterals were also constructed of brick. In the early years, one ring of common brick construction nine inches thick was used for all sizes of sewers. Many of these public sewers required rebuilding and repair in the late 19th Century. Repairs generally consisted of restoration of the cross section and lining the interior with a second ring of brick. Later, public sewers were built of two ring brick and the largest ones in three ring brick.

2.8.8 Pipe Rehabilitation Techniques

CIPP

DWSD has been using CIPP (Cured-In-Place Pipe) for the rehabilitation of sewers since 1982. CIPP can be used for the full range of pipes in main line manhole-to-manhole applications. It takes experience to install the pipe liner properly. CIPP is a flexible cured-in-place pipe suitable for a number of different uses and installations. It is available in a full range of pipe diameters and wall thickness. Prior to impregnation within the liner tube, each batch of resin is tested in-house for stability and curing. The pipe also undergoes third-party testing to insure the product exceeds ASTM's strength requirements.

Table 2.13: Lateral Sewer Segment Conditions

	North		West		East		Central		Total	Percent of Total
Segments inspected	166		178		165		128		637	100%
Excellent	9	5.40%	7	3.9%	16	9.7%	6	4.7%	38	6.0%
Good	74	44.60%	95	53.4%	105	63.6%	67	52.3%	342	53.8%
Fair	63	38.00%	48	27.0%	30	18.2%	32	25.0%	174	27.3%
Needs Investigation	20	12.00%	28	15.7%	19	11.5%	20	15.6%	87	13.7%

Figure 2.19 shows the approximate amount of active Cured In Place Pipe that has been completed on existing sewers since 1982.

Open Cut Replacement/Repair

When open cutting occurs in the street, traffic has to be rerouted. This method can put other underground utility structures at risk, and the weather factor makes this method of construction sometimes unpredictable.

Pipe Bursting

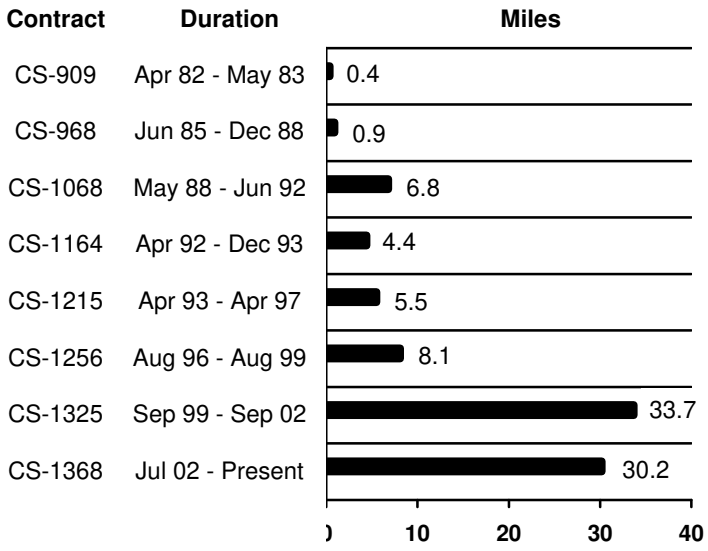
Pipe bursting is the only method of trenchless technology rehabilitation that permits upsizing or size-for-size pipeline replacement. It is cost-efficient, proven in over 32 million feet of use and ideal for cast iron, clay, concrete and other fracturable pipelines. Because of its upsizing capability, an existing 8-inch pipe, for instance, can be replaced with a 10-inch pipe with very little disturbance of the work area. Pipe bursting offers significant cost savings over the dig-and-replace method. It can be done faster and with less disruption of the landscaping.

Pipe Liner

Ultraliner has proven itself to be the most advanced and cost-effective system for lining sewer and storm sewer pipe up to 24 inches. There is little disruption to customers. Liner is capable of lining severe offsets, extreme bends, size transitions, voids in the pipeline and corrugated metal pipe.

Further discussion of pipe rehabilitation is presented in Volume 4 of this Master Plan, *Capital Improvements Program.*

Figure 2.19: Miles of CIPP Installed in Detroit since 1982



2.9 Detroit CSO Facilities

The CSO collection system components under study for the Master Plan are:

- Storage basins
- Screening and disinfection facilities
- Flow regulators
- Outfalls
- Backwater gates
- Outfall diversion dams
- In-system storage devices and system gates

Except for basins, screening and disinfection facilities, etc., which are all relatively new, these components are summarized by component type, district and age categories as shown in Table 2.14. Most of these other system components are in the 25 to 75 year old range.

For the purpose of this Master Plan, the existing condition of these components are rated as follows:

Good: Functional component with no repairs required.

Fair: Functional component with minor repairs required.

Table 2.14: System Component Age

System Component	District	No.	0-25 years	25-50 years	50-75 years	75-100 years	>100 years
Outfall Flow Regulators	Central	40		1	39		
	East Jefferson	1			1		
	Subtotal	41					
Outfalls	Rouge River	22		14	8		
	City of Dearborn	1			1		
	Oakwood	4			1	3	
	Central	50		7	21	10	12
	East Jefferson	4		1	3		
	Subtotal	81					
Backwater Gates	Rouge River	25		17	8		
	City of Dearborn	1			1		
	Oakwood District	3				3	
	Central District	23		3	14	4	2
	East Jefferson	2			2		
	Subtotal	54					
Outfall Diversion Dams	Rouge River	23		15	8		
	Oakwood	1				1	
	Central	31		3	12	7	9
	Subtotal	55					
In-System Storage Devices and System Gates	Rouge River	9	8		1		
	Southfield	1			1		
	City of Dearborn	2	1	1			
	Baby Creek	6	6				
	Central	21	9	12			
	East Jefferson	1			1		
	Subtotal	40					

Poor: Non-functional component or functional component with major repairs required.

Unknown: Inspection required on components that have not been inspected within the last 10-15 years.

Nearly all of the flow regulators are in good condition. A majority of the outfalls are in good condition, except for those in the Central District where most outfalls are in fair or poor condition. A majority of the backwater gates, outfall diversion dams, in-system storage devices and system gates are in good condition.

Table 2.15 shows the maintenance-related collection system replacement and rehabilitation needs by system component and district. This table will be completed in the next submittal phase.

A general guide for inspection and capital improvement for system component replacement and rehabilitation intervals can be found in Volume 4 of this Master Plan. Visual inspections for all equipment with moving parts should be performed at least quarterly and after major storm events. In general, outfalls, flow regulators, backwater gates and in-system storage devices should

Table 2.15: Replacement & Rehabilitation Needs

System Component	District	No.	Age			
			Long Term*	Mid Term*	Short Term*	Inspection Needed
Outfall Flow Regulators	Central	40	39			1
	East Jefferson	1				1
	Subtotal	41				
Outfalls	Rouge River	22	17	2	3	
	City of Dearborn	1	1			
	Oakwood	4	1	1		2
	Central	50	32	12	3	2
	East Jefferson	4	1	2		1
	Subtotal	81				
Backwater Gates	Rouge River	25	21	3	1	
	City of Dearborn	1	1			
	Oakwood District	3	2	1		
	Central District	23	14	6	2	1
	East Jefferson	2	1		1	
	Subtotal	54				
Outfall Diversion Dams	Rouge River	23	23			
	Oakwood	1	1			
	Central	31	27	4		
	Subtotal	55				
In-System Storage Devices and System Gates	Rouge River	9	8	1		
	Southfield	1	1			
	City of Dearborn	2	1		1	
	Baby Creek	6	6			
	Central	21	11	1	7	2
	East Jefferson	1	1			
	Subtotal	40				

*Long term — 15 years, Mid term — 10 years, Short term — 5 years

be inspected in the summer or fall. They should also be inspected after moderate to large rain events.

2.9.1 Purpose and Scope

The purpose of this section of this report is to summarize current information on collection system facilities for the Wastewater Master Plan.

Three detailed tables for the current collection system facilities are presented in the technical memorandum *Review of Collection System, Regulators and Outfalls* on the CD that accompanies this report. These tables show:

- Facility inventory
- Facility deficiencies/ status of recent and currently planned improvements and
- Recommended future improvements

2.9.2 Data Sources

Long Term CSO Plan (July 1, 1996): A significant portion of the *Long Term CSO Plan* was Section 10.06 *Collection System Rehabilitation*. This Section identified existing conditions, rehabilitation requirements, rehabilitation design and costs and an implementation schedule for the collection system. Many collection system components were inspected under the CSO Long Term Program.

PC-695 Regulators / Remote Flow Control Structures and Dam Rehabilitation: This project was initiated and designed under Tasks 2 and 3 of CS-1158, The *Long Term CSO Plan*. This project consisted of the rehabilitation of 59 flow regulator sites and was completed in 1998.

PC-698 In-System Storage: This project was initiated and designed under Task 2 of CS-1158, *Long Term CSO Plan*. It consisted of the construction of seven slide gates in existing rehabilitated backwater gate structures (Task 1 Gates) along the east side of the Rouge River. This project was completed in 2000.

CS-1329 In-System Storage: This project is currently under design and consists of the installation of 13 collection system in-system storage facilities. The construction of this project is to be completed under Contract PC-747 in 2005.

PC-744 Asset Audit Report: This report assessed the current and projected operational status of all significant WWTP and wastewater collection system components, their state of repair, and their projected major maintenance and replacement status.

DWSD Operational Plan: The *Operational Plan* was published in 1994 and contains a system description including service districts, major interceptors, backwater gates, regulators and diversion chambers, fabridams and remote-controlled valves. It is updated annually.

DWSD CS-1281 Real Time Control Wastewater Collection System Operational Elements Data: The Real Time Control Work Group inventories all Wastewater Collection System components and develops collection system guiding principles, strategies and operational protocols. Existing and currently planned and recommended operational elements were inventoried in March 2001. These reports contain maps locating all of the operational elements of the collection system.

PC-665 System-Wide Instrumentation and Control, Wastewater Collection System, Valve Remotes: This contract inventoried and rehabilitated the existing wastewater collection system component instrumentation. Many existing collection system components were listed.

DWSD Wastewater Collection System—Operation and Maintenance Manual: The wastewater collection system covers the system districts, major interceptors, regulators and overflow structures, fabridams, outfalls and backwater gates. Each outfall and flow regulator site is shown in a schematic drawing.

CS-1158 Detroit Regulators Inspection, October

1992: This report discussed the inspection of 78 flow regulators.

CS-1053 DWSD Sewer Outfall Inspection Report, Task Order No. 1, October 1988: Eight outfalls were inspected by Townsend and Bottum Services Group in Association with Wade-Trim Associates, Inc.

2.9.3 CSO Facility Characterizations

Detention Basins

There are three CSO detention basins currently in use to treat and store CSOs in the DWSD Service Area. Construction on these basins was completed in 1999.

Seven Mile Detention Basin: This basin is located on the east side of Shiawassee, north of Seven Mile Road, on the west side of the Rouge River. This basin's treatment performance is currently being evaluated. It is designed to capture and treat CSOs from part of 1,029 acres formerly draining to the Puritan Sanitary Pumping Station discharging at 7 Mile and Frisbee overflows. Its storage capacity is 2.2 mg, and it can provide treatment for up to 656 cfs of flow. The basin was designed for 1-year, 1-hour duration storm (1-inch) with 30-minutes detention. During dry weather, there is no flow routed to the Seven Mile Basin. During wet weather, the control gate at Seven Mile and Shiawassee regulates the flow to the Seven Mile Basin

Puritan-Fenkell Detention Basin: This facility is within Eliza Howell Park east of Telegraph south of Fenkell and west of the Rouge River. The facility is currently in the demonstration/ evaluation period. It captures the remainder of the CSOs from the area draining to the Puritan Station, and provides storage for 2.8 mg of CSO and treatment for up to 845 cfs of flow. The Puritan Fenkell Basin was designed for 1-year, 1-hour duration storm (1-inch) with 20 minutes detention.

Hubbell-Southfield Detention Basin: This basin is located just upstream of the outfall from the Hubbell Sewer to the Rouge River. During dry weather, the flow is diverted to the Northwest Interceptor. During wet weather, the regulator will be set to divert a maximum of 86 cfs to the NWI. Remaining flow is captured behind an inflatable dam up to an elevation of 100 ft. (City of Detroit Datum). Four other facilities are currently under construction or in the planning stage. They are: St. Aubin, Conner Creek, Leib and Baby Creek. Details of the Detroit basins are shown in Table 2.16.

Outfalls

Eighty-nine outfalls are shown in Figure 2.21. Outfall sewers are sewers leading from flow regulators and/ or dams to the Detroit or Rouge Rivers. Outfall sewers carry CSOs during certain wet weather periods and discharge into the Detroit and Rouge rivers.

Flow Regulators

There are 41 flow regulators in the DWSD system. Locations are shown in Figure 2.20. Flow regulators are flow control devices that control flow from trunk sewers into interceptors based on the wastewater level in the receiving interceptor. Most of the diversion and combined sewer regula-

Table 2.16: CSO Basins, Screening and Disinfection Pilot Facilities in Detroit

Facility	Capacity (mg or cfs)
Seven Mile Basin	2.2 mg
Puritan-Fenkell Basin	2.8 mg
Hubbell-Southfield Basin	22 mg
Baby Creek Pilot Treatment Facility (under design)	5000 cfs
Conner Creek Pilot Treatment Facility (under construction)	13,262 cfs, 30 mg
St. Aubin Pilot Treatment Facility (under construction)	250 cfs
Leib Pilot Treatment Facility (under construction)	2000 cfs
Belle Isle CSO Basin (under design)	—

Figure 2.20: Detroit Outfall Regulators

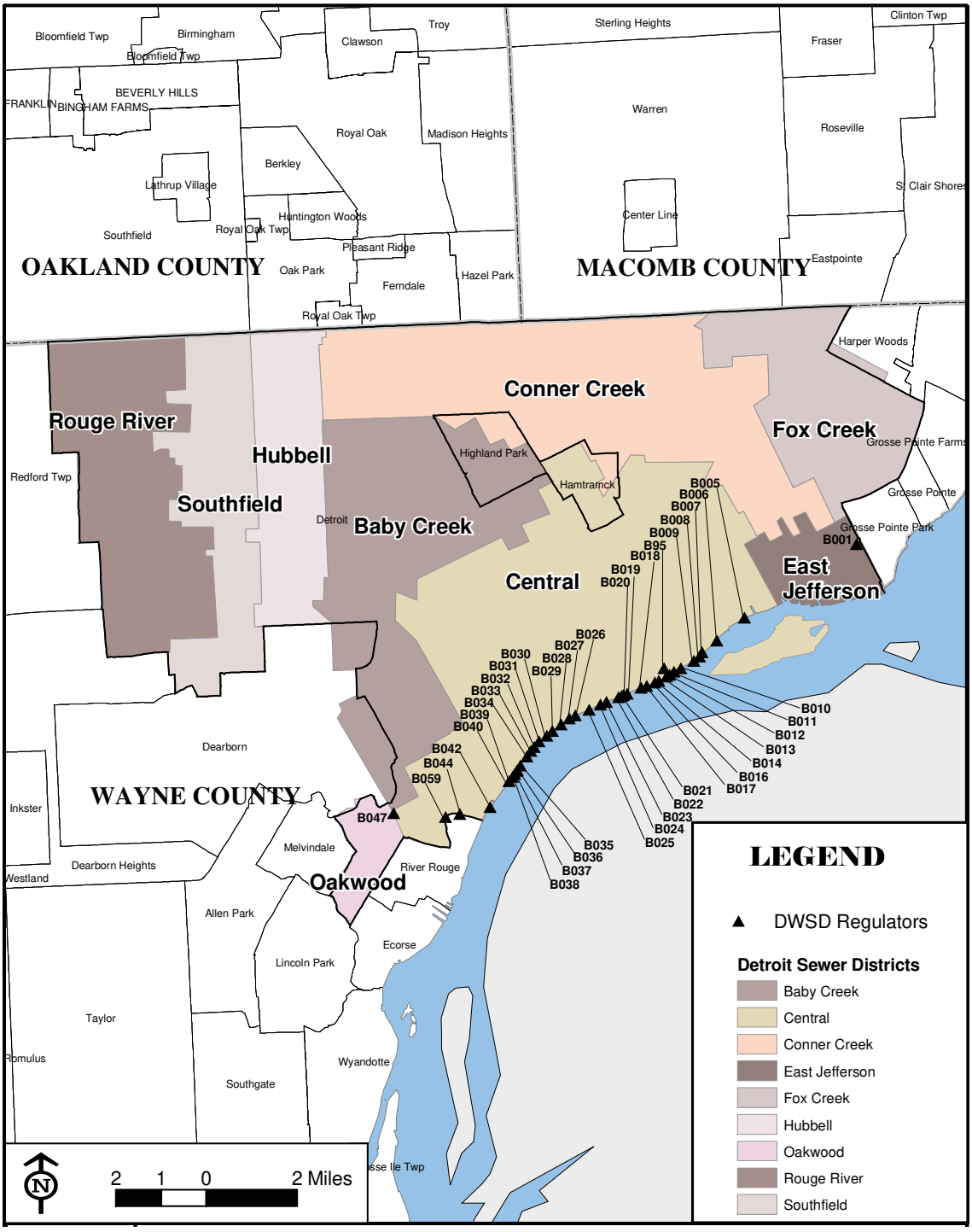
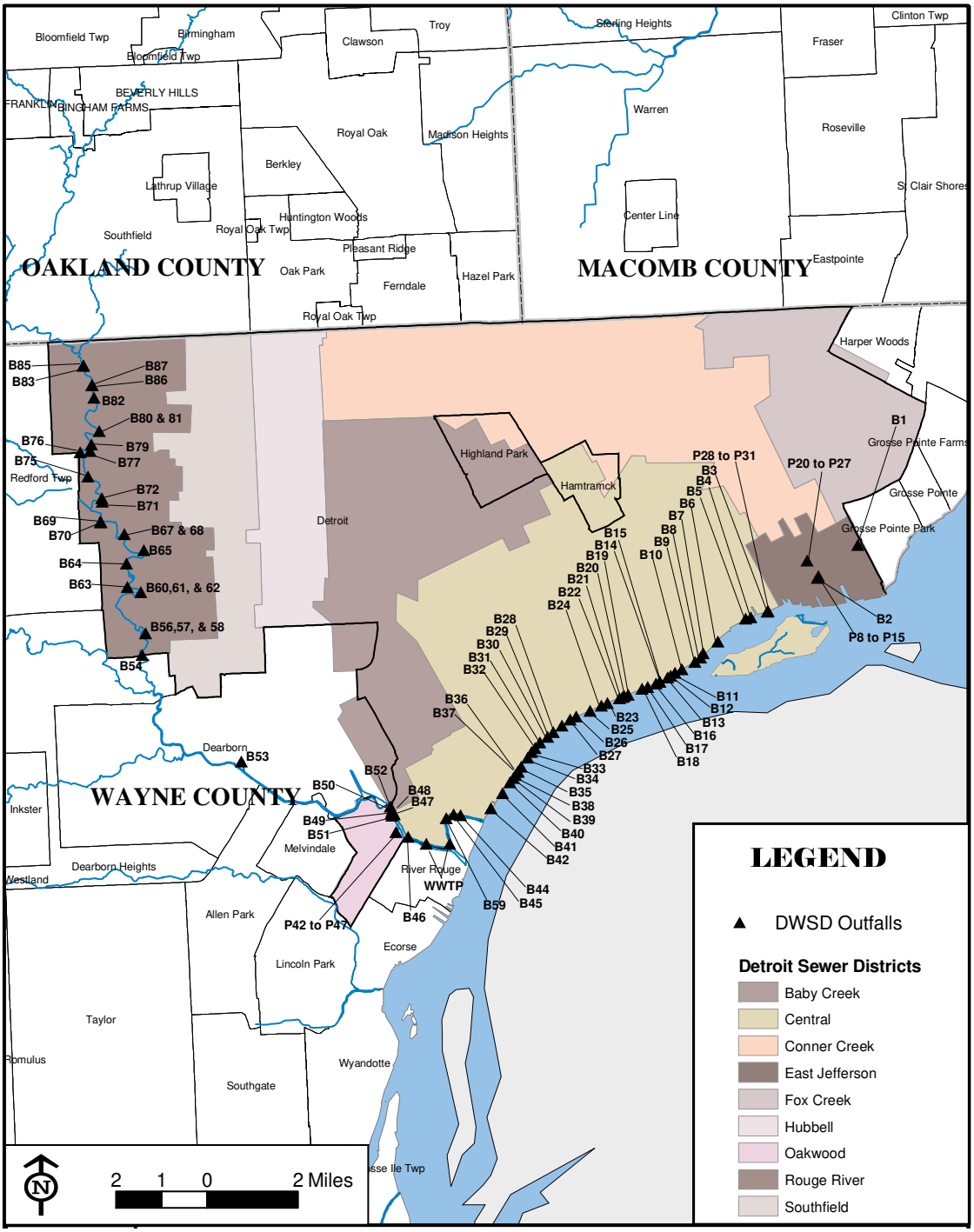


Figure 2.21: Detroit Outfalls



B — Gravity outfalls, P — Outfalls associated with pump stations

tor structures are located along the Detroit and Rouge rivers. These regulating structures were designed to divert sanitary flow during dry weather conditions and combined sanitary and storm flow during storm weather conditions. During storm weather conditions, combined storm and sanitary flow from trunk sewers is diverted partially to an interceptor and the rest to river outfalls. There are two types of mechanical float regulatory assemblies originally used in the Detroit collection system: the Brown and Brown (B&B) regulator and the McNulty regulator. Most of these regulators have been replaced with hydraulic slide gates.

Backwater Gates

Fifty-four backwater gates are shown in Figure 2.22. Backwater gates are devices installed in the CSO outfalls along the Detroit and Rouge rivers. The purpose of the backwater gates is to prevent water from the Detroit and Rouge rivers from entering the DWSD collection system. The backwater gates are installed at the overflow side of the regulators (usually two sets of gates — a sewer gate and a river gate) and act as check valves when the river levels are higher than the invert elevations of the outfalls.

Outfall Diversion Dams

There are 55 dams shown in Figure 2.23.. Outfall dams are located in the outfall barrel between the diversion chamber or regulator structures and the river to intercept combined wastewater flows from flowing into the rivers and to prevent river water from entering the collection system. In places where the river might rise higher than dam elevations, backwater gates were added to allow CSO flow into the river, but prevent river water from flowing into the sewer. Most dams are fixed concrete detention construction. In the 1980s some of the dam elevations were raised by installing wooden flashboards to further elevate the dam height, thereby increasing flow in the interceptors.

In-System Storage Devices and System Gates

There are 40 in-system storage devices and system gates shown in Figure 2.24..

In-system storage gates: Seven Task 1 Gates were built along the east side of the Rouge River at CSO outfalls per Contract No. PC-698 in 2000. The slide gates were installed in existing rehabilitated backwater gate structures. These new gates replaced 12 existing backwater gates. The function of the new gates is to create storage in upstream outfalls and to regulate flow into the Northwest Interceptor.

System Gates: There are (17) valve remotes (VR) within the collection system. They all have VR numbers (VR1 to VR17). The following valve remotes were removed from Remote Operation: VR1, VR2, V3, VR4, VR5, VR6, VR7, VR10, VR12, and VR14. They are in manual operation.

New In-System Storage Devices (ISSD): These 13 proposed ISSD, under CS-1329, will be installed by the third quarter of 2003. DWSD is constructing them to maximize storage within the collection system during wet weather operation.

Existing In-System Storage Devices: There are three existing ISSD. (LR 2 at Livernois Relief sewer, HUB 1 at Hubbell/ Southfield sewer and Dubois ISSD at Dubois sewer.) All are inflatable dams. The most recent dam was installed in 2001 at Dubois Sewer as a part of the St. Aubin Screening and Disinfection Facility.

Figure 2.22: Detroit Backwater Gates

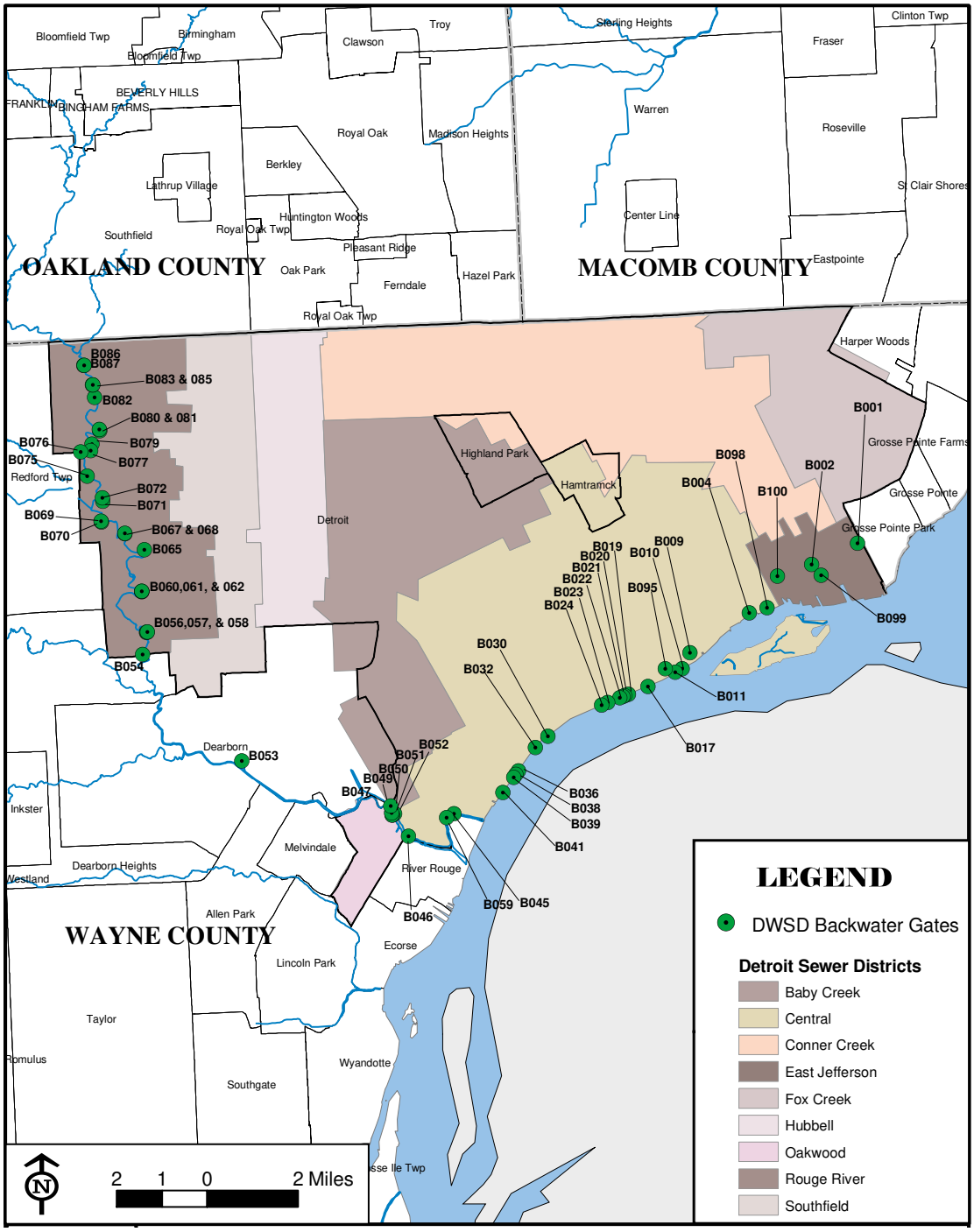


Figure 2.23: Detroit Dams

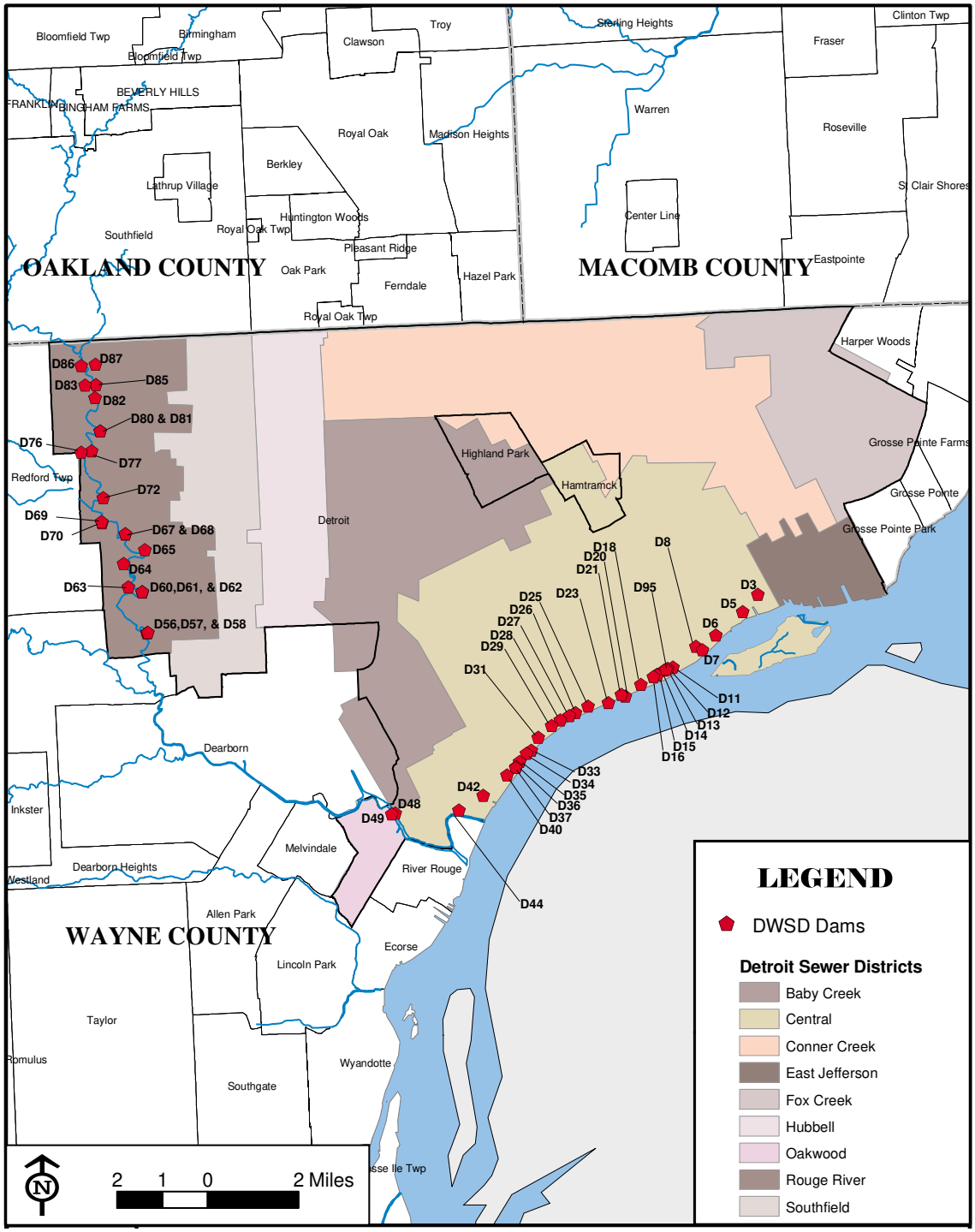
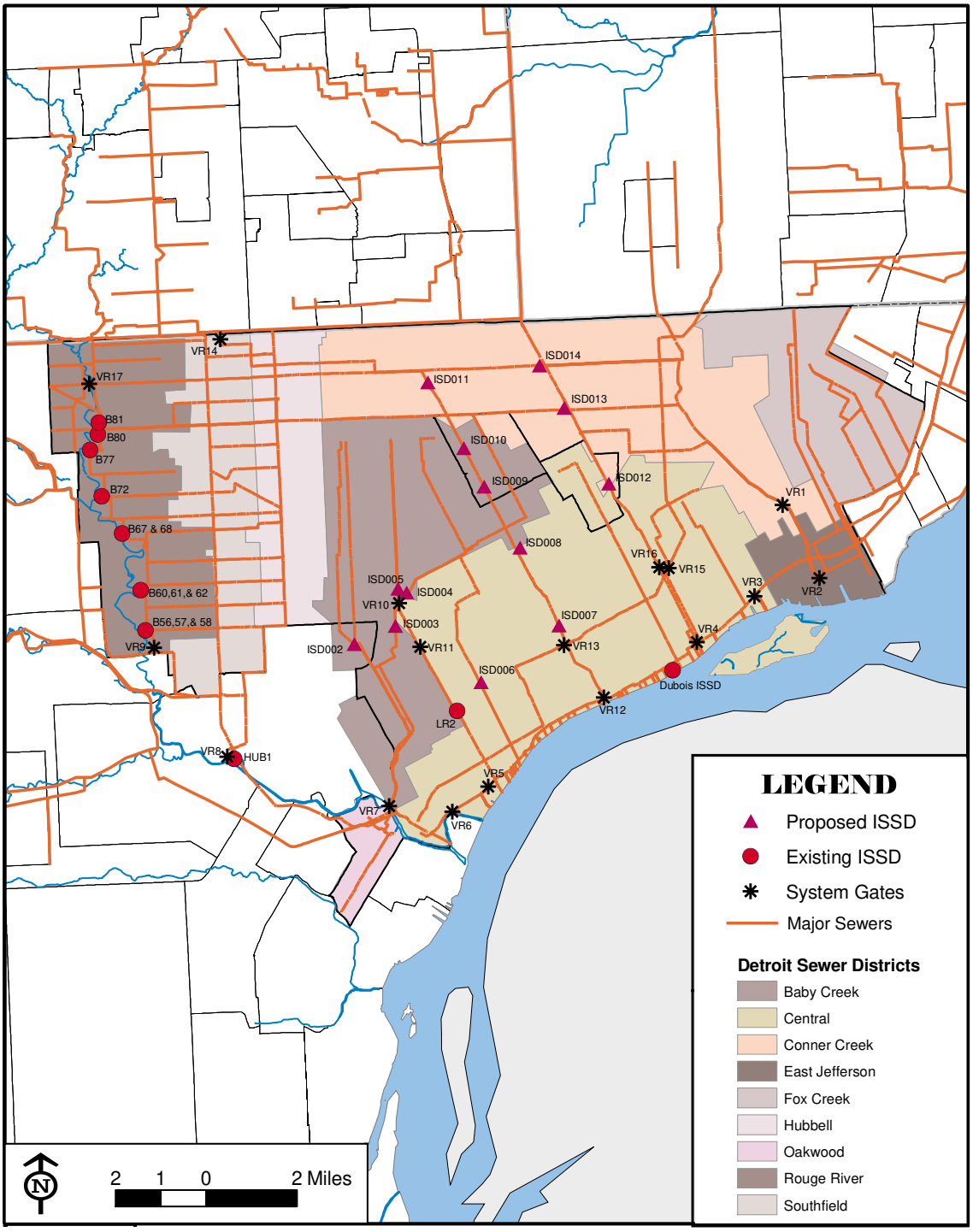


Figure 2.24: Detroit In-System Storage Devices



2.10 Facilities on Private Property

2.10.1 On-Site Sewage Disposal Systems

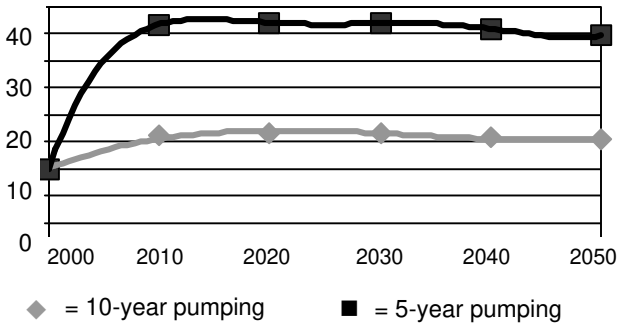
Overview of Septage Handling

Septage is generated when a septic tank is pumped as part of routine maintenance or when there is a problem with the on-site sewage disposal system. There are approximately 134,000 on-site sewage disposal systems (OSDS) in the DWSD septage planning area.

In 2000, DWSD estimated that 15,000,000 gallons of septage (12 percent of the total for all of Michigan) was deposited in the Detroit system. Septage accounts for about .01 percent of the flow at the Detroit Wastewater Treatment Plant. Septage is stronger than domestic wastewater. Biological and chemical oxygen demand and phosphorous in septage is about 30 times more concentrated than domestic wastewater. At the wastewater treatment plant during the peak month for septage, chemical/ biological oxygen demand would increase by 4.4 percent and phosphorous by 0.9 percent.

The regulation of on-site sewage systems and septage is controlled by local health departments and MDEQ. The amount of septage removed from septic tanks in Michigan is currently estimated to be 120 million gallons per year. Proper maintenance of OSDS requires periodic removal of solids that have accumulated in the septic tank. Septic tanks are pumped out an average of every 10 years. Half of septage goes to land and half goes to publicly owned treatment works (POTWs). The increased percentage of new growth using on-site sewage systems will result in more septage disposal. The growth in the 1990's will begin to result in increased septage quantities. Figure 2.24 projects the amount of septage that will be pumped in the DWSD septage planning area through 2050 based on five-year and 10-year pumping scenarios. A septic tank that is pumped twice over a 10-year period will generate twice as much septage as one pumped once every 10 years.

Figure 5.2: Septage Disposal Projections (millions of gallons)



While septage disposal is largely an issue of growth in the outlying areas of the DWSD septage planning area, it is also an urban matter. This issue is reviewed in the technical memorandum *On-Site Sewage Disposal Systems in the City of Detroit* on the CD that accompanies this report.

DWSD requires that haulers provide analytical testing of their septage twice a year. In addition DWSD also collects samples from haulers' trucks on an unannounced basis. Health departments are responsible for issuing permits for installation of OSDS. About 3,400 OSDS permits are issued each year in the septage planning area to serve new buildings.

Septage haulers and St. Clair and Macomb counties have recommended that new septage receiving stations be built nearer communities that rely on OSDS.

Further details on issues relating to these septage issues are included in the technical memorandum *Septage Transport and Disposal to the Detroit Wastewater System* on the CD that accompanies this re-

port.

Future Suitability of Systems

A review was made of the conservation soil maps of four counties (Oakland, Macomb, St. Clair and Lapeer) to determine soil suitability for OSDS. Soils were rated suitable, marginal, unsuitable and unclassified.

Suitable soil is generally soil that is well-drained, sandy soil or soil that has a permeability that is less than 60 minutes per inch and has a seasonal high water table two feet or more below the ground surface.

Marginal soil is generally soil that is somewhat poorly drained with a seasonal high water table one to two feet below the ground surface and soil permeability of 60 to 300 minutes per inch.

Unsuitable soil is soil that is poorly to very poorly drained with a seasonal high water table of less than one foot below the ground surface or is soil that is highly impermeable (permeability greater than 300 minutes per inch).

Unclassified soil is soil that was not mapped. It includes landfills, made land, filled land and others.

Figures 2.25, 2.26 and 2.27 on the following pages show soil suitability areas in Macomb, Oakland and St. Clair counties respectively.

The maps give a visual representation of the suitability of soils in the three counties. The least suitable soil area is the northeast section of the septage planning area.

The lowest percentage, 0.8 percent of OSDS suitable soil is in China Township in St. Clair County. The community with the highest percentage of suitable soil is Bruce Township in Macomb County, with 58.1 percent suitable soil. The community with the highest percentage of unsuitable soil is Berlin Township in St. Clair County, with 90.5 percent unsuitable soil. The community with the lowest percentage of unsuitable soil is the Village of Leonard in Oakland County, with 19. 7 percent unsuitable soil.

There are 15 communities that will continue to rely on OSDS that have 75 percent or more of the soils classified as marginal or unsuitable for OSDS. Development in these areas will require "engineered" or alternative sewage systems. Some types of alternative OSDS being used for marginal or unsuitable soil are mound systems, sand filters and aerobic treatment units. These systems often cost $10,000 or more. They also require regular maintenance or they will malfunction, resulting in expensive repairs and environmental contamination.

Along with soil suitability problems, regulatory issues, residential concerns, growth, and public health and safety issues will result in dramatic decreases in land disposal of septage and thus an increase in the amount of septage that is pumped into the DWSD system in the future. Details on this issue are presented in the technical memorandum *"Soil Suitability for On-Site Sewage Disposal Systems"* on the CD that accompanies this report.

By 2050, over 140,000 people living in communities that now rely on OSDS may need DWSD sewer service. Table 2.17 shows the projected population numbers by community.

2.10.2 Service Connections

The wastewater collection system operated by DWSD and its customer communities consists of many components within the public ownership that are intended to convey and treat wastewater from homes, businesses, and industry. These are the most easily addressed by DWSD and community sewer utilities.

However, flows to these facilities are always carried by privately owned conveyances prior to entering the public system. Long-term planning needs to consider the effect of these facilities on

Figure 2.17: OSDS Soil Suitability for Communities in Septage Study Area

Community	Part or all OSDS	% OSDS Suit-able	Projected Pop. Change 2000-2050	Potential 2050 Pop. Needing Sewers
Macomb County				
Armada	A	31	3,885	600
Bruce Twp.	P	44	11,397	1,100
Ray Twp.	A	38	3,358	600
Richmond Twp.	A	12	4,898	5,000
Oakland County				
Holly Twp.	P	15	3,764	3,764
Lake Angelus	A	35	-55	-55
Leonard	A	10	10	120
Milford Twp.	P	47	3,134	3,134
Oakland Twp.	P	26	17,813	17,813
Rose Twp.	A	25	3,664	3,600
Groveland	A	44	1,646	1,400
Addison Twp.	A	20	5,463	3,600
Brandon Twp.	P	32	7,450	750
Independence Twp.	P	46	6,748	7,600
Lyon Twp.	P	19	43,328	43,328
Springfield Twp.	P	52	10,370	7,000
White Lake Twp.	P	53	6,952	6,200
St. Clair County				
Berlin Twp.	A	2	7,962	8,000
Casco Twp.	A	3	1,040	2,100
China Twp.	P	1	1,220	1,600
Columbus Twp.	A	9	3,589	2,800
Riley Twp.	A	1	2,853	5,000
St. Clair Twp.	A	6	3,335	3,600
Wales Twp.	A	7	1,860	1,600
Clay Twp.	P	5	2,863	2,800
Cottreville Twp.	P	2	1,586	3,000
Lapeer County				
Dryden Village	A	N.A.	-13	-13
Almont Twp.	A	N.A.	3,694	3,000
Dryden Twp.	A	N.A.	5,862	1,500
Hadley Twp.	A	N.A.	2,593	1,200
Metamora Twp.	A	N.A.	6,515	1,700
Metamora Village	A	N.A.	-11	-11
Total			**178,773**	**143,509**

overall system condition and operation.

Most notable of the critical private facilities are individual service connections which connect homes and businesses to the public sewers. While these service connections may seem insignificant individually, collectively they make up a major component of conveyance. In fact, the total length of service connections is estimated to exceed the total length of publicly owned sewers within the DWSD service area. Table 2.18 shows the estimated length in miles of service connections in the DWSD Service Area.

As plans are made for reduction in total flow transported and treated by the collection system, total flow from these sources need to be considered. Extraneous infiltration finding its way into private service connections is likely a major component of the total infiltration and inflow observed in the collection system.

Many of the homes and other buildings within the service area introduce excess flow into the system through footing drain connections to the public sanitary or combined sewers. Since footing drains that are directly connected can account for major portions of both wet and dry weather infiltration they also must be counted as critical facilities located on private property.

While the upkeep and maintenance of privately owned facilities has traditionally been the responsibility of the property owner, some recent studies are suggesting that removal of footing drain flows and reduction of I/ I from service connections can be a justified as a cost effective alternative to expenditure of public funds for storage or treatment. Ann Arbor, Michigan has initiated a city wide footing drain disconnection program that is publicly funded, and Sarasota, Florida is conducting a pilot program in which private service connections are being replaced, using pipe bursting methods, in order to reduce I/ I in a cost effective manner.

Table 2.18: Miles of Service Connections in DWSD Service Area

	Detroit	Suburbs
Constructed before 1945	1,536	352
Constructed 1946-1975	2,679	8,613
Constructed after 1976	71	3,121

Figure 2.26: Oakland County Soil Suitability for OSDS

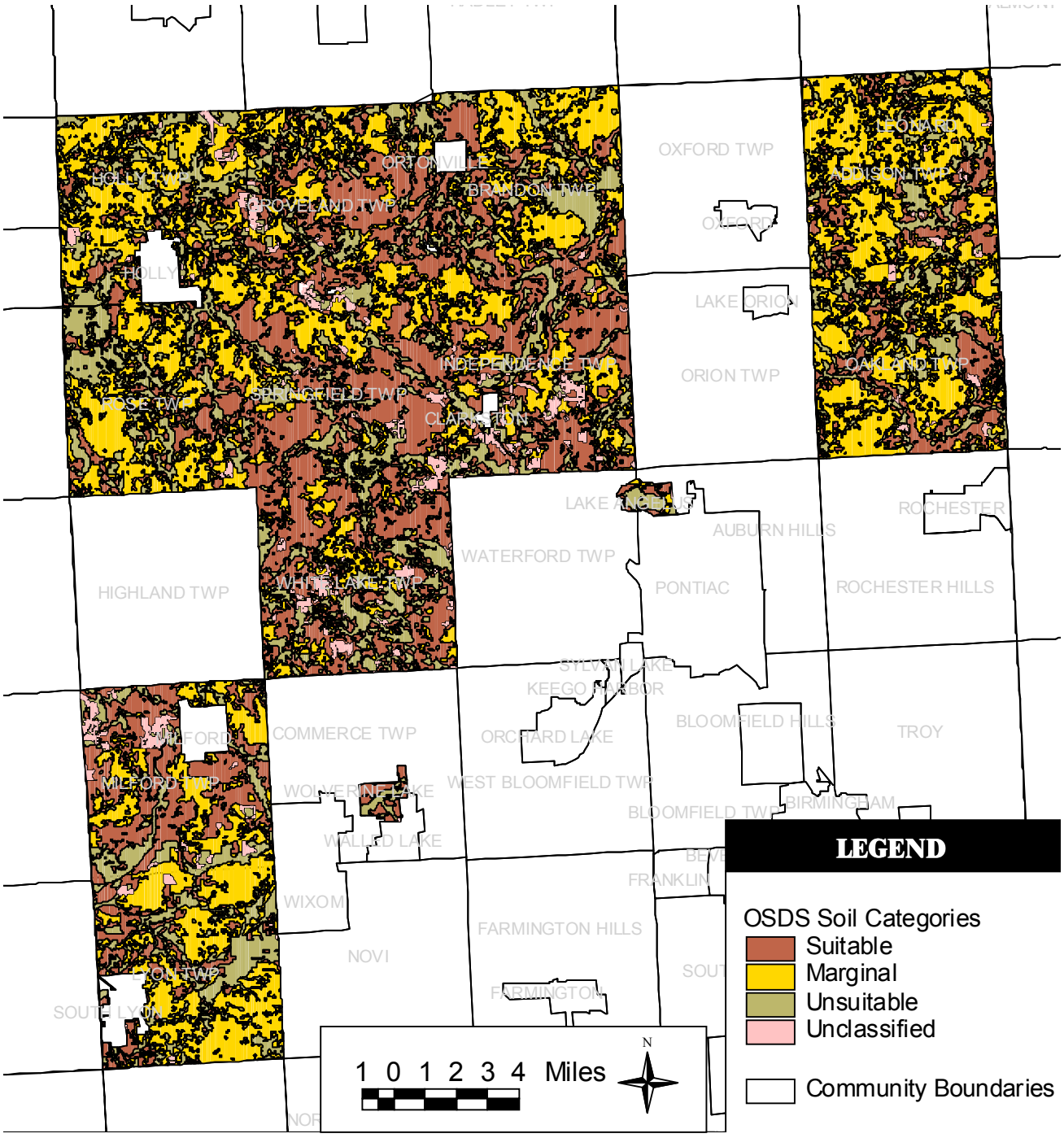
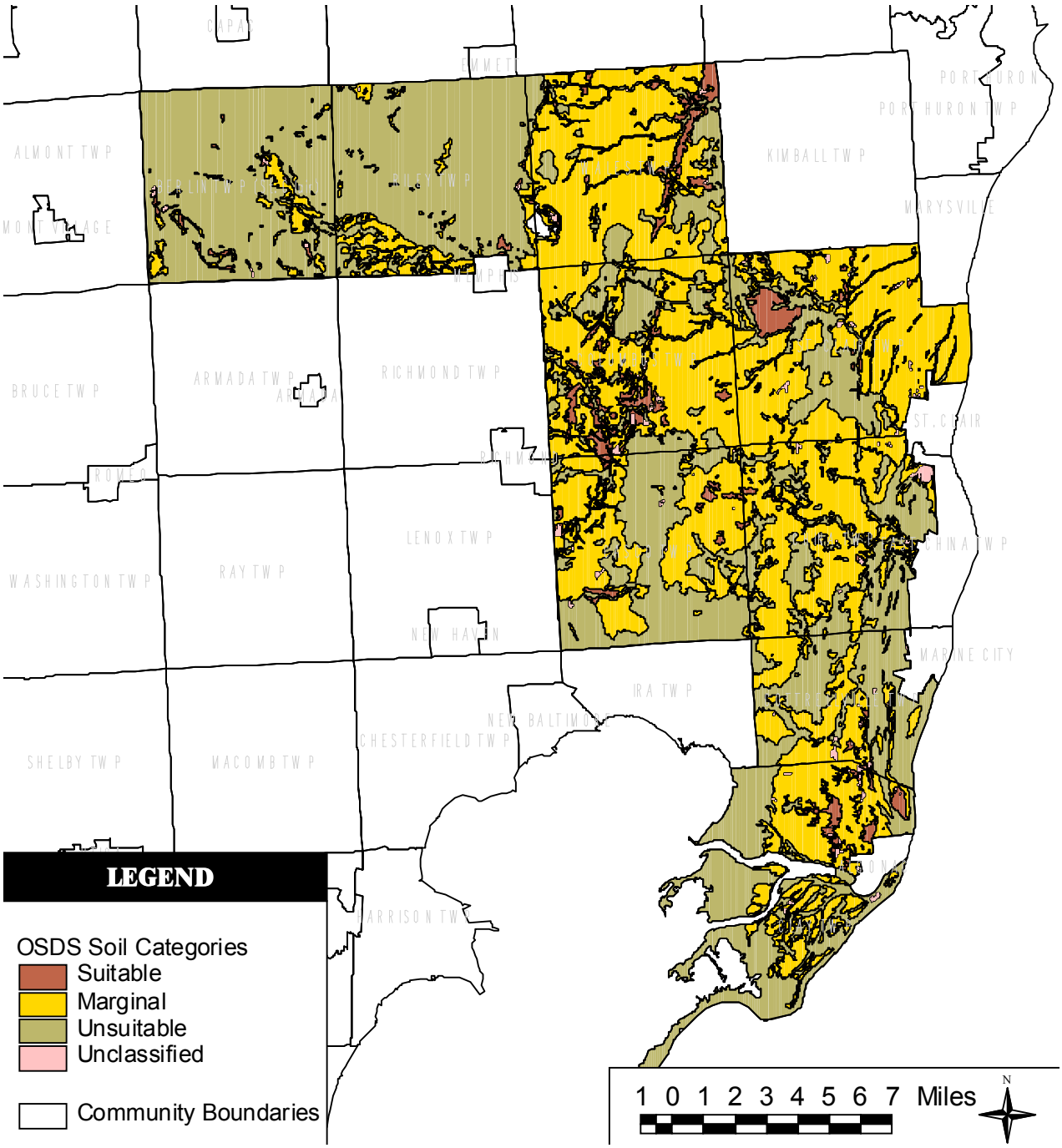


Figure 2.27: St. Clair County Soil Suitability for OSDS



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Total			**178,773**	**143,509**

3. Capacity Management

3.1 Approach

When dealing with the issue of handling additional flows derived from future growth, a broad assessment of existing flows and the consideration of methods to manage them and future flows should be considered.

This "reclaiming" of capacity can be achieved by seeking cost-effective measures to reduce or eliminate unnecessary flows in the system. This involves identifying flow sources beyond what is normally looked at. Traditional inflow/ infiltration programs tend to focus on wet weather flows, but assessment of programs to reduce flows during dry weather conditions can offset, or nearly offset, the demands that will be placed on the system by future growth.

A goal of the Master Plan is to identify such dry weather sources. Most dry weather I/ I occurs in older areas and places where water tables are high. Footing drains and service connections are typical system components that can be targeted to improve dry weather flow. An atypical component is the urban stream, which may be able to be diverted to restore capacity.

Proper handling of wet weather capacity is another area under examination. Using the existing facilities in the most efficient and equitable manner can reduce the number of SSOs and minimize basement backups.

In newly developing communities, local ordinances as well as federal guidelines require the use of water conserving plumbing fixtures. A similar reduction in sanitary flow from newly constructed homes and businesses will result. However, the effect from new construction on the overall collection system will be minor. Detroit and customer communities should encourage or require by ordinance that all replacement plumbing fixtures installed be reduced-flow.

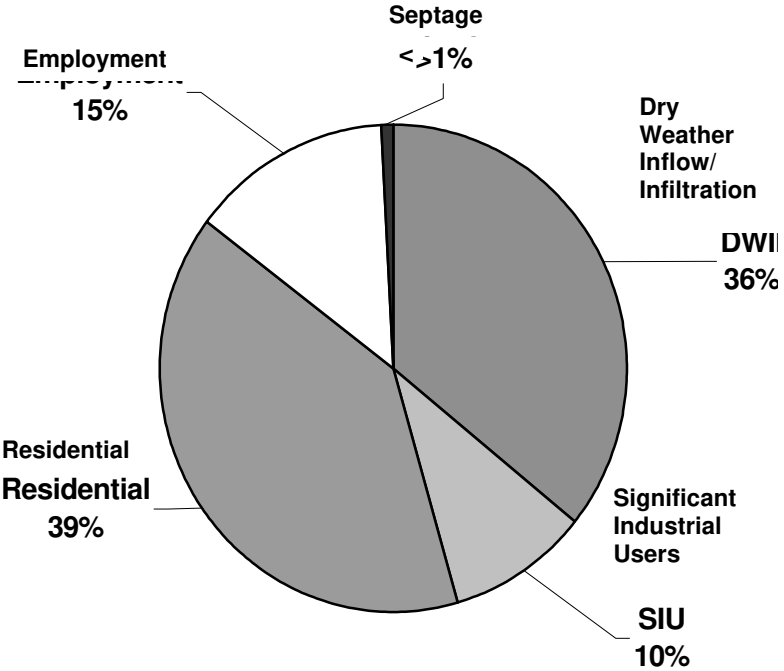
3.2 Opportunities for Future Flow Management

3.2.1 Footing Drains

Based on the 2000 population and two years of flow data from 1997 and 1999, the Detroit Waste Water Treatment Plant (WWTP) treats nearly 568 million gallons of sewage on the average dry weather day. Estimates presented in Volume 1 of this Master Plan, *Planning Criteria*, break this flow into component parts by percent. Thirty-nine percent of the flow is from residential domestic waste sources; 10 percent is waste from significant industrial users; 15 percent is generated by other industrial and commercial sources; and less than 1 percent is septage.

However, the second-largest single source of flow to the treatment plant on dry weather days is infiltration, or water entering the collection system from groundwater through defects in the pipe net-

Figure 3.1: Composition of Dry Weather Flow at Detroit WWTP



work or from footing drains connected to the sanitary or combined sewers. Thirty-six percent of the average day's dry weather flow, or about 198 million gallons, is dry weather infiltration and inflow that must be treated by the Detroit Wastewater Plant. Figure 3.1 shows the composition of dry weather flow at the Detroit WWTP.

As redevelopment within the current service area and expansion of the service area occurs, additional demands for treatment capacity will have to be met. As an option to construction of new or expanded treatment facilities, reduction of extraneous infiltration to the system should be considered.

Major sources of dry weather infiltration to the Detroit collection system are footing drains that are connected to sanitary or combined sewers and leaks in service connections which in total make up more than half of the total length of sewage conveyance structures within the service area.

Based on analysis of recent local projects where dry weather I/ I was estimated and on preliminary results from ongoing footing drain monitoring, the average footing drain contribution is estimated to be 100 to 150 gallons per household per day. The Master Planning effort has established residential domestic flow at 77 gallons per capita per day in dry weather. Wet weather rates are much higher (See Chapter 4). Thus, on average, removing footing drain flows would be the equivalent of reducing each household population by up to 2 persons. Current average household size throughout the study area is about 2.5 persons.

Within only suburban communities, about 172,000 homes are estimated to have connections to footing drains. This equates to between 17 and 26 mgd in footing drain-derived flow that must be treated at the Detroit WWTP. System-wide, including combined sewer areas, about 570,000 households may have footing drains connected to the collection system. In total, dry weather infiltration of between 57 and 85 mgd may be attributable to footing drain connections. This represents between 29 percent and 44 percent of estimated total DWII.

3.2.2 Service Connections

Similar contributions may be expected from service connections. Volume 1 of this Master Plan, *Planning Criteria*, estimated that a total of about 12,150 miles of sanitary and combined sewer make up the public sewage collection system tributary to the Detroit WWTP. However this is only the portion of the system in public ownership. The largest portion of the collection system, in terms of total miles of pipeline, is made up of service connections. An estimated 1.5 million homes, businesses and industries that contribute sanitary flow to the system are connected by service connections that run from the home or business' interior plumbing to the lateral sewer, usually in the street or alley adjacent to the property. By far the largest number of these connections are the residential lines connecting each household in the service area to the collection system. It is estimated that there are over 16,000 miles of service connections, mostly on private property.

An estimate of the total length of service connections in each meter district, and collectively throughout the system was made. This estimate was made by applying a standard estimated average length to all homes constructed within three time frames. Time frames were chosen to reflect both approximate lot size and construction materials/ techniques. SEMCOG data within the Master Plan database was used to determine the number of homes constructed before 1945, from 1946 through 1975, and those built after 1975.

Service connections, especially in older areas, are notorious for misaligned joints, major cracks or breaks, and potentially significant tree root damage. All of these conditions lead to development of major sources of infiltration. Some study of wet weather infiltration through service connections

has been made in other parts of the country, but no significant effort has been made to quantify dry weather infiltration from this source.

In order to estimate the potential volume of DWII entering the system from these sources, a baseline level of infiltration was established. This was assumed to be the "allowable level of infiltration for newly constructed sewers" as contained in the Ten States Standards. This allowance is 200 gallons per day per inch diameter per mile of sewer. Commonly referred to as 200 gallons per inch mile (gal/ in/ mi).

For homes built before 1945 the average service connection length is 50 feet and I/ I was estimated at 300 to 800 gal/ in/ mi.

For homes built between 1945 and 1975 the average service connection length is 75 feet and I/ I was estimated at 200 to 300 gal/ in/ mi.

For homes built after 1975 the average service connection length is 100 feet and I/ I was estimated at 100 to 150 gal/ in/ mi.

Based on the assumed infiltration rates described above, potential infiltration quantities associated with service connections were computed by sewer service district. A district-by-district table presenting an estimate of the DWII potentially associated with leaking service connections can be found in the technical memorandum *Dry Weather Flow from Footing Drain and Service Connections* on the CD that accompanies this report.

Although not as easily quantifiable, infiltration from service connections unnecessarily burdens the treatment capacity of the Detroit WWTP. Privately owned service connections are seldom inspected, and usually only maintained when blockages occur. Within only the suburban communities, up to 12 mgd of treatment capacity may be taken up by infiltration to service connections. Up to an additional nine mgd is likely to be due to infiltration entering service connections within Detroit.

Suburban flows attributable to dry weather inflow/ infiltration total approximately 55 mgd. Thirty-eight mgd can be assigned to footing drain and service connection sources. Through recommended disconnection and inspection these values can be expected to be reduced by about 50 percent.

These are projections of potential flows based on a system-wide average applied to individual districts. Detailed community-by-community analysis will be required to quantify infiltration related flow in any specific area.

The Master Plan has developed recommendations to adopt the following policies:

- Policy that would require disconnection of footing drains, either as a community-wide program at the time property changes ownership or some other approach.
- Policy that would require periodic inspection of service connections, at least at the time property changes ownership, and the repair or replacement of the line if conditions warrant.

Within Detroit an extensive study of infiltration and inflow sources is currently underway. It is critical that this study address dry weather infiltration as well as I/ I from wet weather sources. It is expected that the I/ I study will identify reductions in dry weather infiltration of 15 to 20 percent.

If City of Detroit I/ I efforts are able to reduce dry weather flow by 21 to 28 mgd and the suburban system can reduce dry weather footing drain / service connection flows by 12 mgd to 19 mgd then a "reclaimed" treatment capacity of 33-47 mgd may be achieved.

3.2.3 Manhole Rehabilitation

Manhole rehabilitation is an effective technique for infiltration/ inflow reduction. Several suburban communities have initiated successful pro-

grams. There are about 257,700 manholes in the system and most are 50-100 years old. SSES evaluations of manhole infiltration/ inflow during wet weather simulations have indicated that between two and 15 gpm excess flow can be added to the system from deteriorated manholes. These manholes, when located in areas with a high water table, can also be sources of dry weather infiltration.

Efforts are underway to determine how much dry weather manhole leakage is occurring. Detroit has not had a comprehensive program for manhole rehabilitation. The Master Plan's recommendations for such a program appear in Volume 4, *Capital Improvement Program*.

3.2.4 Separation of Former Urban Streams

Detroit's earliest sewers were constructed in order to keep waste from flowing in the open drainage ditches that carried rainwater to the natural rivulets and streams in the city. These historical drainage courses provided natural drainage paths for storm water to flow toward either the Detroit or Rouge river. Figure 3.3 shows the location of natural watercourses within Detroit based on hydrological atlases of the early 1900s. In these early days of development, the purpose of sewer construction was to provide an enclosed conveyance for wastes to be transported downstream for discharge to the river. Treatment came quite a bit later.

Over time, most of the natural streams within the city were replaced with sewers that transported both the rainfall runoff that would normally have been carried in the streams, and sanitary wastes generated from the homes and businesses being built in a growing Detroit. Often these sewers were constructed directly within old streambeds. This practice allowed the natural topography to direct flows, either overland or in branch sewers, downhill to the new sewer. It also placed the sewer in a location most susceptible to groundwater impacts. Groundwater flows that previously flowed underground until they reached the open stream now flowed to the trench in which the new sewers were constructed. These flows continue to this day, and often saturate the soils surrounding many of the sewers in the city.

Today's engineering practices would not allow development of the sewerage system in this way. At minimum, storm and sanitary flows would be conveyed in separate collection systems. In ideal circumstances, storm flows would be directed toward natural or manmade wetlands that would feed a network of streams tributary to the Rouge or Detroit rivers. However, it is impractical to expect that all of Detroit could ever return to this natural state. At best, portions of the city may be candidates for redeveloped urban streams.

Significant I/ I is likely to be found in these older sewers constructed in streambeds. As the city moves forward with neighborhood redevelopment, the opportunity exists for reconfiguring both the sanitary and storm water collection systems. Potentially significant flow reductions from redeveloped areas can be achieved if locations for redeveloped urban streams can be identified, and stormwater and groundwater flows now being transported to the Detroit WWTP are returned to open watercourses.

Beyond redeveloped areas, opportunities exist for reduction of groundwater infiltration to Detroit's sewer system. Policies should be considered to review drainage practices on public property, such as parks (especially riverfront parks), golf courses, City Airport, etc. Where practical, provisions in these areas should be made for surface drainage to be directed initially away from the collection system to retention ponds or underground retention facilities where flows could naturally be directed toward open watercourses or used to recharge groundwater tables where soil conditions allow. Care must be taken in design to exclude storage

Figure 3.3: Detroit's Urban Streams

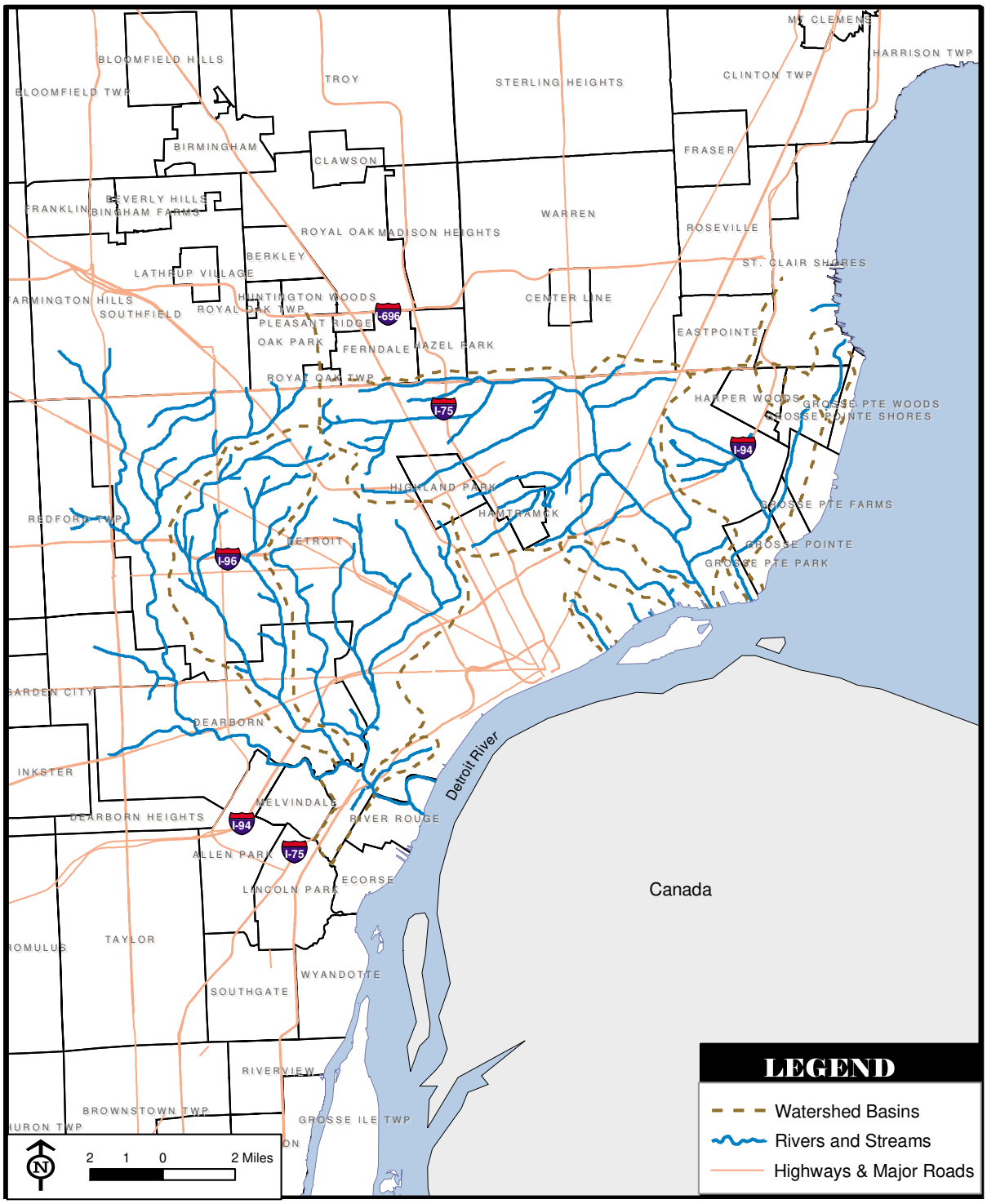


Figure 3.2: Regional Operating Plan Work Group Guiding Principles

1. Operate the system in the best interest of the service area and the environment at an affordable cost.
2. Operate the system to prevent or minimize basement flooding in the event of unforeseen emergency conditions or storm events which exceed capacity of the system.
3. Operate the system to provide adequate transport and treatment capacity for sewered areas.
4. Operate the system in a coordinated manner.
5. Coordinate operational plans with MDEQ.
6. Provide information to all operators, including satellite systems, in the system.
7. Manage hydraulics of the total system to minimize problems within the system.
8. Minimize pollutant loading and controlled overflows to the receiving waters.
9. Maximize system capacity for storm events, including the use of rapid dewatering and decanting.
10. Dewatering should not cause an increase in overflows.
11. Decanting should be managed to not adversely affect water quality.
12. Ensure that local SSO projects, CSO basins and relief sewers do not adversely affect the regional system.
13. Utilize system performance information to show value (cost).
14. Reduce infiltration and inflow to the extent such work is cost-effective throughout the service area.
15. Share system infrastructure to maximize storage and/or treatment capabilities for non-uniform storms.
16. System is defined as all transportation, storage and treatment facilities in the service area.

from areas adjacent to sanitary or combined sewers where infiltration takes place.

As part of the alternatives development portion of this Master Plan, the concept of redeveloped urban streams was investigated. A potential area for daylighting of a stream was identified in Detroit's Graydale neighborhood. This is described in Section 3 of Volume 3, Wastewater Service Alternatives.

3.3 WIMPROP Goals and Role in the Master Plan

Coordinated operation of the regional system offers another approach to capacity management. The Wastewater Improvements and Regional Operation Plan (WIMPROP) work group was established by DWSD and first convened in February 2001. It has the goal of developing an operating plan in conjunction with the Master Plan to better protect the environment during and after wet weather events. Figure 3.2 lists the guiding principles of the Regional Operating Plan work group.

This work group is developing a regional operating plan that will be completed in August 2003 and will deal with two general issues:

- How to operate the system during wet weather events
- How to dewater the system after wet weather events

Dealing with best practices issues for facilities as they come on line during wet weather events, the goal is to make sure the facilities operate at peak efficiency and develop the most capacity-efficient dewatering protocol after the event.

The WIMROP work group is evaluating the feasibility of performing more flow control in the regional system by using existing flow control capabilities to a greater extent. These flow control points include:

- Warren-Pierson control gate
- Conner Forebay control gate
- Shiawassee control gate
- Detroit basin storage
- In-system storage control facilities
- Pump station controls (including Northeast, Conner, Freud, Fairview, Woodmere and Oak-

wood).

In addition, new or unidentified control facilities considered are:

- A new gate in the Detroit River Interceptor to throttle flow in wet weather to give preferential treatment to flows from the Northwest Interceptor and the Oakwood Interceptor
- Fairview Pump Station capacity increase
- Connor Pump Station capacity increase

The feasibility analysis will include an evaluation of the capability of these controls to more effectively control CSO discharges for non-uniform rainfalls. This evaluation will test different control approaches for CSO reduction through the use of continuous model analysis. The WIMROP group will also evaluate dewatering protocols at the CSO and wet weather flow equalization basins throughout the system. It will evaluate the opportunities to coordinate the operational plans of the DWSD, Wayne County, Oakland County, and Macomb County into a set of synchronized standard operating procedures that would reduce overall discharges to the receiving waters.

It is expected that spatial rainfall data will be critical for operating the system in a coordinated manner and to be able to respond effectively to non-uniform rainfall events. Currently SEMCOG is maintaining a set of rain gages in southeast Michigan. However, data collected at these gages are not available in real time or even near real time. In addition, SEMCOG is planning to no longer support data collection at these gages. The WIMROP group is currently investigating how data being collected from existing and/ or new gages can be connected to the DWSD SCADA system. This data collection would include not only DWSD-owned gages, but also gages maintained by some first-tier customers. It is anticipated that the data would be available through this system in essentially real time. It will also be available for input to the GDRSS model for evaluating various potential operations to reduce overall discharges to the receiving waters. This data is critical if the operation and response of the regional system are to be better understood and improved.

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