Detroit Water and Sewerage Department

Wastewater Master Plan

DWSD Project No. CS-1314

Summary of "1978 Segmented Facilities Plan with Environmental Assessment" and "1981 Detroit Facilities Plan – Alternative Facilities Interim Report"

Technical Memorandum
Original Date: May 8, 2003
Revision Date: May 31, 2003
Author: TetraTech MPS

Table of Contents

1. Background 1

2. Summary of the Segmented Facilities Plan (SFP) 3

3. Recommendations of the SFP 10

3.1 First Category Optimization of Existing Facilities 10
3.2 First Category New Major Construction Programs (1977-81) 13
3.3 Second Category Major Construction (1981-2000) 15

4. Financial Plan of the SFP 17

5. Summary of the "Alternative Facilities Interim Report (AFIR)" 22

6. Recommendations of the AFIR 24

7. Status of Recommendations Made in the SFP and AFIR 26

Summary of "1978 Segmented Facilities Plan with Environmental Assessment" and "1981 Detroit Facilities Plan – Alternative Facilities Interim Report"

1. Background

In the mid-1960s, the Detroit Water and Sewerage Department (DWSD) commenced serious planning and design of improvements to the primary wastewater treatment plant and began to acquire adjacent property to provide space for secondary treatment. Land acquisition was complete and construction was underway when the 1972 Amendments to the Water Pollution Control Act were enacted, mandating secondary treatment for all municipal wastewater treatment discharges by June 1977. The new amendments forced DWSD to accelerate the construction schedule and require an increased rate of financing. At the same time, nationwide inflation rates soared which resulted in increased costs for the treatment plant program. This large-scale funding for capital construction programs depleted funds available for plant operation and maintenance.

The Water Board authorized a rate increase in 1975 that was challenged in Court by suburban customers. An additional authorized rate increase in 1977 was also challenged in Court by suburban customers. This litigation prevented DWSD from selling bonds.

Federal funding through the United States Environmental Protection Agency (EPA) required that a facilities planning be prepared and approved prior to funding design and construction projects. DWSD commenced Facilities Planning in 1974 and submitted a draft Overview Plan in 1975. This 1975 report was not accepted since it lacked an environmental assessment and other required material. A draft Overview Plan with Environmental Assessment was submitted in June 1977.

After negotiations started in April 1977, a Consent Judgment was signed on September 9, 1977 by the City of Detroit, United States EPA (USEPA), Michigan Department of Natural Resources (MDNR) and all agencies under contract with DWSD for sewerage services. The Consent Judgment split the Facilities Plan into two parts: (1) a Segmented Facilities Plan to be completed by January 31, 1978 to cover the "upgrading" of treatment and interim control for combined wastewater; and (2) a Final Facilities Plan to include dry weather flow treatment requirements, combined sewer overflow management, and all required elements of a facilities plan with environmental assessment.

The "Segmented Facilities Plan with Environmental Assessment (SFP)" was prepared by a joint venture of Giffels Inc. and Black and Veatch. This report was published in January 1978, and consisted of sixteen (16) books. Book I was the "Summary Report".

The remaining fifteen (15) books were Appendices to Chapters in the Summary Report.

The SFP was prepared to define improvements to the Detroit regional wastewater treatment system to upgrade its capacity to 1050 million gallons per day (mgd) in accordance with Civil Action No. 7-71100 (The Consent Judgment). A Final Facilities Plan (later referred to as the "Detroit Facilities Plan") was required to be prepared as stipulated by the Consent Judgment and Federal Regulations to define requirements needed for the remaining facilities and the sewerage system as a whole.

Work proposed, financial projections and construction schedules in the SFP were based on information available up to December 1977, and were developed to help DWSD to comply with the mandates of the Consent Judgment. Even though the SFP focused on the Detroit Wastewater Treatment Plant (DWWTP), work proposed in the SFP was interrelated with other parts of the sewerage system, both existing and future. To differentiate between the segmented and final facility plans, the SFP labeled all work outside of the Consent Judgment as "Second Category Construction" and "Continuing Programs". Work to be completed before 1981 (part of the Consent Judgment) was labeled as "First Category Optimization of Existing Facilities or New Major Construction Programs".

The Detroit Facilities Plan (DFP) was also prepared by the joint venture of Giffels Inc. and Black and Veatch under DWSD Contract CS-806. The objective of the Detroit Facilities Plan was to investigate all aspects related to the transport, storage and treatment of combined sewer overflows (CSOs), plus treatment of dry weather flows in excess of the Detroit WWTP capacity.

Work under the DFP was divided into three phases. The first phase was completed in March 1979. It established the scope of work and outlined activities, direction, products and processes to be used during the development of the Detroit Facilities Plan. Phase I responded specifically to Item IV.B of the Consent Judgment, which stipulated the objectives for the DFP. A rough-level analysis of all the alternatives (total of 25) was conducted in Phase I.

The second phase carried out the tasks listed in Phase I, with some minor modifications. The Joint Venture, in coordination with DWSD, EPA and MDNR developed a detailed definition of the project goals, which required a decrease in frequency, magnitude and duration of CSOs and their impacts. The degree of reduction was evaluated in terms of a cost/benefit analysis along with environmental, technical, economic and implementability criteria. After the alternatives were screened and evaluated, they were ranked utilizing a planning-level model that analyzed their performance and impact. A recommended set of "few best" alternatives were developed.

Some of the interim reports published as part of the DFP include:

- Detroit Wastewater Treatment Plant Influent Evaluation, May 1980
- Detroit Wastewater Treatment Plant Capacity & Capability Evaluation, Sept 1980
- Quantity and Quality of Combined Sewer Overflows, Sept 1980
- Evaluation of Existing Detroit Wastewater Treatment Plant Preliminary Treatment Complex, April 1981; and
- Alternative Facilities Interim Report (AFIR), June 1981

The third phase was to re-evaluate and re-analyze the few best alternatives, and one alternative was to be picked for implementation. However, the Detroit Facilities Plan was abandoned after completion of Phase II.

The AFIR summarized work done during Phase II and addressed Item IV.A.7 of the amended Consent Judgment, which stipulated the following:

- Description of the costs and benefits resulting from improved water quality for each of the alternative levels of control.
- An environmental information document.
- Proposed outfall requirements and effluent limitations for each facility, and
- Implementable site plans.

2. Summary of the Segmented Facilities Plan (SFP)

The following summary was prepared from Book I – Summary Report of the "Segmented Facilities Plan with Environmental Assessment".

The SFP was a final update to the draft Overview Plan with Environmental Assessment, which was published in June 1977. The SFP was funded by the USEPA, MDNR and DWSD (which also administered the program). The SFP complied with provisions of Public Law 92-500, the Water Pollution Control Act (1972 Amendments).

Following were the general conclusions from the SFP:

- DWSD should continue to be the regional sewerage entity.
- DWWTP process elements should be renovated and repaired, and operation and maintenance be greatly improved so that plant capabilities can be realistically determined before major long-term construction is carried out.

- The service area shown in Figure V-C-1 of the Summary Report (see Figure 1) can be served by the DWWTP up to year 2000, for a projected peak dry weather flow of 1,050 mgd.

- Conventional (air and oxygen) activated sludge treatment plus chemical phosphorus reduction and disinfection is more cost-effective than other treatment systems such as land disposal of effluent or effluent reuse.

- Combined sewer relief and lateral sewer construction programs should be vigorously continued. Proposed combined sewer reliefs in western Detroit should be redirected to the lower Rouge River south of Michigan Avenue, rather than due west.

- The proposed North Interceptor – West Arm should be constructed from the DWWTP to Eight Mile Road.

- Combined sewer overflows (CSOs) should be sampled and monitored prior to design and construction of CSO control facilities, to determine the quality and effects of overflows. Model studies should be included to provide a design basis for structural and non-structural control of CSOs.

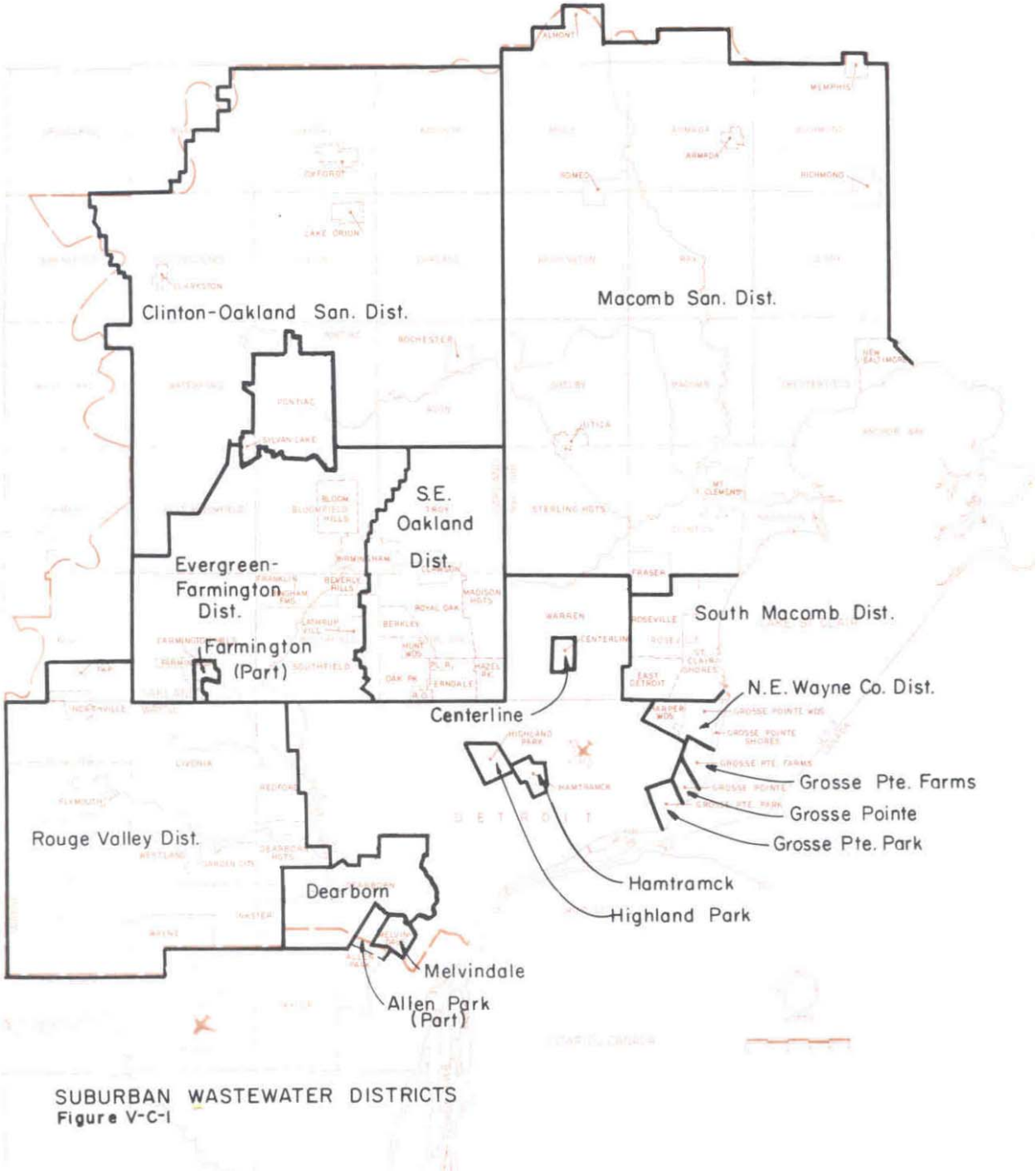

Figure 1. Service Area for Detroit WWTP up to Year 2000 (From 1978 SFP)

- System Control Center (SCC) functions must be eventually tied with real-time DWWTP operating conditions so that inflows to the North Interceptor – East and West arms can be regulated remotely so that plant inflows match DWWTP capacity thus providing maximum CSO control at the DWWTP.

The Consent Judgment had four issues that were to be resolved by December 31, 1977. These issues, termed as "progress tasks", were addressed in the SFP and were as follows:

1. Plant site – The SFP concluded that up to 1,050 mgd of wastewater could be treated at the existing DWWTP site and meeting the effluent limitations of the Consent Judgment. However, the primary basins would eventually need to be replaced. The four interceptors (including the East Arm that was under construction and the proposed West Arm) had a total capacity of 2,600 mgd. The Final Facilities Plan would determine how excess flows would be handled (treated remotely, allowed to overflow untreated, or treated at DWWTP site). The long-range plan of the SFP recommended that new primary basins on adjacent property and existing primaries could treat up to 1,300 mgd of excess combined flows, before being discharged to the Detroit River. The SFP looked at two sites, both adjacent to the DWWTP, for plant expansion. Even though the final selection was left to the Final Facilities Plan, the SFP assumed that the north site (48-acre triangle bound by I-75, Dearborn Avenue and Penn Central tracks) would be selected.

2. West Arm Interceptor – When the SFP was completed, the East Arm (serving Macomb County and northern Oakland County) was almost complete. Partial utilization of the East Arm indicated significant water quality improvements in the Clinton River watershed. The West Arm system was to achieve the same goals in the Rouge River watershed. Due to the depth of the proposed West Arm, it was determined that the existing Main Pumping Station at the DWWTP would not be able to serve the West Arm. A new pumping station would serve both the West and East Arms. Various alternatives for the West Arm were analyzed in the West Arm Segmented Facilities Plan submitted in May 1977. The tunnel interceptor alternative (C-12; tunnel interceptor from Eight Mile Road to the DWWTP) was determined to be most cost-effective and implementable. Early in 1977, a proposal from Wayne County pollution control officials for the construction of a separate interceptor and treatment plant (which would discharge to the lower Detroit River and remove one-half million customers from the regional system) almost derailed the West Arm project. However, the MDNR issued a policy statement that required non-overflowing transport and treatment of suburban separated sanitary sewage, which could be economically met by completion of the West Arm. In addition, Oakland County went on record saying that they needed the West Arm to adequately serve their population. Hence, the SFP concluded that the West Arm was viable and recommended it.

3. Permanent sludge disposal – The SFP concluded that if operation and maintenance of the present DWWTP incinerators were improved, they would be capable of processing all solids produced at the 1,050 mgd peak flow condition. The SFP indicated that additional qualified operators were needed to maintain the higher solids handling capacity.

4. Air quality control – The unresolved issues were improving DWWTP incinerator emission abatement systems and stack emission dispersion characteristics. The dispersion modeling methodology and emissions inventory used for dispersion modeling had to be accepted by the MDNR and Wayne County Department of Health (WCDH). The SFP concurred with MDNR that the emissions should be reduced rather than increasing dispersion. Upon completion of Contract PC-400 and alternative stack modifications, dispersion modeling indicated than maximum 24-hour ambient particulate concentrations would reduce to 70 ug/m3 in the adjacent industrial area, 40 ug/m3 at the adjoining residential area property line, and 30 ug/m3 300 meters away.

The Consent Judgment required that a schedule for combined sewer overflow sampling be furnished before December 31, 1977 in order to prepare a work plan.

The long-range plan for DWSD's water pollution control program was defined by the following goals:

- Insure that Lake Erie and tributary river waters are swimmable and sport fish are abundant.

- Reduce combined wastewater and storm water flooding to a 10-year statistical frequency throughout the City and ensure virtual cessation of basement flooding caused by sewer inadequacy. This would require construction of combined sewer reliefs, lateral reliefs and replacement of inadequate laterals.

- Achieve optimum efficiency of wastewater system operation. This could include construction of new primary basins, construction of low maintenance grit facilities, modification of incinerators to approach or achieve autogeneous burning, and provide continuous preventive maintenance to the plant and system.

- Reduce airborne contaminants to an insignificant level by modifying incinerators and scrubbers.

The following conclusions arose from the Segmented Facilities Plan, and were categorized into twelve (12) major issues:

1. Population and wastewater flows – the total service population (excluding self-served communities such as Warren, Pontiac, Sylvan Lake) would increase from approximately 3.3 million in 1976, to 4.5 million in 2000, and to 4.9 million in

2020. The average and peak dry weather flows would increase from 561 and 783 mgd in 1976, to 716 and 1024 mgd in 2000, and to 766 and 1099 mgd in 2020.

2. Storm flows – the average additional flow due to storage would increase from 80 mgd in 1976 to 109 mgd in 2000. The average annual influent flow to DWWTP would increase from 641 mgd in 1976 to 825 mgd in 2000.

3. Water Quality – a simple water quality model was used to assess the long-term impacts on water quality for the various alternatives. The assessment showed that, even with measures proposed in the SFP, the Rouge River basin would have problems with total dissolved solids (TDS), suspended solids (SS), ammonia, phosphorus and fecal coliform; the Clinton River basin would have problems with TDS, SS, ammonia and fecal coliform; and the Detroit River would have problems with fecal coliform and phosphorus. Most of these problems were attributed to storm water runoff or industrial wastewater discharges.

4. Air Quality – The DWWTP contribution to the ambient particulate concentration would be significantly reduced after completion of PC-400.

5. Discharge Limitations – The MDNR described proposed future effluent limits for the DWWTP in facilities planning as: 30 mg/L for 5-day BOD and TSS, 93 lb/day for phenol, total phosphorus limited to 20 percent of influent or 1 mg/L, and 200/100 ml for fecal coliform bacteria. The Consent Judgment ordered the following 30-day average effluent standards: 30 mg/L with minimum 85 percent removal for 5-day BOD and TSS, 0.1 mg/L for phenol, 1 mg/L for total phosphorus, and 200/100 ml for fecal coliform bacteria. New chemical feeding and mixing equipment would be required to achieve the 1 mg/l goal for phosphorus.

6. Wastewater collection – In 1978, the DWSD sewer system served approximately 650 square miles in Wayne, Oakland and Macomb counties; with 62 percent of the total area with separated sewers. All dry weather flow in the DWSD collection system was transported to the DWWTP via the interceptors. The North Interceptor – East Arm (NI-EA) was under construction and would transport suburban flows from Eight Mile Road, south of Centerline, to the DWWTP; and would have additional capacity to transport some combined flows. The Oakwood-Northwest Interceptor (O-NWI) flows by gravity to the DWWTP. In the Detroit River Interceptor (DRI), all flows upstream of the Fairview Pumping Station had to be pumped. The interceptors were designed to carry dry weather sanitary flow, and the high-strength "first flush" overland runoff from storms. Significant rainfalls resulted in runoffs in excess of the interceptors' capacity resulting in combined sewer overflows to the Rouge and Detroit Rivers. A sophisticated system of remotely controlled gates and inflatable dams provided controllable storage; and several suburban communities had off-line retention basins to store storm flows. The total storage in the system was estimated at 300 million gallons (MG), of which Detroit had 170 MG. A short length of 42-inch

diameter interceptor south of McNichols Road in the O-NWI caused a bottleneck and needed relief. The DRI needed relief between Conner Creek and Fairview Pumping Stations.

7. Infiltration/Inflow – The cost of treatment was $55.80 per MG (based on 1975-76 annual operation and maintenance costs). The estimated present value cost of eliminating 40 percent of infiltration ($52.9 million) was far greater than the treatment cost ($2.9 million). In 1976, the average infiltration, river flow and accounted flow were 32, 39 and 45 mgd (a total of 17 percent of average influent flow at the DWWTP). The river inflow was reduced in 1976 due to installation of flashboards and due to lower river levels. The present value of replacing temporary flashboards with permanent facilities was far less than treating the excess river inflow.

8. Wastewater Treatment Plant – The preliminary treatment system was maintenance intensive and had a reliable firm capacity of 790 mgd. The existing phosphorus removal system was inadequate to achieve the phosphorus effluent limits. The addition of new primary clarifiers would increase solids removal and increase the amount of primary sludge. Reducing sludge recycling would enhance BOD and TSS removal during primary treatment. The secondary treatment aeration basins, and air and oxygen generating equipment would provide treatment at rated flows and loads; however, the final clarifiers limited the secondary treatment performance. After final clarifier modifications and all pure oxygen aeration basins, the secondary treatment capacity would be 1,200 mgd (24 of 25 clarifiers); if aeration basin 1 remained as air and 21 of 25 final clarifiers were in service, the secondary treatment capacity would be 1,050 mgd. A new disinfection system was required since the existing system was in poor condition and had some safety hazards. Deficiencies in the process water system had to be rectified. The sludge thickening, blending and storage capacity was ample for projected average loadings; but additional sludge storage was needed for peak flows. The vacuum filters worked well, but additional staffing and improved operation and maintenance techniques were needed; additional sludge dewatering units were also needed. Autogeneous burning of sludge in the incinerators was possible, and pilot studies were needed to determine the appropriate method. Maintenance at the DWWTP was conducted only in crises and was due to shortage in funds, personnel, equipment and spare parts; improved and expanded maintenance was recommended as the plant was being expanded. There was a serious shortage of supervisory staff, and skilled operators and tradesmen. A formal job training program and a streamlined personnel procurement program was needed. Electrical power was being supplied by Public Lighting Commission and Detroit Edison Company; with the Public Lighting Commission service being maintenance intensive.

9. Institutional Issues – Due to recent rate increases, relations between DWSD and its suburban customers had been adversely affected. Wayne County had

proposed a wastewater plant expansion to serve DWSD's Rouge Valley customers. Some of the existing contracts did not limit the maximum rate of flow, and needed review. The Final Consent Judgment was signed in September 1977 between EPA, MDNR and DWSD ordering the City and DWSD to carry out a scheduled construction and training program. A recent rash of changes within the Water Board was seen as a weakness, which could affect morale and impede in formulating a consistent policy for DWSD.

10. Revenues and Expenses – There was no apparent wasteful or inefficient use of funds for capital improvement programs or operation within DWSD. The need for increased revenue was due to the construction of a secondary treatment system and associated operational costs. Costs borne by the customers were "local share" of funded construction, non-funded construction, and operation and maintenance costs. The rate increase in 1975 was not sufficient to offset the increase in operating expenses, which resulted in another rate increase in 1977 to cover debt services.

11. Customer User Charges – The user charges collected by DWSD were grossly deficient to carry out the pollution control program mandated by Federal Law. Detroit customers were among the lower charged wastewater customers in the nation.

12. Alternative Plans – Eleven (11) alternative plans to provide a solution for wastewater management were selected for cost analysis, of which four (4) were considered viable.

3. Recommendations of the SFP

The SFP provided a list of recommended construction and management improvements that were needed by 1981 to achieve a treatment capacity of 1,050 mgd at the DWWTP. These recommendations were categorized under First Category Optimization and First Category Major Construction. The SFP also created a Second Category Major Construction list that was to be accomplished between 1981 and 2000, and was to be covered in detail in the Final Facilities Plan.

3.1 First Category Optimization of Existing Facilities

a. Detroit Wastewater Treatment Plant (DWWTP)

   1. Primary treatment – modify scum buildings serving the rectangular primaries to add a portable scum container; redesign and replace scum removal arms in circular primaries A1 and A2, and redesign the scum beach and scum hopper for A1 and A2; replace electrical equipment and controls for rectangular primaries.

   2. Secondary treatment – modify peripheral influent lines in all final clarifiers based on results from prototype testing; new cable and raceways

at intermediate lift pumps 1 and 2; replace electrically operated discharge valves with mechanical check valves in B1, B2, B8, B10 and B14; provide centrally located ventilation failure alarm for final clarifier buildings and for ventilation facilities for aeration tank buildings; renovate aeration tank gates used to maintain liquid level in aeration tanks; seal deck of aeration tank 2.

3. Disinfection – improve existing chlorine feed system for greater reliability; provide leak detection device with alarm in chlorine feed room.

4. Phosphorus removal – new chemical feed pumps and piping to feed temporarily to raw water pump suction lines; temporary mixers in well downstream of original grit channels; replace existing flow metering equipment and control valves in pickle liquor and polymer storage and feed systems.

5. Sludge treatment – replace mechanical mixing system with air mixing system in one blending tank; change two constant speed blending tank pumps to variable speed units; renovate main control panel at sludge thickening complex; modify piping to improve operational flexibility of sludge thickening, blending and storage facilities; ultrasonic generators to clean magnetic flow meters; air filters and dryers on vacuum filter air lines.

6. Sludge and grease incineration – replace oxygen analyzers and calibrate instruments in Complex II; repair scum and grease incinerator and provide emission controls; conduct pilot studies on various issues related to incineration; provide facilities for reheating stack gas and modify the stack to increase gas exit velocity.

7. Solids handling – rebuild sludge conveyor system in Complex II for functional redundancy and reliability; renovate Complex II ash handling system by separating dry and wet ash systems; renovate ash silo discharge to provide closed feed to trucks; continue rebuilding Complex I sludge handling system per PC-400; complete grit studies under CS-816 and implement recommendations; improved weighing system for dewatered sludge; facility for measuring ash volume.

8. Flow measurement and sampling – modify venturi meters and flow control gates on primary influent conduits; improve flow metering throughout the plant; modify flumes from intermediate lift stations to aeration tanks 1 and 2 with open channel flow meters and samplers; lines and sinks to sample primary sludge from each clarifier; improve existing raw wastewater sampling stations and add new stations if required.

9. Miscellaneous improvements – provide and expand the central laboratory for the DWWTP and industrial waste monitoring program; continue renovation of raw wastewater pumps; reliable power supply to computers and a fire protection system in computer room; implement an inventory control system; improve screened final effluent with a backup and improve plant water system; purchase additional non-affixed equipment; temporary employee quarters and training facilities; expand power system to accommodate proposed process facilities; provide above-ground electrical distribution centers near rectangular primaries.

10. Pilot studies – for plastic chains and fiberglass flights in rectangular primaries; verify if 8 percent sludge can be removed from primaries; if so, design to send sludge directly to blending or storage tanks; otherwise, pump sludge to gravity thickeners; alternate chemicals and feed points for improved phosphorus removal (CS-822); capability of vacuum filters under various sludge mixtures and loadings (CS-823); determine recycle characteristics by metering and sampling incinerator scrubber, vacuum filter and sludge thickener recycle flows and investigate feasibility of eliminating these recycle flows to the head of the plant; meter influent and effluent flows of the plant; evaluate use of smaller capacity oxygen plant air compressors for improved redundancy and reliability.

11. Maintenance and plant staffing – preventive maintenance for electrical equipment; controls at Main pumping station for screens, grit collectors and other facilities; provide necessary staff, equipment and supplies; routine maintenance program; specific areas of responsibility and chain of command; contract versus in-house maintenance; implement proposed organization, staffing and training program; inventory control system and buildup.

12. Mandated construction – complete all "given" contracts except for Sludge Complex III – grit removal system improvements (CS-816), circular primaries A3 and A4 (PC-276), primary flow control (PC-299), renovate four existing rectangular primaries (PC-407), aeration basins 3 and 4 (PC-283), oxygen plant (PC-288A), twelve final clarifiers (PC-284, PC-406A, PC-408), four final clarifiers (PC-285), six sludge thickeners (PC-294), sludge complexes I and II modifications (PC-400 and CS-802), site improvements (CS-801, PC-418), employee service building (CS-804), electrical system renovation (CS-805), computer maintenance contract, instrumentation service contract (PC-413), operation and maintenance (CS-803), interim sludge disposal contract (CS-813), renovate eight rectangular primaries (similar to PC-407).

b. Interceptor sewers – study existing combined sewer regulators and backwater gates, and design improvements; design in-system storage devices.

c. Institutional and financial programs

   1. Management – upgrading staff, training and operator responsibility should be the highest priority to comply with the Consent Judgment schedule, with quality rather than quantity; use privately contracted maintenance where possible (some were already implemented when the SFP report was published); strengthen the internal training program; strengthen efforts to recruit and retain qualified supervisors and tradesmen; continue to improve purchasing procedures; contract some construction management services; strengthen communication between designers and operators.

   2. Institutional – develop changes in sewage disposal service contracts to meet changing conditions and install flow metering and control devices at points of connection to the DWSD system; develop more detailed and enforceable waste control ordinances; review disinfection requirement in light of receiving water use; be prepared for changes in effluent limitations with a flexible planning process.

d. Industrial waste control – implement an industrial waste control program based on pretreatment at source in accordance with City Ordinance; organize and staff DWSD industrial waste control.

3.2 First Category New Major Construction Programs (1977-81)

a. DWWTP

- The new facilities were intended to improve overall plant performance and phosphorus removal
- Construct a new 2,350 mgd firm capacity raw wastewater pumping station (initial capacity will be 1,300 mgd) which would include screening and flow measurement and separate East and West Arm flows from DRI and O-NWI
- New disinfection facility for 10 mg/l chlorine dose and flow of 1,050 mgd with provision for expansion
- Expand laboratory into abandoned chlorination facility area
- New chemical building for phosphorus removal to treat 1,050 mgd and feed primary and secondary processes
- Addition to existing maintenance building

- New sludge blending and storage tanks
- Additional sludge dewatering units
- New ash lagoons to provide space for new pumping station
- Additional sludge storage tanks to provide sludge storage resulting from 1,050 mgd flow for 48 hours.

b. Interceptor sewers and combined sewer overflow systems

- Construct West Arm interceptor to serve western Detroit and portions of western and northern suburbs (15'-6" diameter from DWWTP to Hubbell-Southfield regulator, 15'-0" diameter from Hubbell-Southfield regulator to Warren Ave/Evergreen, 8'-6" to 11'-0" diameter from Warren Ave/Evergreen to Eight Mile Road/Lahser), provide control facility for Evergreen-Farmington district and include remotely controlled regulators
- Complete construction of the East Arm with remotely controlled regulators
- Construct 7'-6" force main and 10'-0" gravity interceptor, parallel to DRI, to relieve DRI from Conner Creek pumping station to Helen Avenue
- Construct 6'-0" relief interceptor paralleling O-NWI from McNichols Road to Puritan Road
- Construct improvements (electrical, sanitary sewage pump, connection to new force main) at Conner Creek pumping station
- Construct improvements (two new 100 mgd pumps, renovation of oil skimming facilities) to Oakwood pumping station
- Install fabridams with instrumentation and control at following locations (Telegraph and Puritan, Seven Mile Road and Shiawassee, Frisbee and Woodbine, McNichols and Bramell)
- Install sluice gates with instrumentation and control in Wyoming relief, Upper Livernois relief, Ashland relief
- Bulkhead Ashland sewer upstream of Fox Creek backwater gate and construct either a drop inlet into Fox Creek relief sewer or drop inlet into Mack Avenue relief or 13'-6" sewer from upstream of Ashland bulkhead to Manistique sewer
- Construct improvements to regulators and backwater gates

- Construct suburban interceptors (Mt. Clemens Arm and control facilities for Mt. Clemens and Northeast Clinton Twp, Lakeshore Arm-H.B.Joy Road to 21 Mile Road, Richmond Arm-along 21 Mile Road from Gratiot to Chesterfield lagoon and control facility for Chesterfield Twp, extension of Romeo Arm from Garfield/Clinton River Rd to Garfield/18 Mile Rd, Armada Arm-21 Mile Rd/Gratiot to 21 Mile Rd/North Ave, control facilities for Clinton Twp at 15 Mile Rd/Little Mack and for Fraser at 15 Mile Rd/Hayes and for N.E. Shelby Twp)

- Determine needs of Systems Control Center and revise/expand/relocate SCC to achieve operational efficiency; install new 194 mgd (300 cfs) pump at Bluehill pump station

- Provide sludge disposal facilities to accommodate solids removed from an additional 1,300 mgd combined wastewater and projected increases in dry weather flows.

3.3 Second Category Major Construction (1981-2000)

a. DWWTP - The best alternative for future expansion of the DWWTP was determined to be the North site.

- Construct sixteen aerated grit basins for either site alternative

- Construct diffuser structure on the Rouge River outfall

- Renovate circular primaries A1 and A2 as recycle treatment tanks

- Construct new square primaries (North site alternative would contain 32 primary clarifiers); expand chlorination facility to feed 18 mg/l chlorine dose for additional 1,300 mgd combined wastewater

- PLC and DEC provide dual power feeds to the plant – construct a vital load electrical substation connected to both PLC and DEC to feed critical locations within plant in case of total failure of either source

- Purchase and clear new site for plant expansion

- Install remaining pumps in new pumping station to increase firm capacity to 2,350 mgd.

b. Interceptor sewers and combined sewer overflow systems

- Construct a dewatering force main from Freud pumping station to DRI

- Construct additional facilities at Oakwood pumping station to increase total pumping capacity to 647 mgd (1000 cfs) and a force main to O-NWI

- Install additional pumps at Northeast pumping station depending on future suburban service

- Construct fabridams and overflow control equipment in Plymouth/West Chicago and Joy/Tireman relief sewers at their Rouge River outfalls

- Install sluice gates and overflow control equipment at Three Mile Road sewer

- Construct combined sewer reliefs to interceptors in the following districts – Northwest area (paralleling Southfield and Hubbell sewers, combining together at Ford Rd and discharging to Rouge River south of Michigan Ave), Baby Creek (paralleling Edison, Linwood and Joy sewers and discharging to Lonyo sewer), Conner Creek (paralleling McNichols sewer discharging to Conner Creek sewer), Fox Creek (paralleling Rivard-McCormick sewer), East Jefferson (paralleling existing Jefferson Ave east and west relief sewers), Oakwood (paralleling Liddesdale sewer), Central (in sub-districts C-3 through C-8)

- Suburban sewer construction should be in accordance with local suburban 201 facility planning and paid by local suburban sewer districts; DWSD, if requested by suburbs and in accordance with 201 facility planning and in conformance with regional needs would agree to the following:

  - Extend connection serving Centerline from Eight Mile Rd to NI-EA

  - Extend Romeo, Armada, Richmond arms to Corridor interceptor

  - Construct new Clintondale pumping station and 15 Mile Rd interceptor in Macomb County when required

  - Construct 9'-0" diameter sewer along 8 Mile Rd between Lakeshore Dr and Northeast pumping station

  - Connect trunk sewers carrying sanitary flows from western Wayne County townships to NI-WA

  - Direct connection of Southeast Oakland County System to North Interceptor

  - Connect Evergreen-Farmington, Rouge Valley system, Dearborn, Allen Park, etc., to NI-WA

  - Additional modification of SCC to provide for suburban connections and their effect on the City system, to ensure efficient operational and control of the DWSD collection system).

4. Financial Plan of the SFP

The Financial Plan included capital improvement costs, collection system O&M costs, treatment plant and administrative O&M costs, debt service, and total revenue requirements. All costs were estimated using wages as of June 1976. Annual costs until 2000 were projected using appropriate adjustments for inflation. Capital cost items were totally funded in the first year of construction, regardless of construction duration, unless definite construction stages were planned. Costs for Second Category facilities were provided only to forecast overall revenue requirements and were expected to be refined in the Final facilities Plan.

Table 1 (Table I-D-1 from the Summary Report of the SFP) shows the costs for Capital Improvement Program Mandated Construction.

Table 1. Capital Improvement Program Mandated Construction

Item	Already Funded (M$)	1978 Total (M$)	1979 Total (M$)	Total To Be Funded (M$)
North Interceptor – East Arm (PCI 21)	9.7	-	-	-
North Interceptor – East Arm (PCI 22)	-	20.0	-	20.0
Total Collection System	***9.7***	***20.0***	***0.0***	***20.0***
Grit removal (CS-816)	-	0.45	3.0	3.45
Primary tanks A3 and A4 (PC-276)	-	12.0	-	12.0
Primary flow control (PC-299)	0.58	-	-	-
Renovate four primary tanks (PC-407)	0.44	1.0	-	1.0
Aeration tanks 3 and 4 (PC-283)	38.9	-	-	-
Oxygen plant (PC-288A)	10.4	-	-	-
Twelve final tanks (PC-284, 406A, 408)	33.0	-	-	-
Four final tanks (PC-285)	-	13.0	-	13.0
Six sludge thickeners (PC-294)	5.5	-	-	-
Renovate sludge complexes I & II (PC-400)	9.5	1.0	1.0	2.0
Complex II modification (CS-802)	-	1.4	-	1.4
Site improvements (CS-801, PC-418)	-	2.2	-	2.2
Employee service bldg and garage (CS-804)	-	5.4	-	5.4
Electrical bldg renovation (CS-805)	-	0.3	2.0	2.3
Computer maintenance contract	-	-	-	-
Instrumentation service (PC-413)	-	2.0	-	2.0
O & M manuals (CS-803)	3.0	-	-	-
Renovate eight primary tanks	-	1.4	1.4	2.8
Total Treatment Plant	***101.4***	***40.15***	***7.4***	***47.55***
TOTAL MANDATED CONSTRUCTION	**111.1**	**60.15**	**7.4**	**67.55**

Table 2 (Table I-D-2a of SFP Summary Report) shows costs for First Category Optimization.

Table 2. CIP Segmented Facilities Plan (First Category Optimization)

Item	Percent Locally Funded	Fiscal Year Ending (in $1,000)				
		1978	1979	1980	1981	Total
A. TREATMENT PLANT						
Primary treatment						
Scum removal & modifications	20		579			579
Rehab primary treatment instrumentation	20		310			310
Secondary treatment						
Modify clarifiers	20		5,000			5,000
Rehabilitate I&C	20		600			600
Modify aeration basins	20		560			560
Disinfection						
Renovate existing chlorine system	20		1,340			1,340
Phosphorus removal						
Upgrade & modify chemical feed, mixing and flocculation system	20		2,540			2,540
Sludge treatment						
Modify sludge pumps, piping, thickener, blending tanks & instrumentation	20		837			837
Sludge and grease incineration						
Replace oxygen analyzers & calibrate instrumentation	20		64			64
Repair scum and grease incinerator	20		50			50
Pilot studies	20		8,940			8,940
Stack gas reheat, increase exit velocity	20		1,400			1,400
Solids handling						
Upgrade solids handling facility	20		5,710			5,710
Flow measurement and sampling						
Modifications to plant flow metering	20		2,500			2,500
Primary sludge sampling lines & sinks	20		45			45
Upgrade wastewater sampling stations	100		100			100
Miscellaneous improvements						
Provide central laboratory	20		170			170
Rehabilitate raw wastewater pumps	100	250	940			1,190

Item	Percent Locally Funded	Fiscal Year Ending (in $1,000)				
		1978	1979	1980	1981	Total
Computer modif and inventory control	20		3,275			3,275
Renovate SFE and plant water systems	20		4,150			4,150
Purchase non-affixed eqpt (grant eligible)	20		1,375	725		2,100
Purchase non-affixed eqpt (non-grant eligible)	100	400				400
Provide temporary employee quarters	20	200				200
Power system upgrade & expansion	20		2,255			2,255
Pilot studies	20		4,000			4,000
Inventory buildup	100	175	1,000	678		1,853
B. INTERCEPTOR SEWERS						
Study CSO regulators	20		50			50
Design pipe storage devices	20		144			144
TOTAL FIRST CATEGORY OPTIMIZATION		**1,025**	**48,384**	**1,403**		**50,812**

Table 3 (Table I-D-2b of SFP Summary Report) shows cost for First Category Major Construction.

Table 3. CIP Segmented Facilities (First Category Major Construction)

Item	Percent Locally Funded	Fiscal Year Ending (in $1,000)				
		1978	1979	1980	1981	Total
A. TREATMENT PLANT						
Construct new pumping station	20		56,030			56,030
Construct new chlorine facility	20		1,640			1,640
Expand laboratory	20		100			100
Construct phosphorus removal facility						
Phosphorus removal studies	20	3,600				3,600
Chemical feeding & mixing facilities	20		5,200			5,200
Flocculation facilities	20		10,700			10,700
Facilities & addnl space for maintenance	20		420			420
Sludge blending and storage facilities	20		5,000			5,000
Additional dewatering facilities	20		3,315			3,315
Construct ash lagoons	20		2,500			2,500
Additional sludge storage tanks	20		1,500			1,500

Item	Percent Locally Funded	Fiscal Year Ending (in $1,000)				
		1978	1979	1980	1981	Total
B. INTERCEPTORS & COMBINED SEWERS						
West arm interceptor	20		54,000	55,000		109,000
East arm regulators	20		2,300			2,300
Detroit river interceptor relief	20			10,400		10,400
Oakwood-northwest interceptor relief	20			500		500
Improve Conner Creek pumping station	100		4,100			4,100
Improve Oakwood pumping station	100		2,100			2,100
Install fabridams	20		584			584
Install sluice gates	20		379			379
Construct Ashland diversion and modify Fox Creek backwater gate	80		600			600
Improve regulators & backflow gates	80		550			550
Construct suburban interceptors						
Mt. Clemens arm	20		1,200			1,200
Extend Lakeshore interceptor	20		6,800			6,800
Part of Richmond arm	20		1,810			1,810
Extend Romeo arm	20		2,750			2,750
Part of Armada arm	20		2,150			2,150
Control facilities	20		490			490
Modify system control center	20		1,485			1,485
Install pump at Bluehill pumping station	100			4,000		4,000
Additional sludge disposal facilities	20			111,000		111,000
TOTAL FIRST CATEGORY MAJOR CONSTRUCTION		**3,600**	**167,703**	**180,900**		**352,203**

Table 4 (Table I-D-c of SFP Summary Report) is a summary of the capital improvement program for the entire Segmented Facilities Plan.

Table 4. Capital Improvement Program Segmented Facilities Plan

Item	Percent Locally Funded	Fiscal Year Ending (in $1,000)																							
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
TOTAL FIRST CATEGORY OPTIMIZATION		**1,025**	**48,384**	**1,403**																					50,812
TOTAL FIRST CATEGORY MAJOR CONSTRUCTION		**3,600**	**167,703**	**180,900**																					352,203
SECOND CATEGORY CONSTRUCTION																									
A. TREATMENT PLANT																									
Aerated grit basins, influent flumes, flow meters	20					34,160																			34,160
Rouge River outfall diffuser	20							3,950																	3,950
Renovate A1 &A2 for recycle treatment	20									3,250															3,250
Primary clarifiers with rapid mixing & flocculation	20					81,200																			81,200
Construct three final clarifiers & convert air aeration basin to oxygen	20					9,530			9,600																19,130
Expand chlorine facility	20							2,970																	2,970
Improve electrical system	20								3,500																3,500
Purchase & clear new site	100				30,000																				30,000
Install addnl pumps at main pumping station & reroute DRI	20					11,880																			11,880
B. INTERCEPTORS & COMBINED SEWERS																									
Freud station dewatering main	20				1,300																				1,300
Expand Oakwood station & build main	100				15,000																				15,000
Install pump at Northeast station	100								1,100																1,100
Install addnl fabridams	20				468																				468
Install addnl sluice gates	20				257																				257
Construct combined sewer reliefs	80				15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	15,800	316,000
Total Second Category Construction					**62,825**	**152,570**	**15,800**	**22,720**	**30,000**	**19,050**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**15,800**	**524,165**
CONTINUING PROGRAMS																									
A. COLLECTION SYSTEM																									
Lateral sewer replacement	100	9,500	11,500	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	239,400
Relief sewer replacement	80	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	57,500
B. ADMINISTRATION																									
Facility plan updating	20						100	100	200	100	100	100	600	100	100	100	100	600	100	100	100	100	600	100	3,400
Rate studies	90		1,200				100			100				100					100					100	1,700
Value engineering	20		834	140	1,126	95	95	874	200	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	4,789
Total Continuing Programs		**12,000**	**16,034**	**13,040**	**14,026**	**12,995**	**13,195**	**13,874**	**13,300**	**13,195**	**13,095**	**13,095**	**13,595**	**13,195**	**13,095**	**13,095**	**13,095**	**13,595**	**13,195**	**13,095**	**13,095**	**13,095**	**13,595**	**13,195**	**306,789**
FINAL FACILITIES PLAN	**20**	**12,209**																							**12,209**
MANDATED FACILITIES		**60,150**	**7,400**																						**67,550**
TOTAL CAPITAL IMPROVEMENT PROGRAM		**88,984**	**239,521**	**195,343**	**76,851**	**165,565**	**28,995**	**36,594**	**43,300**	**32,245**	**28,895**	**28,895**	**29,395**	**28,995**	**28,895**	**28,895**	**28,895**	**29,395**	**28,995**	**28,895**	**28,895**	**28,895**	**29,395**	**28,995**	**1,313,728**

5. Summary of the "Alternative Facilities Interim Report (AFIR)"

The objective of the AFIR was to identify those alternatives that controlled combined sewer overflows in the most cost-effective, environmentally satisfactory, technically feasible, economically sound and implementable manner. The AFIR verified the dry weather treatment capacity of the DWWTP for year 2000 conditions and reviewed the extent of the CSO problem in order to develop alternatives that provided various levels of CSO control.

The average and peak dry weather flows for year 2000 were estimated to be 608 mgd and 800 mgd, respectively. As part of the DWWTP capacity evaluation, field-testing of the DWWTP secondary treatment capability was done at 800 mgd instead of the 1,050 mgd recommended in the Segmented Facilities Plan. Hence, the alternatives had to be modified to account for the new capacity.

A five-step approach was used to generate the alternatives: a definition for "controlling CSOs" was developed; a statistical storm water assessment methodology (SSAM) was developed for the Detroit system to determine the extent of the CSO problem; the hydrologic and hydraulic characteristics of the Detroit system were developed in order to use the SSAM; 17 years of hourly rainfall data, area-transformed using the Thiessen method, was used to generate the rainfall characteristics; SSAM was used to convert basin rainfall statistics for each of the eight Detroit basins to calculate surface runoff and long-term combined sewer capture fractions. The eight basins or watersheds were Rouge River North (RRN), Rouge River South (RRS), Hubbell-Southfield (HS), Baby Creek West (BCW), Baby Creek East (BCE), Conner and Baby Creek (CBC), Conner Creek-Central (CCC) and Fox Creek-East Jefferson (FCE). After least-cost control options were developed for each of the eight basins, corresponding control and operational regimes were combined to generate general system-wide control alternatives. The general alternatives were converted to specific control alternatives by designating specific sites for control facilities, and by the sizing and placement of control facilities, interceptors and relief sewers.

Various levels of treatment were considered. The options for CSO control ranged from preliminary treatment (coarse screening, grit and suspended solids removal, and chlorine disinfection) to slow rate land treatment with no surface water discharge. The general options for sludge processing ranged from returning sludge to the interceptor continuously for processing at the DWWTP to storing, thickening and dewatering the sludge onsite followed by truck transport for ultimate disposal.

The dry weather flow treatment alternatives were flow surge control at the DWWTP and advanced wastewater treatment at the DWWTP. Since a surge control method was not in place at the DWWTP, all of these alternatives considered the addition of two secondary clarifiers (35 mgd capacity each) that would increase the dry weather capacity to 880 mgd (800 mgd raw wastewater flow plus 80 mgd recycle flow).

However, if a surge control strategy were implemented, the capacity of the secondary clarifiers would increase to 40 mgd each thus negating the need for the two new clarifiers. Three tertiary effluent criteria (TEC) were considered: 30 mg/l TSS, 12-15 mg/l BOD, 1 mg/l TP; 20 mg/l TSS, 7-10 mg/l BOD, 0.5 mg/l TP; and 10 mg/l TSS, 5-10 mg/l BOD, 0.25 mg/l TP. The capital costs for these three TECs at 800 mgd flow ranged from $65.6 million to $306.1 million (in 1980 dollars).

A total of 26 CSO control alternatives were proposed. This included a "Future No Action" alternative and 25 system alternatives.

The No Action alternative included no changes to the transport system, continuing the use of the existing system storage, and no changes in quantity and quality of industrial flows.

Alternatives 1 and 2 provided 50 percent control of wet weather volumes; alternatives 3 and 4 provided 60 percent wet weather volume control; alternatives 5 and 6 provided 70 percent wet weather volume control; alternatives 7 and 8 provided approximately 80 percent wet weather volume control; these controls were achievable by the construction of new transport facilities and new storage/treatment facilities in the eight drainage basins.

Alternative 9 provided about 65 percent wet weather volume control with new in-system storage and increasing the DWWTP primary capacity by 125 mgd (880 mgd to 1005 mgd). Alternative 10 utilized the maximum in-system storage without building any offline storage facilities; and provided about 60 percent wet weather volume control. Alternative 11 provided about 75 percent wet weather volume control by building new transport facilities and increasing the DWWTP primary capacity to 1450 mgd (increase of 570 mgd). Alternative 12 provided about 85 percent wet weather volume control by building new transport facilities (in-system storage and relief sewers) and increasing the DWWTP primary capacity to about 2,200 mgd (increase of 1,300 mgd).

Alternative 13 provided approximately 55 percent control of wet weather volume by building new transport facilities and increasing the DWWTP capacity (both primary and secondary) to 923 mgd (increase of 43 mgd). Alternative 14 provided about 65 percent wet weather volume control using new transport facilities, new offline storage facilities and increasing the DWWTP capacity to 974 mgd (increase of 94 mgd). Alternative 15 provided about 65 percent wet weather volume control using new transport facilities, new offline storage facilities and increasing the DWWTP capacity by 94 mgd. Alternative 16 provided approximately 80 percent wet weather volume control using new transport and offline storage facilities, and increasing the DWWTP capacity to 1,192 mgd (increase of 312 mgd).

Alternative 17 provided about 80 percent wet weather volume control by adding new transport and offline storage facilities, and increasing the DWWTP capacity by 312 mgd. Alternative 18 provided about 85 percent wet weather volume control by

adding new transport and offline storage facilities, and increasing the DWWTP capacity to 1,344 mgd (increase of 464 mgd). Alternative 19 provided approximately 85 percent wet weather volume control using new transport and storage facilities, and increasing the DWWTP capacity by 464 mgd.

Alternative 20 provided about 70 percent wet weather volume control using new transport and offline storage facilities, and management practices such as sewer flushing on a small scale. Alternative 21 also provided about 70 percent wet weather volume control using new transport and offline storage facilities, and sewer flushing on a small scale. Alternative 22 provided about 75 percent wet weather volume control utilizing new transport and offline storage facilities. Alternative 23 also provided approximately 75 percent wet weather volume control using new transport and offline storage facilities. Alternatives 24 and 25 provided approximately 80 percent wet weather volume control using new transport and offline storage facilities. Other options considered were sewer separation, flow reduction, and large tunnel alternatives.

Probable costs were developed for each of the 25 alternatives. Cost curves from the Segmented Facilities Plan were adjusted upward by 15 percent to reflect Detroit construction costs, and were further increased by 38 percent to update to 1980 costs. The Joint Venture team estimated costs not available in the SFP. The probable wet weather facilities capital costs (in 1980 dollars) ranged from $4.9 million for Alternative 2 to $1,228 million for Alternative 7. The total wet and dry weather costs (including amortized capital costs and O&M costs) ranged from $67.8 million per year for the "Future No Action (FNA)" alternative to $125.3 million for Alternative 24.

6. Recommendations of the AFIR

The screening and ranking of alternatives resulted in the selection of eight alternatives as the few best alternatives (Alternatives 2, 3, 4, 9, 10, 11, 13 and 15). These alternatives ranged from minimum collection system additions and DWWTP modifications to extensive additions incorporating relief sewers, offline storage, in-system storage control gates and additions at the DWWTP. A summary of the few best alternatives is presented in Table 5 in the order of their ranking.

Table 5. Summary of the Few Best Alternatives

Ranking	CSO Alternative	Transport	Storage/Treatment
1	10	Maximum potential in-system storage without new sewers	No offline storage facilities. Increase DWWTP primary by 490 mgd.
2	9	Several in-system storage control gates.	No offline storage facilities. Increase DWWTP primary by 125 mgd.
3	2	Utilize portion of potential in-system storage with new control gates, and no new sewers.	No offline storage facilities. Increase DWWTP primary by 490 mgd.
4	11	New relief sewers for DRI and O-NWI	No offline storage facilities. Increase DWWTP primary by 570 mgd.
5	15	Additional in-system storage and new relief sewers.	Offline storage facility for CCC and HS. Increase DWWTP capacity to 976 mgd (including 80 mgd recycle).
6	13	No new sewers. New in-system control gates.	No offline storage facilities. Increase DWWTP capacity by 43 mgd.
7	4	New in-system storage and new relief sewers.	New storage basins in BCW, CCC, HS and BCE. Increase DWWTP primary by 490 mgd.
8	3	New in-system storage and new relief sewers.	New storage facilities in all eight basins except FCE. Increase DWWTP primary by 490 mgd.

The probable total costs for the few best alternatives and the FNA alternative are presented in Table 6 (Table 1-1 of the AFIR).

Table 6. Probable Total Cost for the Few Best and FNA Alternatives

CSO Alternative	Capital Cost (1980 Dollars in Millions)				Annual Cost (in $Millions)		
	Collection System	Storage / Treatment	Addnl DWWTP Facilities	Total Capital Cost	Amortized Capital Cost	O&M Cost	Total Annual Cost
FNA	0	0	137.5	137.5	8.42	59.43	67.85
10	0	17.9	137.5	155.4	9.42	59.89	69.31
9	0	4.4	166.9	171.3	10.44	59.56	70.00
2	0	4.9	137.5	142.4	8.69	59.54	68.23
11	130.0	0	174.4	304.4	16.36	60.68	77.04
15	48.8	74.4	203.8	327.0	18.84	59.92	78.76
13	0	4.4	177.1	181.5	10.95	59.86	70.81
4	55.9	190.2	137.5	383.6	21.02	60.39	81.41
3	41.4	197.7	137.5	376.7	29.72	60.13	80.85

The costs for sewer separation (installing separate sanitary sewers) in the combined sewer districts of Rouge Valley, Baby Creek, and a strip along the Detroit River were evaluated. The cost per acre average approximately $37,000.

The reduction in influent flow to the DWWTP by implementing a residential, industrial and commercial conservation program was evaluated. The present worth cost for implementing the conservation program in the DWSD service area was $25 million over 20 years, which would result in a DWWTP flow reduction of 18 mgd or a savings of $10 million. The residential flow reduction program was deemed not to be cost-effective.

7. Status of Recommendations Made in the SFP and AFIR

Recommendations from the SFP and their current status are summarized in Tables 7 and 8. Where recommendations have not been implemented, an explanation, if known, is provided. In many cases, recommendations from the SFP have been superceded by later studies and capital programs, particularly PC-744 and the LTCSOCP for the Detroit and Rouge Rivers. Many relief sewer projects recommended in the SFP have not been implemented, but assessments of the hydraulic capacity of the collection system were done as part of the LTCSOCP. Providing relief capacity should be an ongoing consideration for DWSD.

Table 7. Status of First Category Major Construction (1978-81) SFP Recommendations

Recommendation	Status of Recommendation
A. TREATMENT PLANT	
Construct new 2,350 mgd firm capacity raw wastewater pumping station; initial firm capacity will be 1,300 mgd.	Pump Station 2 (PS-2) was completed in the mid 1990's.
Construct new chlorine facility (10 mg/l dose and 1,050 mgd flow) with provision for expansion.	Construction of the new chlorination and dechlorination facilities is almost complete, and will be in operation by Feb/March 2003.
Expand laboratory into abandoned chlorine facilities area.	Not implemented.
Construct new chemical building for phosphorus removal, with storage, transfer and feeding facilities for selected chemical. Feed points to primary and secondary processes.	PS-1 mixed liquor facility was renovated in late 1970's. A new mixed liquor facility for PS-2 was built in the mid 1990's.
Provide addition to maintenance building.	Not implemented.
Construct sludge blending and storage facilities.	Complex B thickening facility was built in early 1990's. But no new sludge blending and storage facilities were built. Under PC-744, Contract DWP-1016 was initiated to rehabilitate Complexes A and B sludge thickeners and associated facilities.
Provide additional dewatering units.	Lower level belt presses were added in early 80's and are being replaced with centrifuges. Upper level belt presses were added in late 1990's.
Construct new ash lagoons to provide space for new pumping station.	When PS-2 construction was started in early 90's, new ash lagoons were built. Some of the ash lagoons were removed to make way for two new circular primaries currently under construction.
Construct additional sludge storage tanks (48 hour storage for sludge resulting from 1,050 mgd flow).	The LTCSOCP and PC-744 revised the dry weather flow capacity to 830 mgd. Contract DWP-1016 under PC-744 will rehabilitate Complexes A and B sludge thickeners and associated facilities.
B. INTERCEPTORS & COMBINED SEWERS	
Construct West Arm Interceptor	The West Arm Interceptor was not built. However, the 1996 LTCSOCP and a 2001 update have proposed construction of an Upper Rouge Tunnel that would provide additional relief capacity.
Construct remotely controlled regulators in East Arm.	Three regulators within the City of Detroit were built.
Construct 7'-6" force main and 10'-0" gravity interceptor to relieve DRI between Conner Creek pumping station and Helen Ave.	The dry weather capacity is adequate. Construction of the Conner Creek pilot CSO control facility will minimize the impact of any restriction of wet weather flows.

Recommendation	Status of Recommendation
Construct 6'-0" O-NWI relief interceptor from McNichols Rd to Puritan Rd.	Not implemented. The proposed Upper Rouge Tunnel may address this need.
Improve Conner Creek pumping station – electrical, install sanitary sewage pump, connection to new force main.	Electrical improvements and sewage pump were implemented; new force main was not implemented.
Improve Oakwood pumping station – two new 100 mgd pumps, renovate oil skimming facilities, improve access for O&M.	Improvements have been made to the Oakwood pumping station including improved oil skimming. A major project to add storage, skimming and disinfection will be initiated in 2003.
Install fabridams – Telegraph/Puritan, 7 Mile/Shiawassee, Frisbee/Woodbine, McNichols/Bramell.	Telegraph/Puritan – Puritan-Fenkell CSO basin was built; 7 Mile/Shiawassee – 7 Mile CSO basin was built; Frisbee/Woodbine – connected Frisbee sewer to Puritan-Fenkell CSO basin; McNichols/Bramell – This location was not one of the locations for in-system gates or dams. The recommended locations were established generally in the LTCSOCP and specifically in Contract CS-1329 (Installation of in-system storage devices).
Install sluice gates – Wyoming Relief, Upper Livernois Relief, Ashland Relief.	Storage devices in the Wyoming relief and Upper Livernois relief are included in Contract CS-1329, currently under construction. Gates for Ashland relief were included in the initial CS-1329 contract, but were dropped from the final contract.
Bulkhead Ashland sewer immediately upstream of Fox Creek backwater gates and build either a) drop inlet to route Ashland sewer flow to Fox Creek relief sewer at Ashland/Kerchevel or a drop inlet to Mack Ave Relief or b) 13'-6" sewer from immediately upstream of bulkhead to Manistique sewer.	The 2001 LTCSOCP Update recommends that the Fox Creek backwater gates outfall be used only as an emergency bypass during extreme events.
Improvements to regulators & backwater gates on overflows.	Implemented.
Construct suburban interceptors:	
Mt. Clemens arm and control facilities for Mt. Clemens and Northeast Clinton Twp.	Not implemented. The City of Mt. Clemens is no longer a DWSD customer.
Extend Lakeshore interceptor from H. B. Joy Rd to 21 Mile Rd.	Implemented.
Richmond arm – along 21 Mile Rd from Gratiot to Chesterfield lagoon, and control facility for Chesterfield Twp.	Implemented, but not as proposed in the SFP (lagoon is no longer in use).
Extend Romeo arm from Garfield/Clinton Rd to Garfield/18 Mile Rd.	Implemented.
Armada arm from 21 Mile Rd/Gratiot to 21 Mile Rd/North Ave.	Implemented, but not as proposed in the SFP.

Recommendation	Status of Recommendation
Control facilities for Clinton Twp at 15 Mile Rd/Little Mack, for Fraser at 15 Mile Rd/Hayes, for N.E. Shelby Twp.	Control facilities at 15 Mile Rd/Little Mack and 15 Mile Rd/Hayes have not been implemented, but are under review by DWSD. Currently, there are three flow meters for Shelby Twp.
Revise, expand and/or relocate System Control Center to achieve operational efficiency when additional facilities designated in SFP are completed.	Was implemented as needed. Future control of the collection system for wet weather control is being addressed under the LTCSOCP. The SCC will be moved to the Central Services Facility on Huber Rd. Contract PC-713 will add/upgrade instrumentation at the SCC.
Install new 300 cfs pump at Bluehill pumping station.	Currently under review by DWSD.
Provide sludge disposal facilities to accommodate solids removed from an additional 1,300 mgd combined wastewater and projected increases in dry weather flows.	Currently being addressed under PC-744 (for a maximum flow of 1700 mgd primary and 830 mgd secondary).

Table 8. Status of Second Category Major Construction and Continuing Programs (1981-2000) SFP Recommendations

Recommendation	Status of Recommendation
SECOND CATEGORY CONSTRUCTION	
A. TREATMENT PLANT	DWSD project PC-744 at the Detroit WWTP, when completed, will provide a firm and reliable capacity of 1,700 mgd primary and 830mgd secondary.
Construct 16 aerated grit basins with influent flumes and flow meters at either site alternative.	Aerated grit chambers were included for Pump Station 2.
Construct diffuser structure on Rouge River outfall.	Was not implemented. After completion of the second Detroit River outfall (DRO2), the Rouge River outfall (RRO) will only be used as a backup to the two Detroit River outfalls.
Renovate circular primaries A1 and A2 for recycle treatment.	After completion of the two additional circular primaries (5th and 6th), the firm primary capacity at the DWWTP will be 1,700 mgd (based on 5 of 6 circular primaries and 10 of 12 rectangular primaries in service, and 100 mgd for plant recycle flows).
Construct square primary clarifiers with rapid mixing & flocculation (North site would contain 32 clarifiers).	Was not implemented. The firm primary treatment capacity after completion of all PC-744 related projects will be 1,700 mgd.

Recommendation	Status of Recommendation
Construct three additional final clarifiers for a total of 28.	Was not implemented. The existing 25 secondary clarifiers provide a firm secondary capacity of 830 mgd, which is greater than the current peak dry weather flow.
Expand chlorine facility to feed 18 mg/l dose for additional 1,300 mgd combined wastewater.	New chlorination and dechlorination facilities will be in operation by Feb/March 2003 (Contracts PC-692 and 693).
Improve the dual feed electrical system from DEC and PLC. A vital load electrical substation could be built, connected to both DEC and PLC, for supplying power to critical plant locations in case of total failure of either source.	Work is being done under PC-744 to bring in a third DECO feed. The PLD feed is not being used.
Purchase and clear new site for DWWTP expansion.	The Detroit Marine Terminal (DMT) property south of the DWWTP was purchased in the mid 1990's.
Install remaining pumps at new pumping station to increase firm capacity to 2,350 mgd.	An additional pump is being installed at PS-2 under Contract PC-740 to increase the firm raw wastewater pumping capacity to 1,750 mgd to match the 1,700 mgd primary treatment capacity..
B. INTERCEPTORS & COMBINED SEWERS	
Construct a dewatering force main from Freud pumping station to DRI.	Was not implemented.
Expand Oakwood pumping station to provide total pumping capacity of 1,000 cfs and build a new force main to O-NWI.	This work is being reviewed as part of proposed Oakwood pumping station project improvements.
Install additional pump(s) at Northeast pumping station, depending on future suburban contracted service.	This project may be advertised in 2003.
Install fabridams and overflow control equipment in Plymouth/W. Chicago and Joy/Tireman relief sewers at their Rouge River outfalls.	Fabridam at Plymouth/W. Chicago was not implemented. The storage device for Joy/Tireman is part of CS-1329 (on Joy, east of Whitfield).
Install sluice gates and overflow control equipment at the Three Mile Road sewer.	Gate in the Three Mile Road sewer was not implemented. The study and design phases of CS-1329 did not recommend this sewer/location.

Recommendation	Status of Recommendation
Construct following combined sewer reliefs with appropriate connections to interceptors:	(GENERAL: The 1996 LTCSOCP indicated that trunk sewers in Southfield, Hubbell and Rouge River Districts were rated for between 1.5" to 2.2", 24-hour storm events; trunk sewers in Fox Creek and East Jefferson Districts were rated for between 1.5" to 2.4", 24-hour storm events; trunk sewers in Central, Baby Creek and Conner Creek Districts were rated for between 1.7" to 2.2", 24-hour storm events)
• Relief sewers paralleling Southfield and Hubbell sewers and combining at Ford Rd and discharging to Rouge River south of Michigan Ave.	• Not implemented.
• Relief sewers paralleling Edison, Linwood and Joy sewers discharging to Lonyo sewer.	• Not implemented.
• Relief sewer paralleling McNichols sewer discharging to Conner Creek sewer.	• Not implemented.
• Relief sewer paralleling Rivard-McCormick sewer.	• Not implemented.
• Relief sewers paralleling existing Jefferson Ave east and west relief sewers.	• Not implemented.
• Relief sewer paralleling Liddesdale sewer.	• Not implemented. This work is included as part of proposed Oakwood pumping station project.
• Relief sewers in Central sub-districts C-3 through C-8.	• Not implemented.

Recommendation	Status of Recommendation
Suburban sewer construction at expense of local suburban sewer districts and if requested by suburbs:	(GENERAL: Projects not implemented were generally not needed or were not requested by the suburban customer)
• Extend connection serving City of Centerline from 8 Mile Rd to NI-EA.	• Not implemented.
• Extend Romeo, Armada, Richmond arms to Corridor interceptor. Construct proposed new Clintondale pumping station and 15 Mile Rd interceptor only when justified by future population growth.	• Romeo was implemented; Armada and Richmond arms were implemented, but different from SFP. Clintondale pumping station and 15 Mile Rd interceptor were not implemented.
• Construct 9'-0" sewer along 8 Mile Rd between Lakeshore Dr and Northeast pumping station.	• Not implemented.
• Connect trunk sewers carrying sanitary flows from western Wayne County townships into NI-WA.	• Not implemented since the NI-WA was not built.
• Direct connection of Southeast Oakland County system to North interceptor.	• Not implemented since the NI-WA was not built.
• Connect Evergreen-Farmington, Rouge Valley system, Dearborn, Allen Park, etc. to NI-WA.	• Not implemented since the NI-WA was not built. However, the E-F relief is indirectly connected to NI-EA.
• Additional modifications to SCC to provide for future suburban connections and their effects on the City system.	• Implemented as needed.
CONTINUING PROGRAMS	
A. COLLECTION SYSTEM	
Lateral sewer replacement.	Some work was done (sporadic); about 6 contracts have been executed.
Relief sewer replacement.	Not implemented.

The AFIR (Phase II of the Detroit Facilities Plan) did not make any specific recommendations, but narrowed down the list of 25 system alternatives to eight "few best" alternatives. These eight alternatives were ranked based on a preliminary evaluation. The Detroit Facilities Plan was not pursued through Phase III, which would have re-evaluated the "Few Best" alternatives in greater detail, and recommended one of the alternatives for implementation.