Detroit Water and Sewerage Department

Wastewater Master Plan
Volume 5

Customer Service and Technical Support Program

CDM Camp Dresser & McKee

Draft — May . 2003

Detroit Water and Sewerage Department

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Appendix: Performance Benchmarking Technical Memorandum

Technical Memoranda*

- The following Technical Memoranda were used in the preparation of *Customer Service and Technical Support Program*, Volume 5 of the Detroit Water and Sewerage Department's Wastewater Master Plan.
- *Performance Benchmarking*
- *Financial Planning*
- *Human Resources Plan*
- *GIS and Data Management Process*
- *Greater Detroit Regional Sewer System Model Setup and Analyses*
- *Data Update and Model Display Tools*
- *Energy Management*
- *Stakeholder and Public Involvement Program*
- *Potential Mosquito Reduction Activities for DWSD Sewerage Facilities*

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

Executive Summary

Introduction

This is Volume 5 of the Detroit Water & Sewerage Department (DWSD) Wastewater Master Plan. This *Customer Service and Technical Support Program* report concerns itself with customer service and technical support for implementing recommendations of the Master Plan. Among the topics addressed are:

Performance Benchmarking — a comparison of certain DWSD operating parameters to other water and sewer agencies around the country.

Financial Planning — a basic analysis of the master plan capital projects and estimated operation and maintenance costs to 2050. The impact on future rates is part of this analysis.

Human Resources Plan — a framework for human resource initiatives that will allow DWSD to address changes in facilities, technology and methods, customer needs, and regulatory requirements over the planning period.

GIS and Data Management Process — a description of GIS and data sets used to support the master planning process.

Wastewater Master Plan Model — the tools for planning and analyzing regional system flows and capacity that builds upon the GDRSS model and includes sub-models for Macomb and Clinton-Oakland, including a presentation of the Mike-SWMM modeling environment that will be provided to DWSD planning staff.

Energy Management — an analysis of potential energy management programs that can be implemented over the planning horizon.

Customer Surveys — examples of the customer surveys conducted as part of the Master Plan addressing planning data and the DWSD service to tier-one customers.

Performance Benchmarking

CDM performed a performance benchmarking assessment that provides comparable information gathered from other wastewater service providers or utility standards. The following areas were part of the benchmarking task:

- High-level metric benchmarks (i.e. costs per gallon of sewage)
- Collection System and Capital Improvement Projects
- Human resources
- Wholesale sewer customer relations

The assessment also looked at some of the information on a trend basis. Overall, the objective was to provide evidence on the competitive position held by DWSD. The main focus was on wholesale customer relations in light of the increased work on the contractual issues between DWSD and its first- and second-tier customers.

Conclusions & Recommendations

The following conclusions and recommendations have been developed:

- Overall, DWSD falls within the range of expense and operations parameters compared to the sample wastewater utilities group.
- Total cost increases have been moderate, but relative costs (expenditures per flow unit) have been increasing more rapidly.
- DWSD has had elevated employee turnover over the last several years. Emphasis should be placed on correcting this trend in order to avoid future excessive hiring and training expenses in light of the magnitude of the department's labor costs.
- For system maintenance and improvement, DWSD finds itself within the average of the comparables group. However, a continued effort

should be placed on system rehabilitation initiatives.

- DWSD should continue its efforts to emphasize wholesale customer relations practices. Current efforts by DWSD to strengthen the role of its Steering Committee should continue. An emphasis should be placed on the development of a standardized contractual agreement with the wholesale customer group as well as the application of these principles in the relationships with DWSD's first- and second-tier customers.

Financial Planning

The financial planning chapter evaluates the impact of the recommended improvements and management programs on DWSD's future revenue requirements and future wholesale and retail rates. The financial plan will enable DWSD to assess the magnitude of revenue increases that will be required as well as to plan for the issuances of debt. This plan provides a snapshot at a point in time and the recommendations and projections should be revisited and evaluated on a regular basis. This financial plan takes into account the recommendations of the Master Plan, the department's obligations to abate combined sewer overflows, allowances for the significant renovation of the wastewater treatment plant, and the department's ongoing obligations.

Human Resources Planning

The Master Plan makes a number of recommendations for capital and management projects. Both are impacted by the people of DWSD. The knowledge, skills, and, most importantly, attitude of DWSD's workforce will affect the development and implementation of the projects. Moreover, they will affect DWSD's ability to manage, operate, and maintain the infrastructure, equipment, and O & M practices recommended in the Master Plan. As a result, the assessment and recommendations of human resource strategies, over the course of the Master Plan will optimize the performance of the workforce and Master Plan implementation.

The Process

A review of prior documents, multiple management interviews and staff focus groups was conducted to develop an understanding of current and potential issues which could affect the performance of the projects identified in the Master Plan.

The results were compared with a model for integrating people, projects and processes. 'Gaps' or potential areas where a new or improved HR strategy could contribute to Master Plan project performance were identified.

Finally, a broad set of strategies was recommended. These strategies, if pursued, will help maximize the expected benefits of the Master Plan's recommendations.

HR Recommendations

HR Support for Performance Initiatives — DWSD will face increasing demands for cost and process performance improvement. DWSD needs to focus on performance, particularly cost performance. Current efforts are bringing a sharper focus on this area. Support mechanisms will need to be improved and new ones created to enable a change to an increasingly performance-oriented culture. Recommendations in this areas include:

- Performance scorecards;
- Progressive/ positive discipline procedures;
- Improved legal, and management support for dealing with substandard performance;
- New recognition/ reward process and group incentive programs;
- Strengthened organization development section of internal HR; and
- Focused business and work process reengineering projects.

Competency Development — An essential component of successful capital project performance is the competence of those charged with managing, operating and maintaining the processes or equipment in the project. Competence is a result of having the right people (see recruitment/ selection below), the relevant knowledge and skills and the right work attitude. Recommendations in this area include:

- Substantially strengthen existing training and development programs;
- Build on existing certification initiatives;
- Explore a pay-for-skill system; and
- Create smart user involvement strategies as capital projects are designed and implemented.

Labor-Management Strategy — The labor-management environment that exists upon completion of Master Plan capital projects may well have as much impact on the ultimate performance and success of those projects as the physical or technical systems themselves. The cultivation and development, over the long term, of a favorable labor-management climate is critical to DWSD's success. Recommendations include:

- The development of a long-term management strategy for productive relations;
- The development of a joint labor-management vision statement; and
- Labor involvement in competitive assessment.

HR Support — The adage, "you can't manage what you can't measure" applies here. Contemporary HR Information Systems are essential for improving organization performance. HRIS functions particularly important to DWSD include staffing planning, development planning, and succession planning.

Recruitment Selection Process — As organizational performance increases, the workforce does more with the same or fewer numbers. The existing staff, however, becomes more critical to the operation. It will be vital to DWSD as the Master Plan unfolds to recruit and hire those critical skills necessary for managing, operating or maintaining more sophisticated, complex technologies. A re-engineering of the recruitment-selection business process is recommended, to be performed jointly by the DWSD and Department of Human Resources unit with DWSD. This re-engineering could become a model for other departments within the City.

GIS and Data Management

As with any long term master plan, the basis of the planning effort is information. The DWSD Wastewater Master Plan established a project GIS and relevant data management applications. In this area, the following was accomplished:

- Procured and installed project computer systems;
- Developed specifications for transmitting electronic data from DWSD to the project;
- Analyzed and recommended GIS tools for use in the project and ultimate use by DWSD;
- Recommend prerequisite training for software products;
- Specified and procured base map and demographic data;
- Obtained and converted the existing data on the DWSD collection and interceptor systems;
- Obtained and integrated the DWSD GDRSS model data into the project system; and
- Provided maps for reports, technical memoranda, and presentations.

Based upon the work completed for this Master Plan, GIS and data management recommendations are:

- The DWSD Planning staff needs to be integrally

involved in the upcoming GIS project (CS-1367). The new GIS project will be creating the standards for several technical topics that will affect the master planning process including:

- The DWSD service area base map
- GIS and data management software
- Computer hardware
- Sewer data, both spatial and attributes
- Application definition and integration such as GIS links to Mike SWMM.

- DWSD planning staff must work closely with SEMCOG to receive critical updates on population and employment data.
- DWSD planning should find and hire a GIS technician to support the planning staff in its master planning projects. The GIS and its related data will be an important component of an updated Master Plan in the near future.
- DWSD planning should begin, in concert with the GIS project (CS-1367), to procure required computer hardware (high end GIS and modeling workstations, plotters, etc.) and the necessary software (GeoMedia, Oracle, ArcGIS, etc.)

Wastewater Master Plan Model

The Master Plan required the use of a system-wide sewer model to analyze the impacts on the DWSD service area in the year 2050. To accomplish this, the Master Plan was constructed from the existing DWSD GDRSS model established in late 1998 (Baseline). Updates to the GDRSS model were made in 2001 and this version became the Wastewater Master Plan model.

Based on the evaluation of the model and related components, a number of recommendations for enhancing model capabilities for Master Plan use were made. The GDRSS model was extended to better address system capacity for future needs and demands. How wet weather is handled in the system is still critical, but transport capacity needs of customers were also evaluated. The model was updated as follows:

- The model was extended to include DWSD-owned transport system components not included.
- The model was extended to include the major DWSD pumping stations in Macomb County.
- The model was expanded to include the interceptors in the Clinton-Oakland Sanitary District.
- The spatial resolution of the model tributary area was increased by delineating additional sub-areas to include at a minimum one sub-area per DWSD billing meter.
- The GDRSS Phase IV flow metering was used to obtain estimates of wet weather (RDI/ I) parameters for the new sub-areas in Macomb County.
- The model's representation of suburban connections to the DWSD system was reviewed and updated or extended to better represent connection hydraulics.
- The model was updated to include facilities that have recently been built and were notrepresented.
- A list of improvements and/ or changes to the collection system was maintained in order to ensure that the model reflected current conditions.
- The projected changes to the service area to 2050 were incorporated into the model for analysis. These projections were provided on a 10-year increment basis for the model simulation scenarios .
- The dry weather flows (DWF) as determined from the metering program conducted by DWSD over the last several years were incorporated into the model to improve the accuracy and spatial distribution of DWF throughout the system.

The integration of the Master Plan model with GIS

and related database was completed to facilitate the analysis of a number of anticipated scenarios.

To make the GDRSS model updates, two additional sub-models were enhanced and developed. These addressed the Macomb Sanitary Sewer District and the Clinton-Oakland Sanitary Sewer District. Components addressed by the sub-models include:

- Description of the available flow and rainfall data required to drive the models. These data sets provided the definition of both dry weather and wet weather parameters used in the models —DWF factors and RDI/ I factors.
- Description of the physical sewer network being modeled. The sewer network included new changes found in the Macomb and Clinton-Oakland districts.
- Discussion of the calibration of the model. That is, the comparison of model results with measured flows.
- A description of the final hydraulic model used to analyze the total system and the sub-models that were developed.

In addition, several actions are recommended to maintain and support the WWMP Model Version 1. developed for the Master Plan, including the following:

- Procure the necessary computer hardware and software to operate the WWMP Model Version 1. which utilizes the Mike SWMM software environment. This will also include a companion software product call MOUSE GIS that utilizes the GIS information.
- Establish a training and conference program for DWSD planning staff. This would include formal Mike-SWMM and generic SWMM training and attendance at SWMM-related conferences.
- Coordinate with the GDRSS project and work group to take advantage of enhancements made to the GDRSS model that could be used in the WWMP Model and vice versa. An update to the GDRSS model is expected in late 2003.
- Combine the two sub-models - Macomb and Clinton-Oakland - into one to reduce the complexity of running the model and facilitate the use of Mike-SWMM.

Description of Mike-SWMM

A set of data update and model display tools is needed to maintain the model and the GIS, and keep future conditions updated. Given the use of the project GIS and the use of sewer hydraulic models (see above), the suite of tools selected for use by DWSD planning staff is Mike-SWMM.

Mike-SWMM is a versatile, cost-effective modeling package for analysis of water and wastewater systems. Mike-SWMM is an exceptionally powerful combination of a widely accepted mathematical model with a user interface that enhances productivity.

Mike-SWMM has many applications, including:

- Analysis of complex hydraulics in systems with open and/ or closed channels;
- CSO and SSO analysis and mitigation;
- Assessment of hydraulic performance of storm and sanitary drainage systems;
- Flooding studies;
- Analysis of complex flow regimes (such as bridges, culverts, detention basins, backwater effects, surcharged systems, etc.);
- Water quality assessment; and
- Integrated storm water quantity and quality assessment.

The sewer network developed for the Wastewater Master Plan model has been input to the Mike-SWMM system. The Mike-SWMM environment provides the capabilities required to update the Master Plan.

Energy Management

As part of the master planning effort, the issue of energy management was examined. A technical memorandum accompanying this report:

1) Identifies existing reports that address energy-use issues;
2) Quantifies existing energy usage at the Detroit Wastewater Treatment Plant (WWTP) and wastewater pumping stations;
3) Discusses various energy management options;
4) Discusses DWSD's current energy management plan; and
5) Makes recommendations for energy and cost savings at the DWSD wastewater facilities.

Seven data sources were reviewed as follows:

- Electrical Energy Audit (July 1999)
- PC-744 Needs Assessment Study.
- PC-744 Asset Audit.
- Retail Wheeling Feasibility Study (December, 2000)
- Natural Gas By-Pass Feasibility (September, 1999)
- PC-713 Department-Wide Instrumentation Control and Computer System Program II.
- DWSD Summary of Operating Statistics (1982-89)

Significant energy-using facilities at the WWTP and in the collection system were inventoried and energy use and energy costs are presented. Currently the WWTP requires 721 KwHr per MG which compares reasonably to other wastewater facilities.

Recommendations are made for both the WWTP and the Wastewater pumping stations. At the WWTP it is recommended that: 1) a Variable Frequency Drive (VFD) drive be considered for Influent Pump Station No. 1. 2) VFD drives should be investigated for at least one of the SFE pumps. 3) energy savings can be achieved by switching off lights during daylight hours.

For the wastewater pumping stations it is recommended that at least one of the pumps at the Clintondale and Woodmere pumping stations should be considered for a VFD.

In general when planning new sewers, DWSD should provide for deep sewers so as to minimize the number of pumping stations.

DWSD should also evaluate the actual power consumption versus the theoretical power demand for actual flow and head readings at pumping stations every three years are when purchasing new equipment make sure that high efficiency motors are specified.

Customer Surveys

The master planning team conducted surveys of wholesale customer programs for infiltration/ inflow control and sanitary sewer overflow mitigation, and a survey to confirm population projections and projections of sewer service area. Results of the survey on infiltration/ inflow and sanitary sewer overflows are presented in Volume 6. Results of the survey to confirm population projections and projected sewer service areas are presented in the technical memorandum *Stakeholder and Public Involvement Program* on the CD that accompanies this Master Plan.

1. Performance Benchmarking

As part of the master planning effort, a performance benchmarking exercise has been undertaken to provide comparable information gathered from other wastewater service providers or utility standards. In particular, the following areas were part of the benchmarking task:

- High-Level Metric Benchmark
- Collection System and CIP
- Human Resources
- Wholesale Sewer Customer Relations

The analysis relates DWSD data to comparable utility information, examines trends and provides evidence on the competitive position held by DWSD. It focuses on wholesale customer relations in light of the increased work on the contractual issues between DWSD and its first- and second-tier customers.

The benchmarking task is summarized here and included as an Appendix at the end of this volume.

1.1 Objective

The objective of this section is to develop an overview of the operational and financial posture of the Detroit Water and Sewerage Department (DWSD). This assessment compiles performance indicators in several key areas such as the operations of the utility, human resources, and the service provided to wholesale sewer customers. Performance benchmarking has taken a prominent role with water and wastewater universally. It is in each utility's interest to assess its competitive position and the progress that the organization has made. The term benchmarking is being used in numerous different contexts and needs to be defined clearly before laying out the purpose and outline of this task.

In general, a benchmarking exercise includes the computation of certain performance indicators, which can then be compared against similar measures for other utilities or national or regional averages. Additionally, performance values can be tracked over time or compared to an industry standard or privatized approach. By doing so, the utility can establish threshold performance values that it should meet. Benchmarking performance indicators are primarily quantitative concepts that allow for easy comparison against other entities. However, a benchmarking study may also include a qualitative assessment of the utility's competitive position as well as the system of performance monitoring currently used.

1.2 Scope of Work

The scope of the benchmarking evaluation includes analyses of general high-level performance benchmarks as well as the assessment of three key strategic areas. The chosen strategic areas that have been identified are:

- Collection System and CIP-related measures
- Human Resource-related indicators and
- Wholesale Customer Relations & Service

These areas are emphasized because of DWSD's interest to collect information on comparable practices as expressed in several rounds of interviews with DWSD staff.

1.3 Background

The DWSD's sewerage system serves an area of approximately 904 square miles in Detroit and communities in Wayne, Oakland and Macomb counties. Sewer disposal service is provided on a retail basis within Detroit and on a wholesale basis to 76 first- and second-tier communities in the three counties. DWSD has sewage disposal agreements with all of its first-tier wholesale customers and is indirectly involved with the second-tier

Table 1.1: Comparable Utilities Group

Utility Characteristics	DWSD	MSD	WSSC	Chicago	MCES	MWRA	WASA
Area Served (sq. mi.)	921	400	1,000	225	No data	502	725
Population Served	3,003,222	800,000	1,539,000	2,896,016	2,350,000	1,961,000	2,172,000
Type of Service	Wholesale & Retail	Wholesale & Retail	Retail	Retail	Wholesale & Retail	Wholesale	Wholesale & Retail
Sewer Wholesale Customers	77*	33	N/A	N/A	104	43	7
Average Flow (MGD)	615	174	181	969	300	324	322
Employees**	2,027	752	1,500	1,208	767	1,543	1,309
Length of System (miles)	3,000	3,000	4,989	4,300	5,550	5,628	1,800

communities through their respective agreements with the first-tier group. Most of these agreements have gone through multiple rounds of amendments over the last decades.

1.4 Chosen Comparable Utilities

Comparable utilities have been chosen based on their similar characteristics in service provided, area covered and annual flow processed. Some of the chosen wastewater utilities are significantly different in size and do not provide a combination of wholesale and retail service (e.g. MWRA – only wholesale; Chicago – only retail). However, the chosen group provides a sufficient sample of data for the assessment and evaluation of DWSD's performance. The wastewater wholesale provider sample group includes the following utilities:

- MSD - Metropolitan Sewerage District, Cincinnati, Ohio
- WSSC - Washington Suburban Sewerage Commission, Baltimore, Maryland
- Chicago - City of Chicago Sewer Department, Chicago, Illinois
- MCES – Metropolitan Council Environmental Services, St. Paul, Minnesota
- MWRA - Massachusetts Water Resources Authority, Boston, Massachusetts
- WASA - Washington Area Sewerage Agency, Washington, District of Columbia

The benchmarking analysis was performed using blinded comparisons. This means that, in order to facilitate the cooperation of each utility in the data collection process, the identities of utilities will not be disclosed in the actual data tables and charts. The utilities will also not be ranked because the choice of comparables determines the overall ranking. Precise determination of rank measuring performance is therefore meaningless.

Table 1.1 shows DWSD and the six comparable utilities. Initial comparisons are made by listing the area and population served, the number of wholesale customers, total employees, average flow in 2001 and total length of the system (including community customer systems).

DWSD is the largest wastewater wholesale provider in terms of service area and population served. Average flows are only exceeded by the Chicago's sewerage department.

Based on the FY 2002 Budget, DWSD provided funding for 3,919 budgeted positions in both the water and sewer division. However, there is a significant gap between the actual number of employees and the number of budgeted positions. Based on the FY 2001 Summary of Operating Sta-

tistics, the number of employees is 3,213. The sewer-only budget for the same fiscal year lists 1,081 employees in this division. The actual number of employees for the water division is listed as 303 in Appendix B, 2001-D Official Statement. Based on the same source, 40-50 percent of positions not directly assigned to either division apply to the sewerage system. Forty-five percent was used as the sewer-applicable percentage. The overall total amounts to an estimated 2,027 sewer-only positions.

1.5 Data Collection

Comparable utilities have been contacted directly. As part of this process annual budgets, capital improvement plans, bond feasibility reports, and audited financial statements were collected. Additional information and data were then also collected from each utility's Web site. If not stated to the contrary, all data showing utility comparisons refer to fiscal year 2001.

Information on customer relations and service practices on the wholesale level was obtained by descriptions provided in annual reports and other documents as well as by submitting a list of questions to each utility and then following up with the responsible individuals at each provider.

1.6. Performance Indicators

Comparing the chosen performance indicators to the comparable values for other utilities as well as trend patterns of DWSD data over time assesses DWSD's overall performance. One general and three strategic areas have been chosen.

- High level Performance Measures
- CIP and System related Indicators
- Human Resources/ Staff related Indicators
- Customer Service/ Relations Indicators

The first three groups will be analyzed in a quantitative way while the last category, covering wholesale customer relations, will be analyzed qualitatively.

In the following text, the term "Sewer Costs" is defined as costs related to wastewater collection and treatment, including industrial wastewater control.

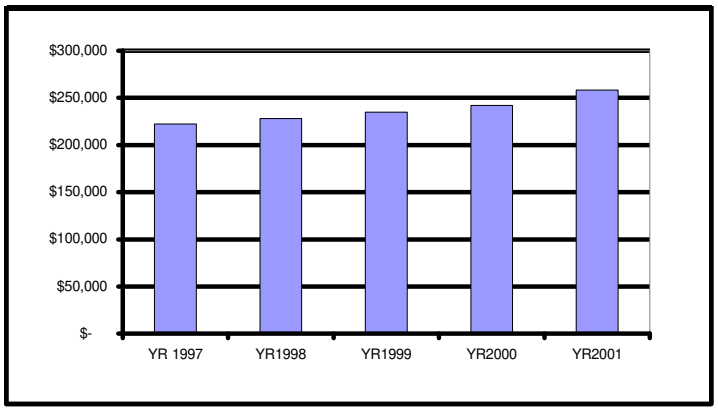
1.6.1 High Level Performance Measures

Cost of Operations (O&M) per MGD

Relative operating cost can be measured by calculating total operations cost, i.e. operations- and maintenance-related expenses, per million gallons of wastewater treated. The total wastewater collection and treatment O&M actual expenditures from 1997 to 2001 increased from approximately $148 to $172 million.

Figure 1.1 shows the relative cost measured in O&M cost per MGD processed. DWSD exhibits an upward cost trend over the last five years in relative terms. The flow number used in this figure is 667 MGD, equal to the average flow for the last five years. This number was used because DWSD treated flow has decreased over that timeframe,

Figure 1.1: Sewer O&M Cost per MGD treated*



*MGD treated calculated from 5-year MGD average per DWSD Summary of Operating Statistics. O&M costs are year-end actuals per Audited Financial Statements.

which would distort this measure if annual flow estimates were used. DWSD has decreased the average volume of sewage treated from 710 MGD in 1996 to 615 MGD in 2001.

The reasons for the average flow reduction over time are two-fold. First, these reductions are due to changes in metering and methods used to calculate flow. DWSD has set up a metering task force that has looked at these issues. Second, the flow reductions constitute fluctuations in weather patterns and the level of precipitation per year.

Figure 1.2 illustrates the comparison of O&M cost per MGD to the chosen utilities. At roughly $258,000 per MGD in 2001, DWSD operates below the average of the other wholesale sewer providers of $455,000. However, this comparison directly depends on the choice of comparable utilities and is also driven by the mix of wholesale-to-retail service for each entity.

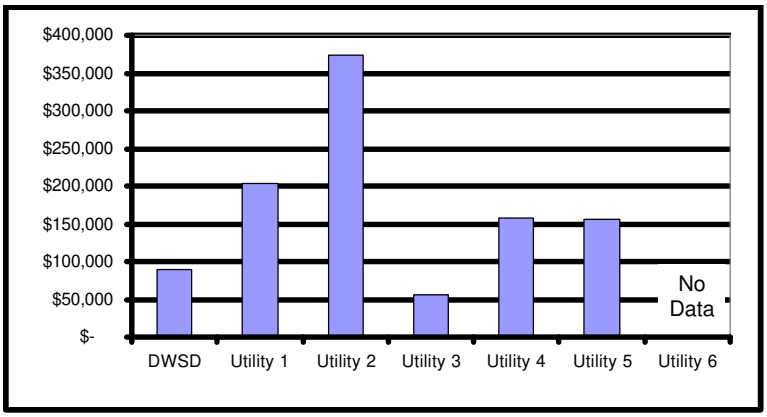
1.6.2 Labor Cost per MGD

Operating costs alone do not draw a complete picture of the competitiveness of a utility. Breaking down the total cost into sub-categories allows an analysis of disaggregated cost trends. For instance, labor costs provide a useful indication of how staff-intensive the operations of a utility are.

DWSD's cost measure of roughly $90,000 is below the average of the comparable group of approximately $190,000 (Figure 1.3). However, this number does not take into consideration any contract labor cost incurred. Based on additional data analyzed, the average percentage increase over the six-year timeframe amounts to 11 percent.

DWSD faces labor costs that take up close to 35 percent of total O&M expenses as illustrated in Figure 1.4. The level of these costs is approximately in line with the comparable utilities' group. However, these costs are significant and a clear driver of the overall operating costs incurred by the Department.

Figure 1.3: Sewer Labor Cost per MGD*



*DWSD Labor Costs based on Operating Statistics Report, June 30, 2001, page 1.

Figure 1.2: O&M Cost Benchmarking

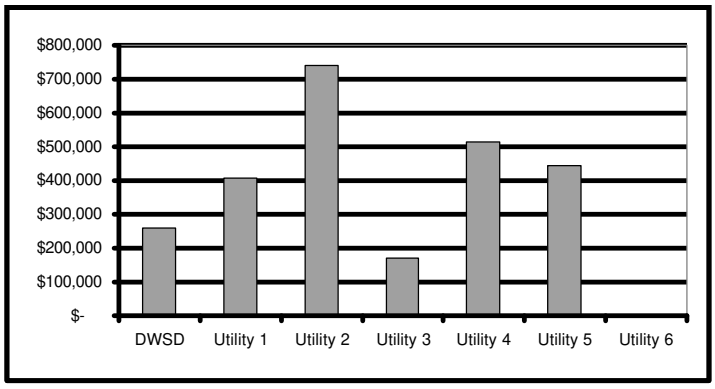
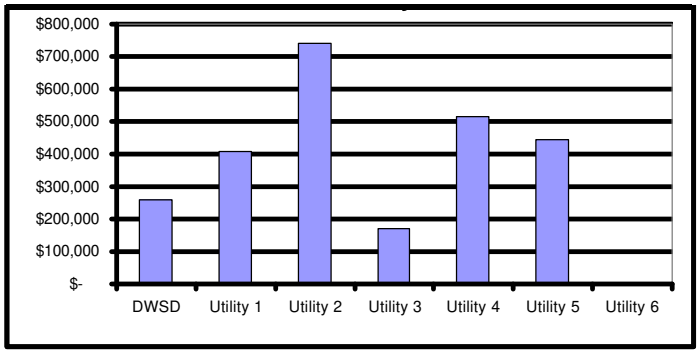


Figure 1.4: Sewer Labor Cost Benchmarking (Percent of O&M Cost)



1.7. Summary & Conclusions

The purpose of this section was to analyze the competitive position of DWSD through a benchmarking comparison with other wholesale wastewater service providers. In several cases, not only a point-in-time comparison was made but also a trend analysis of DWSD data. The assessment centered on different strategic areas identified though rounds of interviews of DWSD staff members.

DWSD falls within the range of the utility sample in regard to cost of operations and the current level of staff per million gallons of water treated. Overall, operations cost appear to be controlled and within the average of other utilities. However, labor costs take up a significant share of the total O&M budget and have exhibited an increasing trend over time.

In general, there has been an increasing trend of relative cost over the last six years even when controlling for fluctuations in metered flow due to changes in metering procedures and precipitation.

DWSD staff turnover appears to be elevated in recent years even though this number has come down from the peak in FY 2000. Going forward, an emphasis should be placed on retaining employees in order to avoid additional cost to retrain and hire new people.

As to system and CIP specific performance indicators, cleaning and rehabilitation work performed on the collection system by DWSD is within the average of the group. However, continued focus should be placed on system rehabilitation. In terms of debt load, DWSD is in a stable position considering the share of revenue spent on annual debt service. However, the level of debt may increase significantly due to the ongoing wastewater master planning effort.

DWSD has additional work to do in order to come closer to the standard set by the sample group. Other utilities have established detailed policies, procedures and customer relation departments that provide more comprehensive service than that of DWSD. This is in part due to the nature of service agreements between wholesale providers and their community customers. DWSD does not have a standardized wholesale contract but a variety of different agreements with numerous amendments dating back up to 85 years. Emphasis should be placed on the establishment of standardized contractual relationships and their application into the management of customer relations with the first-tier community group.

2. Financial Plan

2.1 Objective

The objective of this chapter is to determine and evaluate the impact of the recommended Master Plan on the DWSD's future revenue requirements and the rates that must be charged wholesale and retail customers. This financial plan will enable the department to assess the magnitude of revenue increases that will be required as well as to plan for the issuances of debt. This plan provides a snapshot at a point in time and the recommendations and projections contained herein should be revisited and evaluated regularly. This financial plan takes into account the recommendations of the Master Plan, the department's obligations to abate combined sewer overflows, allowances for the significant renovation of the wastewater treatment plant, and the department's ongoing obligations.

2.2 Approach

The Master Plan financial planning involves developing 50-year projections of the department's budget, revenue and requirements and wholesale and retail rates taking into account the department's existing obligations and the Master Plan's recommendations. The intent is to evaluate the impact on revenue requirements and then to indicate the order of magnitude impact on wholesale and retail customers. It was decided through a series of meetings and discussions with DWSD staff not to produce wholesale rates over the forecast period for each wholesale customer. Rather, it would be more productive to group wholesale customers into a limited number of groups (two or three) and show how typical retail bills would change over time.

Currently, the Master Plan projections are being refined. That information will be input into the DWSD financial model. To ensure consistency with existing financial projections developed for the department, several important assumptions have been made. These include:

- Master Plan project implementation has been largely deferred through 2010 since the department has a substantial improvement program that is it currently implementing.
- The Master Plan adopts and builds off of many of the economic assumptions that are currently used by the department. These include debt structure, interest rates, and inflation rates. This ensures some consistency between the Master Plan projections and those currently used by the department. The Master Plan may modify the amount of flow for which customers are being billed as well as shift the flow between customer classes.

The key economic assumptions used in these projections are:

- The annual inflation rate is assumed to be 3 percent per year.
- Customer growth of approximately 0.1 percent per year starting in FY2008.
- The department is not expected to receive any state or federal grants in support of its capital improvement program. However, 10 percent of annual debt financed expenditures will be financed through the State Revolving Fund.
- In the years FY2003 through FY2007, funding of approximately $374 million is expected to be received as part of the State Revolving Loan Funds (SRF) by DWSD. Starting in FY2008, the department is assumed to be eligible to finance 10 percent of its annual capital needs through SRF loans. These loans are assumed to carry an interest rate of 2.5% over a term of 20 years.
- The department is assumed to use both pay-as-you-go capital and debt financed revenue bonds for the balance of the CIP. Pay-as-you-go capital is essentially raised through the department's

debt service coverage amounts described below. All other capital expenditures are assumed to be financed through the issuance of long-term debt. The bond issues are assumed to have a term of 30 years with an interest rate of 6 percent starting in FY 2006. Debt issued in prior years carries an interest rate of 5.5 percent. The issuance costs of all debt are assumed to be 3 percent of the financed amount plus one percent to be added to a bond reserve fund. For all debt issues, two years of interest payments are assumed to be capitalized. Principal payments are assumed to be delayed by one year to 18 months consistent with the department's recent debt issuances.

- The department is assumed to fund an emergency repair and replacement reserve at 15 percent of annual operating expenses. In addition, an operating reserve is assumed to be funded equivalent to 45 days of operating expenses.
- The department is assumed to follow a debt service coverage requirement of 140 percent for all of its issued long-term bonds. While the department has a legal coverage requirement of 125 percent, for planning purposes the department has set a target of 140 which is consistent with the department's short-term planning for the recent past. It is assumed that this requirement will be applied to all senior and junior debt currently outstanding and to be issued over the next 50 years.
- Over the 50-year timeframe, the department will use annual rate revenue to finance capital expenditures in every year. The percentage of total capital expenditures varies significantly over the forecast period. In particular, the department is assumed to finance between 5 and 43 percent of capital expenditures from current rate revenue.
- As part of the CIP, the department will add additional facilities to its system. For instance, the CIP lays out that several new CSO facilities will be added over the forecast period. This will require the department to hire additional staff for the operation of these facilities. In the financial projections, we have conservatively assumed that these new facilities will be staffed entirely with new employees and are assuming that approximately 100 new employees will be required. However, there is the possibility that the district might reallocate existing staff to new functions. However, in order to be conservative in our projections, we have not included a reassignment of staff in our assumptions.
- Existing operating and maintenance costs are projected to inflate at a 3.0 percent average annual rate over the study period. Capital costs are projected to inflate at that same rate. Base-year operations and maintenance expenses are based on the department's approved FY 2003 budget level of approximately $191 million. Over time, we adjust these figures to reflect annual inflation as well as the anticipated staff increases required to operate and maintain new CSO facilities coming on-line. Besides these CSO facilities, our projections do not assume that the DWSD will require a significant number of new facilities.

2.3 Financial Impacts

The Detroit Water and Sewerage Department has engaged in a large-scale master planning effort for its sewer system. The purpose of the Master Plan is to assess the department's infrastructure needs over the next 50 years. The CIP includes improvements to the existing collection system as well as the treatment and CSO facilities. The CIP ranges from between $13.5 to $16.1 billion over 50 years depending on the chosen level of annual replacement and renewal. These capital expenditures will place a significant financial burden on the department as well as the City of Detroit and the wholesale suburban customers.

Overall, the revenue requirement is projected to increase from $335 million in FY2004 to between $2.2 and $2.5 billion depending on which CIP alternative is chosen. A significant amount of these expenses will be incurred in early years, which results in average annual rates that are projected to

increase by 8 percent on average. However, in the long run, the impact of the CIP will be mitigated by the long implementation timeframe of the CIP and the advantages of replacing expiring debt with newly issued bonds.

Over the 50 years implementation timeframe, the revenue requirement for the department is projected to increase by between 4.1 and 4.3 percent depending on the exact cost alternative chosen. However, the exact rate of increase is highly dependent on the assumptions used, the overall economic environment, and the timing of the CIP projects. The timing of the increases is heavily frontloaded, with the required increases much larger in the early years than later years. In addition, the increase for the City of Detroit customer base will be higher than those anticipated for the suburban customer base.

3. Human Resources Plan

The DWSD Wastewater Master Plan makes a number of recommendations for capital projects and management projects. Both types of projects are impacted by the people of DWSD. The knowledge, skills, and, most importantly, the attitude of DWSD's workforce will affect the development and implementation of the projects. Moreover, they will affect DWSD's ability to manage, operate, and maintain the infrastructure, equipment, and O&M practices recommended in the Master Plan. As a result this section of the Master Plan assesses and recommends human resource strategies that, over the course of the Master Plan, will serve to optimize the performance of the recommended projects.

The Process

First, prior documents were reviewed, multiple management interviews were conducted and several small group meetings were facilitated to develop an understanding of current and potential issues that could affect the performance of the projects identified in the Master Plan. Many of those issues are categorized in the technical memorandum *Human Resources Plan* on the CD that accompanies this report.

Next the results of our review were compared with our model for integrating people, projects, and processes. 'Gaps' or potential areas where a new or improved HR strategy could contribute to Master Plan project performance were identified.

Finally, broad strategies are identified. If pursued, they will help maximize the expected benefits of the Master Plan's recommendations.

The HR Recommendations

Performance Management

For a number of compelling reasons DWSD will face increasing demands for cost and process performance improvement. Historically, a focus on performance, particularly cost performance, has not been a high priority. The new administration (and, most likely, succeeding administrations) brings a sharpened focus on results. Support mechanisms will need to be improved and new ones created to enable a change to an increasingly performance-oriented culture. Our recommendations in this area include:

- Build commitment to the "Service Improvement" performance review process;
- Develop unit performance scorecards;
- Strengthen progressive/ positive discipline procedures;
- Improve legal and management support for dealing with substandard performance;
- Develop new recognition-reward processes and/ or group incentive programs;
- Strengthen organization development section of internal HR; and
- Encourage focused business and work process re-engineering projects.

Staff Development

An obvious yet very important element of successful capital project performance is the competence of those charged with managing, operating and maintaining the processes or equipment provided by the project. Competence is a result of having the right people (see recruitment/ selection), the relevant knowledge and skills and the right work attitude. Willingness and commitment go a long way toward minimizing skill deficiency. Our recommendations in this arena include:

- Substantially strengthening the existing training and development function;
- Building on existing certification initiatives;
- Exploring a pay-for-skill system; and
- Creating smart user-involvement strategies as

capital projects are designed and implemented.

Labor-Management Strategy

The labor-management environment that exists upon completion of Master Plan capital projects may well have as much impact on the ultimate performance and success of those projects as the physical or technical systems themselves. The cultivation and development, over the long term, of a favorable labor-management climate is critical to DWSD's success. Our recommendations include:

- The development of a long-term management strategy for productive labor-management relations incorporating the following elements:
- The development of a joint labor-management long-term vision statement;
- Labor involvement in competitive assessment;
- Intentional development of progressive labor-management leadership;
- Development of a "meet and confer" process;
- The expansion of interest-based negotiating skills and methods; and
- Development of a job classification "broad banding" strategy.

HR Support - HRIS System

The old adage, "you can't manage what you can't measure" applies here. DWSD needs to improve its level of information on very important HR measures. Contemporary HR systems are essential to improving organization performance. HRIS functions particularly important to DWSD include staffing/ workforce planning, development planning, and succession planning. Recommendations include the following steps to procure an effective HRIS system.

- Developing HRIS Requirements and Priorities with City HR & DWSD Management. Emphasis should include staff planning, development planning and succession planning;
- Competitive selection and procurement; and
- DWSD-specific implementation.

HR Support - Staffing/Workforce Planning

In addition to the skill needs noted in the development section above, DWSD will require the ability to deploy skills and human resources where needed, as well as the ability to selectively staff those areas requiring skills which are unavailable internally. To meet that requirement, DWSD must develop an effective staffing planning process that will enable management to see where skills exist and how they can cost-effectively staff those skills in areas requiring additional resources. It would likely include a skills inventory system that enables DWSD to perform a gap analysis to address the differences between needs and resources.

As noted, the key tool for developing an effective workforce planning solution is a sound HRIS system. Using that system, HR can create a continuous planning process that informs (with good data) recruitment, promotion, training, deployment, and succession. Recommendations include:

- Development of an accurate skills-resource inventory;
- Conducting an annual organizational requirements status, gap identification;
- Developing appropriate acquisition and deployment strategies to fill identified gaps; and
- Developing and implementing an on-going formal succession planning system.

HR Support - Recruitment Selection Process

As organizational performance increases, the workforce does more with the same or fewer numbers. The existing staff, however, becomes more critical to the operation. It will be vital to DWSD as the Master Plan unfolds to recruit and hire those critical skills necessary for managing, operating or maintaining more sophisticated, complex technologies. A complete re-engineering

of the recruitment-selection business process is recommended. The re-engineering should be DWSD-focused but include at least stakeholders from city HR, city management, DWSD management, technology experts, and DWSD HR.

- Identify current practices and performance;
- Develop desired performance goals;
- Apply public-sector redesign "rules-of-thumb";
- Identify implementation obstacles;
- Implement new processes; and
- Monitor new performance-versus-goals and adjust as appropriate.

HR Support - Compensation

Compensation issues will continue to be a challenge for DWSD and the city. The pressure for enhanced productivity and competitive performance will undoubtedly increase. Where workforce redundancy decreases, the importance of existing jobs increases. High technology skills, of course, will be difficult to acquire and retain. Key process skills, experience and specialization will also command a premium. Salary compression, especially in high demand skills areas, will continue to require attention. Current activities in the compensation arena will need to be supported. Our recommendations include:

- Build on a fundamentally sound current approach to compensation;
- Use a sophisticated workforce planning system to plan and identify critical human resource needs;
- Expand on and 'target' salary survey activity to those areas identified as critical for DWSD;
- Develop targeted strategies for competitive salary adjustments or longer term strategies in those critical arenas;
- Work to "broadband" (eliminate multiple titles/ ranges) in other non-critical positions; and
- Consider group incentive goal-sharing plans contingent on specific DWSD performance targets.

3.1 Introduction

Public sector capital projects are built for wide variety of reasons. A few generalities may be useful, however. Broadly, the private sector tends to focus on financial return while the public sector does not. On the private side, projects are discussed and approved on the basis of payback. Return on Invested Capital (ROIC) is generally the key criterion. The public sector, on the other hand, has historically tended to invest in projects that resolve growth, compliance, or rehabilitation issues. Cost issues have often been a "poor cousin" to regulatory or capacity-driven requirements. If costs have been considered, they have been purchase costs or costs of design/ construction. Project goals expressed in terms of return on investment have been, from a public agency standpoint, rather rare. For project managers, therefore, operating or life cycle-cost considerations were often an intriguing but abstract concept.

Looking toward the future, public sector demands are changing. Fiscal austerity is the watchword. Reinventing, re-engineering government initiatives are popular. The desire for the public sector to operate more like a business is pervasive. Outsourcing solutions are often seen as a means to increased efficiency. Public-private partnerships are sought for their innovative methods.

The common thread through all of these initiatives is the desire to control escalating public costs. Taxes and rate structures are caught in the squeeze between service needs and resources. As the kinds of initiatives noted above run their course, policy makers and public officials look for more options. One of those options is clearly the intelligent use of capital. If the public sector is to be "run like a business," public officials are in-

creasingly aware that capital investment should result in some form of financial return. Capital projects should not only resolve capacity or regulatory issues, they should provide a financial return as well. In short they should *perform.*

A Return on Capital for the Public

Capital projects can provide a financial return by saving or holding the line on annual consumable, energy, maintenance, or labor costs. The lowest capital cost alternative, of course, does not always provide the best return. The catch is that very few of these improvements are achieved by simply building the project . Most successful projects are not "plug and play." In fact, how a project is managed, operated, and maintained after substantial completion, is often the *real* determinate of the project's success. The recent evolution of Asset Management as an organizational discipline can be seen as a reflection of that truth. You cannot judge a project's success unless it operates effectively over a period of time and achieves the expected financial result.

Keys to Performance

Performance is a blend. It is a blend of technology, work process, and people. Consultants, utility managers, and engineers are well acquainted with technology and technical processes. It's when the work process and people are addressed that problems crop up. Technology and technical processes encompass the "hard" side of capital projects. The work processes and people are the "soft" side of capital projects. Most of the Master Plan focuses on the technical, and technical process issues. This section focuses on the more elusive soft side.

Work Process

Much has been written on the importance of altering work practices. Re-engineering business processes has become a larger-than-cottage industry. Many capital projects cannot perform and many others won't perform optimally without new or altered work practices. Word processing, to use a new technology example, replaced dictation and displaced the typing pool. Hordes of managers and professionals are now doing their own typing. Without the change in work practice, the potential of word processing is not realized. Similarly, the potential of a new process control system is not fully realized if it's unaccompanied by relevant changes in operating and maintenance practices.

Managing People

Beyond work practices, even more has been written on the challenges of managing people. Simplified, to support new technology and enhanced technical or business processes, people need relevant knowledge, applicable skills, and an appropriate attitude. Capital project plans, as noted above, often provide for training and development that supports the use of a new technology or process. It is not the lack of training, however, that frequently derails projects. It is the lack of desire. Attitude often affects more projects than ability

Ability vs. Attitude

The lack of ability is readily observed and the fix is straightforward; stated loosely it is, "train 'em." Attitude is not so easily addressed. Robert Mager put his finger on it when he sub-titled one of his classic training texts, "You Really Oughta Wanna." Too often that's precisely the approach taken by those who design and build capital projects. "We know what's good for you and if you know what's good for you, you'll go along with it." When that *doesn't* happen and disaster strikes it's usually cast as an unavoidable or unforeseeable. And it's always someone else's fault.

A large Midwestern Wastewater Facility needed a new process for dewatering its sludge. A new centrifuge based process would reduce a number of costs and enhance plant safety. It also impacted the number of plant jobs. A new centrifuge was ordered for test purposes. On the morning of the day the centrifuge was delivered, the construction crew arrived to find the business

manager for the operators union chained to the centrifuge piping. Needless to say, the project suffered.

More often resistance is passive.

Another Midwest utility purchased and installed a large, expensive CMMS. The system was up and running and the staff received training. Within two months the project was terminated and the system scrapped. The resistance wasn't active; no one had chained themselves anywhere. Staff simply took the trouble to point at every fault in the system. Complaints were received daily about the increase, not decrease, of time required to use the system. Union trades "worked to rule' and use of the system degraded. Passive resistance effectively killed the project.

Most often, however, projects aren't killed by attitude, they just aren't optimized. Ambivalence, though not as destructive, can prevent a project from achieving the performance level that was expected.

It doesn't have to be this way. People issues, including attitudes, can be anticipated and addressed at the inception of a capital project. Capital projects, in fact, can become powerful catalysts for changes in the work culture. There are strategies available for consultants, engineers and utility management to use to leverage the "soft side" of capital projects

3.2 Background Review

CDM reviewed the current and past situation by obtaining existing data and the results from several previous studies. Operating statistics from the annual operating statistics report were reviewed from 1998 to 2002. The HR handbook provided by the HR department was reviewed. The Deloite Touche compensation study and the Organizational and Operational Review Update management Study prepared by Economic and Engineering Services, Inc. were reviewed. The Training Vision report provided to the Detroit Wastewater Partners and the Detroit Wastewater Plant by The Emdicum Group was also reviewed.

CDM conducted 29 management interviews at multiple management levels and a variety of sites to develop an insight and perspective into the issues which might affect the performance of the Master Plan's projects.

The results of the interviews are summarized and categorized in appendix A of the technical memorandum *Human Resources Plan* on the CD that accompanies this report.

3.3 People and Projects Model

Five Key Strategies

A five-part model was used as a checklist for dealing with dealing with the intersection of people and capital projects. Simply stated, an agency needs the right people with the right skills committed to effectively manage, operate and maintain the systems proposed in the Master Plan. To get there people need knowledge, skills and attitude.

There have been hundreds if not thousands of varying concepts offered over the years that relate to managing the people side of an enterprise. Five broad strategies, however, encompass key themes from that body of work and apply particularly well to capital projects. Managers of capital projects who wish to fully realize the potential of these projects would be well advised to address the strategies early, in their project plans. Anything less increases the risk that the project will not deliver on its purpose.

Development

The need for training and development in conjunction with many capital projects is evident. People require new knowledge and skills to operate and maintain new equipment or processes. Development requires careful planning and integration with improved or altered work practices. Most importantly the importance of development for successful project performance should not be minimized. Because training and development of-

ten occur near the close of the construction phase of a project, it tends to loose its priority. When operations success is defined early, as part of project performance, training intentions are more likely to be achieved.

Involvement

Perhaps more has been written about the wisdom of involvement, in one form or another, than about any other people-management concept. From McGregor's theory Y, through empowerment, to teams and autonomous work groups, the evidence for the efficacy of involvement is overwhelming. And there is good reason for it. The concept works. It works for a variety of reasons and it serves multiple goals. Simply stated, people who are affected by the introduction of new technology or technical systems should be involved in implementation decisions. Involvement cannot be casual or careless, however. Clear ground rules need to be developed and expectations clarified at all organization levels or involvement can become counterproductive.

Alignment

Organization and political issues often derail projects. When members of management do not share the same understanding of the need for the project or the goals of the project, problems quickly ensue. Time spent early in the project's life cycle building understanding and consensus among key managers is time well spent. A relatively neutral third party from within or without the organization can test the level of consensus. Various forms of organizational readiness assessments can uncover misalignment as well as other potential roadblocks to the project's success. Plans can then be made and actions taken to deal with organizational or misalignment issues.

Accountability and Incentive

Where performance is paramount, accountability is essential. The keys to O&M performance are a few critical, agreed-upon unit performance targets. These targets need to be SMART targets; Sensible, Measurable, Attainable, Realistic and Timebound. New capital projects offer an ideal opportunity to develop those targets. Simply developing targets is not enough, however. Using the targets wisely, and publicly is helpful. Providing incentives and consequences is essential. Again, the basic concept is simple – reward target achievement, deal with target failure. These issues are among the most difficult for public agencies, but they should not be avoided. As in other endeavors, strategies requiring greater effort offer greater reward. The best incentive programs may require legislative changes to be workable. There is public precedent to draw on, however. Moreover, good accountability programs, often under the banner of performance management, will require legal support and may require labor-management contractual changes. Again there is public precedent to draw on.

Communication

Change strategies, whether connected to capital projects or not, often suffer from a lack of coordination and misunderstanding. Communication is the glue that binds these strategies into a coordinated whole. Organization staff needs to understand the need for projects, the goals for the project, the implications for their work lives, and "what's in it for me." The understanding should, as much as practical, be achieved through two-way dialogue. As with involvement, smart strategies can be developed for optimal communication that does not bog the project down. New visually-based communications strategies coupled with new technology offer much promise

Build Soft-Side Plans into Projects

Every capital project should address the five strategies in the project plan. Agencies may choose not to, but failing to plan for and deal with soft-side issues risks project performance and the project's ultimate success. Given the costs in-

volved with major capital projects, it makes sense to make a relatively small investment in comprehensive "soft-side" planning.

3.4 GAP Analysis/Primary Issues

The people and task needs identified in Table 3.1 on the following pages were considered part of the information gathered as part of the background review. Issues were identified by comparing all information gathered in that review with the "People and Projects Model" outlined previously. Gaps between DWSD's current situation as understood from the review and the "People and Projects Model" were identified as Primary Issues. They represent potential high payoff areas for improvement in the organization's ability to manage operate and maintain the projects identified in the Master Plan.

Issues were identified by comparing information gathered as part of the background review with the "People and Projects Model" outlined in Table 3.1. Gaps between DWSD's current situation as understood from the review and the "People and Projects Model" were identified as Primary Issues. They represent potential high payoff areas for improvement in the organization's ability to manage operate and maintain the projects identified in the Master Plan.

Support for Performance Initiatives

DWSD efforts toward improved overall performance will be well served by a future focus on creating people management strategies that specifically support performance initiatives. Current support for accountability and organization alignment can be enhanced.

Staff Development

The need for new knowledge and skill is apparent. As automation, new equipment and new processes evolve, the need escalates. DWSD has created a training vision for its treatment plant. It is a strong first step that needs to be expanded, enhanced, and wisely implemented.

Labor Strategy

The labor environment of DWSD's future will impact its ability to manage, operate, and maintain the projects recommended in the Master Plan. As noted earlier, workforce attitudes affect performance. Proactive efforts in this arena can pay dividends down the road.

3.5 Recommended Strategies

3.5.1 Performance Management

The current performance review process is an excellent start to a sound performance management system that will support the performance initiatives being undertaken at DWSD. Modifications should be considered, however, to ensure compatibility with the performance measures being developed currently. Further, DWSD should consider, over the long term, the goal of negotiating a consistent agreed performance review process as a formal part of each labor agreement. Performance reviews are a key step to begin differentiating performance issues from conduct issues on the job.

Consideration should also be given to developing unit performance scorecards in conjunction with unit measures or targets. Progress towards the performance targets can begin to foster a sense of healthy internal competition as well as pride in performance. Targets should be publicly visible and introduced in a carefully planned and phased manner beginning with units expected to offer the most cooperation.

In conjunction with the performance measures initiatives, a positive discipline program should be considered. Eventually the progressive procedure should become part of the labor agreements in support of an enhanced review process. Such discipline procedures are constructed in a manner that deals with conduct and performance.

Provide support, both legal and management for dealing with substandard performance (failure to

Table 3.1: Human Resource Needs for Various Projects

Sewer Infrastructure Programs		
New Tasks, Procedures, Practices	**Development Needs**	**Workforce Attitude/Commitment Needs**
More advanced inspection techniques	New SOP Training	Involvement in SOP development
Improved inspection strategy	New Inspection Technology Training	Accountability/Incentive improvement
Improved Maintenance Planning	Maintenance Skills Training	Organized labor awareness
Improved Corrective and Preventive Maintenance Tasks	Maintenance Planning and Scheduling Training	Optimized staff deployment (the right resources where needed)
		Readily available information and two-way communication

CSO and SSO Control Program		
New Tasks, Procedures, Practices	**Development Needs**	**Workforce Attitude/Commitment Needs**
New sampling Tasks	New SOP Training	Involvement in SOP development
Improved inspection strategy	Maintenance Skills Training	Accountability/Incentive improvement
Improved Maintenance Planning	Maintenance Planning and Scheduling Training	Organized labor awareness
Improved Corrective and Preventive Maintenance Tasks		Optimized staff deployment (the right resources where needed)
		Readily available information and two-way communication

System Control and Wastewater Treatment Programs		
New Tasks, Procedures, Practices	**Development Needs**	**Workforce Attitude/Commitment Needs**
Improved Operating Practices & Processes	O&M SOP Training	Involvement in SOP development
New O&M SOP's	Maintenance Skills Training	Accountability/Incentive improvement
New SCADA Practices	Maintenance Planning and Scheduling Training	Organized labor awareness
Improved Maintenance Planning	New Materials Management Practice Training	Optimized staff deployment (the right resources where needed)
Improved Corrective and Preventive Maintenance Tasks	SCADA Training	Readily available information and two-way communication
Improved Materials Management practices		

Table 3.1: Human Resource Needs for Various Programs (continued)

Environmental Protection Program		
New Tasks, Procedures, Practices	**Development Needs**	**Workforce Attitude/Commitment Needs**
New Testing and Monitoring SOP's	New Testing Monitoring SOP Training	Involvement in SOP development
New Data Management SOP's	Data Management and IS Training	Accountability/Incentive improvement
Improved Corrective and Preventive Maintenance Tasks	Maintenance Skills Training	Organized labor awareness
		Optimized staff deployment (the right resources where needed)
		Readily available information and two-way communication

Customer Service Program		
New Tasks, Procedures, Practices	**Development Needs**	**Workforce Attitude/Commitment Needs**
New Work Group and Committee SOP's	Customer Service Training	Involvement in SOP development
New Information Management SOP's	Group Management and Facilitation Skills Training	Accountability/Incentive improvement
	Information Systems Training	Organized labor awareness
		Optimized staff deployment (the right resources where needed)
		Readily available information and two-way communication

meet performance targets) not just substandard conduct (absence, drugs, alcohol etc.). Engage the city's legal resources to look for ways to make the process more effective and less time-intensive. Train managers to follow the legal, ethical, and fairness standards established. Provide support for managers who take the time and effort to deal with performance issues.

Introduce routine recognition/ reward process for *measurable* above-standard performance. It is important that the performance is measurable by standards that peers consider reasonable. Consider recognition lunches and internal communications coverage. Hats, jackets and dinner coupons for employees and spouses have been effective elsewhere especially when coupled with recognition. Make these programs frequent, visible, and routine. These programs should be introduced in parallel with the performance targets initiatives noted above.

Consider group incentive programs. As unit performance targets are initiated, the private sector often uses goal-sharing or gain-sharing initiatives to achieve targeted performance. The public sector has been slower in adopting these techniques but must consider them if it is to be competitive with the private sector over time. Public legislation sometimes must be changed but it has been done elsewhere. Group incentive programs can be the "quid pro quo" necessary to gain labor acceptance of some of the measures.

Strengthen the organization development section of the internal HR group. Effective organizational development (OD) groups can marshal resources and support for the improvement efforts undertaken by management. OD groups understand change management, help to deal with workforce resistance, and can undertake or sponsor business process re-engineering. Competent internal OD groups are often well equipped to judge the potential of outside organization consultants to support management's change initiatives.

With or without the support of an internal OD group, undertake focused business and work process re-engineering projects. Projects should target specific functions or cross-functional processes deemed by management to be critical to the organization's performance improvement. Private industry has had great success in achieving efficiencies through re-engineering. Public agencies have had less experience but can benefit similarly. Consultants offering these services should have deep public sector experience owing to the difference between the public and private sectors.

3.5.2 Staff Development

It is important that DWSD recognize the importance of developing the knowledge and skill of its future workforce. The skill level within DWSD will become more critical as processes and practices are improved. A number of anticipated new or different skill requirements are noted:

- More instrument tech skills
- Operators with more computer skills
- New Process Knowledge
- UV, Ozone,
- Greater process knowledge
- Greater need for analytical skills/ lab knowledge
- More microbial knowledge needed
- More chemical knowledge in the water business
- More engineering knowledge/ skills in management
- Engineers will need to acquire more operating familiarity
- More growth opportunities for those with potential

The list is not exhaustive. Skills assessment and skills inventories will become increasingly important for successful workforce deployment. Staffing and workforce planning will be an important in-

gredient. An effective Human Resource Information System (HRIS) will be the most important tool available to the HR department.

Training and development strategies will also be important. Development of these new and different skill sets within the existing workforce will be crucial to maintaining performance at DWSD. Fortunately a good first step has been taken in the creation of a training vision document. DWSD should build on the *Training Vision* (September 27, 2001) prepared for the Detroit Wastewater Partners and the Detroit Wastewater Treatment Plant in the following manner:

Apply the vision to the whole of DWSD not just the treatment plant and recognize that it may take some time;

Hold training group management accountable for developing measurable standards that reflect the recommendations in the vision document;

Hold training group management accountable for achieving the measures they develop;

Hold line management accountable for ensuring that employees have reasonable development plans and that they are implementing them;

Consider elevating the function to report directly to the director or an assistant director;

Add a job rotation component to the training vision through the succession planning system;

Explore pay for skill initiatives, especially in areas identified as critical strategic areas; and

Employ a variety of staff involvement strategies, especially in the development of new Standard Operating Procedures (SOPs) and/ or new work practices. The goal of these involvement strategies will be to increase staff ownership of and commitment to the new practices and increase the likelihood of successful use of new skills.

Elements of *Training Vision* that will have particular value to DWSD's future are:

- Training development planning
- Needs analysis
- Individual development plans
- Variety of instructional methods focusing on the hands-on & SOP training
- E-learning
- CD & other individualized instructional alternatives
- OJT
- Rotation
- Structured experiential learning
- Small group instruction
- Train-the-trainer strategies
- Supervisory-management training
- Safety training
- Policy training
- HRIS "training-tracking" system
- Certification alternatives
- Organizational issues
- Benchmarking

3.5.3 Labor Strategy

DWSD's labor environment will impact its ability to manage, operate, and maintain the projects recommended in the Master Plan. As a result, a proactive, long-term plan to create a productive labor-management relationship that will serve both parties' interests is recommended. The following are elements of that plan;

- Collaboratively create a 10- to 20-year vision of where DWSD wants labor management relations to go. Contrast Dearborn and Flint UAW models;
- Involve labor in visits to privately operated facilities. Capitalize on the idea that reasonable

people confronted early enough with the same information, will come to similar conclusions;

- Create a private management strategy that deals with how management can cultivate (or at least keep from deterring) progressive labor-management leadership within both DWSD labor and DWSD management ranks. Communicate that strategy to key management members;
- Develop a meet-and-confer process to be used between negotiating periods to deal with interim issues and invite the union to confer on traditional management rights issues. The goal is to strengthen labor- management relations over the long term, develop progressive labor and management leadership, and facilitate enhanced negotiations;
- Drive the interest-based negotiating model into the heart of both formal negotiations as well as informal meet-and-confer processes; and
- Continuously focus both negotiations and meet-and-confer efforts on "broadbanding" to reduce multiple classifications at DWSD.

3.5.4 HR Support

Implement a few key improvements in the HR group's core functions that will enable DWSD to have the right people (qualifications) in the right jobs to manage, operate and maintain the Master Plan projects.

HRIS

There are many Human Resource Information Systems (HRIS) available in the marketplace. DWSD will need to develop a set of specifications to use in evaluating and selecting a HRIS. There are many city legacy systems and data files that a new HRIS would have to integrate and / or replace. All of these would need to be defined.

Quick research via the Society of Human Resource Managers (SHRM) shows over 200 software packages available that address one or more components of the required HRIS. Further documentation can be provided on a selected set of HRIS packages that would address the basic functions needed by DWSD. Once these functions are defined, the research can be completed.

Staffing/ Workforce Planning

The next 50-years will bring a number of changes and challenges for the DWSD workforce. Examples of the types of changes anticipated are:

1. More automation, instrumentation
2. More focus on water quality goals
3. Organization more process focused
4. More and more complicated mechanical equipment to maintain
5. Tighter security requirements & costs
6. More growth opportunities for those with potential
7. More accomplished with fewer people
8. Increased competitive environment
9. Increased cost pressure from rate payers

In addition to the skill needs noted in the development section above, DWSD will require the ability to deploy the workforce thoughtfully, and the ability to selectively staff those areas requiring skills which are unavailable internally. To meet that requirement, DWSD must develop an effective staffing planning process that will enable management to see where skills exist and how they can cost-effectively staff or deploy those skills to areas requiring additional resources. It would likely include a skills inventory system that enables DWSD to perform a gap analysis to address the differences between needs and resources.

The key tool for developing an effective workforce planning solution is a sound HRIS system. Using that system, HR can create a continuous planning process that informs (with good data) recruitment, promotion, training, deployment, and succession.

A successful workforce planning system may require some changed roles within the HR section as well. For example, HR professionals may increasingly be viewed as staff planning consultants, not just recruiters. Their responsibilities would lie in the development and implementation of a successful staff planning system that works closely in support of the senior management team.

Recruitment Process

In spite of the best internal development and staff planning/ deployment systems, DWSD will be required to recruit and hire from the outside. Key skills are, and will continue to be, very competitive commodities. DWSD will be forced to acquire and retain those skills competitively. To do that, the external recruitment-hiring process must be significantly improved.

To improve that effort, it is recommended that DWSD, in conjunction with the city, implement a business process redesign, focusing on the recruitment/ hiring process. Such a redesign project would involve multiple stakeholders from city and DWSD management and HR groups. It should create honest current-state measures to begin the effort and develop a system to track improvements from the current state.

Business process redesign efforts have been successfully conducted at a number of government agencies for a variety of business processes. Such an effort is ideally suited to the recruitment hiring process at DWSD. The effort would include developing clear redesign goals, including expected cycle time and candidate perception, at the outset. Goals would be benchmarked against competitive organizations in the area (those with whom DWSD competes for talent). The re-engineering should be DWSD-focused but include stakeholders from the Detroit Department of Human Resources, Mayor' office representatives, DWSD management, technology experts, and the DWSD HR Unit.

Compensation

Compensation issues will continue to be a challenge for DWSD and the city. The pressure for enhanced productivity and competitive performance will undoubtedly increase. Where workforce redundancy decreases, the importance of existing jobs increases. High technology skills, of course, will be difficult to acquire and retain. Key process skills, experience and specialization will also command a premium. Salary compression, especially in high-demand skills areas will continue to require attention. Current activities in the compensation arena will need to be supported. Recommendations include:

Build on a fundamentally sound current approach to compensation. DWSD, through the city, has a fundamentally sound, rational, performance based compensation system. It will need to be supported and expanded to meet future requirements. Salary survey activity will need to be expanded and tailored to specific needs. Strategies for competitive skill will have to be developed. More specificity will be needed in some areas, focusing on DWSD needs versus overall city needs. In other areas, such as those with multiple, minimally differentiated positions, less specificity will be required. In sum, the compensation system will become more flexible and responsive to strategic, often changing, needs.

Expand on and 'target' salary survey activity to those areas identified as critical for DWSD.

As areas are identified as strategically important and lacking in appropriate resources or suffering salary-based turnover, they will become the basis for narrower, targeted surveys looking across the nation, perhaps, at similar situations. More effort can be focused in these tailored surveys if new approaches successfully free-up resources from other parts of the compensation effort.

Develop targeted strategies for competitive salary adjustments or longer-term strategies in

those critical arenas.

Specific customized solutions are possible and justifiable when more information is available. A good workforce planning system will help differentiate critical specific skill sets and/ or work areas one from another. That information combined with a solid understanding (based on specific surveys) of how the "outside" world deals with similar situations can enable and justify creative exceptions needed to support DWSD's goals.

Work to "broad-band" in other non-critical positions.

"Broad-banding" is the popular current term for flattening the job titles and or job categories within an organization by eliminating multiple titles and ranges of job classifications. Modern organizations, both public and private, faced with mounting competitive pressures find it necessary to increase the flexibility of their workforces. Broader jobs, entailing multiple skill sets and tasks are needed to enable quick response to changing needs and efficient deployment to resource-deficient work areas. The public sector also finds broad-banding an effective way to decrease bureaucracy in both management and labor ranks. As with all compensation issues, integration with labor-management strategy is essential.

Consider group incentive goal-sharing plans contingent on specific DWSD performance targets.

As DWSD seeks to become more competitive, it will need to employ methods common to the private sector. Group incentive plans are routinely employed by contract operators in the water and wastewater industries to reward the achievement of specific unit performance targets. The public sector has begun to employ these approaches in a number of locales. Where public law has prevented such approaches, statutory changes have been made in recognition of the need to "level the playing field" with the private sector. As long as such approaches are tied to performance they offer the opportunity for a win-win situation between the utility, the public, and organized labor. When considered as a part of an overall labor-management strategy, group incentives can offer a creative means to instituting a progressive positive labor-management client, which serves the long-term interests of all concerned.

4. GIS and Data Management Process

4.1 Introduction and Purpose

This section presents the elements of the master planning GIS and related databases established for the Master Plan. The section elaborates on these GIS and data management components:

- Procuring and installing project computer systems.
- Developing specifications for transmitting electronic data from DWSD to the project.
- Analyzing and recommending GIS tools for use in the project and ultimate use by DWSD.
- Recommending prerequisite training for software products.
- Specifying and procuring base map and demographic data.
- Obtained and converted the existing data on the DWSD collection and interceptor systems.
- Obtaining and integrating the GDRSS model data into the project system.

4.2 Master Plan Computer Systems

The Wastewater Master Plan project was supported by a comprehensive GIS and data management environment. The Master Plan computer environment consists of hardware, software, datasets and technical staff that assembled and delivered the information. All hardware and software information was maintained in an MS Access database which was updated quarterly.

4.2.1 Computer Hardware

At the heart of the Master Plan Computer System is a project server that served as the main data repository for WWMP GIS and attribute data. The server is attached to an uninterruptible power supply to provide backup power in event of power failure or severe power fluctuations. Daily backups of all server hard drives are performed daily using a tape drive installed in the server in conjunction with backup software.

Attached to the server are two GIS workstations. The workstation is the primary unit for map creation, data maintenance and spatial analysis work.

Several laptops were purchased to provide a mechanism to support the display of computer-generated meeting presentations, GIS system demonstrations and for training sessions.

4.2.2 Computer Peripherals

Several computer peripherals were integrated into Master Plan project (Figure 4.1). Three printing devices were purchased and installed for the project:

- A plotter that supports plotting of color and black and white pages up to 42” x the length of

Figure 4.1: Master Plan GIS/Database Network

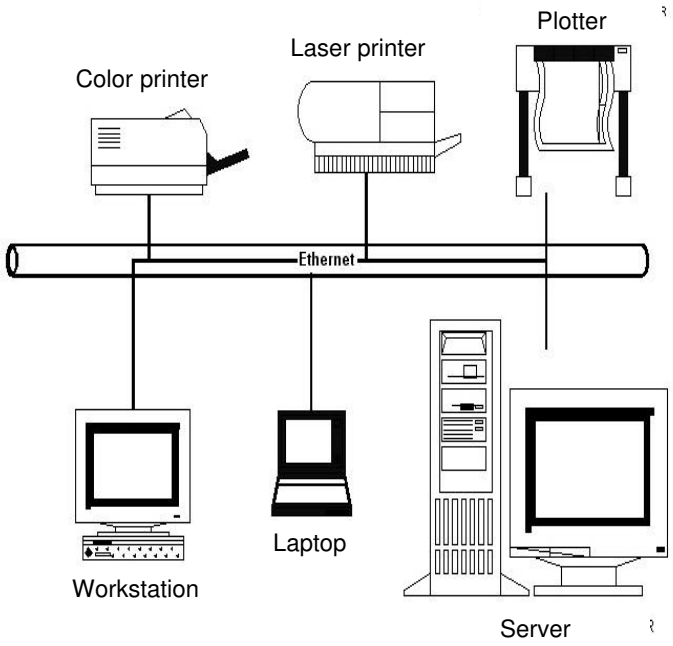
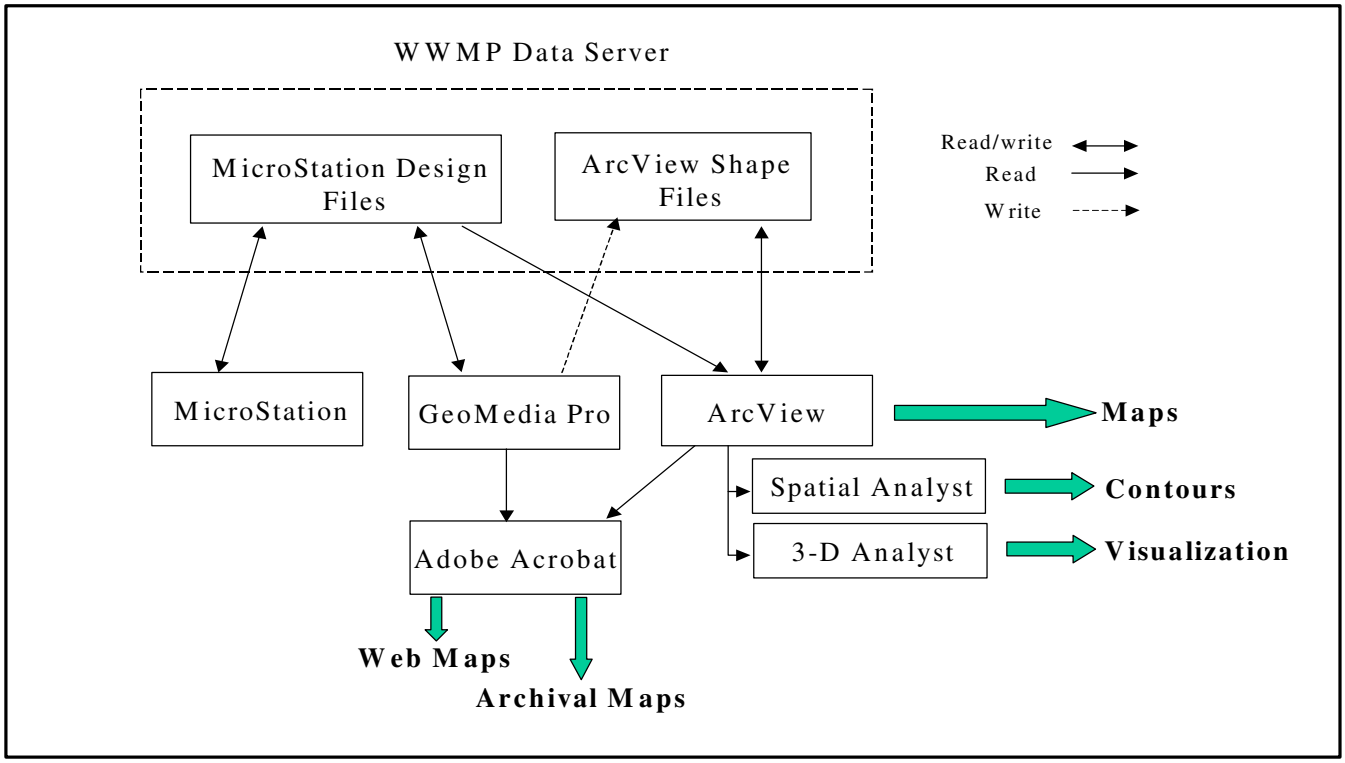


Figure 4.2: Software Relationships in Master Plan GIS/Database Network



the paper roll.

- A color printer that provides printing of pages up to 11" x 17".
- A laser printer that provides high-speed black and white laser printing of pages up to 11" x 17".

These printers provide the Master Plan project with the production facilities needed for reports, technical memoranda, maps, etc.

4.2.3 Computer Software

In addition to the computer hardware obtained for the master planning project, several key software products were purchased and integrated. While no single GIS software package meets the needs of the Master Plan, by leveraging the strengths of several packages, a suite of GIS tools more capable and robust than any one individual package was developed.

A variety of GIS software tools was evaluated for use with the WWMP GIS. Software was evaluated for a number of criteria including but not limited to:

- Suitability to need
- Availability
- Ease-of-use
- Cost
- Functionality
- Ability to work with project data formats.

To complete the work required, a variety of software packages was required. Their relationship is shown in Figure 4.2.

- GeoMedia Professional 4.0 – Intergraph desktop GIS software.
- Microstation Geographics 7 – Intergraph CAD software.

- ArcView 3.2a – ESRI desktop GIS software.
- ArcView 3-D Analyst 1.0 – ESRI spatial analysis software used for 3-D visualization.
- ArcView Spatial Analyst 2.0a - ESRI raster data analysis software.
- Dream Weaver – HTML Web development tool.
- Cold Fusion 5 – Web application development tool.
- Paintshop Pro 7.0 – Image editing tool.
- MS Visual Studio – Application development tools.
- Adobe Acrobat – Portable document file (PDF) creator.
- MS Office – Database, presentation, spreadsheet and word processor.
- MS Visio – Information systems and business processes diagramming tool.
- MS Project – Project management tool.

4.3 Data Transfer Specifications and Procedures

The Master Plan required the establishment of digital data transfer specifications and procedures between consultant teams and the DWSD. The following section describes the types of data transferred between the project teams and DWSD; the transfer specifications; and procedures for requesting and obtaining data.

4.3.1 Data Types

The Master Plan utilized information from a variety of sources within DWSD. The primary data provider was the Engineering Records Section that maintains water and sewer information. The following is a list of the data types that were transferred between the project teams and DWSD.

- MicroStation DGN files
- Oracle data export/ dump files
- GeoMedia Warehouse (GWS)
- Spreadsheets (EXCEL)
- Text documents (WORD)
- Other databases (ACCESS)
- WEB information (HTML, JPG, GIF, etc.)

4.4 Data Conversion Process

Data for the Master Plan project GIS was obtained from a number of sources and arrived in various formats, datums and projections. In order to provide a common data format and to insure consistency for use with the project software, each data set was examined for system compatibility and processed as necessary. The following section describes the steps followed for those data sets requiring processing.

4.4.1 DWSD Sanitary System Data

DWSD sewer system data created under DWSD contracts CS-1211 and CS-1213 was maintained in a GIS/ mapping system utilizing MicroStation GeoGraphics. In this system, MicroStation was used to create and maintain graphic features, while attribute data for the sanitary system was stored in an Oracle database. A link between the graphic feature and the Oracle database record is established through the use of the GeoGraphics software. It is referred to as the MSLINK value.

Although the project GIS software, GeoMedia, offers a strong toolset for working with MicroStation DGN files, it does not offer a native interface to the GeoGraphics data model. That is, it can easily work with the graphic features, but cannot connect to the associated attribute data stored in the Oracle database. The following procedures were used to produce a GeoMedia friendly representation of the DWSD data.

- DWSD's sanitary system attribute database was exported from the DWSD Oracle database to an Oracle dump file, which replicated the database structure and data tables. This dump file was

then imported into the WWMP Oracle database. In order to increase accessibility and ease of use, the Oracle data tables were then exported to a Microsoft Access database.

- MicroStation GeoGraphics maintains the link between graphic features and database rows through the use of "MSLINK" values that are stored both with the graphic feature and the database row. Any graphic feature can have multiple MSLINK values assigned to associate it with different rows in different tables. However, when GeoMedia accesses a DGN file, it reads only the first or "primary" MSLINK value it encounters. In order to ensure that only data pertinent to the Master Plan was extracted, it was necessary to remove other MSLINK values.
- A GeoMedia CADD Server file was created to allow all of the individual DGN files to be read as a single seamless coverage. GeoMedia was then used to import and re-project the DGN data to NAD 83 State Plane Feet, as well as import the database tables from the Access database. A join was performed between the MSLINK field of the graphic features and the MSLINK field of the appropriate database table to associate the graphics with their database attributes. This data set was then exported to an ESRI ArcView shape file (SHP), which maintains both the graphic features and database attributes. The ArcView shape file is used for map production.

4.4.2 DWSD Section Map

An AutoCAD drawing (DWG) formatted file of the DWSD Sewer Index Map (Maintenance Districts – City Only) was obtained from DWSD's Division of Maintenance and Repair. The file was stored in CAD or model space and therefore needed to be transformed to enable it to fit with the Project GIS data. The transformation was accomplished using the GeoMedia vector registration tool. The DWG file was imported to GeoMedia and the grid boundaries were stretched to coincide with community boundaries where appropriate. Determinations of vector registration points were made using the Index of Detail Maps, City of Detroit Topological Survey, July 1, 1954.

4.4.3 Greater Detroit Regional Sewer System (GDRSS) Data

GDRSS data was obtained from the GDRSS project team as ArcView shape files in the Michigan State Plane Coordinate System, South Zone, NAD 1927, units of feet. In order to use the data in the WWMP Project GIS the data was re-projected using the ArcView projection utility to:

Zone: Michigan South (FIPS: 2113)

Datum: North American Datum of 1983

Units: Feet

The pipe network map prepared for use with the GDRSS model was prepared as a schematic representation of the pipes in the sewer system and does not necessarily depict accurate spatial pipe locations. In order to display the GDRSS model output in a spatially accurate manner, each GDRSS modeled pipe was matched with its corresponding DWSD pipe segment(s). This association of pipes was accomplished by overlaying the GDRSS pipes on top of the DWSD pipe network and using such information as pipe diameter, length, directional change, intersections with other pipes, etc., to identify related pipes. Once related pipes were determined, the GDRSS pipe ID was appended to the DWSD pipe segment attribute table, establishing the link between the GDRSS pipes and the DWSD pipes.

4.4.4 Digital Elevation Model Data

Thirty-meter digital elevation model (DEM) data was obtained from Spatial Insights Inc. to create contour lines and for use in data analysis and display. The data was received in ARC/ INFO GRID format in geographic coordinates (latitude/ longitude). In order to use the data in the WWMP Project GIS, the grid data was re-projected in ARC/ INFO from geographic coordinates to the state plane projection using the following parame-

ters:

Zone: Michigan South (FIPS: 2113)

Datum: North American Datum of 1983

Units: Feet

For the generation of contour data, the GRID was re-sampled in ARC/ INFO using a bilinear interpolation method, which yielded an approximate GRID cell size of 7.5 meters.

4.4.5 Oakland County Data

The Oakland county interceptor sewer network was obtained from the Oakland County Drain Commission as an AutoCAD drawing (DWG) formatted file. The file was displayed in ArcView using the ArcView Cad Reader extension and then saved as an ArcView shape file using the *Theme, Convert to Shape File* option. Since the AutoCAD file was already in the WWMP Project GIS coordinate system (Michigan State Plane, South, NAD83, feet) no projection or transformation was required.

4.4.6 Wayne County Data

A variety of data sets were obtained from the Wayne County GIS Management Unit (GISMU) including street centerlines and examples of digital ortho-imagery. Fortunately, all the data sets obtained were of the same datum and projection that are used by the project and therefore required no additional processing.

4.4.7 Michigan Geographic Framework

The base map is an integral component of the overall project GIS, providing enough basic reference information so that users can associate and locate features and attribute data for purposes of comparison or geographical correlation. The intent was to use the same base map for both the Comprehensive Water (CS-1278) and Waste Water (CS-1314) Master Plan Projects to provide consistency and continuity. In choosing a base map several factors were considered: cost, availability, accuracy, spatial extent and maintainability and several sources were investigated.

The Michigan Geographic Framework (MGF) is the successor to the Michigan DNR MIRIS program and has data available for the state of Michigan at no cost. MGF data consists of features and attributes from the current TIGER/ Line Files and base map features from the MDNR MIRIS files. MIRIS data is based upon USGS 1:24,000 quad sheets. The DSWD service area occupies a region where data processing is incomplete, resulting in minor discontinuities at county boundaries. These discrepancies will be eliminated in phase 3 of the MGF program. All data will be updated on an ongoing basis. The Master Plan projects should continually avail themselves of these base maps as they are improved over time.

Base map data such as roads, railroads, rivers/ streams, drains, lakes, and county and community boundaries were obtained from the Michigan Geographic Framework. Data was received in a format compatible with the Project GIS and required no further processing. In order to view roads at multiple scales however, the *allroads* layer was separated into local roads, expressways and service ramp layers.

An updated version of MGF data (2a) became available in the summer of 2002. The data was downloaded from the Michigan Geographic Data Library (MGDL) (http:/ / www.state.mi.us/ webapp/ cgi/ mgdl/) by county for the planning area. The data layers were then appended so as to create a single planning-area-wide layer for each feature type. Once appended, each feature layer was converted from the MGDL standard Michigan GeoRef coordinate system to the project standard Michigan State Plane Coordinate System, NAD83, South zone, with units of feet.

Dynamap 2000 data purchased from Geographic Data Technology was used extensively on the GDRSS project and is based on TIGER/ Line Files.

Accuracy, availability and extent are similar to MGF data. Updates may be purchased in quarterly, semiannual, and annual releases.

Many counties in the DWSD service area currently have or are building their own Geographic Information Systems and would be willing to share their data through data sharing agreements. This data tends to be more accurate and up-to-date than either MGF or Dynamap 2000 data and it is therefore recommended, and the process has been initiated, to establish data sharing agreements with these counties.

Due to its accuracy, extent, lack of cost and scheduled updates by the state, MGF data has been acquired as a base for both the Comprehensive Water and Wastewater Master Plans and later, when possible, will be supplemented with data from the individual counties as data sharing agreements are put in place.

In addition, demographic data, based on the 1990 census, was obtained from SEMCOG along with Traffic Analysis Zone boundaries for incorporation into the GIS.

4.4.8 Environmental Systems Research Institute (ESRI)

ESRI supplied data was used to provide an intermediate scale road network between major highways and local roads. The ESRI data was obtained in geographic (latitude/ longitude) format and was converted in ArcView 3.2a by setting the View projection to Michigan State Plane Coordinates, South Zone, NAD 83 and View units to feet and using the *Convert to shape file* option from the Theme menu to create a new shape file in the desired datum and projection.

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5. Wastewater Master Plan Model

5.1 Introduction

The Wastewater Master Plan Model was created to analyze and understand the DWSD sewer system's response to future growth. In addition, planned sewer system expansions were added to the model. This section describes the updates to the GDRSS model (the primary basis of the Wastewater Master Plan Model); a description of the Macomb Sanitary District sub model; a description of the Clinton-Oakland sub model; and the final summary information, by community, of the flows projected to the year 2050.

5.2 GDRSS Updates

The GDRSS Phase III Model was completed in 1998. Both a Baseline (1998 Condition) and a Preferred Plan (Future Condition) version of the model were created at that time. The Preferred Plan version of the model included the best representation of Detroit's Long Term CSO Control Plan components based on planning level information available at that time. The model also included planned system improvements and CSO facilities located in suburban communities.

The Preferred Plan version of the GDRSS Model has been updated in 2001 to incorporate information currently available on various CSO Control Plan components. The model updates were performed as part of the CS-1314 Wastewater Master Plan project to become the baseline conditions for the development of the Wastewater Master Plan (WWMP) Model.

This section documents the items included in the GDRSS Model-2001 Update. Both the Event Model (RUNOFF/ EXTRAN) and the Continuous Model (RUNOFF/ TRANSPORT) have been updated. These updates include the following items:

In-System Storage (ISS) facilities: The model representation of the planned in-system storage facilities was updated using the most recent information provided in the September 2000 Basis of Design report (DWSD CS-1329). This update included revising the locations of the facilities that changed during the basis of design, subdividing several sub areas, and adding additional upstream conduits.

Screening and Disinfection (S&D) Facilities: This update included the addition of the Baby Creek, Leib, and St. Aubin screening and disinfection (S&D) facilities. A Basis of Design report for the Leib Screening and Disinfection was completed in July 1998. The facility is currently being built and is expected to be in operation in 2003. Information from the Basis of Design Report and construction drawings were used to add a representation of the proposed facility to the GDRSS Model for the 2001 Update.

A representation of the proposed St. Aubin screening and disinfection facility was added to the GDRSS Model for the 2001 Update. A basis of design report for the facility was completed July 1, 1998. The construction of the facility has been substantially completed (September 30, 2001). Information from the Basis of Design Report and construction drawings were used to add a representation of the proposed facility to the GDRSS Model for the 2001 Update.

CSO basins: This update included the refinement of the representation of the Seven Mile, Puritan Fenkell, and Conner Creek CSO basin facilities.

Dewatering: This update included a change to the EXTRAN code of the SWMM engine used by the GDRSS Model (SWMMRPO) to include orifice control, where an orifice (gate) is open or closed depending on the elevation at a specified node. This option has been used in the above updates to improve the model's representation of the facilities dewatering protocol.

Source Control (Downspout Disconnection):

This update incorporated the results of the Rain Water Control Pilot Project investigation into the impact of the downspout disconnection program. The previous representation estimated that the directly connected impervious area (DCIA), a key component in the model, would be reduced by 32 percent with downspouts disconnected. Pilot project results have indicated that the average reduction is 42 percent in the DCIA values, which has been incorporated into the model for residential areas of Detroit.

Catch-Basin Restriction: The previous model assumed use of catch basin inlet restrictions in select areas of Detroit. These did not reduce the volume of runoff, but changed the shape of the responding hydrograph by reducing the peak discharge. Representation of these inlet restrictions was not included in the present model configuration, as these are no longer being considered in the Preferred Plan.

Refined Area Delineation: A number of sub area delineations were refined to better align with the hydraulic changes already mentioned. These include the 7-Mile and Puritan-Fenkell basins, the in-system storage facilities (using Basis of Design Report for CS-1329) and the Baby Creek S&D facility.

For the Continuous Model, the following changes were also made:

Precipitation Records: The precipitation records used for the continuous simulations has been expanded from three years (1984-1986) of hourly data to 36 years (1960-1995) of hourly rainfall record from Detroit Metropolitan Airport Gage.

Monthly Infiltration Capacities: As infiltration rates vary throughout the year due to changes in ground conditions, monthly infiltration capacities were included in the model. This is an improvement from the previous version of the continuous model which used the same infiltration rate for the entire year.

Depression Storage: The depression storage for pervious areas was assumed to be 0.29 inches in the previous version of the model. This value is reasonable for summer months only, and it also assumes average-to-dry antecedent conditions. For the continuous simulations, the depression storage value was changed to 0.1 inches as it better represents ground conditions over the entire calendar year.

Upper Rouge Tunnel: The configuration of the inflows into the Upper Rouge Tunnel was revised to account for individual drop shafts planned as part of this project. In addition, allowances were made in the model representation of the Upper Rouge Tunnel to account for surge control. These updates to the Upper Rouge Tunnel representation were developed under the Upper Rouge Tunnel Overflow Frequency Analysis.

Splitters: A complete review was made of all the rule-based flow splitters used in TRANSPORT to best represent flow diversions within the system based on the updated EXTRAN model.

With these updates and improved representations incorporated, the new Wastewater Master Plan Model (i.e. the updated GDRSS Model) was run for both design storm events and for 36 years of precipitation record. These simulations were made with the following conditions:

- 2020 projected dry weather flow (no change from previous model;
- WWTP capacity at 1700 MGD; and
- Detroit River elevation of 95 feet.

Table 5.1 gives the total flow to DWSD. The total flow is reduced slightly from 280,285 MG/ yr to 280,041 MG/ year. Table 5.2 gives the total overflow in MG/ year for all the districts. The total overflow is reduced from 13,823 MG/ year to 11,776 MG/ year. This overflow includes treated effluent from the various treatment facilities that are part of the Long Term CSO Control Plan.

The updated Continuous Model has been used to support evaluation of the Long Term CSO Control

Table 5.1: Summary of Flow to DWSD by Sanitary District

Sanitary District	Total Flow to DWSD (MG/yr)				
	1998 CONDITIONS - Baseline Simulation with WWTP at 1520 MGD			2020 Conditions - Preferred Plan Simulations 1700 MGD	
	Level 2.0	Level 2.5	Level 3.0	Level 3.12	Level 3.13
Clinton Oakland	10,055	13,209	11,528	15,536	15,564
Macomb County	17,337	19,885	15,851	21,701	21,746
South Macomb	9,941	9,104	9,102	8,995	8,961
Northeast Wayne County	3,209	2,793	2,886	2,850	2,805
Evergreen-Farmington	17,183	16,725	16,353	17,913	17,935
Southeast-Oakland	25,702	27,075	25,759	26,416	26,190
Rouge Valley (Wayne Cty)	26,586	32,353	31,004	32,807	32,809
City of Farmington	863	897	827	784	785
City of Allen Park	564	1,056	570	508	499
City of Centerline	478	559	527	541	540
City of Melvindale	682	1,173	1,243	1,211	1,211
Grosse Pointe Park	1,055	877	867	624	623
Grosse Pointe Farms	1,126	844	834	833	825
City of Grosse Pointe	593	353	355	355	351
City of Dearborn	12,563	12,186	10,145	10,724	10,621
City of Detroit	133,900	141,659	138,769	138,487	138,573
TOTALS	**261,837**	**280,748**	**266,620**	**280,285**	**280,041**

Table 5.2: Summary of Overflow by Sanitary District

Sanitary District	Total Overflow (MG/yr)				
	1998 CONDITIONS - Baseline Simulation with WWTP at 1520 MGD			2020 Conditions - Preferred Plan Simulations 1700 MGD	
	Level 2.0	Level 2.5	Level 3.0	Level 3.12	Level 3.13
Clinton Oakland	0	0	0	0	0
Macomb County	0	0	0	0	0
South Macomb	369	149	229	227	213
Northeast Wayne County	378	361	388	337	335
Evergreen-Farmington	598	534	313	315	336
Southeast-Oakland	1,689	1,659	2,038	1,992	1,988
Rouge Valley (Wayne Cty)	1,018	1,047	999	862	842
City of Farmington	1	1	0	0	0
City of Allen Park	0	0	0	0	0
City of Centerline	0	0	0	0	0
City of Melvindale	0	0	0	0	0
Grosse Pointe Park	61	47	58	0	0
Grosse Pointe Farms	28	30	31	38	32
City of Grosse Pointe	0	0	0	0	0
City of Dearborn	1,873	1,609	1,833	638	585
City of Detroit	14,800	16,972	14,049	9,414	7,446
TOTALS	**20,815**	**22,409**	**19,938**	**13,823**	**11,776**

Plan update completed in December 2001 as part of the CS-1281 project. Additional model results and evaluations are included in that report.

For the Master Plan project (CS-1314), the updated GDRSS Model (Event and Continuous) incorporates the best representation of existing and planned improvements to the greater Detroit wastewater collection system. The update provides the basis for the development of the Wastewater Master Plan (WWMP) Model currently underway.

Project Information: During the completion of the Wastewater Master Plan modeling, several worksheets, memoranda to the files, working schematics were created. These project files are available at CDM's office for review and will be organized into a reference notebook and placed on the CD that accompanies this Master Plan. This reference notebook will contain all the drawings, notes, schematics, etc that the modeling team generated during their work effort.

5.3 Macomb Sanitary District Sub-model

This section describes the expansion of the WWMP Model for the Macomb Sanitary District (MSD).

The sewer system in Macomb Sanitary District (MSD) consists of six major gravity Interceptors and three DWSD pumping stations. These Interceptors are: Edison Corridor, Oakland Arm including Avon Arm, 15-Mile Road, Romeo Arm including Sterling Heights Arm, Lakeshore, and Garfield (under construction). The pumping stations are: Garfield (will be abandoned after the Garfield Interceptor is in place), Clintondale, and Northeast. Interceptors and pumping stations locations are shown in Figure 5.1.

The Macomb SD model input file was developed using the data obtained from DWSD plan-profile drawings for all the gravity sewer Interceptors. The data collected included node numbering; conduit numbering; length; diameter; and roughness coefficient. The pumping data included: on and off levels, and three data points of the pumping curves for each pump. The selection of node locations along the Interceptors was based on modeling criteria in terms of maximum and minimum lengths, change in direction, change in diameter, change in slope, change in material and inflow points.

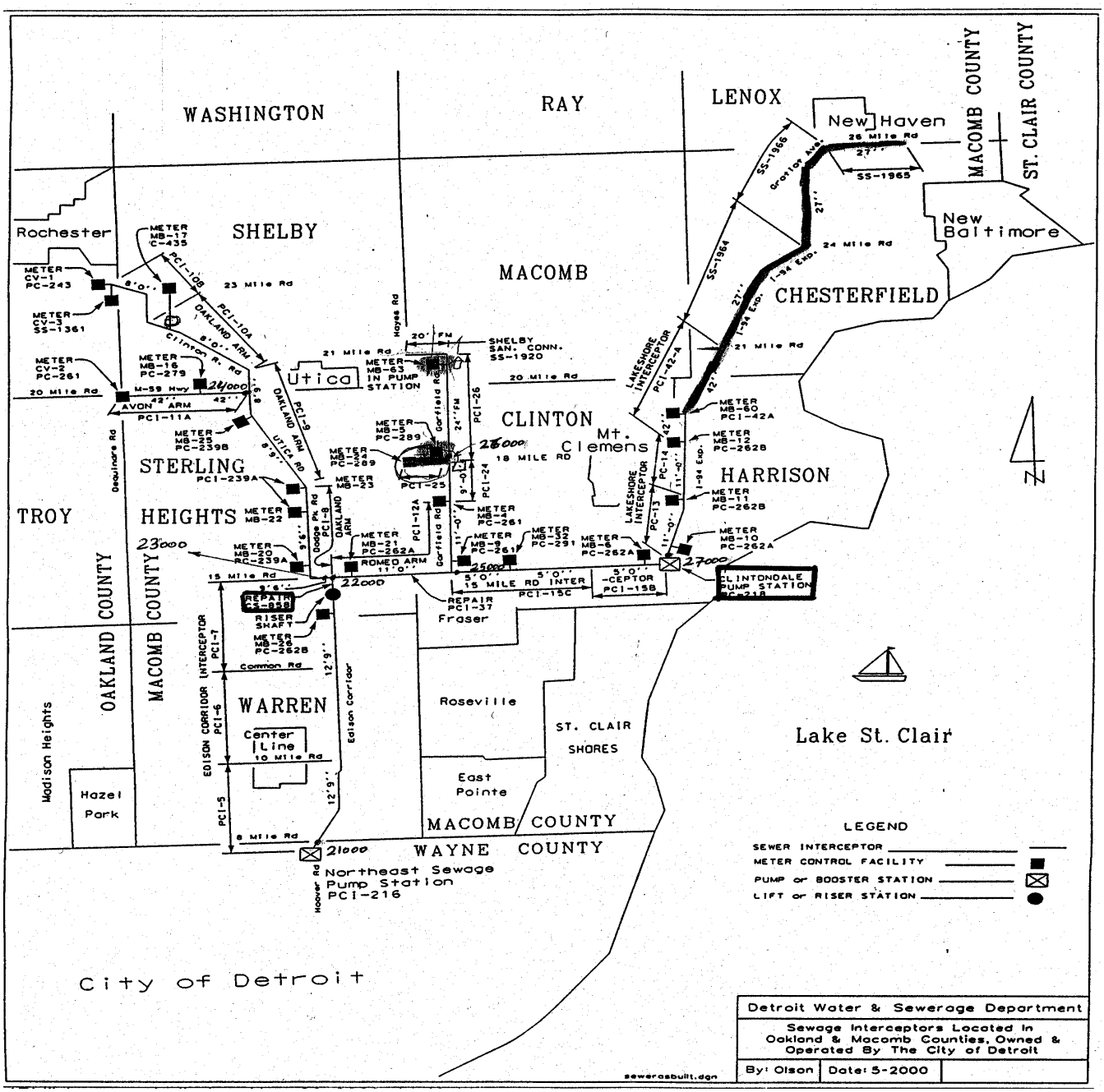
The data representation reflects the current and future conditions of the sewer system for the current force main that connects the Garfield Pumping Station and the Romeo Arm Interceptor, and the future Garfield Interceptor. The future condition information is included in the model as commented lines. When the Garfield Interceptor is put into service, the Garfield pumping station and the force main will be abandoned. The model code can be updated at that time by removing the pump and force main lines and "turning on" the lines that represent the Garfield Interceptor.

There are 11 communities within this district. They are: Chesterfield Township, Lenox Township, New Haven, Clinton Township, Fraser, Harrison Township, Sterling Heights, Macomb Township, Shelby Township, Washington Township, and Utica. These communities are all served by separate sanitary sewers that are tributary to DWSD owned interceptors in this district.

The flows from these areas are measured and monitored through 19 billing meters. The meters have tributary areas ranging from 258 to 38,000 acres. The previous GDRSS Model framework used one sub-area to represent this district. It also did not include the DWSD-owned interceptors in this district.

For the WWMP Model, a total of 22 sub-areas were defined for the Macomb Sanitary District Sub-model. The flow monitoring data obtained from the meters was analyzed to determine the wet weather response for these areas. In addition

Figure 5.1 Macomb County Interceptors



to increasing the level of detail in the sub-area delineations, the model was expanded to include the DWSD-owned interceptors in this district. The data collected within each tributary flow meter area included flow data and rainfall data. This data is discussed below and details can be found in the technical memorandum on the CD that accompanies this report.

Flow Data

Flow monitoring data was obtained from the 19

billing meters installed in the Macomb County tributary areas. The data collected from the meters covered the time period of October 2000 to September 2001.

Rainfall Data

Rainfall data was obtained from the Southeast Michigan Council of Governments (SEMCOG). At the time of the analysis, data was available through June 2001 and showed hourly and daily time interval. These rain gages were selected because they are located within the watershed boundary of the planning service area in Macomb County.

Calibration of Macomb SD Sub-model

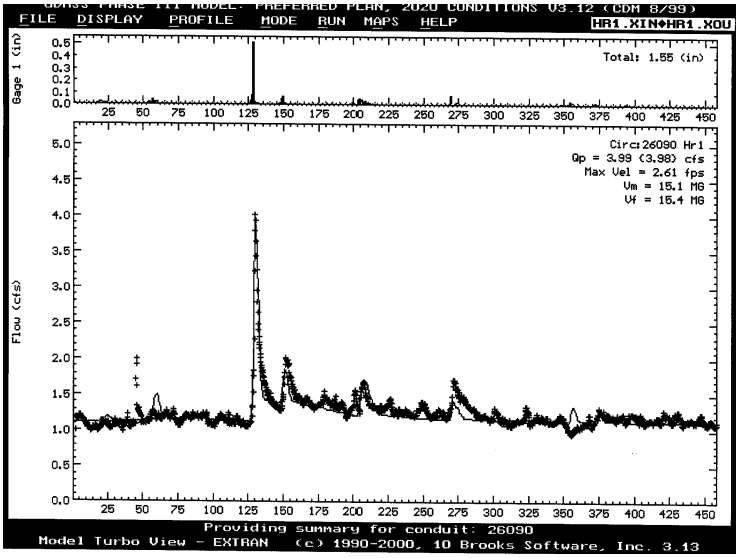
The data utilized for calibration consisted of rainfall and flow data described earlier. Three rainfall events were selected. A total of 25 sets of data were used in the calibration process.

The remaining flow meters were excluded from the calibration process for one of the following reasons:

- Flow meters data had noisy hydrographs and no clear peaks, or
- Missing data (meters were out of service)

The parameters were adjusted and the model runs were repeated until the volume, peak, and shape of hydrographs reasonably matched the measured ones. A sample of the actual and predicted hydrographs after calibration is shown in Figure 5.3.

Figure 5.3. Measured and Predicted Flows after Calibration



Model results shown as a solid line. Measured data shown with *

5.4 Clinton-Oakland Sanitary Sub-model

The Clinton-Oakland Sanitary District is under the jurisdiction of the Oakland County Drain Commissioner. There are 13 communities within the district. These communities are all served by separate sanitary sewers that are tributary to Oakland County-owned interceptors in this district. Most of the sewer district enters the DWSD Sewer System through the Oakland Arm Interceptor in Macomb County. A small area in the Southeast corner of Rochester Hills enters the Avon Arm Interceptor separately. The flows from these areas are measured and monitored through two DWSD billing meters.

The flow monitoring data obtained from the two flow meters was analyzed to determine the wet weather response for these areas.

The existing GDRSS Model used two sub-areas (i. e., 1899 and 1900) in the RUNOFF model as inflows loaded at two separate nodes just upstream of Northeast Pumping Station to represent the Clinton-Oakland Sewer District. With the new development to COSD sub-model, the flows were routed in RUNOFF through the two sub-areas and consequently through the sub-area representing Macomb County to the GDRSS EXTRAN model at the Northeast Pumping Station. The RUNOFF and TRANSPORT models developed for the Oakland County Drain Commissioner, which was utilized as the basis for the expansion, are described in this section.

The Clinton-Oakland Sanitary District (COSD) comprises the Northeastern part of Oakland County. It includes the communities west, north

and east of Pontiac.

The COSD is under the jurisdiction of the Oakland County Drain Commissioner. There are 13 communities which are entirely or partly within the Clinton-Oakland Sanitary District: Auburn Hills, Clarkston, Independence Township, Lake Angelus, Lake Orion Village, Oakland Township, Orion Township, Oxford Township, Oxford Village, Rochester, Rochester Hills, Waterford Township and West Bloomfield Township. These communities are all served by separate sanitary sewers that are tributary to Oakland County-owned interceptors in this district. The district contains two major interceptors, the Paint Creek Interceptor and the Clinton-Oakland Interceptor, which flow by gravity to the Oakland County boundary with Macomb County and enter DWSD's Oakland Arm Interceptor. A small area in the Southeast corner of Rochester Hills enters the Avon Arm Interceptor separately. The meters have tributary areas of 73,835 acres (Oakland Arm meter) and 5,264 acres (Avon Arm meter).

There are two major interceptors in the COSD. The Clinton-Oakland Interceptor extends west from the boundary with Macomb County at 23 Mile and Dequindre along the valley of the Clinton River. It serves the Southern part of the COSD, sub-areas 1 through 36 in the RUNOFF input. It has several branches off the main interceptor. The other major Interceptor is the Paint Creek Interceptor. This joins the Clinton-Oakland Interceptor near the confluence of Paint Creek and the Clinton River. This sewer serves the Northern part of the COSD, sub-areas 37 through 53.

An existing sub-model of the sewer system in the Clinton-Oakland Sewer District was developed in RUNOFF and TRANSPORT modules in 1991 for the Oakland County Drain Commissioners Office. This model was used as the basis of the GDRSS model expansion.

The validation process was performed using the same storm event that was used in the existing model.

The resulting RUNOFF parameters were then used for verification by selecting the maximum and minimum hydrographs for each set for this purpose. A sample of predicted hydrograph compared to the field hydrograph for set 1 sub-area 907 is shown on Figure 5.4.

Model Validation

Model validation was necessary to check the feasibility of the RUNOFF parameters that were obtained from the validation process. The validation process was performed by utilizing actual flow and rainfall data for the Clinton-Oakland Sewer District. Design RUNOFF parameters were then determined and tabulated.

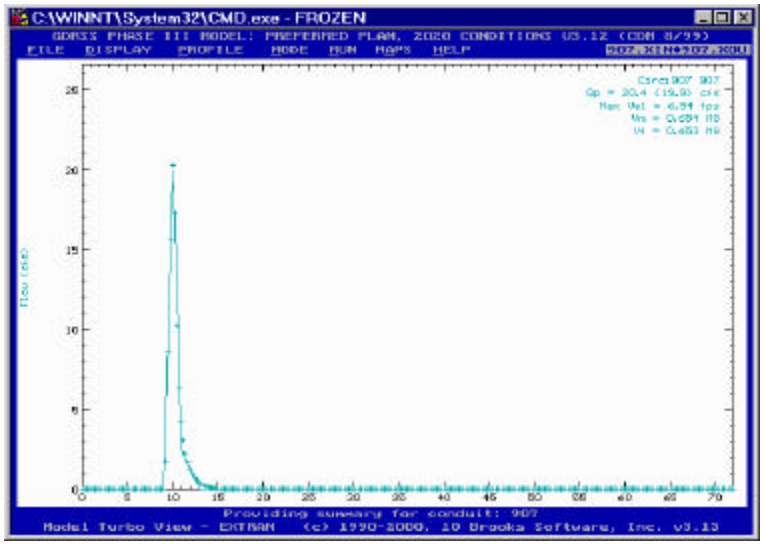
The data collected within each tributary flow meter area included flow data and rainfall data. Flow monitoring data was obtained from the two billing meters installed at the Clinton-Oakland Sewer District boundary with Macomb County. These meters are OC-S-2 at the connection to the Oakland Arm and RC-S-1 at the connection to the Avon Arm. The data collected from the meters covered the period from November 3, 1997 to February 5, 2002. The data was represented in hourly intervals.

Rainfall data was obtained from the Southeast Michigan Council of Governments' (SEMCOG) rainfall database. At the time of the analysis, data was available through October 2001. The data was of hourly and daily time interval.

There were 19 individual events identified for the Oakland Arm tributary area for the period from April 2000 to October 2001. For the area tributary to the Avon Arm, 25 events were identified for the same period.

The wet weather responses from December 2000 through the end of March 2001 were not considered in this analysis. The reason was that these responses would generally be due to snow melting

Figure 5.4: Predicted and Field Hydrographs for Set 1 Subarea



and it is difficult to determine the amount of snowmelt to correlate to these wet weather responses.

The parameters were adjusted and the model runs were repeated until the volume, peak, and shape of hydrographs matched reasonably the field flow data. A sample of the actual and predicted hydrographs after validation is shown in Figure 5.5.

Clinton-Oakland-Macomb Sub-model Validation

The Clinton-Oakland sub-model was connected to the preciously developed Macomb sub-model through two inflow junctions located at the most upstream limits of Oakland Arm and Avon Arm Interceptors. The flow meter data upstream of the Northeast Pumping Station were used to check the validation of the two sub-models after the connection.

The predicted hydrograph just downstream of the Northeast Pumping Station compared to the field data at the same location is shown in Figure 5.6.

For further information and more details, all tables and necessary calculations are available on technical memoranda on the CD that accompanies this report.

The GDRSS Model has been expanded to include 54 sub-areas to represent the wet weather response in the COSD. These areas were analyzed and incorporated into the model using flow and rainfall data collected from fall of 2000 through June of 2001. While the overall response compares closely to the response used in the GDRSS Model previously, the increase spatial resolution improves the variation in the response within the COSD area. The improved resolution will improve the ability of the model to account for projected growth within the region and to determine capacity constraints and needs for the WWMP planning.

5.5 Wet Weather Flows

Wet weather flows depend on rainfall, groundwater and antecedent soil conditions, pipe capacity to transmit flows, and capacity in the DWSD system to accept flows. Wet weather flow projections are also dependent on the results of the emerging policy in Michigan for controlling sanitary sewer overflows. The existing interceptor system can de-

Figure 5.5: Actual and Predicted Hydrographs

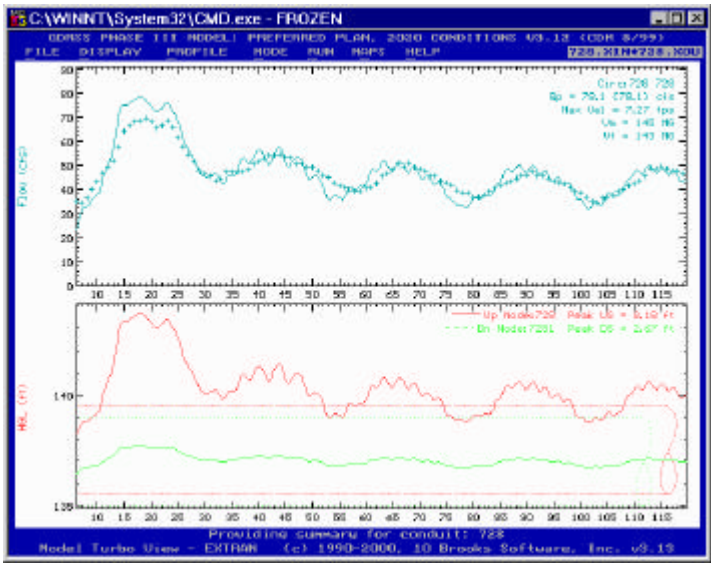
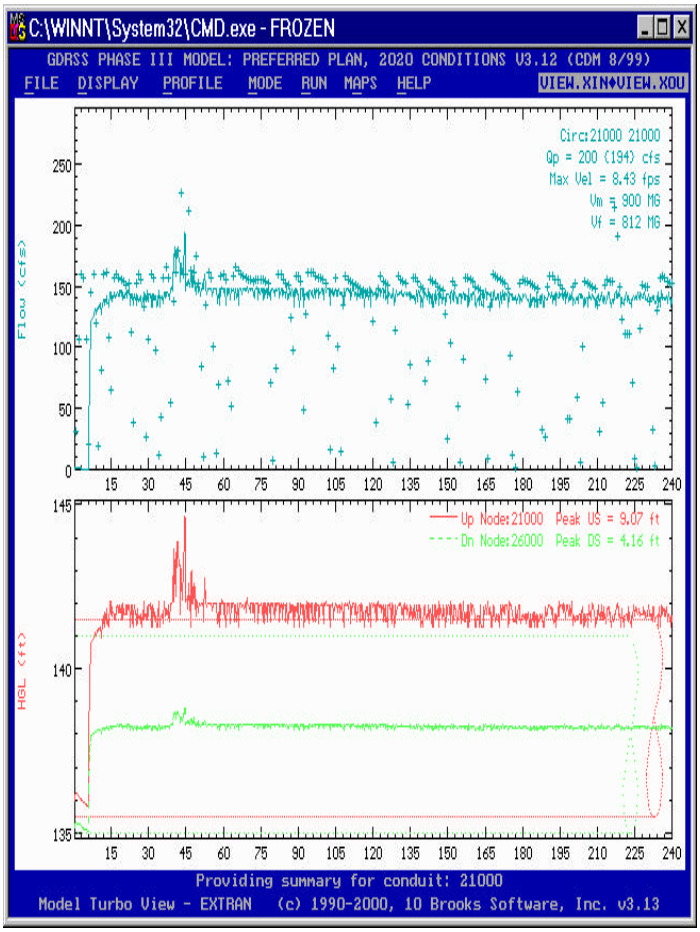


Figure 5.6: Actual and Predicted Hydrographs U/S of Northeast Pumping Station



liver approximately 3,500 mgd from the service area to the site of the wastewater treatment. The two pumping stations at the treatment plant can lift about 1,700 mgd to treatment. The remaining 1,800 mgd in the interceptors (the flow that exceeds the capacity of the pumping stations at the treatment plant) discharge through combined sewer overflows and CSO treatment facilities.

Projections of peak wet weather flow rates were developed for Detroit and DWSD's 17 first-tier customers through 2050. The development of these flow projections has been supported by a subcommittee of the WWMP Technical Work Group. These projections were based on analyses that included projecting flow needs during both dry and wet weather. Dry weather flows needs were developed based on meter data and projected to future conditions based on population and sewer area growth. Wet weather flows were calculated based on a standard developed by the SSO Work Group.

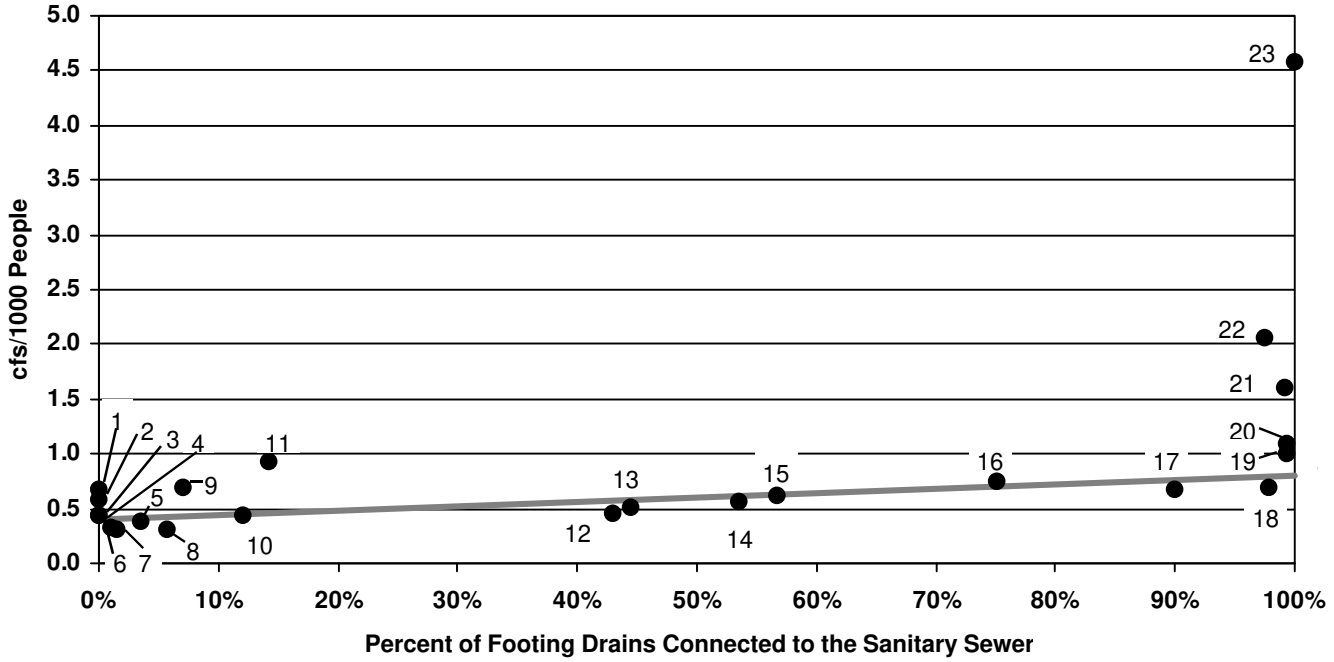
This standard was developed based on review of current peak flows resulting from a 10-year, 1-hour design event for growth (summer) antecedent conditions from each community within the DWSD service area for which data and model results were available. The peak rates, after removing employed and SIU flows, were unitized using residential population to compare the peak rates on a common basis. These peak rates were then plotted against the percent of homes with connected footing drains within each community. The percent of footing drains connected accounts for the degree of wetness in the system, which typically can be related to the age of the system and/ or the type of construction methods. In this case, the presence of footing drains being connected to the sanitary sewer system was used to define the degree of wetness.

A linear regression was performed on the data with outliers removed. A tolerance of 0.1 cfs (~25%) was added to get a line that ranged from 0.4 cfs/ 1,000 residents for no footing drains connected to 0.8 cfs/ 1,000 residents for all footing drains connected. A discussion and this figure can be found in Volume 6 of this Master Plan, *Evaluation of Regional SSO Controls.* This figure shows that systems that have footing drains connected are allowed a higher standard than systems without connected footing drains.

The flow limit defined in Figure 5.7 reflects the residential flow needs only. The allowable limit is defined as this flow limit plus an allowance for Significant Industrial Users (SIUs) and employed population (50 gpd/ employee).

Results of this analysis are provided for 2020 in

Figure 5.7: Proposed 10-Year, 1-Hour Allowable Flow



1	Shelby Twp2 (SY-S-2)
2	Macomb Twp
3	Rochester Hills
4	Shelby Twp (SY-S-1)
5	Clinton Twp (CT-S-1,3,4)
6	Chesterfield
7	Oakland County (Clinton-Oakland)
8	Harrison Twp (HR-S-2)
9	Harrison Twp (HR-S-1,3)
10	Utica
11	Sterling Heights
12	Oakland County (Evergreen-Farmington)
13	Clinton Twp (CT-S-2)
14	Fraser
15	Wayne County (WC-S-1,2,3)
16	Center Line
17	Farmington
18	SEMSD-NEWC (WM-S-2)
19	Dearborn (Greenfield PS)
20	Dearborn (Miller Road PS)
21	Melvindale
22	Grosse Pointe Park
23	Allen Park

Table 5.3. This table includes the current projected 10-year peak flows and the calculated wet weather treatment peak. This peak defines what is considered to be a reasonable discharge from a community to the DWSD system during the peak of a 10-year, 1-hour event. These can be established for any decade through 2050; 2020 was selected to provide a reasonable time frame into the future for consideration of customer flow needs.

The table also includes the communities existing contracts and a "Treatment plus Transport Peak (TTP)" column. The TTP column recognizes that some communities have what can be understood to be transport needs in addition to treatment needs. That is, their contract peak rates were not intended to represent expected treatment rates, but rather the transport of storm flows to a receiving water. Hamtramck, for instance, is essentially landlocked. Its contract peak of 1244.5 cfs allows

Table 5.3: Projection of Peak Wet Weather Flow Rates for DWSD Customers (2020)

a	b	c	d	e	f	g	h
First-Tier Customer & Detroit	Model 10-yr, 1-hr Peak cfs	Calculated Wet Weather Trtmt Peak cfs	Trtmt + Transport Peak cfs	Existing Contract Capacity Criteria cfs	Existing Contract Capacity Peak Rate cfs	Peak Capacity for Hydraulic Analysis Alt. A cfs	Peak Capacity for Hydraulic Analysis Alt. B cfs
Allen Park	not available	7.4		.4cfs/1000 or Ind Hyd Eqv.	**10.6****	10.6	30.0
Center Line	7	**8.6**		6.5	6.5	8.6	
City of Detroit	not available	499		not applicable		not applicable	
Clinton-Oakland	93	**128**		.4 cfs/1000	108	128	
Dearborn	100 + unmetered	96		100 + unspecified	**100 + unspecified**	100 + unspecified	
Dearborn Heights District 2	not available	0.21	**10 yr storm[1]**	none		10-Yr Storm	
Evergreen-Farmington	148	**178**		170	170	178	
Farmington	6	**7.5**		6.6	6.6	7.5	
Grosse Pointe	192	5.2	**192[2]**	192	192	192	
Grosse Pointe Farms	342	5.8	**554[2]**	554	554	554	
Grosse Pointe Park	25	9.2	**84[3]**	84	84	84	
Hamtramck	not available	13	**1244.5[4]**	1244.5	1244.5	1,244.5	
Harper Woods	not available	**1.42**		none		1.4	
Highland Park	not available	6.6	**10 yr storm[4]**	10 yr storm	n.a.	10-Yr Storm	
Macomb***	258	**234**		.4cfs/1000	196	234	
Melvindale	15	**9.9**		.5cfs/1000	5.0	9.9	
N.E. Wayne	127	**136**		127	127	136	
NHV/RV without WTUA*	not available	284		380	**380**	380	
Redford Township	not available	0.16	**10 yr storm[1]**	none		10-Yr Storm	
S.E. Oakland	270	207		260	**260**	260	
Wayne Co Area 6	not available	0.45	**10 yr storm[1]**	none		10-Yr Storm	
Total		**1,837**					
Total (MGD)		**1,187**					

C:\AY\WWMP\FlowMgt\FlowDB\[sbc314b_taz_analyze_meth2.xls]FN3_All_sum

Col. b: Peak flow as determined from GDRSS/WWMP Model for 10-year, 1-hour summer storm event. Provided for reference only; in some cases, peak flow is not available as internal hydraulics are not represented in the model.
Col. c: Peak calculated based on resident, employed, and significant industrial user flow needs
Col. d: Some communities have what can be understood as transport capacity needs; the following notes indicate the path of these flows:
1All flows directed towards Northwest Interceptor via DWSD collection sewers with potential for discharge to Joint Regional Tunnel
2All flows directed to Detroit River Interceptor via Fox Creek Enclosure, with potential for discharge via Conner Creek CSO basin
3All flows pumped directly into Detroit River Interceptor
4All flows directed to Detroit River Interceptor via DWSD collection & trunk sewers
Col. e & f: Existing Contract Capacity as understood in 2003. For contracts with population based criteria, residential population of applicable year is used to calculate a peak rate provided in Column f.
Col. g & h: Peak Capacity used for review of capacity needs within the system. Alt. A uses the larger of Col C or F, while Alt. B reviewed impact of a larger contract capacity for Allen Park, Center Line, and Melvindale
*The values for North Huron Valley/Rouge Valley (NHV/RV) are calculated without Western Township Utility Authority (WTUA) communities -- WTUA flows assumed to be diverted to YCUA WWTP after year 2007
**Based on methodology that takes into account industrial hydraulic equivalent

for storm flows to be directed to the Detroit River via the DWSD system. A portion of this flow would be intercepted at the DRI, along with Detroit's flows, for treatment.

These projections were used to provide a technical basis for evaluation of current or future capacity issues in support of the Wastewater Master Plan-

ning. Two alternatives were developed for this evaluation. Alternative A used the larger of the calculated wet weather treatment peak or the existing contract peak rate. Alternative B investigated the impact of allowing a higher peak flow rate than what the standard would allow for Allen Park, Center Line, and Melvindale. The peak capacities for these two evaluations are also provided in the table.

The flow needs for the First-Tier Customers of DWSD have been determined for average day, peak month, and peak hour through 2050. Projections of future flows were made by determining the existing components of wastewater flows and using population projections for sanitary flow projections and using existing DWII rates for future sewered areas. A standard developed by the SSO Work Group has been utilized to determine a reasonable peak hour rate to be accepted by DWSD for treatment. Recognition of existing contracts and existing facilities within the system was made by defining a transport flow need in addition to a treatment need. This information will be provided to the contracts work group for input on future contract negotiations. It is also being used to update the model DWFs and to review the system for potential capacity constraints.

6. Energy Management

6.1 Purpose and Scope

The section presents information and strategies for reducing energy consumption at the DWSD Wastewater Treatment Plant and in its wastewater collection system.

The following tasks were performed in the development of this Energy Management Plan:

- Identify energy management issues and applications for the collection system.
- Evaluate pumping versus gravity flow for transportation of wastewater for new and existing systems.
- Identify preferred improvements with respect to energy management.

This section examines the current DWSD Energy Management Plan and makes recommendations for energy and cost savings at the DWSD wastewater facilities are made.

The technical memorandum *Energy Management* on the CD that accompanies this report details technologies that can be used to remedy energy management-related deficiencies; discusses improvements and recommended solutions including cost estimates for implementation; and presents a prioritized implementation plan that can be developed for all recommendations. In the technical memorandum, existing reports which address energy use issues are identified; existing energy usage at the WWTP; and Wastewater pumping stations is quantified and energy management options are discussed.

6.2 Data Sources

Seven data sources were reviewed for this section:

- Electrical Energy Audit (July 1999)
- PC-744 Needs Assessment Study.
- PC-744 Asset Audit.
- Retail Wheeling Feasibility Study (December 2000)
- Natural Gas By-Pass Feasibility (September, 1999)
- PC-713 Department-Wide Instrumentation Control and Computer System Program II.
- DWSD Summary of Operating Statistics (1982-89)

6.3 Current DWSD Energy Management Plan

Several recommendations provided in the 1999 Energy Audit (CS-1272) are described below.

6.3.1 Wastewater Treatment Plant

Consideration should be given to providing a VFD for at least one of the pumps for Main Pump Station No. 1.

SFE pumps which include a 600 HP, and 7-1000 HP are run four at a time. The pumps are constant-speed pumps with a fluctuating demand. Investigation of variable frequency drives or alternative methods of pump management may provide energy reduction opportunities.

During plant visits it was noted that yard lights were on in daylight hours. Simply switching lights off when not needed for safety or to perform work would reduce energy consumption.

6.3.2 Wastewater Pumping Station

At least one pump at the Clintondale and Woodmere Pumping Stations should be considered for providing VFDs.

6.3.3 Current Energy Management Program

Some energy management efforts are being made. Plant operators prefer to start large motors off-peak, when possible. But because of the weather-driven nature of the operation, finding a balance between available capacity and pump station

flows is difficult to plan. When possible, motors are ramped up using plant-treated effluent to avoid sudden heavy start loads. Operators prefer running two pumps at full load rather than three at partial load.

There are several improvements in the works that will increase efficiency and reduce electrical use. The eddy current drives on the Intermediate Lift Pumps No. 1 and No. 2 are presently being replaced with VFD's. Pumps 3, 4, 7 are scheduled to receive VFD's.

6.4 Master Plan Recommendations

The Master Plan provided the following recommendations with respect to energy management.

- An analysis of pumping versus gravity flow indicates that building long, deep sewers is more economical, on a present worth basis, than providing shallow sewers with intermittent pumping stations. Thus new construction should utilize as few pumping stations as practical.
- Three wastewater pumping stations should be considered for providing at least one VFD. They are the Clintondale and Woodmere Wastewater pumping stations and the Main Pump Station No. 1 at the WWTP. The Clintondale Wastewater pumping station is also a candidate for a smaller pump.
- At the WWTP, it would save power if the yard lights were turned off during daylight hours. If it is not convenient to turn the lights on and off manually, timers could be installed.
- When obtaining new or replacement equipment, make sure that high efficiency motors are specified.

Every three years evaluate the theoretical water (head and flow) power demand to the actual electric motor power demand to evaluate the pump efficiency. If the pump efficiency has decreased due to changes flow, head or impeller wear, consider replacing the pump and motor.

7. Customer Surveys

This section describes the basic scope and procedures of developing the planning criteria survey forms to be distributed to 76 communities within the DWSD wastewater master planning service area.

7.1 Purpose of the Survey

The Wastewater Master Plan will include new analyses of wastewater collection and treatment needs to 2050.

The purpose of the survey was to confirm the basic planning criteria such as population and flows that are being developed under the Master Plan. Communities are most knowledgeable about their future planning needs. Therefore, their feedback is critical to insure the accuracy of the plan.

More specifically, the survey solicits the community comments on the following issues:

- Service area population projections;
- Sewer service area extensions;
- Average dry flow and peak wet flow projections;
- Changes in major industries;
- Dry weather inflow and infiltration flow; and
- Major potential development projects.

7.2 Survey Form Layout

Figure 7.1 at the end of this section is a sample survey form for Macomb Township. The survey package consists of a cover letter, and a four-page survey form. Some communities will also receive a sewer area projection map in its survey package. A pre-stamped self-addressed returning envelope is also included in each survey package.

Two pages of the survey form contain the six questions and relevant information. A third page is blank for writing the comments. The response to question 2 "Major Potential Development Projects" is required to confirm to certain tabulated format that is provided on Page 4.

7.3 Survey Form and Question Development

There are either five or six questions on each survey form.

The first question, "Service Area Population Projections," asks the communities to provide comments on the SEMCOG projections of its residential and employment populations. SEMCOG projections, by decades, are depicted in a bar chart. Population number is a critical element in determining the community sewer needs and flows.

The second question, "Major Potential Development Projects," aims to identify major development projects that may affect future community sewer flow.

The third question, "Major Industry," seeks community input on major industrial development that could significantly impact on the employment population and industrial flow.

The fourth question, "Wastewater Flow Projection," solicits community comment on the average day dry flow projections for the community up to 2050. The flow projection by is shown in a line graph. The dry flow calculation formula was also presented in case the community wanted to verify the number and assumptions.

Base dry weather wastewater flow is directly proportional to population, and total wastewater flow is estimated by the following equation: Average Flow = (Residential population x 77 gallons per day) + (Employment population x 50 gallons per day) + Significant Industrial User (SIU) flow + Dry Weather Inflow/ Infiltration (DWI/ I) flow. The SIU flow used is based on a 2000 value and is assumed to be constant through 2050.

The fifth question, "Dry Weather Inflow/ Infiltration," presents the community's dry weather inflow/ infiltration in 2001 and its percentage compared to the average dry flow in 2000. The community is asked to review the number and indicate any plan, if applicable, to reduce the inflow/ infiltration.

The sixth question, "Sewer Service Area Projections,", appears on in certain communities' survey forms if the communities were designated as "growth" communities. Those are defined by minimum of 20% residential population growth from 2000 to 2050. A sewer services area map is included in the survey form for growth communities. The sewer services area projections in different years are color- coded on the maps.

7.4 Survey Procedures

Once the survey packages were developed for all communities, they were distributed by mail or at county workshops in March and April 2003. A summary of the survey results is included in the technical memorandum titled *Stakeholder and Public Involvement Program* on the CD that accompanies this Master Plan.

Figure 7.1: Sample Customer Survey

[On DWSD letterhead]

«FirstName» «LastName»
«JobTitle»

«Company»

«Address1» «Address2»

«City», «State» «PostalCode»

February ____, 2003

RE: DWSD Wastewater Master Plan: Customer Survey

Dear «Title» «LastName»,

The Detroit Water & Sewerage Department (DWSD) is preparing a Wastewater Master Plan which will include new analyses of wastewater collection and treatment needs to the year 2050. The purpose of this survey is to confirm the basic planning criteria such as population and flows that are being developed under the Wastewater Master Plan. Your input is critical to ensure the accuracy of the plan and enable DWSD to meet your sewer system needs well into the future.

Please review the attached information carefully, and provide your comments. If necessary, please pass the form to appropriate person(s) to complete the survey. We would appreciate if you can provide any related or supplemental information regarding any specific comment on:

- Service area population projections
- Sewer service area extensions
- Average dry flow and peak wet flow projections
- Changes in major industries
- Dry weather inflow and infiltration flow
- Major potential development projects

We look forward to hearing from you. **Please return the survey form by March 31 to LaJoyce Mullins-Williams at CDM, One Woodward Avenue, Suite 1500, Detroit, Michigan 48226.** If you have any questions regarding this survey, please contact **LaJoyce Mullins-Williams** of CDM at (313) 230-5622.

Figure 7.1: Sample Customer Survey (continued)

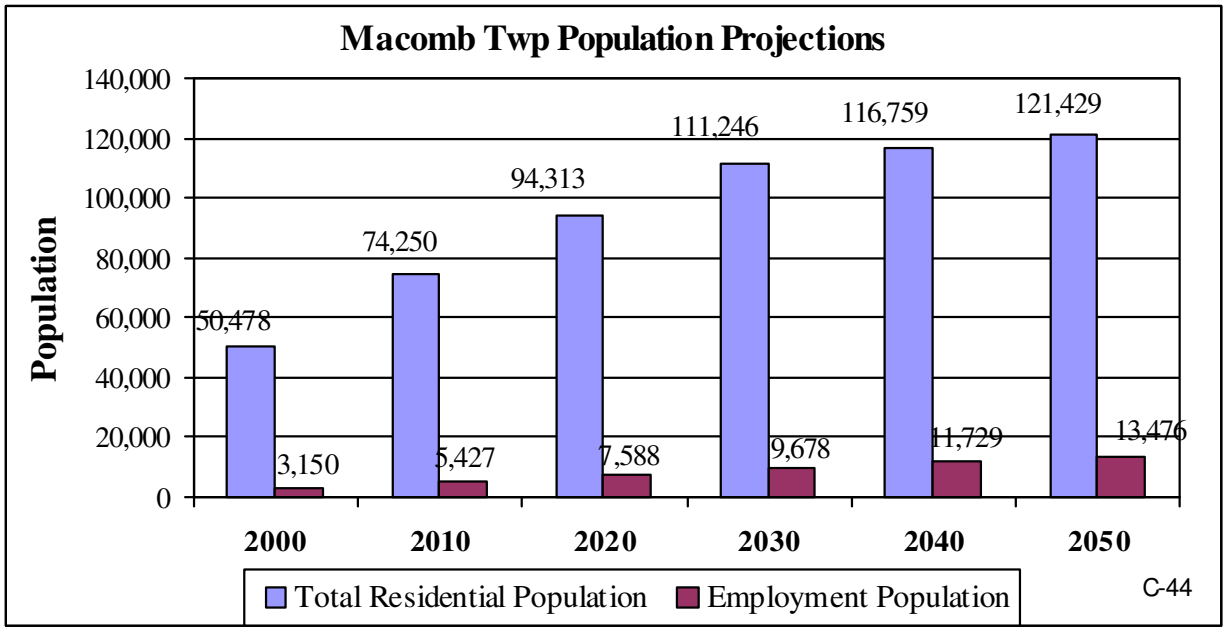
Wastewater Master Plan

MACOMB TOWNSHIP

Customer Survey on Planning Criteria - March 2003

SURVEY QUESTIONS

1. **Service area population projections**
   The following population projections have been developed by SEMCOG for Macomb Township. Note that it is the total residential population not the sewered population. Please let us know if you have any concerns or comments to the projections.



2. Major potential development projects within DWSD planning area

Below is a major potential development project within Macomb Township. Please inform us of other major potential projects and who should we contact for additional information. Please place your comments in the table provided on the last page.

Community	Location	Known as	Type	Size
Macomb Twp.	22 to 23 E. of Hayes	Westminster (old Berz-Macomb Airport)	Mixed Res/Office/ Com'l	340 acres

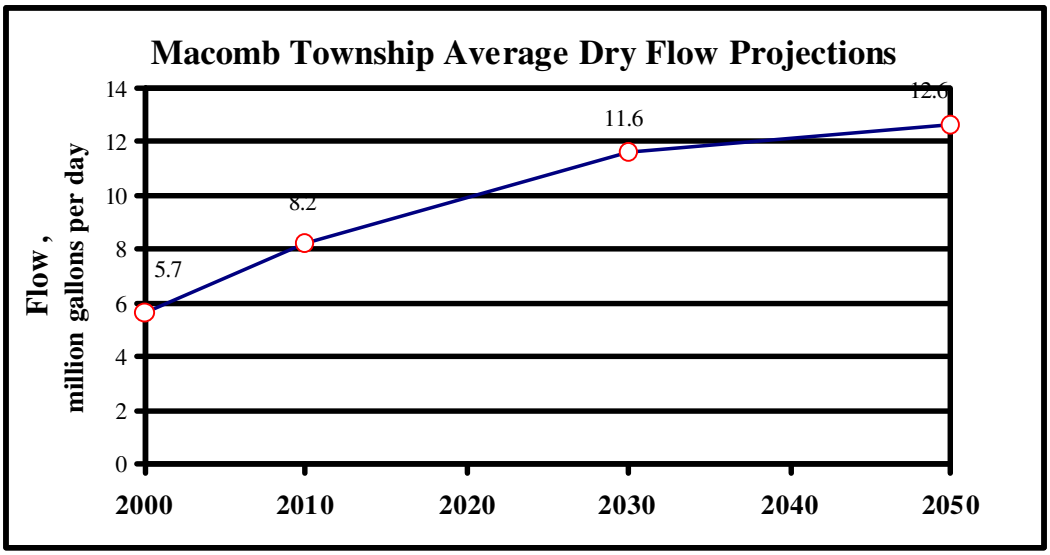
Figure 7.1: Sample Customer Survey (continued)

3. Major Industry

Are there any changes of the major industries in your community in the foreseeable future? Please provide your comments on Page 3 of this form.

4. Wastewater Flow Projections

The following sewer flow projections have been developed by the WWMP team for Macomb Township. Your technical representative should contact LaJoyce Mullins-Williams (313-230-5622) if you have any questions or concerns.



Wastewater flow is directly proportional to population, and is estimated by the following equation: Average Flow = (Residential population x 77 gallons per day) + (Employment population x 50 gallons per day) + Significant Industrial User (SIU) flow (0.0463 mgd) + Dry Weather Inflow/Infiltration (DWI/I) flow. The SIU flow is assumed to be constant through 2050.

5. Dry Weather Inflow/Infiltration

Metered DWI/I for your community is estimated as 2,168,000 gallons per day during 2001, or 38% of your average daily flow. Are there any comments on this number, and any plans to reduce the flow in the future?

6. Sewer service area projections

Please review the attached *Service Area Projection* map for Macomb Township and provide any comments regarding our sewer area projections of when and where sewers would be built? Please place all comments on Page 3 of this form.

Figure 7.1: Sample Customer Survey (continued)

Please provide ALL comments on this page, except for Question #2. Thank you.
Comments:

Figure 7.1: Sample Customer Survey (continued)

Table for providing additional comments to Question #2: Potential Major Development Projects

Location	Known as	Type (such as Residential, office, commercial)	Size

References

Detroit Water and Sewerage Department, *Contract No. PC-744 – Assets Audit Report for the Detroit Wastewater Treatment Plant and Collection System,* December 19, 2001

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Detroit Water and Sewerage Department, *Contract No. CS-1158 Long Term CSO Control Plan Section 10.06B – Pump Stations Rehabilitation*, July 1, 1996.

Detroit Water and Sewerage Department, *Contract No. CS-1272 – Study and Evaluation of DWSD Electric Utility Rates, Task 1- Electrical Energy Audit Final Report*, July 1999

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Detroit Water and Sewerage Department, *Contract No. CS-1272 – Study and Evaluation of DWSD Electric Utility Rates, Task 9.1 Natural Gas By-Pass Feasibility* September 1999.

Detroit Water and Sewerage Department, *Contract No. PC-713 Department – Wide Instrumentation Control and Computer System Program II Emergency Generators Control Narrative For Water and Wastewater Stations, DATA.NE,* June 2002

Detroit Water and Sewerage Department, *Labor Costs based on Operating Statistics Report,* June 30, 2001

Detroit Water and Sewerage Department, *Sewer Budget, FY 2002, Mission, Goals, and Budget Summary*

Detroit Water and Sewerage Department, *Summary of Operating Statistics,* Year ending June 30, 2001

DHI Water and Environment, *Mike SWMM User Guide* 2001.

DHI Water and Environment, *Mike VIEW – a Results Presentation Tool for MOUSE, Mike SWMM, Mike NET and Mike 11 - User Guide and Tutorial* 2001.

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Iowa Association of Municipal Utilities, *How to Save Energy and Money in You Water and Wastewater Systems* August 199.

New York State Energy Research and Development Authority, *Energy Efficiency in Municipal Wastewater Treatment Plants.*

WEF, *Energy Conservation in Wastewater Treatment Facilities, Manual of Practice No. MFD-2.*

Appendix

Performance Benchmarking Technical Memorandum