905R90002

USEPA
REGION V

Example of a

COMBINED SEWER SYSTEM OPERATIONAL PLAN

Technical Support Section

Water Compliance Branch

June 1990

FOREWORD

On June 23, 1986, the USEPA Region V Office issued "NPDES Permit Strategy for Combined Sewer Systems" in an attempt to improve community management of combined sewers. NPDES permit conditions now require operation and maintenance procedures by the permittee to control combined sewer overflows to be identified and implemented. One of these permit conditions requires the development of an operational plan, which integrates both dry and wet weather operation of the complete wastewater treatment system. This plan is tailored to the community's specific system and includes mechanisms and specific procedures to ensure that: the collection and treatment systems are operated to maximize treatment; storm water entry into the sewer system is regulated; the sewer system storage capacity is identified and fully utilized during wet weather; the greatest quantity of wet weather flows receive maximum possible treatment; all dry weather flows are treated to the level specified in the NPDES permit; and the sewerage system is adequately maintained. The conceptual contents of an operational plan are outlined in "Technical Guidance For Use In The Development Of A Combined Sewer System Operational Plan" September 1986, which presents a menu of items that communities should consider.

The operational plan is a unique document providing for both the preliminary planning and the implementation of operational measures with the intent of reducing the environmental impact of combined sewer overflow over an extended period of time. Thus, the document is a multifaceted product which provides direction to a community's effort to control combined overflow impacts through an examination of the following key questions:

1. What are the strengths and weaknesses of a community's combined sewer overflow system with regards to reducing the extent and impact of combined sewer overflows?

2. What can be done in a non-capital intensive manner to take advantage of the strengths and to steer around the weaknesses of the community's system?

3. Based on extensive weather records and the knowledge of the strengths and weaknesses of the combined sewer system, what kind of project is necessary to completely capture low intensity storm events?

During 1989, Region V through a contract with Science Applications International Corporation who subcontracted with TRIAD Engineering Incorporated developed an actual combined sewer system operational plan to use as an example of the level of effort and detail expected in an operational plan. East Lansing, Michigan was selected at the candidate community.

The operational plan for East Lansing provides answers to all of the previous key questions and is also useful as an example because of the extent of variations which can impact combined sewer overflow control including:

1. Combined sewer areas with and without the capability for insystem storage;

2. Mainline interceptors with and without the capability to accept additional flows;

3. An exceptional sewer maintenance program;

4. A wastewater treatment plant with the ability to revise operations in order to accept some of the storm induced flows;

5. Administration which has to deal with impacts to and from (and ownership by) a major university and a Township; and,

6. A large surrounding area of sanitary sewers with significant infiltration/inflow problems.

By utilizing the strengths and by designing around the weakness of the East Lansing Combined Sewer Overflow System, this operational plan provides the concept for a relatively low cost system which reduces or eliminates the combined sewer overflows from 70% of the overflow events. Additionally, the plan provides recommendations in the administrative and maintenance areas to enhance the effectiveness of the system's operation.

It is also noted that for the relatively complex East Lansing sewer system for a moderate sized community of 50,000, the analysis of storm induced flows utilizing the U.S. EPA Storm Water Management Model, Version 4.3 was the appropriate level of analysis. For smaller communities with relatively simpler sewer systems, a desktop hydraulic analysis may be more appropriate.

COMBINED SEWER SYSTEM OPERATIONAL PLAN

EAST LANSING, MICHIGAN

Prepared by the

United States Environmental Protection Agency
Region V
Chicago, Illinois

and

Science Applications International Corporation
McLean, Virginia

with

Triad Engineering Incorporated
Milwaukee, Wisconsin

July 6, 1989

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APPENDICES

NOTE: Although the following Appendices are an important part of a comprehensive Combined Sewer Operational Plan (CSOP), these Appendices are strictly project specific and would not add meaning to this document which has been produced as an example to Municipal bodies for the preparation of a CSOP. Therefore, although listed below, the following Appendices have not been included as a part of this document.

Chapter 1

INTRODUCTION/EXECUTIVE SUMMARY

INTRODUCTION

Combined sewers were designed to convey wastewater and storm water in a single conduit to the treatment plant. During wet weather, runoff enters the collection system resulting in the discharge of storm water and wastewater to surface water. Because of this, combined sewer overflow (CSO) continues to be a significant source of pollution in receiving waters. This is especially true for cities in the upper midwest, and the northeast, where combined sewer systems were installed before the water quality impacts of CSO were understood.

The options for abatement of CSO can involve significant capital costs. Sewer separation, which often requires private property plumbing changes to be effective, has generally been beyond the financial capabilities of many municipalities. Facilities for storage and treatment of overflows are expensive for local communities to finance. Without grant funds, these large scale projects have generally not been implemented.

The City of East Lansing must abate CSOs to comply with federal and state regulations. A proposed in-line storage sewer to convey and store East Lansing CSOs proceeded to the point where plans and specifications were submitted to the Michigan Department of Natural Resources for approval and grant funding. Because of changing regulations and shifting funding priorities, grant funding was not obtained. The City could not proceed with the project using only local funds.

The City then sought non-capital intensive solutions to combined sewer overflows. In 1986 the USEPA prepared guidelines for use in the development of a Combined Sewer System Operational Plan. The objective of this type of plan is to evaluate existing sewers and treatment facilities to determine if different operations during wet weather events have the potential to reduce overflows. Unlike facilities planning, which evaluates facilities required to meet a performance standard, the Combined Sewer Operational Plan determines the capabilities of existing facilities to maximize reduction of overflows. Limited new facilities may be proposed to allow the best use of existing facilities. The combined sewer operational plan is most effective in reducing or eliminating CSOs from low intensity or low volume rainfall/runoff events. The advantage of the operational plan is that pollutant loadings can potentially be reduced by a city without embarking on a major capital improvements program.

The method used to develop the combined sewer operational plan is to examine the major components of the collection and treatment system, the administration of the system, and the maintenance of the system. In each of these areas, opportunities for reduction of inflow, for temporarily storing wet weather flows, or increasing treatment capabilities are explored. Based on these factors, a plan to maximize capture and treatment of wet weather flows and a schedule of activities to implement the plan is developed. Reduced pollutant discharges are the objectives of the plan. The combined sewer operational plan prepared for East Lansing found opportunities for in-line storage of wet weather flows, for rerouting of wet weather flows through an apparently under-utilized interceptor and treatment plant modifications to provide storage of additional wastewater at the plant site.

This study was prepared by the United States Environmental Protection Agency - Region V located in Chicago, Illinois. The Environmental Protection Agency was assisted in this effort by Science Applications International Corporation and Triad Engineering Incorporated. The City of East Lansing was an active participant in this effort. The Michigan Department of Natural Resources participated in the initial scoping of the operational plan.

The following sections summarize existing conditions and recommendations for reducing combined sewer overflows.

EXECUTIVE SUMMARY

Existing Facilities

The City of East Lansing, Michigan, operates a system of sewers and a treatment plant providing tertiary treatment of wastewater. About one-half of East Lansing is served by combined sewers. There are separate sewers in the northern and eastern parts of the city. East Lansing also provides service by contract to Michigan State University (MSU) and Meridian Township. The East Lansing Combined Sewer Service Area is illustrated on Figure 2-1 (page 2-2).

There are four major combined sewer service areas (CSSA). The three eastern areas, Charles Street, Cedar Street, and Willmarth, drain to a single diversion structure and overflow point. The western most area, the Harrison Road CSSA, has three overflow points. The Main Interceptor parallels the Red Cedar River. There is one overflow from the interceptor which is not directly associated with a specific drainage area. Another overflow point exists at the Brody Dorm siphon. Rebuilding of the siphon has significantly reduced or eliminated overflows at this point. A 48-inch interceptor is owned and operated by MSU. Meridian Township has a service contract with East Lansing and utilizes capacity in this sewer.

Analysis of the Collection and Treatment System

The physical features of the collection and treatment system, its administration, and maintenance program were evaluated to determine opportunities for reducing overflows, and to understand the limitations in the system. EPA's Stormwater Management Model, Version 4.3 (SWMM) was used to examine probable combined sewer system performance during four rainfall events ranging from 0.15 inches to 1.0 inches in volume, with average durations and intensities. A 0.5-inch storm event with an average intensity of 0.17 in/hr and a duration of three hours was looked at in greater detail to determine potential in-line storage capacity available, overflow volumes, and maximum flow rates. Of the 65 estimated annual combined sewer overflow events, 46 would occur as a result of rainfall between 0.1 and 0.5 inches. Another 12 occur because of rainfall between 0.5 and 1.0 inches. Control of these lower volume rainfall events would provide elimination or reduction of 70 to 90 percent of the overflow events. The capacities of major interceptors were determined through standard hydraulic formulas for sewers. Based on these analyses, the following system strengths were identified:

- A major interceptor owned by MSU has apparent capacity to convey additional wet weather flows;
- The wastewater treatment plant has capacity to treat additional flow;
- Combined sewer collectors have capacity available for in-line storage in the Cedar Street CSSA and West Harrison CSSA; and,
- The City has an established, well organized, maintenance program to clean sewers and catch basins, and to identify and repair sewers requiring rehabilitation.

The weaknesses in the system include:

- The Main Interceptor has little capacity to accept flow beyond existing dry weather flow;
- Lack of direct administrative control over the volume or rate of wastewater contributions from contract service areas;
- Little or no in-line storage available in East Harrison, Charles Street, and Willmarth CSSAs; and,
- Apparent infiltration/inflow problems in separate sewer service areas reduce both interceptor and treatment plant capacities.

RECOMMENDATIONS

The strengths and weaknesses of the system lead to the following recommendations:

- Perform flow monitoring to confirm model predictions;
- Reduce and redirect Main Interceptor flow by diverting separate wastewater flow to the MSU Interceptor at East Brookfield and Grand River Avenue;
- Provide in-line storage in the combined sewer collectors in the West Harrison and Cedar Street CSSAs;

- Develop off-line storage for East Harrison and Charles Street CSSA;
- Direct wet weather flow from Cedar Street and Willmarth CSSAs through a new relief sewer to the MSU Interceptor;
- Convert unused aeration basins to provide additional wet weather storage at the treatment plant;
- Establish better authority over system users in contract service areas; and,
- Obtain better access to existing facilities on Michigan State property, and rights to utilize capacity in the MSU Interceptor.

REPORT ORGANIZATION

The information collected for this report along with the analysis of data, and conclusions of the study are documented in the following chapters:

Chapter	Title
2	System Inventory
3	Administrative Controls
4	Maintenance Program
5	Control Strategy
6	Implementation Schedule

Chapter 2

EAST LANSING SYSTEM INVENTORY

The purpose of this chapter is to describe the existing wastewater system and how it operates. The system components are summarized below and then described in detail in the major sections of the chapter.

The City of East Lansing owns and operates combined sewers for the collection of sanitary wastewater and rainfall runoff, separate sanitary sewers collecting wastewater only, interceptor sewers, and a tertiary wastewater treatment facility. A combination of wastewater and runoff from the combined sewer service area (CSSA) overflows from combined sewers or the interceptor system and is discharged by design to the Red Cedar River during wet weather conditions. Combined sewer service areas, overflow points, and interceptor designations are illustrated on Figure 2-1. Figure 2-2 provides a schematic of the collection system.

SYSTEM COMPONENTS SUMMARY

Interceptors

For purposes of this operational plan, certain sewers have been designated interceptors. These interceptors are the major conveyance facilities to the treatment plant, or from major service areas to other interceptors. The Main Interceptor is a line which begins as a 24-inch sewer at the diversion structure in the Willmarth CSSA. It continues east along the Red Cedar River increasing in size to a 54-inch diameter pipe before it enters the headworks of the East Lansing Wastewater Treatment Plant. A 48-inch interceptor serves the Michigan State University (MSU) Campus and Meridian Township east of East Lansing. It joins the Main Interceptor west of the Brody Street siphon at the point that the 54-inch section begins.

Three sewers serve as connections from two combined sewer service areas to the Main Interceptor. The first is a 36-inch interceptor which conveys flow from the western point of the Harrison Road CSSA, separate sanitary flow originating from the Woodingham Pumping Station, and some sanitary flow from the adjacent MSU Brody Dorm area to the Main Interceptor. The second interceptor is an 18-inch sewer which serves a small portion of the Harrison Road CSSA plus a portion of the campus. A 60-inch sewer conveys flows from the Charles Street CSSA through the MSU Campus to the Main Interceptor. Separate sanitary flow from the campus may also enter this sewer.

Combined Sewer Service Area

Four major drainage areas illustrated on Figure 2-1 are served by combined sewers. These have the same designations given in the previous Combined Sewer Overflow Facilities Plan prepared for the City of East Lansing. From west to east these are designated as Harrison Road, Charles Street, Cedar Street, and Willmarth CSSAs. Further subdivisions within each area are discussed in the following sections.

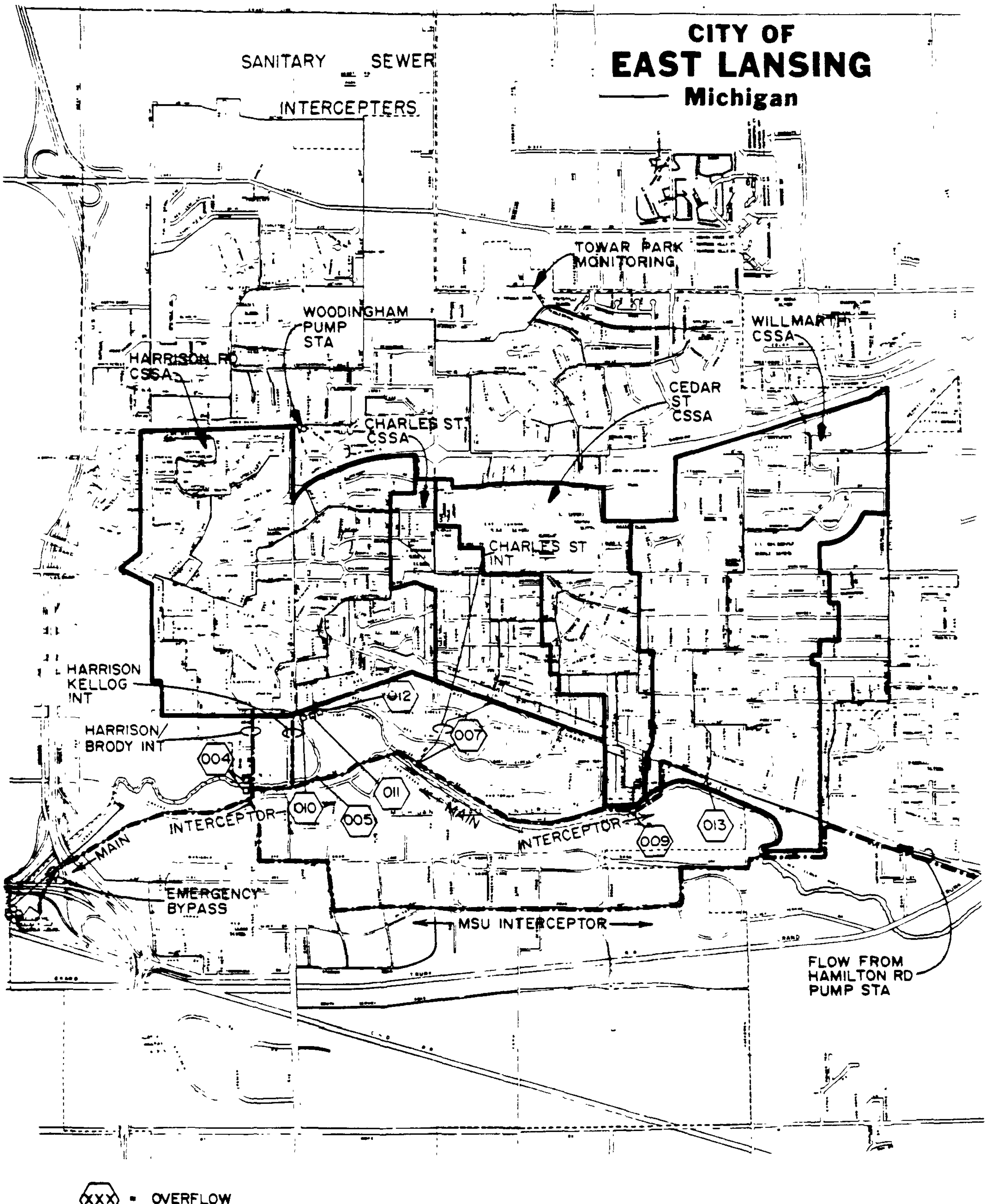


FIGURE 2-1
EAST LANSING COMBINED
SEWER SERVICE AREA

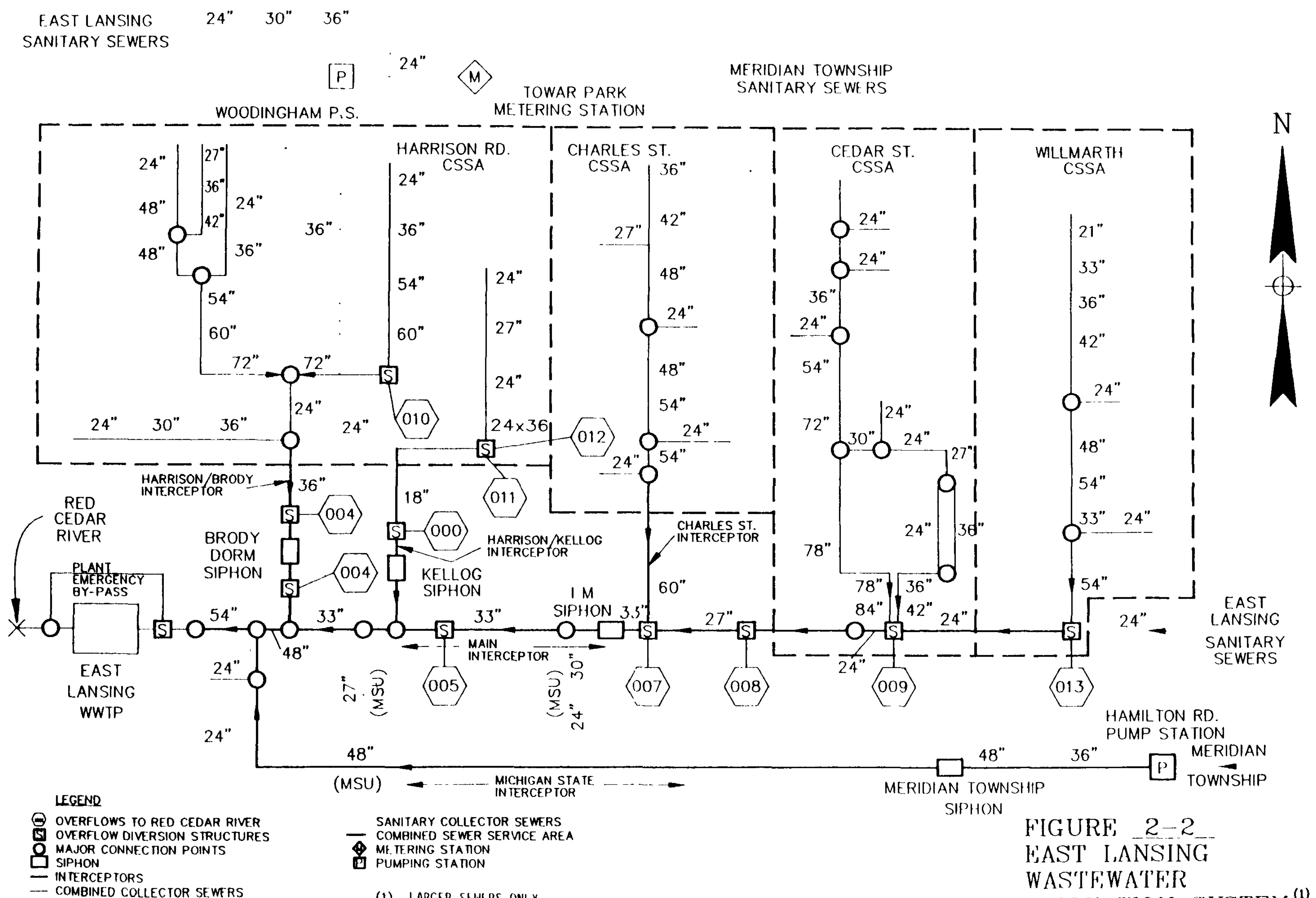


FIGURE 2-2
EAST LANSING WASTEWATER COLLECTION SYSTEM[1]

Separate Sewer Service Area

There are five principal separate sewer service areas. The largest of these is the Michigan State University Campus. The second separate service area is the southwest portion of East Lansing, west of the MSU campus. An area of East Lansing to the north of the Harrison CSSA, and an area to its east in Meridian Township comprise the third area. A fourth area is the area of East Lansing east of the Willmarth CSSA. The fifth area is the area served by Meridian Township which is located to the east of East Lansing.

Wastewater Treatment Plant

The Treatment Plant makes up the final component of the collection and treatment system. The City of East Lansing operates a tertiary treatment plant which has primary settling, activated sludge secondary treatment, and dual media filtration for tertiary treatment. Solids are incinerated and disposed of at the plant site.

INTERCEPTORS

The interceptor system, as defined for this plan, consists of several large diameter sewers which convey wastewater to the treatment plant. Large diameter sewers within the combined sewer service area and larger diameter sanitary sewers are referred to in this report as collectors. Included in this listing are sewers which connect the major combined sewer drainage areas to the Main Interceptor system. A summary listing of segments of the interceptor system is provided in Table 2-1.

Main Interceptor, 54-Inch Segment

The Main Interceptor is the key conveyance facility for East Lansing. Capacity in this sewer determines the volume of wastewater which can be transported to the treatment plant and the volume which overflows to the river during wet weather events. The Main Interceptor east of the Harrison/Brody Interceptor has little capacity beyond dry weather flow.

The Main Interceptor conveys wastewater flow from the separate sewer systems of East Lansing, Meridian Township, and Michigan State University as well as combined sewer flows. The majority of overflows to the Red Cedar River are directly from the Main Interceptor or from Main Interceptor combined sewer diversion structures.

The Main Interceptor begins at the treatment plant. The first segment is a 54-inch diameter section which extends eastward to the point where separate flows from the 48-inch Michigan State Interceptor discharge into it. There is one 24-inch separate sewer collector which flows into this section as well. Maximum capacity estimated for this segment is 40 MGD.

The 54-inch influent line to the wastewater treatment plant has an emergency bypass about 1000 feet upstream of the plant which, during high flow conditions, can direct flow to the 60-inch treatment plant effluent pipe. The overflow manhole on the 54-inch influent sewer has an invert elevation of

TABLE 2-1
INTERCEPTOR SYSTEM SUMMARY

Description	Location	Diameter (inches)	Length (feet)	Overall Slope (ft./ft.)	Maximum Capacity (non-surcharged) (cfs/mgd)	Capacity of Full Pipe (cfs/mgd)
Main Interceptor	Junction of 48-inch MSU interceptor with main interceptor to treatment plant.	54	4827	0.0010	62.3/40.4	57.7/37.4
	MSU Interceptor to the Harrison/Brody connection	48	245	0.0004	33.2/21.5	30.7/19.9
	Harrison/Brody connection to IM Siphon.	33	2667	0.0006*	13.0/8.4	12.0/7.8
	IM Siphon.	16, 16, 8	---	---	12.0/7.8	---
	IM Siphon to Overflow Structure 007.	33	353	0.0006*	13.0/8.4	12.0/7.8
	Overflow Structure 007 to Bogue St.	27	3197	0.0006*	7.7/5.0	7.1/4.6
	Bogue Street to Overflow Structure 009.	24	652	0.0008	6.5/4.2	6.0/3.9

* Obtained from construction plans.

TABLE 2-1 (cont.)
INTERCEPTOR SYSTEM SUMMARY

Description	Location	Diameter (inches)	Length (feet)	Overall Slope (ft./ft.)	Maximum Capacity (non-surcharged) (cfs/mgd)	Capacity of Full Pipe (cfs/mgd)
	Overflow Structure 009 to Overflow Structure 013.	24	2173	0.0003*	3.9/2.5	3.6/2.3
Michigan State Interceptor	Grand River Avenue and East Brookfield to junction with Main Interceptor.	48	11,650		44/28.5**	40/25.9
	Hamilton Road Pumping Station to Grand River Avenue and East Brookfield.	36	estimated 5,280			
Harrison/Brody Dorm Interceptor	Brody Road north to Brody Siphon.	36	1285	0.0012	23.2/15.0	21.5/13.9
	Brody Siphon.	24,12			29.2/18.9	
	Brody Siphon to Main Interceptor.	30	20			

* Based on information provided on the sewer maps. Slopes in this section vary from 0.0440 to 0.0011. The overall slope of 0.0003 was used to determine flowrates.

** Based on the 1961 contract.

TABLE 2-1 (cont.)
INTERCEPTOR SYSTEM SUMMARY

Description	Location	Diameter (inches)	Length (feet)	Overall Slope (ft./ft.)	Maximum Capacity (non-surcharged) (cfs/mgd)	Capacity of Full Pipe (cfs/mgd)
Harrison/ Kellog Interceptor	Michigan Avenue to Kellog Siphon.	18	1151	0.0013	3.9/2.5	3.6/2.3
	Kellog Siphon.	10, 6	---	---	3.4/2.2	---
Charles Road Interceptor	Charles Road and Grand River area to Main Interceptor.	60	1900	0.0028	138.9/90	128.6/83.3

814.10 feet, while the 48-inch diameter overflow to the 60-inch effluent sewer has an invert elevation of 819.98 feet. At the 60-inch effluent pipe, the 48-inch overflow pipe has an invert elevation of 821.50 feet, while the 60-inch effluent pipe at that point has an invert elevation of 815.47 feet according to the record drawings. The 48-inch overflow pipe is actually negatively sloped to the 60-inch effluent pipe. This means that an overflow would occur only if wastewater could not enter the treatment plant, surcharging the Main Interceptor. The 48-inch overflow pipe is also fitted with a flap gate at the point at which it discharges to the 60-inch effluent pipe. This bypass has not operated to date. The intent of the bypass is to protect the plant in the event of a significant extended power failure.

Main Interceptor, 48-Inch Segment

The next segment of the Main Interceptor is a short 48-inch section from the 54-inch sewer to the point where the Harrison/Brody Dorm Interceptor joins it. Maximum capacity is estimated at 21.5 MGD. There are no overflows from this segment.

Main Interceptor, 33-Inch Segment

The next segment of the Main Interceptor is a 33-inch diameter sewer extending from the Harrison/Brody Dorm Interceptor east along the Red Cedar River to the Charles Road Interceptor. This segment receives flow from a second section of the Harrison drainage area through the Harrison/Kellog Interceptor. Separate flow from 27-, 15-, 18-, 30-, 12-, and 10-inch sanitary sewers serving the Michigan State campus enter this segment. Capacity of this segment is estimated to be 8.4 MGD.

There is one overflow (005) which relieves the 33-inch portion of the Main Interceptor. An overflow at this outfall would include wastewater originating in separate service areas.

Outfall 005 is located on the interceptor east of Harrison Avenue near the MSU Fieldhouse. The structure is located directly on the interceptor with no other sewers draining to the structure at that point. The interceptor is 33-inches in diameter at the point at which the outfall structure 005 is located. The overflow structure 005 is detailed on a drawing by Hubbell, Hartgering and Roth, dated June 1927, and titled "City of East Lansing Sanitary Sewer Interceptor" sheet 3 of 7.

The outfall structure itself consists of an underflow baffle off the side of the 33-inch diameter interceptor for a length of 5 feet, which is the interior width of the structure. The underflow baffle extends down to the springline of the 33-inch interceptor. The invert elevation of the interceptor at the outfall 005 structure is 822.10 as per the record drawings. Thus, the approximate elevation of the underflow baffle is about 823.48 feet. Flow from the interceptor passes beneath the side underflow baffle into the adjacent underflow chamber. An overflow occurs when the level in the under flow chamber reaches the overflow point. The overflow point is set at the same elevation as the crown of the interceptor at that point, which is about 824.85 feet. Any surcharge of the interceptor at this point results in an overflow. The overflow itself consists of three 12-inch diameter pipes fitted with flap valves which overflow from the underflow chamber to the overflow chamber. The overflow is then carried from the overflow chamber to the river by means of a 21-inch diameter sewer. The elevation of the overflow pipe at the river is unknown other than a note on the record drawings that the invert is to meet the "low water" elevation.

The IM Siphon is located on the 33-inch segment. It consists of two 16-inch and one 8-inch pipes which convey flow beneath the Red Cedar River.

Main Interceptor, 27-Inch Segment

The next segment of the Main Interceptor is the 27-inch conduit from the Charles Road Interceptor to just west of Bogue Road. There are several sanitary sewers from the Michigan State campus, ranging from 10-inch to 22-inch which join this segment. This segment was recently relined from just west of Bogue Road to just west of Farm Lane using the Insitu Form method. This segment is located beneath sensitive botanical areas of the campus, making maintenance or reconstruction difficult. Maximum hydraulic capacity is estimated to be 5.0 mgd.

There is one active overflow associated with this segment, 007. Overflow 008 which is also located in this segment is permanently sealed with a plate and mortar and no longer functions.

Outfall 007 is located on the MSU campus in the botanical gardens at the junction of the 60-inch diameter Charles Road Interceptor and the 27-inch Main Interceptor. This structure is detailed in a drawing by Hubbell, Hartgering and Roth, dated June 1927 and titled "City of East Lansing Sanitary Sewer Interceptor" sheet 7 of 7.

The outfall structure 007 is located at the point at which the interceptor changes from a 27-inch to a 33-inch diameter. The configuration of this structure is such that the 60-inch Charles Road Interceptor enters a chamber at an invert elevation of 824.35 feet, as per the record drawings. The normal outflow from this chamber is through an 18-inch diameter sluice gate at invert elevation 824.10 feet. This sluice gate discharges into a second chamber, the outflow from which is through another 18-inch pipe to discharge into a third chamber in which the flow from the Charles Road Interceptor combines with the flow in the 27-inch interceptor. Normal outflow from the third chamber is through the interceptor which is 33-inches in diameter. The invert elevation of the 27-inch diameter interceptor in the third chamber is 823.6, as per the record drawings.

Overflows can occur by two different means at this structure. If the depth of flow in the 60-inch Charles Road Interceptor is greater than 2.05 feet at the first chamber, an overflow dam at elevation 826.4 is overcome and flow is directed to the Red Cedar River by means of a 6'-4" by 8'-0" box section, the outlet at the river is normally submerged and at an elevation of 820.0 feet. If the depth of flow in the third chamber (Main Interceptor Flow) exceeds 2.75 feet (an elevation of 826.35), flow is directed out three 12-inch overflow pipes fitted with flap gates, which discharge to an overflow chamber, which in turn discharges to the 6'-4" by 8'-0" box section and out to the river as previously described.

Main Interceptor, 24-Inch Segment

The final segment of the Main Interceptor is a 24-inch sewer from just west of Bogue Road to the structure for Outfall 013. Overflow structure 013 is the point where flow from the Willmarth CSSA enters the interceptor system. The diversion chamber for receiving flow from Cedar Street CSSA, and Outfall 009, are also on this segment. Separate sanitary flow from the 24-inch sanitary collection sewer which serves the eastern portion of East Lansing and portions of Meridian Township also enters the interceptor system at structure 013. Capacity is estimated to be 2.5 to 4.2 MGD.

Outfall 009, known as the Water's Edge or Cedar Street overflow, is located just east of the point at which Cedar Street extended intersects the Red Cedar River. The overflow structure is detailed in a drawing by Hubbell, Roth and Clark, dated March 19, 1956, and titled "City of East Lansing, Michigan Storm Relief Sewer Project" sheet 13 of 13.

The Outfall 009 structure consists of three distinct chambers. The east chamber receives a 42-inch diameter sewer from the north at an invert elevation of 828.50 feet. This 42-inch diameter sewer exits the east chamber as an overflow to the south at an elevation of 829.50 feet. The point at which the 42-inch sewer discharges to the Red Cedar River through a flap gate is at invert elevation 829.00 feet. Flow from the east chamber is via a 10-inch diameter open channel through the center of the chamber at invert elevation 827.75 feet. The east chamber also receives a 24-inch sewer from the east which passes through the base of the east chamber, but does not actually connect. In the same manner both the 24-inch sewer from the east and the 10-inch sewer from the east chamber pass through the base of the middle chamber, but do not actually connect. Both of these sewers discharge into the west chamber, with the 10-inch discharging through a sluice gate. The center chamber receives an 84-inch sewer at an invert elevation of 830.20 feet. An 84-inch overflow sewer exits the middle chamber at 830.20 feet (the same elevation as the incoming sewer) to discharge to the Red Cedar River at invert elevation 830.00 feet through a flap gate.

City of East Lansing personnel commented during a May field inspection that there has rarely been an occasion that this 84-inch flap gate opened. Normal flow exits the center chamber by means of a 12-inch diameter open channel through the center of the chamber at elevation 828.70 feet. This 12-inch channel discharges into the west chamber through a 12-inch sluice gate. Flow from the west chamber discharges into the interceptor, at which point it is 24-inches in diameter.

The overflow structure for Outfall 013 from the Willmarth CSSA is located on Grand River Avenue near the intersection of Spartan Avenue. This structure is detailed in a drawing by Hubbell, Roth and Clark, Inc., dated May 11, 1960 and titled "Sanitary Interceptor extension to intercept the Willmarth Drain, City of East Lansing, Ingham County, Michigan" sheet no. 2.

Flow from the separate sewer area to the east flows to the location of the 013 structure via a 24-inch sewer. At the 013 structure, the 24-inch sewer flows through a series of four manholes in a "U" configuration. The 013 structure is located within the "U" created by the 24-inch sewer. The structure receives flow from the north in a 54-inch sewer at invert elevation 828.53 feet. This 54-inch sewer flows into an overflow tank, which is contained by a broad crested weir about 46 feet in length at elevation 831.23 feet. At the base of the "U", flow from the overflow tank passes to the 24-inch interceptor through a 12-inch sluice gate. If the depth of flow in the overflow chamber exceeds the 821.23 weir elevation, an overflow occurs, at which point the overflow is directed to the south through a 54-inch sewer to discharge to the Red Cedar River. This outfall pipe is at an unknown elevation and is a free discharge (no flap gate).

Figure 2-3 illustrates the 100-year flood boundary adjacent to the Red Cedar River in East Lansing. The Main Interceptor is in the flood plain for much of its length. Manholes and diversion structures are not flood-proofed, so inflow from high river levels is possible. Inflow through flap gates held open by logs or other debris has also been reported.

Michigan State Interceptor

The Michigan State Interceptor runs from its connection to the Main Interceptor south and east to the Hamilton Road Pump Station. It is a 48-inch sewer from the Main Interceptor to Grand River Avenue and East Brookfield Road. A 36-inch sewer runs east from this point to the Hamilton Road pump station. This sewer was constructed with MSU funds and has a capacity of 44 cfs (28.53 MGD). The portion in Meridian Township was constructed by the Township. The City of East Lansing participated in the construction and had the rights to 20 cfs (13 MGD) of the capacity which were assigned to Meridian Township. The remaining capacity is reserved for the University. There is one siphon belonging to Meridian Township on this interceptor. There are no known overflows.

Harrison/Brody Dorm Interceptor

This 36-inch interceptor conveys combined flow from the Harrison Road CSSA, separate flow originating at the Woodingham Road Pump Station and some separate flow which enters along its length. A major overflow point (004) was recently reduced when additional capacity was added to the Brody Dorm Siphon. Maximum flow this interceptor can deliver to the Main Interceptor is estimated to be 15 mgd.

The Brody Siphon conveys flow in this interceptor under the Red Cedar

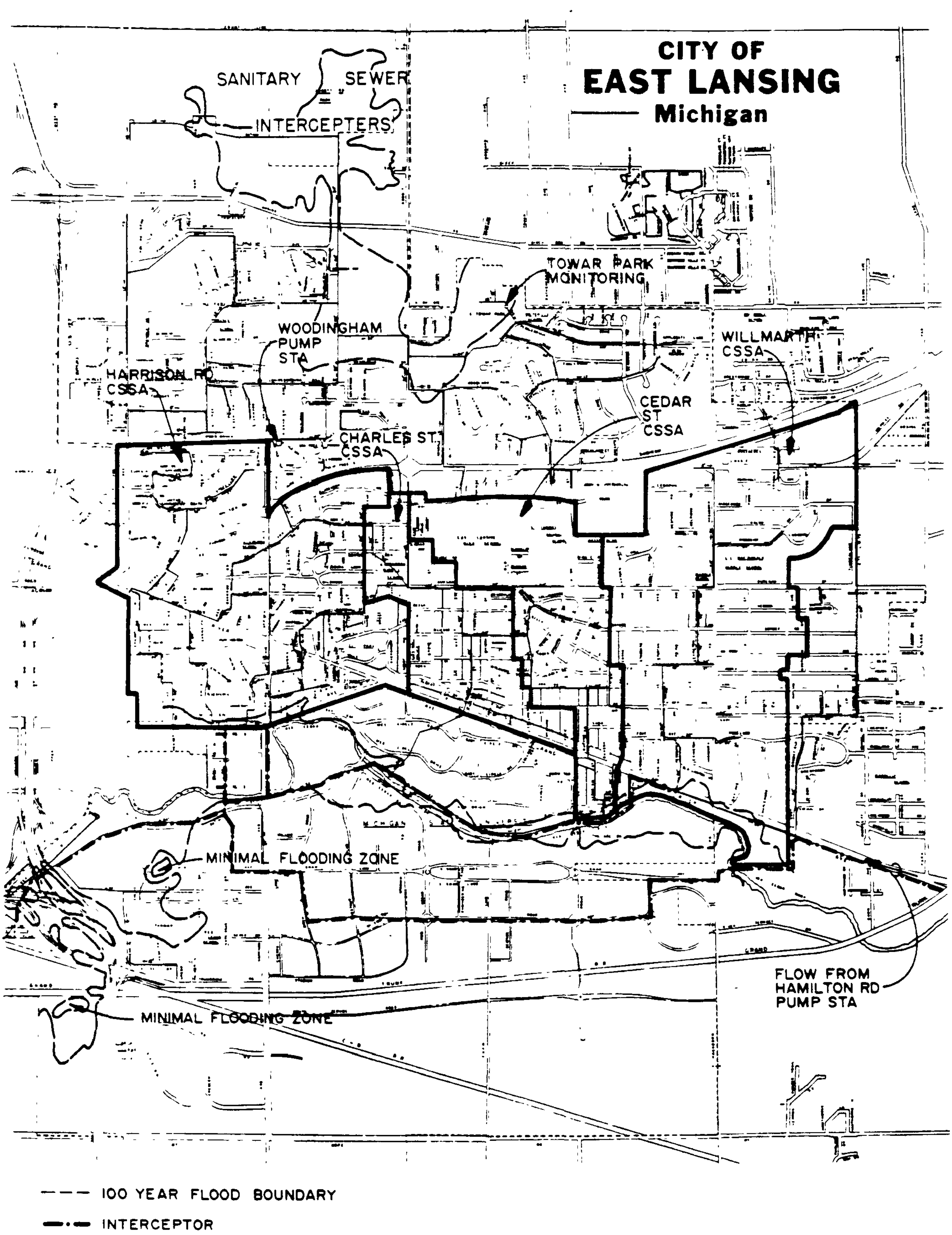


FIGURE 2-3
100 YEAR FLOOD BOUNDARY

River to the Main Interceptor. The siphon is located west of Harrison and south of Brody. The Brody siphon was originally constructed with dual 6-inch barrels. It was upgraded in 1956 with the addition of a third barrel 12-inches in diameter. The capacity of this siphon was further upgraded in 1989 with the addition of a fourth barrel 24-inches in diameter, at which time the existing dual 6-inch barrels were plugged.

The current configuration of this siphon is detailed in three drawings by Hubbell, Roth, and Clark, Inc. dated July 16, 1988, and titled "Brody Dorm Siphon Addition". The current operational scenario of the Brody Siphon is such that the dry weather flows are delivered to the 24-inch barrel with an overflow weir to the 12-inch barrel during high flows or wet weather. If the capacity of both the 24-inch and 12-inch barrels is exceeded, the flow overflows through the chamber of the plugged dual 6-inch barrels and to an overflow chamber through two 12-inch "duck bill" backflow preventing valves (one of the existing 12-inch overflow pipes is bulkheaded). These two 12-inch overflow pipes discharge to a 36-inch pipe which then discharges to the Red Cedar River. This overflow structure configuration is present on each side of the river. During a May 1989 field investigation, only the upstream (north river bank) structure was capable of overflowing, while that on the downstream end (south river bank) was bulkheaded with temporary (removable) bulkheads.

Harrison/Kellog Interceptor

This interceptor is a smaller diameter sewer which conveys flow from a portion of the Harrison Road CSSA to the Main Interceptor. Maximum capacity of this sewer is estimated to be 2.5 MGD. Flow is conveyed beneath the river by 10-and 6-inch siphons.

Outfall 000 is located upstream of the siphon. According to City of East Lansing personnel, the 18-inch overflow pipe from the north structure of the Kellog Siphon is collapsed and therefore incapable of overflowing. The siphon and north and south river bank structures are detailed on a drawing by Hubbell, Hartgering, and Roth dated February 1928. When it was discovered that this overflow pipe had failed, the 18-inch outfall pipe was plugged with concrete at the river.

Charles Road Interceptor

The Charles Road Interceptor is a 60-inch sewer conveying flows from the Charles Road CSSA to a diversion structure which joins the Main Interceptor. This sewer is partly on Michigan State property, and as such may be difficult to maintain. Available sewer mapping does not indicate if separate flows from the campus enter this sewer. However, its location indicates that such connections exist. Maximum capacity of this interceptor is estimated to be 90 MGD.

COMBINED SEWER SERVICE AREA

A large part of the older, central portion of the City of East Lansing is served by combined sewers. There are four main drainage areas which collect sanitary sewage and surface runoff in a combined sewer system. Wet weather flow in the system typically exceeds the capacity of the Main Interceptor system, causing overflow to the Red Cedar River. As previously discussed, six active overflows are from the interceptor system, or at the junction of the combined system with the interceptor. The characteristics of each drainage area are discussed below.

Harrison Road CSSA

The Harrison Road CSSA is the western-most drainage area served by combined sewers. It totals 509 acres. Land use is residential and commercial. There are two major subareas, designated by the interceptors, conveying flow from the area. A summary of the major collectors is found in Table 2-2. The west Harrison subarea consists of 434 acres. Flows are transported from this subarea through the Harrison/Brody Interceptor to the Main Interceptor. The largest collector of this subarea is a 72-inch sewer under Michigan Avenue between Kensington Road and Harrison Avenue. A collector consisting of 60-inch, 54-inch, 48-inch and smaller diameter sewers feeds the 72-inch collector at Kensington Avenue. Another major branch consisting of 60-inch, 54-inch, and smaller diameter sewers enters the 72-inch sewer through a diversion chamber at Harrison Road and Michigan Avenue. This chamber is the diversion point to Outfall 010.

Dry weather flow in the 72-inch sewer is east to west from Kensington Avenue, and west to east from Harrison Road to a junction chamber located 358 feet west of Kensington Avenue in Michigan Avenue. Flow then proceeds from the junction chamber southwest through a 24-inch sewer to a second manhole in Michigan Avenue. This second manhole also receives combined flow from a 36-inch combined sewer and separate sanitary flow from a 24-inch sewer which originates at the Woodingham Pump Station. All wastewater then flows through the Harrison/Brody Interceptor to the Main Interceptor.

During wet weather, wastewater and runoff flows eastward in the 72-inch interceptor from the junction chamber to the diversion structure at Michigan and Harrison. Outfall 010 is the major point of overflow for the Harrison Road CSSA.

Outfall 010 is located near the intersection of Harrison Avenue and Michigan Avenue. This structure is detailed in a drawing by Hubbell, Roth and Clark, Inc., dated March 19, 1956, and titled "City of East Lansing, Michigan Storm Relief Sewer Project" sheet 2 of 13.

The overflow structure at outfall 010 consists of a simple diversion chamber at which flow from the north in a 60-inch sewer makes an approximate 90 degree bend into a 72-inch sewer. At the bend, an overflow dam is built such that when the depth of flow in the diversion chamber exceeds the height of the dam, an overflow occurs. The invert elevations of the 60-inch and 72-inch sewers as they enter the diversion chamber are 826.79 feet and 826.50

TABLE 2-2
COMBINED COLLECTOR SEWERS
WEST HARRISON CSSA

Diameter (in)	Length (ft)	Overall Slope (ft/ft)	Maximum Capacity (non-surcharged) (cfs/mgd)	Capacity of Full Pipe (cfs/mgd)
42	1921	0.0063	80.3/52.0	74.4/48.2
54	996	0.0033	113.6/73.6	105.2/68.2
48	2576	0.0025	72.2/46.8	66.9/43.4
72	350	0.0009	127.8/82.8	118.3/76.7
72	420	0.0010	134.7/87.3	124.7/80.8
60	1020	0.0053	190.7/123.6	176.5/114.4
60	1463	0.0012	90.7/58.8	84.0/54.4
60	1500	0.0009	78.6/50.9	72.7/47.1
54	1550	0.0016	79.1/51.3	73.2/47.4
36	832	0.0018	28.5/18.5	26.3/17.0
36	574	0.0015	26.0/16.8	24.1/15.6
24	1287	0.0018	9.7/6.3	8.9/5.8
24	120	0.0130	25.9/16.8	24.0/15.6
36	975	0.0008	19.0/12.3	17.6/11.4
24	1407	0.0031	12.7/8.2	11.7/7.6
24	1439	0.0071	19.2/12.4	17.7/11.5

feet respectively. The elevation of the concrete dam in the diversion chamber is 827.80 feet as per the record drawings. Overflows are directed to the Red Cedar River via an 84-inch sewer which discharges to the river at an invert elevation of 825.30 through an 84-inch diameter flap gate.

Wet weather flows in the 36-inch combined sewer tributary to the manhole south of the junction chamber will overflow with sanitary wastewater plus flow from the junction chamber at Outfall 004 or reverse flow to the junction chamber and become part of the overflow at 010.

The second subarea, East Harrison, is tributary to the Harrison/Kellog Interceptor. A 24 x 36 inch channel and smaller diameter sewers are tributary to a diversion chamber also located near the intersection of Harrison Road and Michigan Avenue. There are two outfall sewers and two Outfalls, 011 and 012, for this junction chamber to the Red Cedar River. Dry weather flow is conveyed from this diversion structure through the Harrison/Kellog to the Main Interceptor. There is a separate storm sewer also tributary to Outfall 011. There are no record drawings available for this diversion chamber. Major collectors are summarized in Table 2-3.

Charles Street CSSA

The Charles Street CSSA is located immediately east of the Harrison Road CSSA. It consists of a mix of residential and commercial land uses, covering 249 acres. There is one major collector, consisting of 60-inch, 54-inch, 48-inch and smaller sewers which run north-south through the center of this service area. Two 24-inch collectors join the 54-inch collector at Albert and Charles Streets, and 193 feet south of that intersection, respectively. Table 2-4 summarizes the hydraulic characteristics of the collectors in this service area.

All flow, wet or dry weather, is conveyed to the Main Interceptor through the Charles Road Interceptor. Wet weather overflows are through the diversion associated with Outfall 007. Overflows at that location were covered in the interceptor discussion. There is some overlap of this service area with the Cedar Street CSSA. Interconnections were identified in the vicinity of Elizabeth Street and Baily Street.

Cedar Street CSSA

Cedar Street CSSA is located between the Charles and Willmarth service areas. It covers 191 acres. Land use is residential and open space associated with two schools on the northern edge of the service area. There are two subareas, with interconnections, which have been designated East and West Cedar Street, respectively. The largest collectors are associated with the East Cedar Street subarea. These include a 78-inch, 72-inch, 54-inch and smaller sewers. A 36-inch and smaller sewers serve the West Cedar Street subarea. In addition to the cross connections with the Charles Street CSSA, there is an area of cross connections with the Willmarth CSSA. These are located in the vicinity of Gunson Street from Albert to Collingwood Drive.

TABLE 2-3
COMBINED COLLECTOR SEWERS
EAST HARRISON CSSA

Diameter (in)	Length (ft)	Overall Slope (ft/ft)	Maximum Capacity (non-surcharged) (cfs/mgd)	Capacity of Full Pipe (cfs/mgd)
24 x 36*	100	0.0020	19.2/12.4	16.1/10.4
24 x 36*	201	0.0020	19.2/12.4	16.1/10.4
36	225	0.0020	30.0/19.4	27.8/18.0
24 x 30*	628	0.0047	29.5/19.1	24.7/16.0
24	125	0.0280	38.1/24.7	35.2/22.8
24 x 30*	149	0.0075	37.2/24.1	31.1/20.2

* Rectangular channels

TABLE 2-4
COMBINED COLLECTOR SEWERS
CHARLES STREET CSSA

Diameter (in)	Length (ft)	Overall Slope (ft/ft)	Maximum Capacity (non-surcharged) (cfs/mgd)	Capacity of Full Pipe (cfs/mgd)
18	1900	0.0067	8.6/5.6	8.0/5.2
54	193	0.0026	100.8/65.3	93.4/60.5
48	1112	0.0024	70.8/45.9	65.5/42.4
48	1072	0.0016	57.8/37.5	53.5/34.7
48	1072	0.0013	52.1/33.8	48.2/31.2
36	1456	0.0018	28.5/18.5	26.3/17.0

Both east and west subareas are tributary to the Main Interceptor at an interconnected series of structures associated with Outfall 009. This structure was discussed in the interceptor section. Hydraulic capacities are listed on Tables 2-5 and 2-6.

Willmarth CSSA

The Willmarth CSSA is the eastern-most combined sewer service area in the City of East Lansing. The Willmarth area covers 697 acres. Land use in the area is residential. There is one major collector which bisects the service area. It consists of 54-inch, 48-inch, and smaller sewers. Table 2-7 summarizes the hydraulic characteristics of the Willmarth collector system. All flow enters a diversion structure located on Grand River Avenue about 250 feet southeast of its intersection with Spartan Avenue. This structure is associated with Outfall 013.

SEPARATE SEWER SERVICE AREA

East Lansing conveys and treats wastewater from areas served by separate sewers. These areas surround the combined sewer service areas on three sides - north, east, and south. The northwest portion of East Lansing is tributary to the Woodingham pumping station. Flows from the northern part of Meridian Township are monitored at Towar Park and subsequently pumped through Woodingham Pump Station. Flow from the pump station is by gravity through a 36-inch, then a 24-inch sewer to a junction chamber in Michigan Avenue east of Kensington Road which discharges to the Harrison/Brody Interceptor.

The area of East Lansing east of the Willmarth CSSA has separate storm and sanitary sewers. Flow from this area and from an adjacent portion of Meridian Township is conveyed through a 24-inch separate sanitary collector to the Main Interceptor at the diversion structure to overflow point No. 013.

The Michigan State campus is served by separate sewers. This sanitary flow is discharged to either the 48 inch diameter interceptor through the southern part of the campus, or to the Main Interceptor. Flows conveyed through the Main Interceptor system enter directly at manholes along the line, through a 27-inch and 30-inch sanitary collectors in the campus area, and to the Charles Road 60-inch interceptor.

Meridian Township also discharges wastewater to the 48-inch MSU Interceptor through a 40- and 36-inch section owned by Meridian Township. Most of the flow passes through the Hamilton Road Pump Station. This facility is owned and operated by Meridian Township. Flow is monitored at this point through pumping records. Smaller volumes of wastewater also enter the MSU Interceptor System from Meridian Township.

A small area west of the MSU campus, and east of I-496/Highway 127 is served by separate sewers. This wastewater is conveyed through a 24-inch collector to the Main Interceptor about 1500 feet east of the treatment plant.

TABLE 2-5
COMBINED COLLECTOR SEWERS
WEST CEDAR CSSA

Diameter (in)	Length (ft)	Overall Slope (ft/ft)	Maximum Capacity (non-surcharged) (cfs/mgd)	Capacity of Full Pipe (cfs/mgd)
78	341	0.0011	174.8/113.3	161.9/104.9
78	489	0.0050	372.8/241.6	345.2/223.7
78	378	0.0006	129.1/83.7	119.6/77.5
78	88	0.0018	223.7/145.0	207.1/134.2
78	1371	0.0006	129.1/83.7	119.6/77.5
72	1062	0.0006	104.3/67.6	96.6/62.6
54	1101	0.0014	74.0/48.0	68.5/44.4
36	602	0.0050	47.4/30.7	43.9/28.4

TABLE 2-6
COMBINED COLLECTOR SEWERS
EAST CEDAR CSSA

Diameter (in)	Length (ft)	Overall Slope (ft/ft)	Maximum Capacity (non-surcharged) (cfs/mgd)	Capacity of Full Pipe (cfs/mgd)
42	335	0.0080	90.5/58.6	83.8/54.3
36	835	0.0054	49.3/31.9	45.6/29.5
27	1035	0.0027	16.2/10.5	15.0/9.7
24	665	0.0035	13.5/8.7	12.5/8.1
24	1035	0.0010	7.2/4.7	6.7/4.3
18	565	0.0010	3.3/2.1	3.1/2.0
18	160	0.0028	5.6/3.6	5.2/3.7

TABLE 2-7
COMBINED COLLECTOR SEWERS
WILLIMARTH CSSA

Diameter (in)	Length (ft)	Overall Slope (ft/ft)	Maximum Capacity (non-surcharged) (cfs/mgd)	Capacity of Full Pipe (cfs/mgd)
54	1000	0.0050	139.8/90.6	129.5/83.9
54	733	0.0007	52.3/33.9	48.4/31.4
48	841	0.0016	57.8/37.5	53.5/34.7
48	620	0.0009	43.3/28.1	40.1/26.0
42	727	0.0012	35.0/22.7	32.5/21.1
36	771	0.0016	26.8/17.4	24.8/16.1
33	1110	0.0013	19.2/12.4	17.8/11.5
21	1007	0.0040	10.1/6.5	9.3/6.0
33	840	0.0028	28.1/18.2	26.1/16.9
21	390	0.0039	10.0/6.5	9.2/6.0
24	651	0.0034	13.3/8.6	12.3/8.0

Flow is estimated for separate sewer areas in Meridian Township and for the MSU campus because service is provided on a contract basis. There are four direct measurements of wastewater flow. A flow meter at Towar Park measures flow from northern Meridian Township. Flow is also measured through pumping records at the Woodingham Pump Station. This measurement includes the flow from Towar Park. The Hamilton Road Pumping Station and the East End Lift Station measure flow with a magnetic meter. All other contract flows, including those from MSU are estimated based on water usage.

Table 2-8 summarizes recent separate sewer service area flows, and indicates the receiving interceptor system for each flow. Approximately 3.0 mgd of average flow conveyed by the Main Interceptor originates in separate sewer areas. A little over 4 MGD is conveyed through the 48-inch MSU Interceptor to the 54-inch portion of the Main Interceptor.

A study by Hubbell, Roth, and Clark for the City of East Lansing examined wet and dry weather flows in the area tributary to the Woodingham Pump Station to determine design criteria for an expanded pump station. Dry weather flow was estimated to be about 1 MGD. Peak wet weather flows to the pump station were estimated to be about 10.3 MGD. Inflow was judged to be uniformly distributed in the separate sewer area of East Lansing and Meridian Township. This conclusion is supported by flow data recorded in October and November, 1988. Rainfall over a one-week period totaling about 3 inches caused an increase of flow to the station from 1.2 MGD to 3.34 MGD. Rainfall of 0.3 inches resulted in an increase in one day from 1.36 to 2.34 MGD.

Similar records for other separate sewer areas are not readily available. However, it is apparent that similar increases in wet weather flow in other separated sewer areas have a direct effect on overflow occurrence and volume. Increased flow from the Woodingham Pump Station may cause an overflow at Outfall 004. Similarly, increased flow from the separate sewer area tributary to the 24-inch sanitary collector in Timberlane Road will contribute to overflows at outfalls 007 and 009.

Sewers on the MSU campus were separated in about 1960. Since there are no wastewater flow records from the University, the presence or absence of increased wet weather flows from this source cannot be projected. Because the University covers a large portion of the total East Lansing service area, increased wet weather flows from this source, if they exist, would have a significant impact on overall interceptor capacity and overflow volume and occurrence.

TABLE 2-8
Separate Sewer Area Flows

Source	Average 7/1/86-6/30/87	Average 7/1/87-6/30/88	Receiving Interceptor	Estimating Basis
	MGD	MGD		
Michigan State University[1]	1.56	1.62	57%-MSU[2] Interceptor	Water Usage
	1.18	1.22	43% Main Interceptor	
	2.74[3]	2.84[3]		
-State Police	0.12	0.14	Main Interceptor	Water Usage
Meridian Township				
-Hamilton Road Lift Station	2.65	2.78	MSU Interceptor	Magnetic Meter
-Other East Meridian Township Service	0.49	0.48	24-inch collection Timberlane, to the Main Interceptor	Magnetic Meter Water Records
-Towar Park[4]	0.42	0.34	Brody/Harrison & Main Interceptor	Ultrasonic Meter
-Woodingham Pump Station	—	1.37[5]	Brody/Harrison & Main Interceptor	

1. Includes MSU Credit Union, State Control Ld.
2. Campus flow divided based on estimated tributary areas.
3. Total MSU flow.
4. Included in Woodingham Pump Station Flow.
5. August 1988 through April 1989 - for relative comparison only.

WASTEWATER TREATMENT PLANT

A schematic diagram of the existing treatment facilities is shown in Figure 2-4. The overall plant design average day flow is 15.0 MGD, with a peak flow of 40 MGD. The design criteria also provide a rating of 18.75 MGD Average Day of the Maximum Month, and 30 MGD Maximum Day. Major components of the plant are described below.

Influent Sewer

Flow into the plant is via a 54-inch influent sewer, which has an estimated capacity of 42 MGD and an invert elevation of 813.30 feet.

Screening

The flow then passes through the communitors and bar screens before discharging into a wetwell. The two communitors each have a hydraulic capacity of 19 MGD with the bar screens acting as a communitor bypass.

Raw Sewage Pumps

Flow from the wet well is then lifted to the grit chambers by means of six lift pumps (4 constant speed and 2 variable speed) with a total capacity of 48 MGD (8 MGD maximum each).

Grit Chamber

The grit chambers each have a total volume of 94,000 gallons. The aeration capacity at the grit tanks consists of two blowers at 280 scfm each. The grit removal system also includes two grit washers at 200 gpm each and two scum pumps at 85 gpm each.

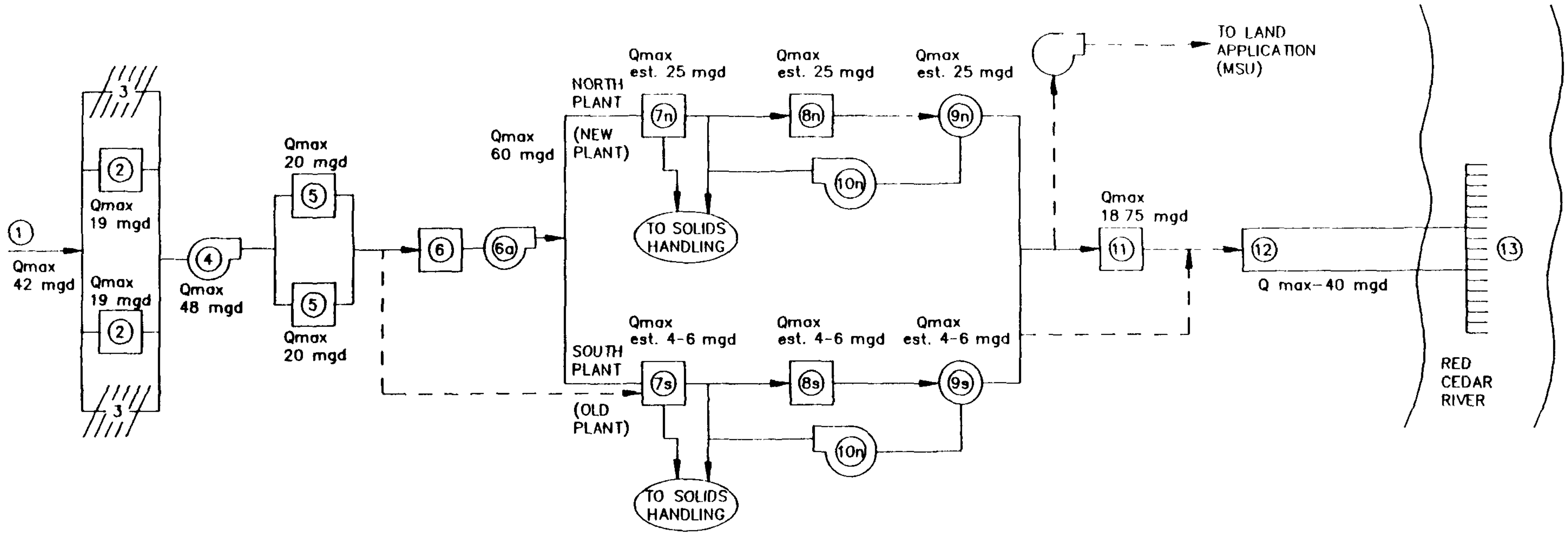
Equalization Basin

The Equalization basin has a volume of 5 million gallons and is aerated. This volume allows for a detention time of 7.6 hours at design flow and 3.0 hours at peak flow. The aeration capacity consists of three blowers at 7,000 scfm each (two in service one standby).

Flows from the equalization basin are pumped to the two plants (north and south) by means of three 20 MGD pumps for a total capacity of 60 MGD. While the original design had the design flow of 18.75 MGD split 6 MGD/12.75 MGD for flows to the south and north plants, respectively, the current operational procedure is to route 3 to 4 MGD to the south plant with the balance of the flow treated by the north plant.

Primary Settling Tanks

The north plant has six primary settling units at 16 feet wide x 117 feet



1. 54" INFLUENT SEWER
2. COMMINUTORS
3. BAR SCREENS (COMMINUTOR BYPASS)
4. RAW SEWAGE PUMPS (6)
   4 @ 8 mgd
   2 @ 3-8 mgd
5. GRIT CHAMBERS
   94,000 gal EACH
6. EQUALIZATION BASIN
   V= 5mgd

6a. EQUALIZATION BASIN PUMPING
   (3) PUMPS @ 20 mgd EACH

7. PRIMARY SETTLING TANKS
   (n)6 @ 168,000 gal EACH
   (s)4 @ 168,000 gal EACH
8. AERATION BASINS
   (n)10 @ 494,000 gal EACH
   (s)7 @ 247,150 gal EACH
9. SECONDARY SETTLING TANKS
   (n)3 @ 570,815 gal EACH
   (s)4 @ 920,000 gal EACH
10. RETURN WASTE ACTIVATED SLUDGE PUMPING
   (n)4 @ 0 5-4.0 mgd
   (s)4 @ 0.5-4.0 mgd
11. DUAL MEDIA FILTRATION--
   (4) TWO CELL FILTERS;
   TOTAL FILTER AREA 3,186 sq ft.
12. CHLORINE CONTACT
   60" EFFLUENT PIPE;
   440,000 gal
13. EFFLUENT DIFFUSER

FIG. 2-4
EAST LANSING WASTEWATER TREATMENT PLANT LIQUID TRAIN

long x 12 feet deep each for a total volume of 1,008,000 gallons and a detention time of 1.9 hours at 12.75 MGD. The south plant has four primary settling units of the same dimensions as those for the north plant for a total volume of 672,000 gallons and a detention time of 2.7 hours at 6 MGD. The design flow for the north primary tanks is 12.75 MGD while that for the south primary tanks is 6 MGD.

Aeration Tanks

The north plant consists of ten aeration basins 24 feet wide x 180 feet long x 15 feet 3 inches deep for a detention time of 9.3 hours at 12.75 MGD design flow; 6.2 hours detention time at 12.75 MGD and 50 percent sludge return. Five tanks are out of service. Each aeration basin contains 494,000 gallons.

The south plant has seven aeration basins 18 feet 6 inches wide x 125 feet long x 14 feet 3 inches deep for a detention time of 6.92 hours at 6 mgd design flow; 4.61 hours detention time at 6 MGD and 50 percent sludge return. Two tanks are kept out of service. Each of these tanks is 247,000 gallons.

Secondary Settling Tanks

The north plant consists of three secondary settling units 90 feet in diameter with a 12 foot side water depth, for a total volume of 1,712,450 gallons and a detention time of 3.22 hours at 12.75 MGD.

The south plant consists of four secondary settling units 57 feet in diameter with a 12 foot side water depth, for a total volume of 920,000 gallons and a detention time of 3.67 hours at 6 MGD.

Tertiary Treatment

The tertiary treatment plant consists of four two-cell mixed media filters with each cell measuring 14 feet x 28 feet for a total filter area of 3,136 square feet. At a flow rate of 18.75 MGD, the corresponding filter rate would be 4.15 gallons per minute per square foot of filter area. There are two backwash pumps each rated at 7050 gpm.

Wastewater Flows

A summary of an analysis of flow records at the treatment plant is provided in Table 2-9. As shown, the average dry weather flow for the period March through November for 1987 and 1988 was 10.27 MGD. The period December through February was not considered in order to eliminate inaccuracies due to freeze/thaw conditions. The average flow for only the period June through August for the same years was 9.09 MGD. The difference between the average for this period and that for March through November (1.18 MGD) is representative of the flow contribution of the transient MSU student population.

The diurnal flows at the plant as observed at the grit chamber (upstream of the equalization basin) result in a peaking factor from the average flow of about 2.0, while the low flow factor is about 0.20.

Wet weather flows for the period March through November of 1987 and 1988 are also shown in Table 2-9, distributed by rainfall event volume. As shown, the volume of rain is directly proportional to increased plant flows.

TABLE 2-9
WWTP FLOWS (MGD)
FOR 1987 AND 1988

		Avg.	Min.	Max.
Dry Weather Flow:	(Mar - Nov)	10.27	6.60	12.90
	(Jun - Aug)	9.09	6.60	21.30
Wet Weather Flow:	(Mar - Nov)	Avg.	Min.	Max.
	<0.20" Rain	11.46	1.38	18.50
	0.20" - 0.50" Rain	11.94	8.06	15.00
	0.50" - 1.00" Rain	13.66	9.90	18.50
	>1.00" Rain	15.55	12.40	21.10

NOTE: Values are based on daily total flows from the NPDES reporting form for the East Lansing Treatment Plant. Peak instantaneous observed flow rates at the plant would exceed these values.

Chapter 3

ADMINISTRATIVE CONTROLS

The preparation of an operational plan to control CSOs includes a review of administrative controls. This chapter describes administrative controls and includes recommendations for modifying them to be consistent with the objectives of the operational plan.

NPDES PERMIT REQUIREMENTS

The City of East Lansing is subject to the rules promulgated in the Michigan Administrative Code, Department of Natural Resources, Water Commission General Rules Part 21, which establishes administrative procedures for issuance of National Pollution Discharge Elimination System permits by the State of Michigan.

East Lansing recently renewed Permit MI0022853 which establishes effluent limits for discharge from the treatment plant outfall (001) to the Red Cedar River. The City is also permitted to discharge up to 4.0 MGD to Michigan State University, (NPDES) Institute of Water Research through NPDES Permit No. MI002321, Outfall 003. A copy of the permit is included in Appendix 3A*.

In addition to the effluent limitations, the City also has requirements for controlling and monitoring the residual solids management program, containment of materials required by Section 5 of the Michigan Water Resources Commission Rules and reporting of any bypassing of overflows from CSO or accidental losses for the system.

The City is complying with the requirement for reporting bypassing events through a recently established monitoring program. This program includes a daily inspection of overflow structures for bypassing of the collection system by members of the sewer maintenance department. Overflow events are visually monitored during rainfall events. Staff members are on call to conduct this monitoring. A copy of the form used for this monitoring program is found in Appendix 3B*.

EXISTING CONTROLS

City Sewer Use Ordinance

The City of East Lansing has several methods of controlling sewer usage. These include the sewer use ordinance and service contracts which are described in this section.

The sewer use ordinance defines procedures for making connections to the City system, gives construction requirements, and limits materials which may be discharged. A copy of the sewer ordinance is reproduced in Appendix 3C*. Major elements of the ordinance include:

*NOTE: Appendices 3A, 3B and 3C are not included as part of this example document.

- o Connection to the city system can be made as long as sewer service is within 100 feet of the property line. Each building is required to have a separate and independent lateral. An old lateral may be reused when a building is replaced by a new building. The plumbing inspector must examine and test the lateral to determine that it meets chapter requirements.

- o Prohibited discharges to the sewer system are listed in the sewer ordinance found in Appendix 3C*. This list is modified and supplemented in the pretreatment ordinance.

- o Grease, oil, and sand interceptors (traps) may be required on the recommendation of the City Engineer. Accessibility of the traps for inspection and maintenance is required.

- o Preliminary treatment by the discharger may be required if BOD_5 levels of the waste exceed 300 ppm (mg/l) or if suspended solids exceed 350 ppm. Quantity of discharge may be subject to control if it exceeds 2 percent of the average daily flow.

- o Industrial waste dischargers may be required to install monitoring manholes.

- o There is a prohibition of discharge to storm sewers other than "storm water or uncontaminated industrial waste."

- o A rate schedule for water and sewer service is established.

Chapter 24A of the sewer use ordinance adopted June 4, 1985, provides detailed industrial pretreatment requirements. It was promulgated to bring the city into compliance with Federal Regulations (40 CFR Part 403) and State of Michigan Laws (Act 245 of Michigan Public Act 1929 as amended, and Section 1 and 11 of Michigan Act 98 of Public Acts of 1913 as amended). Limits for some parameters such as the temperature criteria are modified from the original sewer ordinance. Wastewater discharge permits are required of all significant industrial discharges (as defined in the ordinance). Other industrial or commercial users may be required by the city to obtain a permit as well. Requirements of the permit application are found in Appendix 3C*. Currently there are no sewer users in the City of East Lansing which are administered under the pretreatment ordinance.

<u>Service Contracts</u>

The City of East Lansing provides wastewater conveyance and treatment for Michigan State University and Meridian Township on a contractual basis. Each contract is discussed below. Copies of the MSU and Meridian Township contracts are included in Appendices 3D* and 3E* respectively.

*NOTE: Appendices 3C, 3D and 3E are not included as part of this example document.

Michigan State Contract

Agreements for wastewater conveyance and treatment have existed between the City of East Lansing and Michigan State University since 1927. University ownership of lands where major interceptors and treatment facilities are best located, coupled with the need for treatment of wastewater originating at the University have made these agreements necessary. Land for the original East Lansing treatment plant, located west of Harrison Road and south of the Red Cedar River, and the right of way for the Main Interceptor east of that point were leased for 99 years from the University in the 1927 agreement. Cost apportionment was begun in the 1927 agreement.

In 1963 an updated agreement was developed between the University and the City of East Lansing. The City needed to lease additional land and obtain funding to build what is the south portion of the existing treatment plant, and the 54-inch portion of the Main Interceptor. In addition, the City obtained rights by sharing construction costs for 20 cfs of the 44 cfs capacity of the 48-inch MSU Interceptor. This 20 cfs capacity right was in turn conveyed to Meridian Township. The old treatment plant site reverted to the University.

The 1963 agreement granted Michigan State a minimum of 3 MGD average flow capacity in the treatment plant. Cost sharing was further refined. Operational costs attributable to the University were based on water usage. A general statement that sewage detrimental to the disposal system or public health or safety is included. The location of future sewers or drain lines to be located on University property was made subject to University approval. Trees or buildings may not be damaged without written consent.

The 1963 agreement was updated in 1972, when the treatment plant was expanded. The University's capacity rights were extended to 6 MGD maximum flow. This agreement also stated that Meridian Township would have 5 MGD capacity rights. For purposes of the agreement the size of the expanded treatment plant was set at 15 MGD, leaving 4 MGD for the City of East Lansing. Any party could use more than its share if capacity existed, but such use did not create a permanent entitlement.

An addendum to the 1972 agreement was approved in 1984. A surplus in bond repayment funds generated a sufficient surplus to repay the bonds with no further collection of payments from the University.

A supplement to the 1963 agreement was signed in May, 1988. It incorporated the pretreatment ordinance (Chapter 24A), including numerical limits for several parameters. The University agreed to assume responsibility for monitoring and control of its effluent. A procedure for determining University pollution contributions to sewers with mixed flows is described. The City can require inspections and monitoring to determine the source of pollutants. The University is to notify the City of unusual discharges.

Meridian Township

The initial contract for service with Meridian Township was signed in January of 1961. East Lansing agreed to provide conveyance and treatment of wastewater; Meridian Township agreed to pay their proportionate share of the costs. Capacity rights associated with any of Meridian Township ultimately annexed into the City could either be retained by the township or surrendered to the City, at the discretion of the Township. The township is responsible for reading and maintaining all meters.

A supplement to the agreement was finalized in 1985. The 5 MGD maximum capacity in the treatment plant was continued. A request for service from Alaidon Township, south of Meridian Township, to be administered through Meridian Township could not be addressed using the 1961 agreement. The 1985 supplement allowed the service to be provided upon agreement by both parties, and adoption of an appropriate sewer ordinance by Alaidon Township. Meridian Township was required to adopt a pretreatment ordinance equivalent to that of East Lansing. One industry, Renn Plastics, located in Meridian Township, is subject to pretreatment requirements of the service contract. Maximum capacity rights through the Woodingham Pump Station and the sewer to the diversion structure in Michigan Avenue were set at 3.6 cfs. The City's stated intent was to physically restrict flows to this maximum level. This device has been installed.

RECOMMENDATIONS

Administrative Changes

Modifications to existing contracts and exercising greater control over contract areas will enhance East Lansing's ability to reduce overflows. The following changes are recommended:

1. Amend the sewer ordinance to prohibit roof drain discharges to the combined sewer system;
2. Enforce residential inflow disconnections (e.g., sump pumps);
3. Require separate building laterals from storm and sanitary sewers when reconstruction occurs in the combined sewer service area;
4. Contract directly with townships that request service;
5. Monitor University flows;
6. Obtain easements from the University for maintenance;
7. Establish a sewer utility to uniformly administer sewer ordinance requirements; and,
8. Acquire the 48-inch MSU Interceptor to function as a relief sewer.

The City of East Lansing generally has the ability to regulate discharges into the sewer system within its own boundaries. There is less control over contract service areas. The City Sewer Ordinance (Chapter 24 Section 2.91) prohibits introduction of clear water into the sanitary sewer system. There are ways this ordinance could be strengthened.

The sewer ordinance should be amended to prohibit roof drain discharges to the combined systems, with exceptions granted on a case by case basis. Consideration should be given to prohibiting sump pump discharges to the combined system as well.

The ordinance currently allows roof drain and sump pump connections to the combined system. Residential areas of East Lansing generally have sufficient size lots to reduce this source of inflow by discharging roof runoff. Some of this flow may reach street drains, but the time of concentration is increased. Greater flexibility for operation of the collection system would be gained. For some of the commercial areas, disconnection may be impractical. Consideration could also be given to disconnecting sump pumps from the combined sewers. An estimate of wet weather flow contribution of the sump pumps should be made, and a cost-effectiveness analysis made of a disconnection program before proceeding. For many individual properties in the CSSA, disconnection of sump pumps may be impractical.

Enforcement powers are available to the city under Section 2.94 of the Sewer Ordinance. This power should be utilized to keep inflow sources disconnected. City officials have stated that residences in the separate area of East Lansing have been inspected, with disconnections required. Some reconnections are suspected.

Separate building laterals for sanitary waste and clear water discharges should be required when redevelopment occurs in the combined sewer service area. Redevelopment is most likely to occur in the commercial area along Grand River Avenue. This is also the most impervious area of the city, generating the largest volumes and greatest intensities of runoff. If sewer separation is pursued in the future, this area is closest to the river, and perhaps more easily separated. Building separation would enhance the effectiveness of future separation projects.

East Lansing should contract directly with other townships, such as Alaidon Township, when they request service. The contract should include all sewer ordinance provisions applicable to East Lansing. Conveyance costs to the East Lansing system would be by separate contract with, in the case of Alaidon Township, Meridian Township.

The current institutional arrangement with both the University and Meridian Township is that any restrictions or requirements of East Lansing are negotiated as amendments to a service contract. Future growth, and subsequent demand for sewer service, is largely occurring in townships east of East Lansing. The control of connections is through a second, and in the case of Alaidon Township, a third party. The current contract with Meridian Township sets a maximum allowable flow at one connection point, Towar Park. With this exception, there are no wet weather flow restrictions placed on these communities. East Lansing has little control over inflow from this contract area.

The following options would provide better control of contract areas for East Lansing:

- o Require in the service contract that Meridian Township include clear water prohibitions equivalent to those of East Lansing;
- o Require the submittal of inspection records, and disconnection enforcement actions to the City of East Lansing;
- o Require City of East Lansing review of new development plans for compliance with sewer service requirements;
- o Require the results of sewer line testing for tightness before allowing connection to the system;
- o Develop a cost surcharge for flows which exceed an agreed value. This charge would be for excess inflow or infiltration. The City should develop a typical wastewater generation per capita rate. Allowance for acceptable infiltration should be made. For example, Wisconsin allows a maximum infiltration rate of 200 gallons per inch diameter of pipe per mile per day for new sewer construction. Flows in excess of the calculated value would be subject to a surcharge; and,
- o Require wastewater, rather than water meter monitoring for those areas in Meridian Township currently measured using the water meters.

Major University sewer lines should be monitored for both wet and dry weather flows. This data would establish the relationship between water usage and wastewater flow. It would also indicate if clear water, especially inflow, is a significant factor in wastewater flows from the University. By the 1988 contract, the City can require monitoring by the University.

MSU is a major source of wastewater to the East Lansing system. Critical facilities for conveyance and treatment are located on University-owned property. Service and cost allocation is by contract, as previously discussed. Michigan State separated campus sewers around 1960. All new construction involves separate sewers. Based on discussions with city officials, documentation of the effectiveness of the separation program is not readily available. Water usage is assumed to equal wastewater contribution. This assumption should be verified with monitoring data.

Formal easements with sufficient width for maintenance and repair purposes should be developed with the University. These easements should cover the Main Interceptor and the Charles Street Interceptor. Sufficient areas should be identified for maintenance of diversion structures. These easements should give the City the right to make repairs and modifications to these facilities, with the understanding that site restoration would be required. The City is limited in its ability to modify, repair, or construct additional facilities on campus property adjacent to the Main Interceptor. The City has a lease which allows it to operate the sewer. The Main Interceptor sewer passes through sensitive botanical areas. The University must currently approve any actions on its property. Lack of approval would limit the ability of the City to make needed repairs or modifications.

Pretreatment Controls

East Lansing should develop a pilot monitoring program for commercial establishments which are potential sources of oil and grease to the system. A baseline monitoring report to determine compliance with the 100 ppm oil and grease limit, coupled with random sampling by the City would ensure compliance.

Oil and grease, and fats which occasionally enter the collection system from restaurants have created problems in the past. This material may collect in sewers, reducing capacity, or at diversion structures, overflowing to the river in wet weather. The current program of monitoring and enforcement of the pretreatment ordinance generally follows an actual blockage of a sewer line with grease. Floating grease has been observed at overflow diversion chamber 007. The City's policy is to remove blockages due to oil and grease or fat discharges once from a sewer. The discharger is billed for any subsequent service.

East Lansing has a comprehensive pretreatment program, in compliance with state and federal requirements. The pretreatment ordinance has been incorporated into the Michigan State and Meridian Township contracts. There is one industry in Meridian Township which currently is subject to the pretreatment provisions of the service contract. Monitoring may be required of the University if it is a suspected source of a regulated pollutant. No monitoring has been required to date.

Long-Term Administrative Recommendations

There are two long-term administrative recommendations: establish a sewer utility and acquire the 48-inch MSU Interceptor.

City officials indicated that discussions had been held regarding establishment of a sewer utility. It would be advantageous to establish a sewer utility to uniformly administer requirements. A sewer utility would have more direct control over the proper construction of new sewer connections.

It would also be in the best interest of East Lansing to acquire the 48-inch MSU Interceptor. It appears this sewer can function as an effective relief sewer without limiting use by MSU or Meridian Township. This would enable East Lansing to operate the major components of the entire collection system to most effectively reduce overflows.

It is recognized that implementation of these items would require significant negotiations to preserve rights of each party. All parties should recognize that the objective of forming a new utility with ownership of the MSU Interceptor would be for the purpose of efficiently operating the collection and treatment system to minimize pollutant discharge to the Red Cedar River.

Chapter 4

MAINTENANCE PROGRAM

The East Lansing Department of Public Works has a well organized staff and a comprehensive program for sewer maintenance. The sewer maintenance program was reviewed as part of the overall operational plan. This chapter provides a detailed written description of the program and includes recommendations for upgrading the system.

DEPARTMENT OF PUBLIC WORKS

Personnel

The Department of Public Works has a Superintendent of Sewers. He has two crews of ten persons each who perform routine and special maintenance tasks. Each crew operates under the direction of a crew chief.

Schedule

The city has been subdivided into nine regular maintenance areas. These nine areas are further subdivided into two or three areas designated A, B, and C for catch basin cleaning. Maps of the areas are found in Appendix 4A*. The areas are inspected on a rotating basis on Mondays and Tuesdays. Problem areas are maintained or repaired on Wednesday, Thursday, and Friday. Regular maintenance tasks include sewer flushing, catch basin cleaning, siphon and overflow monitoring, sewer repair, and emergency response.

Sewer Flushing

The City of East Lansing owns two sewer flushing machines. One is an FMC. The second is an Aquatech SJ-15. The latter holds 1500 gallons, has 1500 to 2000 psi pressure, and a 30 degree nozzle. It can flush 500 feet per run. The city also has a bucket machine. The bucket machine is used only if flushing will not work. Experience of the maintenance department has been that bucketing may cause some line damage.

Crews are assigned to inspect the nine sewer areas on a rotating basis. Each inspection area has sewer lines highlighted on an assignment map which are to be flushed on a routine basis. The crews record the location and length of lines which have been flushed. This information is entered into the maintenance management system on the computer. Area flushing is done on Monday and Friday. During flushing, the manhole condition is recorded, or any other pertinent information on the system.

Certain areas are particularly subject to sedimentation problems. Lists have been established called the Wednesday List and the Friday List. Locations on the Wednesday List are flushed weekly. Locations on the Friday List are divided into four groups. These are flushed once per month. The Wednesday and Friday Lists are included in Appendix 4B*.

*NOTE: Appendices 4A and 4B are not included as part of this example document.

Siphon Inspection

Siphons are critical points in the collection system which are subject to sedimentation. The IM siphon on the Main Interceptor is inspected every Monday, Wednesday, and Friday. The chamber is cleaned with high pressure. The Kellog siphon is inspected once per month. The Brody Dorm siphon has not caused problems since it was replaced.

Overflow Inspection

It is the responsibility of the maintenance supervisors to inspect each overflow point and record if an overflow is occurring. This inspection is also conducted if it is raining, and flow to the treatment plant has reached 13.5 MGD. Crew supervisors are on call to make these wet weather inspections. Any overflow event is reported to Michigan DNR by telephone within 24 hours.

Catch Basin Cleaning

East Lansing began a program of catch basin cleaning recently using a Vac-All. It is conducted on the Monday - Tuesday schedule as time permits. The nine flushing areas are further subdivided into A, B, and in some cases, C areas for tracking the work. Crews can clean about 15 basins per day. An inspection of catch basin structures is conducted and recorded. Catch basins needing repair are added to a repair list.

Sewer Repairs

Problems identified during the sewer flushing, catch basin cleaning, through citizen complaints, or other inspection are scheduled for Wednesday, Thursday, and Friday. The city has been systematically televising sewers, especially if a problem is suspected. The city owns televising equipment, and is upgrading it to include computer logging. Misaligned tiles and roots are typical problems subject to repair. There are a number of older brick manholes which require occasional repair or replacement. Repair needs are categorized as urgent (Red), moderate (Blue), or minor (Green).

Citizen complaints of back up are logged and examined. A review of complaints indicates that less than 20 percent of them are caused by a problem with the city sewers.

Street Sweeping

The City of East Lansing has a street sweeping program to reduce street litter. It also serves to reduce the pollutant washoff from the streets. The street sweeping program is conducted five days per week form April through November. Commercial areas are swept two times per week, residential areas once per month.

Record Keeping

The Sewer Maintenance Department uses a Maintenance Management Information System. The program is called "Sidekick" and is used on an IBM compatible system. The program allows data to be entered and edited. The program is currently used for data storage, and problem call documentation. The following repair needs or activities are tracked:

1. Manhole Repair Requirements

   - o Major repairs
   - o Bottom cleaning required
   - o Casting to be centered
   - o Manholes needing to be lowered or raised
   - o Brick or block under castings need replacement
   - o Flow lines to be constructed

2. Lines to be Televised

3. Sewer Repairs Required

   - o Urgent
   - o Major
   - o Minor

4. Root Problems by Location

5. Sewer Complaints

Work/crew activities are recorded on paper. A monthly summary of Maintenance Department work is recorded on forms found in Appendix 4C*.

Sewer Blockage

A running summary of sewer complaints is kept. The most frequent complaint registered is a sewer back-up problem. Problems associated with the city sewers are found on the smaller diameter local collectors which are generally six or eight inches in diameter. Complaints tend to be concentrated in the Harrison and Charles CSSA, possibly because sewers are older in those areas. The occurrence of sewer back-ups due to rainfall is limited. The following locations have had two or more wet weather complaints and the problem was attributed to rainfall:

- o Center and Roxborough;
- o Grove between Beech and Elizabeth;
- o Sunrise Court and Division;
- o Beech and Collingwood; and,
- o Kedzie between Beech and Snyder.

*NOTE: Appendix 4C is not included as part of this example document.

RECOMMENDATIONS

Communication of field conditions to supervisors is one of the keys to a successful maintenance program. City officials report an improving situation in this regard.

Computer tracking of problems could be improved by entering additional information concerning follow-ups to repair needs. Creation of a separate file showing completed work versus needed repairs would be helpful. Currently, the listings do not explain follow-up activities or date completed.

Since the City is divided into segments for the flushing and catch basin cleaning, it would be useful to categorize all repair work, complaints, televising needs by these areas. This will allow efficiencies by sending crews out to one area with several items to examine.

A greater advantage would be the ability to observe trends in repair needs by area. For instance, if an area was indicated to have collapsed tiles, manhole repair needs, and catch basin repair needs, a large scale repair and rehabilitation project might be more effective than individual repairs.

The daily information brought back from the field is currently kept on paper copies. Consideration should be given to entering critical information into the Maintenance Management Information System on a daily basis. The information could then be summarized by a computer program by locations or types of problems. For instance, observed conditions reported from the Wednesday or Friday flushing lists, when looked at over time, should indicate trends which require further investigation.

There is currently no record keeping on operability of flap gates for overflows. With the recording of overflow activity, gate condition, such as being jammed open, and any river inflow should be recorded. Problems with a diversion structure would currently be recorded as a manhole problem. We recommend a separate tracking of diversion structure conditions. This should be on at least a monthly basis. As an example, two slide gates were observed in the diversion structure for 009, but they are not believed to be operable. Control diversion structures will be increasingly important as the system is operated to reduce overflow.

Chapter 5

CONTROL STRATEGY

The objective of a Combined Sewer Operational Plan is to examine existing facilities to determine if alternate operation schemes could reduce overflows and the resultant pollutant loadings. The proposed control strategy for combined sewer overflow at East Lansing provides a reduction in the volume and frequency of overflow using existing facilities. Long-term solutions to gain greater control of overflows are also described. The control strategy can be incrementally implemented with overflow reduction at each step. This chapter describes the steps to be taken in order to minimize overflows.

POTENTIAL CONTROL METHODOLOGIES

The control methodologies considered for reducing combined sewer overflow in East Lansing are described in this section. Terminology used to describe control measures is defined in Table 5-1.

* Storage in the Existing System. Large diameter collectors in the combined sewer service area have the potential for temporary storage of smaller events or a portion of large events. This control method will be evaluated for each of the four combined sewer service areas. Control structures must have the ability to release flow from storage in response to additional incoming flow to prevent backups upstream into the smaller diameter collectors, which could potentially cause basement backups. Control structures also need to be designed to prevent sedimentation. Sufficient velocity should be maintained under selected flow conditions to permit sediment to be conveyed to the interceptor system.

* Flow Reduction. Reduction of inflow sources will reduce the intensity of wet weather runoff. Disconnection of roof drains so that the discharge to lawns will cause some of the runoff to infiltrate to groundwater. For intense rainfall events, the time of concentration will be slowed because of overland travel.

  As previously discussed, roof drains should be disconnected in all residential areas, separate or combined. Disconnection in commercial areas will likely be ineffective because of the lack of pervious areas to absorb or retard flow. Similarly, sump pump disconnection should be required for the separate service area, and considered for the combined areas as discussed in Chapter 3.

  The rate of inflow from street drains in the combined area can be reduced by restricting flow at the inlet. Reducing the rate of inflow would not reduce the overall volume entering the system, and would have to be evaluated relative to increased street flooding. With the catch basin cleaning program and associated rebuilding of catch basins requiring repair, reduction of inlet capacity should be considered for test locations. Flow reduction is an overall strategy rather than basin specific.

TABLE 5-1

DEFINITION OF TERMS

1. In-line Storage - Storage used which consists of the volume available in the pipe beyond the volume being occupied by the wastewater flow.

2. Off-line Storage - Storage located adjacent to a sewer which is used to store flows which exceed the conveyance capacity of the sewer, or the treatment capacity of the plant. Stored wastewater is pumped back into the system when capacity is available.

3. Retention Basin - A facility to store stormwater runoff for late release at a controlled rate.

4. Attenuation - This term refers to an action which reduces the magnitude of a flow rate. Attenuation does not reduce the volume, but spreads the flow of a particular volume over a greater period of time.

5. Diversion - Routing of wastewater flow from one sewer to another.

6. Flow Reduction - A measure which removes a source of clearwater from the collection system.

* Surface Retention. Runoff retention in engineered basins or on other large areas requires land with upstream flow which can be routed to a site, retained and slowly released. The combined sewer service areas of East Lansing have few opportunities for runoff storage. Reviewing aerial photographs, the combined area is considered fully developed. Development is more intense in the older, downstream portion of each service area, versus the upstream areas. Open space is limited. There is some open land, about 10 acres total, associated with East Lansing High School and St. Thomas Aquinas High School at the north edge of the Cedar Street CSSA and a smaller area (3.5 acres) east of J. Hannah Middle School. The two high school properties are at the watershed divide with portions of runoff routed north to separate storm sewers. Retention would not be practical here; however, routing of runoff from the high school parking lot to the separate area would be desirable.

  The middle school open area is also near a watershed divide (between the Charles Street and Cedar Street CSSA), with little area tributary to the site. The school sites, because of their largely pervious areas, contribute little runoff to the combined sewer.

  Surface storage and flow retention facilities are a good option when large volumes of overland runoff or separate stormwater conduits are channeled to a combined sewer. Retention in this situation will provide significant reductions in peak sewer flows. Neither the available sites nor collection system favor this type of facility in East Lansing.

* In-System Controls. In-system controls would consist of a series of gates, weirs, or diversions which slow the flow, in upstream portions of the combined collectors. These measures are considered as part of in-line storage options for each basin. In-system control will also include the diversion of flows from the Main Interceptor to the MSU Interceptor.

* Additional Storage. The 1976 CSO Facilities Plan proposed an over sized sewer with in-line storage. Control of CSO in Harrison and Charles Street CSSA will require additional storage. Storage could be developed in an in-line sewer or in off-line storage. A design level of protection from overflows must be selected to size storage facilities.

* Additional Treatment. The treatment plant has significant capacity available to treat wet weather flows that can be stored and gradually released to the plant without overflowing the sewer system. Biological treatment plants, especially those requiring nitrification, do not respond readily to large variations in flow rates. East Lansing can operate the existing plant within its design criteria at the higher long-term flow rates which would be maintained if wet weather flows are stored and gradually released for treatment. The plant is designed to hydraulically pass up to 40 MGD through the plant. This is the maximum flow the 54-inch influent sewer can deliver. Limitations of the secondary process have been previously discussed. No additional treatment is recommended, although increased storage at the plant site should be implemented as previously discussed.

BASIS OF ANALYSIS

The control strategy is based on existing information concerning the collection systems documented in the System Inventory. The inventory also documented treatment plant capacities, based on design criteria provided by Hubbell, Roth, and Clark, Inc., and operational experience presented by wastewater treatment plant staff. The inventory indicated that while the Main Interceptor is at capacity, storage volume may be available in the combined sewer collectors. The Michigan State Interceptor also has excess capacity and some treatment plant capacity is available.

The sewer system analysis has been conducted using the Stormwater Management Model, Version 4.3 (SWMM). It is important that it be recognized that actual wastewater flow data in the East Lansing collection system is limited to pump station records for two separate areas, and to influent flow data at the treatment plant. A flow monitoring program should be conducted before any system controls are designed and implemented to verify estimates developed on the physical features of the system, and existing records.

Opportunities for overflow reduction are indicated by the source and location of flow entering the collection system, a statistical analysis of rainfall occurrence, and treatment plant capacity. These factors are described in the following sections. In addition, the SWMM model of the collection system is presented.

Dry Weather Flows

Dry weather flows from tributary interceptors and collectors and cumulative flows in the Main Interceptor are listed on Table 5-2. The location of the summaries are illustrated on Figure 5-1. From this summary, the following conclusions may be made:

1) Dry weather flows in the 24-inch Main Interceptor are relatively close to capacity;

2) The 33-inch Main Interceptor is at about half capacity in the segment upstream of the point that the Harrison/Brody Interceptor joins the Main Interceptor. Some wet weather capacity is available; and

3) The 54-inch Main Interceptor flows at about 30 percent capacity under dry weather conditions. Treatment plant flow records for 1987 and 1988 indicate that maximum flows at the plant do not exceed 23 million gallons per day (MGD) during significant wet weather events. This is about 60 percent of sewer capacity.

Treatment Capacity

The treatment plant is designed to hydraulically pass 40 MGD through the secondary process. Tertiary filters are limited to 18.75 MGD. The East Lansing plant is required to nitrify from May through October. Nitrification requires longer sludge age. Washout of solids as a result of hydraulic overload of the secondary clarifiers would reduce the ability of the plant to meet ammonia limits on a consistent basis.

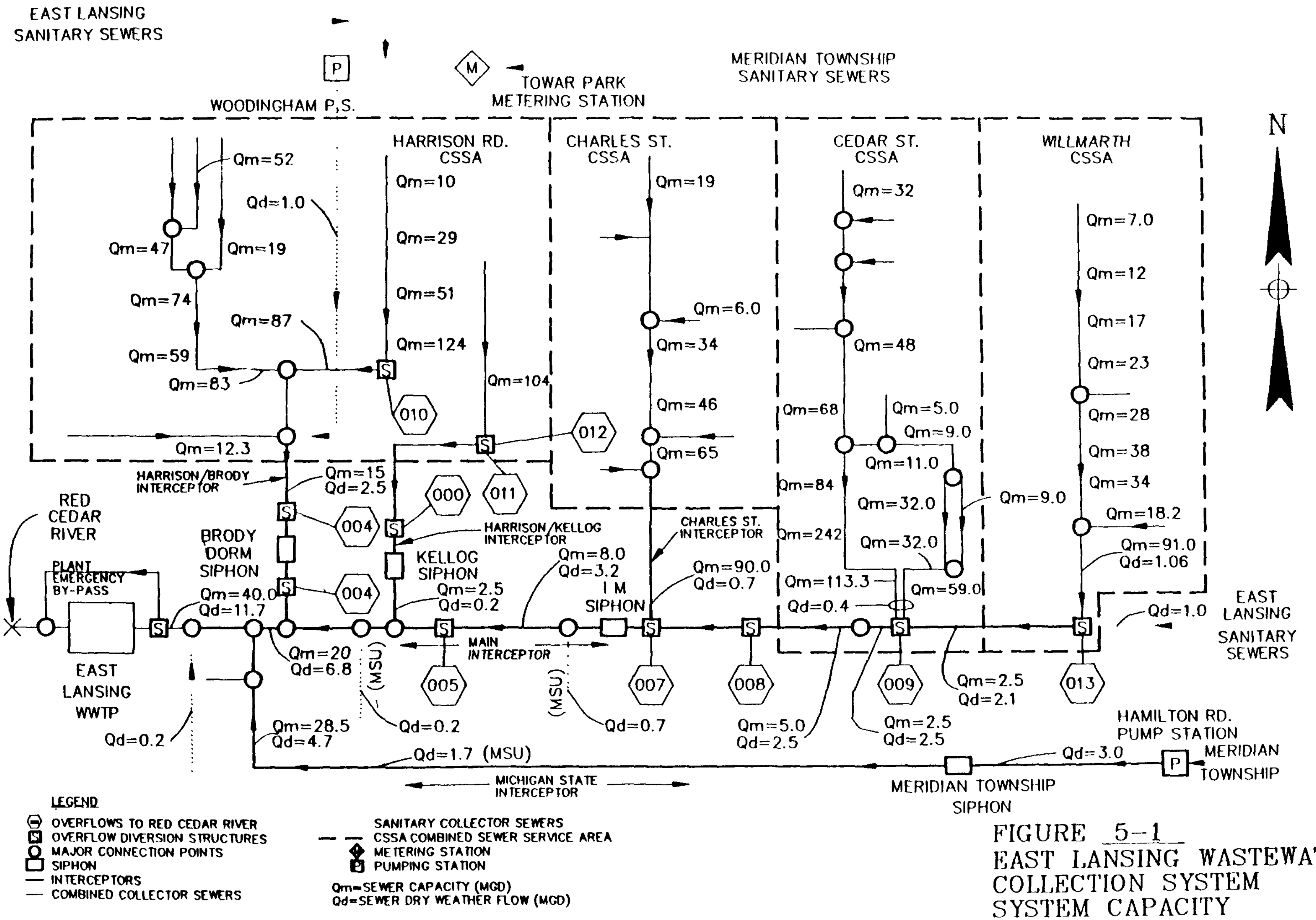


FIGURE 5-1
EAST LANSING WASTEWATER
COLLECTION SYSTEM
SYSTEM CAPACITY

TABLE 5-2
DRY WEATHER FLOW VS. HYDRAULIC CAPACITY

Location	Average Dry Weather Flow MGD	Average Cumulative Flow in Interceptor MGD	Hydraulic Capacity MGD
1. 24" Sanitary Collector[1]	1.0	---	---
2. Willmarth CSSA[2]	1.1	---	---
3. 24" Main Interceptor	---	2.1	2.5
4. Cedar Street CSSA[2]	0.4	---	---
5. 24" Main Interceptor	---	2.5	2.5
6. 27" Main Interceptor	---	2.5	5.0
7. 60" Charles St. Interceptor[2]	0.7	---	---
8. 33" Main Interceptor[3]	---	3.2	8.0
9. 30" MSU Sanitary[4]	0.7	---	---
10. 33" Main Interceptor[5]	---	3.9	8.0
11. 18" Harrison/Kellog Interceptor[6]	0.2	---	---
12. 33" Main Interceptor[7]	---	4.1	8.0
13. 27" MSU Sanitary[4]	0.2	---	---
14. 33" Main Interceptor[8]	---	4.3	8.0
15. 36" Harrison/Brody Interceptor[9]	2.5	---	---
16. 48" Main Interceptor	---	6.8	20.0
17. 48" MSU Interceptor[10]	4.7	---	28.5
18. 24" Sanitary Collector[11]	0.2	---	---
19. 54" Main Interceptor	---	11.7	40.0

1 Estimated flow from SWMM model output for the residential area of East Lansing, plus the wastewater billing records for Meridian
2 Estimated flow from SWMM model
3 Between 007 and MSU sanitary sewer
4 Estimate based on reported annual Michigan State wastewater discharge to the sewers and the approximate service area of the sewer
5 Between MSU sanitary sewer and Harrison/Kellog Interceptor
6 Estimate based on SWMM model for East Harrison subarea, and approximate service area of adjacent Michigan State service area
7 Between Harrison/Kellog Interceptor and MSU sanitary sewer
8 Between MSU sanitary sewer and the Harrison/Brody Interceptor
9 Estimate based on the SWMM model output, estimated flow from Brody Dorm area presented in "Wastewater Collection System Study of Woodingham Pumping Station District and Harrison Road District Brody Dorm Siphon", and average flow from the Woodingham Pump Station Records for 1988
10 Estimate based on reported annual Michigan State wastewater discharge to the sewers and the approximate service area, plus the reported flows from the Hamilton road Pump Station
11 Estimate based on area

The treatment plant has two aeration tanks permanently out of service in the south plant. These have a storage volume of about 500,000 gallons. The north plant has five tanks permanently out of service with about 500,000 gallons of storage. This tankage has aeration equipment and could be converted into aerated storage for wet weather flows, providing 3,000,000 gallons of storage. The treatment plant has piping galleries connecting the different unit processes. East Lansing should be able to add the piping and valves necessary to complete the aeration tank conversion at a relatively modest cost.

The 5,000,000-gallon equalization basin is currently operated to dampen diurnal flow variations. Levels are generally kept low to reduce aeration costs. An operational protocol, specifying that the equalization basin be drawn down when wet weather is expected, would ensure that additional storage for wet weather flows is available. For purposes of this study, it is assumed that 3,000,000 gallons could be made available for wet weather storage in the equalization basin by operating the plant to provide this additional storage when wet weather was anticipated. Flow through the plant should be increased prior to rainfall, thus making storage capacity available in the equalization tank.

The treatment plant has passed 23 MGD during wet weather events without causing process upset. The plant is rated for 30 MGD maximum day treatment based on the design report. Therefore, it is assumed 25 MGD can receive secondary treatment without process upset for treatment during wet weather events. Filtration is limited to 18.75 MGD. Design capacity is 18.75 MGD, maximum monthly average.

Therefore, the plant can provide secondary treatment for 25 MGD on a regular basis and receive an additional 6 MGD into storage for a wet weather event. The storage would not be available on subsequent wet weather days until dewatering of stored wastewater was completed. Additional analysis of long-term rainfall records is required to determine how quickly stored wastewater must be treated to provide storage for subsequent events.

Rainfall Analysis

A rainfall analysis was performed on hourly precipitation data from the Lansing Airport for the periods January 1951 through July 1954, and May 1959 through November 1988. Data was obtained from the National Oceanic and Atmospheric Administration. The results of this analysis were used to select rainfall events to simulate with the SWMM.

Table 5-3 shows the distribution of events by volume over the period of record. Also shown are the return period intervals for each range. The average event duration was 6.30 hours, while the average time between events was 58.21 hours over the period of record. The average volume of an event was 0.23 inches. The maximum volume for a single event was 4.95 inches over a 13-hour duration. The maximum rainfall intensity which was recorded on an hourly basis during the period of record was 2.48 inches per hour.

Storms were selected for events recorded during the period of record which had typical intensities and durations for a particular rainfall volume. The events used

TABLE 5-3

EAST LANSING, MICHIGAN
RAINFALL ANAYSIS
JANUARY 1951 THROUGH JULY 1954
AND
MAY 1959 THROUGH NOVEMBER 1988

Range of Rainfall Volume (in.)	Number of Events Over the Period of Record*	Range of Calculated Return Period** (years)	Events per Year ***
0 - .10	2276	0.01 - 0.02	71
.10 - .20	669	0.02	21
.20 - .30	364	0.02 - 0.03	11
.30 - .40	279	0.03 - 0.04	9
.40 - .50	161	0.04 - 0.05	5
.50 - .60	140	0.05 - 0.07	4
.60 - .70	93	0.07 - 0.09	3
.70 - .80	83	0.09 - 0.11	3
.80 - .90	48	0.11 - 0.13	1
.90 - 1.00	48	0.14 - 0.17	1
1.00 - 1.10	42	0.17 - 0.21	1
1.10 - 1.20	18	0.22 - 0.24	<1
1.20 - 1.30	27	0.25 - 0.30	<1
1.30 - 1.40	28	0.32 - 0.42	<1
1.40 - 1.50	16	0.44 - 0.53	<1
1.50 - 1.60	14	0.54 - 0.64	<1
1.60 - 1.70	8	0.70 - 0.82	<1
1.70 - 1.80	7	0.86 - 1.00	<1
1.80 - 1.90	5	1.03 - 1.18	<1
1.90 - 2.00	5	1.27 - 1.44	<1
2.00 - 2.50	9	1.50 - 2.39	<1
2.50 - 3.00	7	2.58 - 4.92	<1
3.00 - 3.50	4	5.79 - 9.01	<1
3.50 - 4.00	0	---	<1
4.00 - 4.50	1	20.28	<1
4.50 - 5.00	1	54.08	<1

* An event is defined by a minimum intervent time (dry hours between distinct rainfall events) of six hours.

** Based on volume.

*** Based on 4,353 total events and 32 years, 1 month of rainfall records.

Source: National Oceanic and Atmospheric Administration in the SWMM modeling are shown in Table 5-4. These events were selected by examining rainfall records. Only hourly rainfall data was available for this study. Rainfall records which reflect more frequent measurements would likely show higher short-term rainfall intensities and may result in greater overflows than the amounts predicted by the model.

Flow volume and flow rate of runoff and wastewater in combined sewers is a function of the intensity of the rainfall and the duration of the event, as well as the total volume. The rainfall events selected to analyze the collection system provide an estimate of overflow and peak flows which are specific to the intensity of event and its duration. Events with similar volumes but different intensities or durations will have different overflow characteristics. The four events selected allow an examination of trends in combined sewer response to events of different volume. Additional analysis of varying intensities and durations will further refine the understanding of system response to different rainfall conditions.

SWMM Modeling of Collection System

Combined sewer areas within East Lansing were modeled using the USEPA Storm Water Management Model, Version 4.3 (SWMM). SWMM is a computer simulation model that predicts hydrographs (graphs of flow versus time) based on rainfall data and a characterization of the drainage area and sewer system.

For East Lansing, the model was used to:

1) Estimate the volume of combined sewage released to the Red Cedar River at overflow structures for the selected rainfall events;

2) Estimate peak flow rates and the time of peak flow from overflow tributary areas for selected rainfall events; and

3) Assess the potential for in-line storage within large capacity combined sewer collectors.

The four rainfall events in Table 5-4 were simulated in the modeling effort.

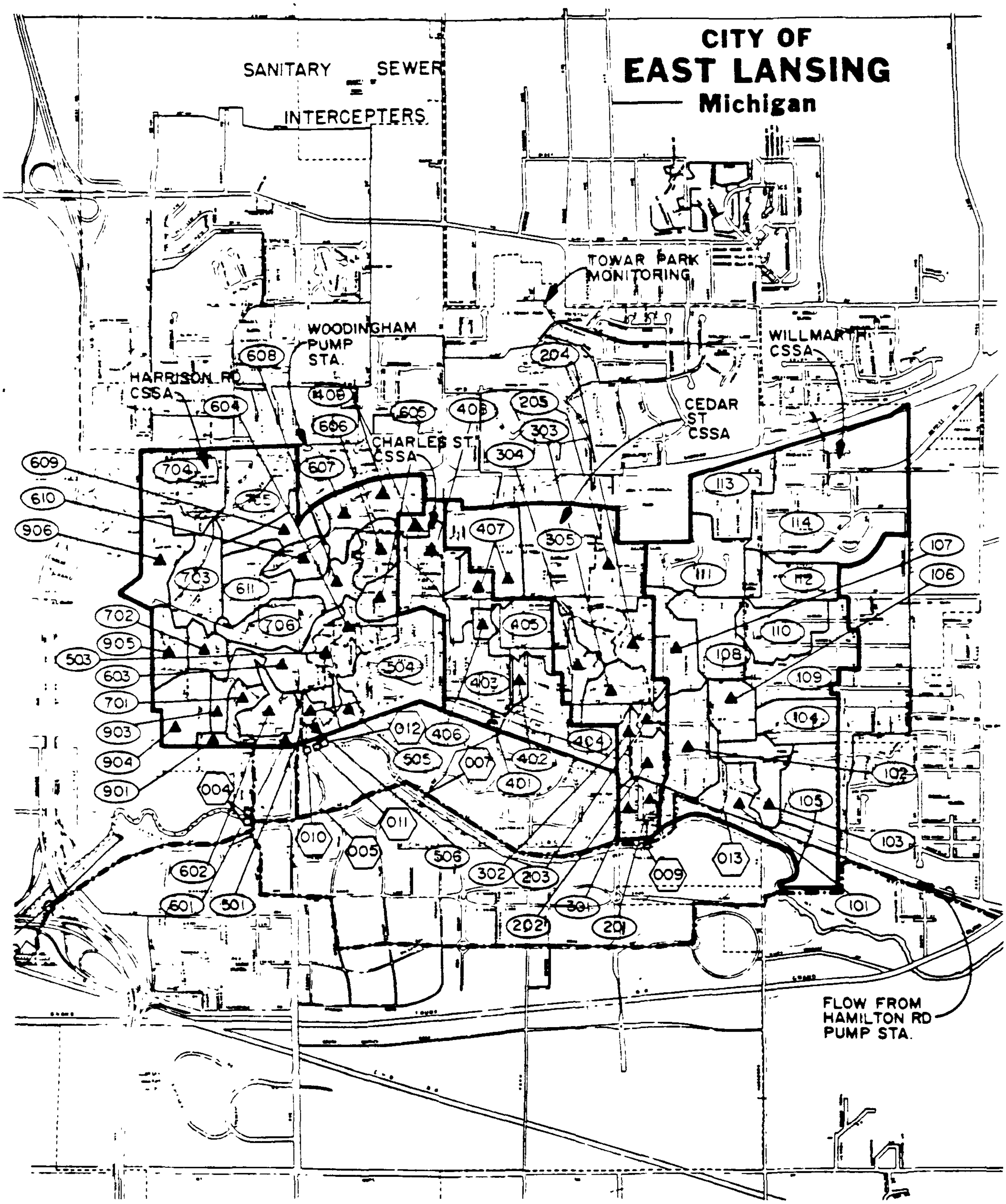
The East Lansing combined sewer system was divided into six areas, each tributary to a specific overflow structure. The tributary areas are identified on Figure 5-2. Each tributary was further subdivided into subareas in order to reflect contributions to different upstream locations in the combined sewer system. The subareas are also identified in Figure 5-2.

Information regarding the area, percent imperviousness, and average surface slope was gathered for each subarea and used as input data to the Runoff Block of SWMM. With the SWMM model this information is used, together with the rainfall data, to estimate hydrographs from each subarea.

TABLE 5-4

RAINFALL EVENTS
FOR SWMM ANALYSIS

Event	Volume (in.)	Average Intensity (in./hr.)	Maximum Intensity (in./hr.)	Event Duration (hr.)	Volume Return Period (yr.)	Events/ Year: Volume	Intensity Return Period (yr.)	Events/ Year: Average Intensity	Duration Return Period (yr.)	Events/ Year: Duration Return Period
1	0.15	0.05	0.07	3	0.02	50	0.03	33	0.01	100
2	0.25	0.08	0.16	3	0.03	33	0.06	17	0.01	100
3	0.51	0.17	0.39	3	0.06	17	0.21	5	0.01	100
4	1.00	0.11	0.6	9	0.17	6	0.10	10	0.03	33



(XXX) hexagon = OVERFLOW

(XXX) oval = AREA NOS.

—·— = INTERCEPTOR

----- = EAST-WEST BOUNDARY

——— = AREA BOUNDARY

FIGURE 5-2
EAST LANSING OPERATIONAL PLAN
SWMM ANALYSIS AREAS

The size, slope, and length of combined sewers linking the different subareas was gathered and entered into the Transport Block of SWMM. The Transport Block routes and combines subarea hydrographs developed in the Runoff Block.

Estimates of combined sewage overflow volumes were developed based on hydrographs generated from SWMM modeling and estimated capacities of the interceptor sewer. It was assumed that any flow that could be accepted by the interceptor would be delivered and that any excess flow beyond the interceptor's capacity would be released through an overflow.

Table 5-5 summarizes the results of the SWMM output as well as a summary of key input data by drainage area. Shown are the area in acres and the average percent imperviousness for each tributary area and the flow capacity limit to the interceptor from each tributary area. Volumes are shown by rainfall event for the total rainfall volume over the drainage area, the total estimated rain-induced flow and the total estimated overflow. The flow contribution limit from each combined sewer tributary area, as identified in Table 5-5, was estimated based on interceptor capacities and potential contributions from upstream sources. Overflows from tributary areas were estimated by subtracting the flow contribution limit from the flow estimates developed for the area using SWMM.

Values for the time of concentration were estimated from the SWMM output for each tributary area. These are shown in Table 5-6. These figures represent the time of concentration for runoff from impervious areas only. The contribution from the pervious areas would result in a later peak which is not of significance in the analysis of the control of low flow rainfall events.

TABLE 5-6

ESTIMATED TIMES OF CONCENTRATION

CSSA	Time of Concentration (hours)
Willmarth	1.7
Cedar	1.0
Charles	1.0
E. Harrison	1.7
W. Harrison	1.0

PROPOSED CONTROL STRATEGIES

Control strategies for each of the major service areas have been identified. The overriding limitation in the East Lansing system is the capacity of the Main Interceptor from the diversion structure for Outfall 013 of the Willmarth CSSA to the point where the Brody/Harrison Interceptor joins the system, and discharges to the 48-inch Main Interceptor segment. The Main Interceptor can handle little flow beyond the normal diurnal fluctuations of dry weather flow.

TABLE 5-5

SWMM RESULTS FOR THE VARIOUS STORM EVENTS ANALYZED

Area	Drainage Area (ac)	Average Percent Imperviousness	Flow Capacity Limit to Interceptor (CFS)	Total Rainfall Volume over Drainage Area (millions of gallons)				Total Estimated Rain-Induced Flow (millions of gallons)				Total Estimated Overflow (millions of gallons)			
				0.15" Rain	0.25" Rain	0.50" Rain	1.00" Rain	0.15" Rain	0.25" Rain	0.50" Rain	1.00" Rain	0.15" Rain	0.25" Rain	0.50" Rain	1.00" Rain
Willmarth	696.9	38	2.5	2.8	4.7	9.5	18.9	0.6	1.1	2.4	4.7	0.6	1.1	2.2	4.5
Cedar	191.1	44	2.5	0.8	1.3	2.6	5.2	0.3	0.5	1.1	2.2	0.1	0.4	0.9	1.9
Charles	249.2	48	5.3	1.0	1.7	3.4	6.8	0.4	0.7	1.6	3.1	0.0	0.3	1.1	2.2
E.Harrison	72.7	54	0.0	0.3	0.5	1.0	2.0	0.1	0.2	0.5	1.0	0.2	0.2	0.5	1.1
W.Harrison	433.5	38	20.0	1.8	2.9	5.9	11.8	0.6	1.0	2.2	4.2	0.0	0.0	0.9	1.9
Totals	1643.4	41		6.7	11.1	22.3	44.7	2.0	3.5	7.7	15.1	0.9	1.9	5.6	11.6

Event 1 - 0.15 inches, average intensity 0.05 in/hr, duration 3 hours

Event 2 - 0.25 inches, average intensity 0.08 in/hr, duration 3 hours

Event 3 - 0.51 inches, average intensity 0.17 in/hr, duration 3 hours

Event 4 - 1.00 inches, average intensity 0.11 in/hr, duration 9 hours

The intent of the control strategy for the CSSA is to:

* Reduce flows in the Main Interceptor;

* Utilize the Michigan State Interceptor to the maximum extent practicable for wet weather relief;

* Store a portion of wet weather flows in the large diameter combined sewer collectors (in-line storage) until conveyance capacity is available in the Main Interceptor;

* Store additional wet weather flow reaching the treatment plant in unused aeration basins converted for storage and drawdown of the equalization basin; and,

* Reduce wet weather flow through a program of inflow source reduction.

Significant unused conveyance capacity is apparently available in the 48-inch MSU Interceptor. This assumption must be confirmed by system monitoring. Excess infiltration and sewer inflow from the separate sewer service area in Meridian Township would reduce available wet weather conveyance capacity in the Michigan State Interceptor. Current agreements give Meridian Township rights to discharge wastewater through the sewer. East Lansing does not have use of the sewer. A summary of the current factors concerning the Michigan State Interceptor are provided in Table 5-7. As stated in Chapter 3, East Lansing should negotiate with both parties to obtain rights to utilize the 48-inch MSU Interceptor.

The strategy is defined for the different flow sources as follows:

Separate Sewer Area: Woodingham Pump Station

The pump station was recently upgraded with an expanded wet well and pumping capacity of 18.8 cfs (121 MGD). Flow data and the design report for the pump station indicate that significant infiltration/inflow of clearwater increases the flow from this area from three to ten times dry weather flow during wet weather events. In addition to source elimination previously discussed, East Lansing should operate this system to retain flows during wet weather.

Consideration should be given to developing additional off-line storage for this area. If flows are held back during a wet weather event, then additional capacity in both the Harrison/Brody Interceptor and the Main Interceptor will be available to accept flow from the Harrison West CSSA. Elimination of inflow sources, and excess infiltration should be an integral part of the overflow control program.

Separate Sewer Areas: Meridian Township/Hamilton Pump Station Service Area

Increased wet weather flow has also been observed through this pump station. A program of infiltration/inflow control for this service area should be implemented for this area as in the area served by the Woodingham Pump Station. Off-line storage for wet weather flows could also be considered for this area.

TABLE 5-7
FACTORS CONCERNING MSU INTERCEPTOR

Design Capacity:	44 cfs	(28.5 MGD)
East Lansing Portion, transferred to Meridian Township (from 1961 contract)	20 cfs	(13 MGD)
MSU Portion	24 cfs	(15.5 MGD)
Estimated MSU usage* - average	2.6 cfs	(1.7 MGD)
peak	5.2 cfs	(3.4 MGD)
Estimated current Meridian Township		
usage - average	4.6 cfs	(3.0 MGD)
peak	9.2 cfs	(6.0 MGD)
Maximum treatment capacity at the plant**		
- Meridian Township	7.7 cfs	(5.0 MGD)
- MSU	9.2 cfs	(6.0 MGD)
Unused capacity***		
- Meridian Township	15.4 cfs	(10 MGD)
- MSU	21.3 cfs	(13.8 MGD)
TOTAL UNUSED CAPACITY	36.7 cfs	(23.8 MGD)

* Estimated (43% of MSU flow discharged to the Main Interceptor)
** By contractual agreement
*** Assumes average flow conditions

Michigan State University Separate Sewer Service Area. No physical changes to this collection system are recommended at this time.

East Lansing/Meridian Township Separate Sewer Area Tributary to the Main Interceptor. Flow from the separate area east of the Willmarth CSSA enters the Main Interceptor system at the diversion structure for Outfall 013. Meridian Township flow is estimated to be 0.5 MGD. East Lansing flows are also estimated to be 0.5 MGD. This 1.0 MGD average flow should be diverted to the MSU Interceptor. There is a connection between the two systems at East Brookfield and Grand River Avenue which has been bulkheaded. This bulkhead should be removed and placed so that all separate area flow is conveyed through the Meridian Township system to the MSU Interceptor. The 0.5 MGD from Meridian Township should be allowable within existing agreements. East Lansing should obtain rights for discharging its flow through the interceptor. This action will immediately reduce downstream surcharging in the Main Interceptor.

Willmarth CSSA

The Willmarth CSSA is served by a major combined sewer collector which bisects the area. Dry weather flow enters the Main Interceptor at a diversion structure just south of Grand River Avenue.

Analysis of the system performance under selected rainfall conditions indicate that Willmarth generates significant amounts of CSO relative to the other CSSAs, as shown in Table 5-5 and 5-8. The maximum allowable contribution to the interceptor sewer from Willmarth was estimated to be 2.5 cfs (1.6 MGD). Actual overflow amounts may differ depending on the ability of the interceptor to surcharge without releasing flows to the river.

Only limited in-line storage potential appears to exist in the Willmarth CSSA as noted in Table 5-9 based on the analysis of the 0.5 inch event.

Control of wet weather flows could be obtained by connecting the Willmarth CSSA to the MSU Interceptor. A connecting sewer running west to east along Grand River Avenue to East Brookfield Drive (2400 feet) or running east on Grand River Avenue and South on Hagedorn Road (2200 feet with a river crossing) could make this connection. A control structure to limit flow to the capacity of the MSU Interceptor would be required. Assuming the East Lansing separate sewer flow has been routed through the MSU sewer, about 22 MGD (average flow) of capacity would be available. Monitoring of flow in the MSU sewer would be required to ensure that flows released from the combined area did not exceed the MSU Interceptor capacity nor limit required capacity for University discharges. Monitoring equipment is available to allow control of one location based on flows at another location.

Cedar Street CSSA

The Cedar Street CSSA is subdivided into east and west sections. The results of the SWMM modeling of the system revealed that approximately 800,000 gallons of unused 54-inch, 72-inch, and 78-inch sewer within the western portion of Cedar CSSA exists above the peak flow depth for the 0.5-inch rainfall event.

TABLE 5-8
ESTIMATED PEAK FLOW RATES
FOR DIFFERENT STORM EVENTS

Estimated Peak Flow Rate (cfs/mgd)

Area	Storm Event No.1	Storm Event No.2	Storm Event No.3	Storm Event No.4
Willmarth	13/8.4	28/18.1	64/41.5	110/71.3
Cedar	6/3.9	14/9.1	31/20.1	51/33.0
Charles	9/5.8	19/12.3	46/29.8	73/47.3
East Harrison	2/1.3	5/3.2	12/7.8	21/13.6
West Harrison	12/7.8	26/16.8	59/38.2	98/63.5

Event 1 - 0.15 inches, maximum hourly intensity 0.07 in/hr

Event 2 - 0.25 inches, maximum hourly intensity 0.16 in/hr

Event 3 - 0.51 inches, maximum hourly intensity 0.39 in/hr

Event 4 - 1.00 inches, maximum hourly intensity 0.60 in/hr

TABLE 5-9

IN-LINE STORAGE CAPACITY
MAJOR COLLECTORS

Area	Length (ft)	Pipe Diameter (in)	Volume Full (gal)	Estimated Excess Volume* 0.5" Storm (gal)
Willmarth	1000	54"	120,000	65,000
Cedar	1100	54"	131,000	100,000
	1060	72"	224,000	170,000
	2670	78"	663,000	540,000
			1,018,000	811,000
Charles	1800	60"	260,000	150,000
East Harrison	300	2'x2.5'	<12,000	---
West Harrison	1800	60"	260,000	170,000
	1200	72"	253,000	200,000
				370,000

* Volume in sewer above maximum flow depth during 0.5 inch rainfall event with average intensity of 0.17 in/hr; duration of 3 hours

Approximately 0.9 million gallons of overflow was estimated to occur for the same 0.5-inch event. Based on the modeling results, the overflow at Cedar, for the 0.5-inch event analyzed, could be reduced by approximately 90 percent if storage capacity in the sewers were utilized.

The diversion structure to outfall 009 severely limits flow into the interceptor. A 10-inch pipe transfers flow from the West Cedar branch to the interceptor, a 12-inch pipe connects the East Cedar area. These small pipes limit storage dewatering capabilities. Only 2.5 cfs (1.6 MGD) was estimated to be available for flow from the Cedar Street CSSA to the interceptor.

If the Willmarth/MSU connection is made, the sewer should be extended 1100 feet west to connect with the West Cedar collector at Milford and Grand River, and another 600 feet to the West Cedar collector at Durand and Grand River. Storage and dewatering of the two combined service areas would have to be jointly operated.

Charles Street CSSA

It was apparent from SWMM modeling analyses that the Charles Street CSSA is also a major source of combined sewer overflows, as shown in Table 5-5. However, the contribution from Charles Street to the interceptor was estimated to be less since it appears for the events examined the interceptor can accept up to 5.3 cfs (3.4 MGD) from Charles Street, as compared to 2.5 cfs (1.6 MGD) from Willmarth.

Only limited in-line storage appears to be available within the Charles CSSA sewers, as identified in Table 5-9 based on analysis of the 0.5 inch event.

Significant overflow reduction may require off-line storage. Locations for this storage appear to be limited to University property, adjacent to the 60-inch Charles Street Interceptor. This interceptor is also the sewer with capacity to provide storage. Control structures for storage will require additional construction near the 007 diversion structure. This structure dates to 1927, when the interceptor was originally constructed. Its location in the flood plain, with brick construction, indicates that replacement should be considered as part of the design of the storage control structure.

Harrison Road CSSA

The Harrison Road CSSA was run on the SWMM modeled as two separate areas. The Combined sewer system within the Harrison CSSA is complex. Flow routing, based on available sewer records, was difficult to predict. East Harrison is considered as the area tributary to the Kellog Siphon while West Harrison is considered as the area tributary to the Brody Dorm Siphon.

During rainfall events, all of the interceptor capacity upstream and immediately downstream of the Kellog Siphon connection to the interceptor was assumed to be taken up by upstream sources. All of the combined sewer flow from East Harrison was thus assumed to overflow during a rainfall event since there appeared to be no additional interceptor capacity available.

Based on modeling efforts, East Harrison provides the least potential for in-line storage of the combined sewer service areas. Relatively small rectangular and circular sewers are used within East Harrison. Off-line storage or additional hydraulic capacity in the interceptor downstream of the Kellog Siphon may be the only alternatives available for reducing the combined sewage contribution from East Harrison.

West Harrison was estimated to contribute the greatest amount of flow to the interceptor sewer for rainfall events modeled. Approximately 20 cfs (12.9 MGD) was estimated to be available at the interceptor for flow from West Harrison. As with other combined sewer areas, the amount of overflow from West Harrison was considered as the flow from the area which exceeded the estimated interceptor sewer capacity. This assumption may underestimate the actual overflow from West Harrison because of the overflow control device at Michigan and Harrison. The top of the overflow weir is only about one foot above the pipe invert. Nearly all of the flow from the eastern branch of West Harrison likely overflows during a storm event.

Significant in-line storage capacity appears to exist within the West Harrison large diameter sewers, as noted in Table 5-9. This storage could be utilized by constructing an adjustable weir or gate at the Michigan and Harrison overflow structure. Based on the modeling performed for a 0.5-inch rainfall event, the overflow volume from West Harrison could be reduced for a storm of this volume and intensity by approximately one-third if in-line storage was used.

The Hubbell, Roth, Clark Study also recommended off-line storage, to be located at Harrison and Michigan on the north bank of the Red Cedar River. A storage volume of 2 to 3 million gallons would be necessary. With cooperation of the University, open space directly south across the Red Cedar River could potentially be utilized for storage. This site, along with others previously suggested, should be evaluated in further detail. Storage facilities need not be a large visible structure; generally they are located below ground and covered. A small structure with street access for maintenance and cleaning would be required.

PERFORMANCE OF PROPOSED SYSTEM

The proposed system operation will provide greatest control for low intensity, lower volume events. However, control of the precipitation events will potentially eliminate or reduce the volume of a significant number of CSO events. Of the 65 estimated annual CSOs, 46 would occur as a result of rainfall between 0.1 and 0.5 inches. Another 12 occur because of rainfall between 0.5 and 1.0 inches of precipitation. Control of these lower volume rainfall events would provide elimination or reduction of 70 to 90 percent of the overflow events.

The ability to use plant capacity is dependent on being able to route the flow there, and distribute it into the plant for treatment in a controlled fashion. The proposed operational plan provides routing of wet weather flows to sewers with hydraulic capacity, storage of flows in the combined collector system for later release, storage in off-line facility, and additional storage at the treatment plant. Available in-line storage in combined sewer collectors is variable by basin, as illustrated on Table 5-9. Storage of over 800,000 gallons was found to be available in the Charles Street Interceptor for the 0.5-inch event evaluated using the SWMM model, while the Willmarth CSSA had only 65,000 gallons available for the same event. Using the proposed operational plan, virtually all of the overflow volume could be stored in Cedar CSSA during the event. Flow from Willmarth could be routed to the Michigan State Interceptor. As interceptor and treatment plant capacity was available, stored combined sewer overflow (CSO) from the Cedar CSSA would be released to the MSU Interceptor.

Capacity made available by rerouting may allow some of the CSO beyond the 150,000 gallons of storage in the Charles Street CSSA to be conveyed through the Main Interceptor. About 40 percent of the event would be stored in the collector system; the remainder would be stored in off-line storage. Off-line storage with later release would also be utilized for the East Harrison subarea. Figure 5-3 illustrates a potential flow routing, using the 0.5 inch storm analyzed as an example. Flow rates at different points in the system are illustrated.

OPERATIONAL SYSTEM REQUIREMENTS

A detailed control strategy which defines priorities for storing, rerouting, and releasing of overflow must be developed. Control criteria would include prevention of system back-ups, and protection of the plant treatment process, while maximizing capture of CSO. Operation of this system will require remote controls because response times of manual control would not be sufficient. Controls would operate from monitoring of the collection system at key points.

Additional facilities required to implement the operational plan have been discussed. A summary of these include:

* Diversion structures with gating and controllers at a minimum of seven locations;

  These are:

  1. The 24-inch separate sewer at East Brookfield and Grand River Avenue, to Meridian Township, and the Michigan State Interceptor;
  2. Willmarth collector at Grand River Avenue;
  3. Cedar East at Milford and Grand River Avenue;
  4. Cedar West at Durand and Grand River Avenue;
  5. Control gate upstream of the diversion structure for Outfall 007;
  6. Diversion to off-line storage for East Harrison at about Harrison and Michigan; and,
  7. Control structure for storage of West Harrison flows.

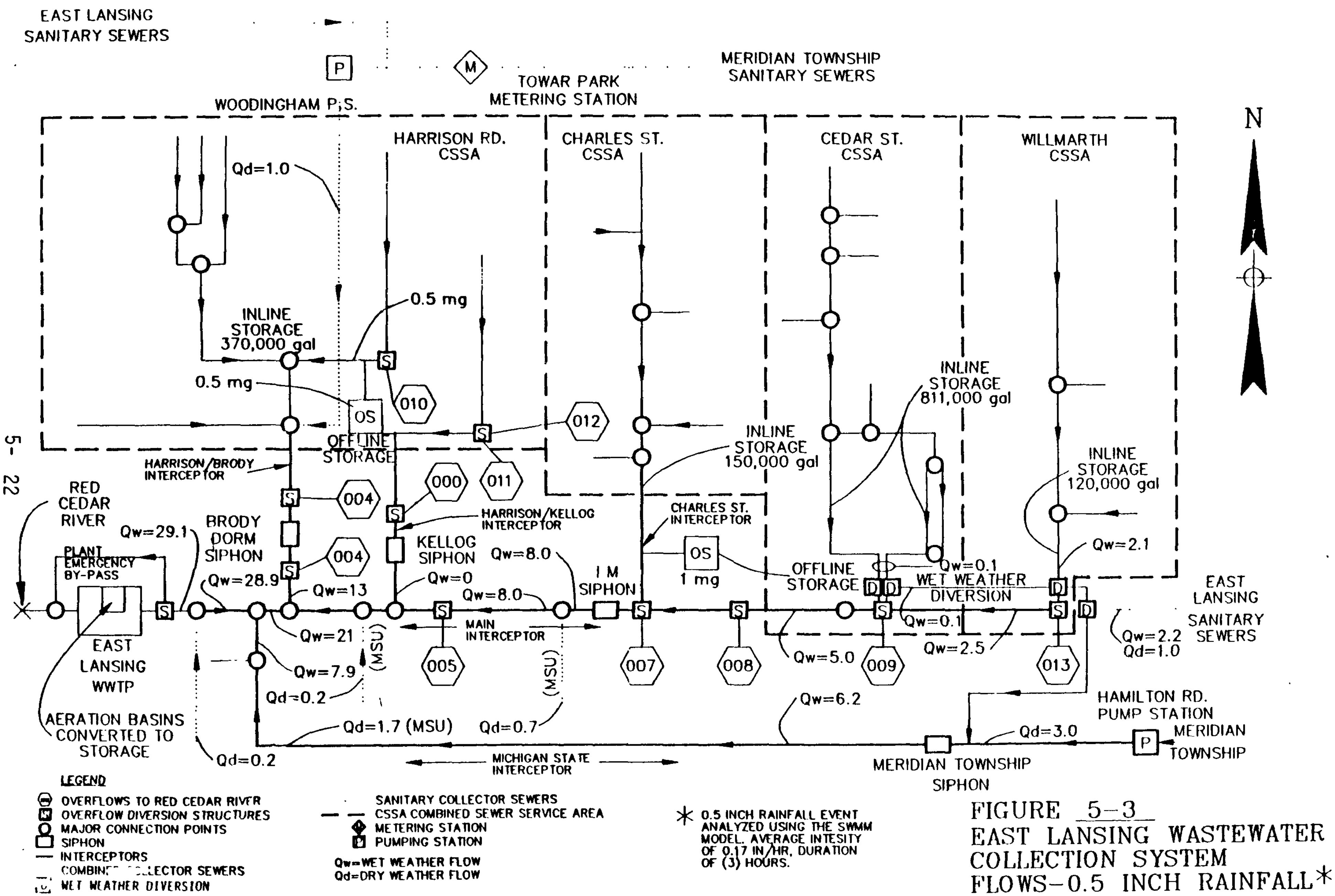


FIGURE 5-3
EAST LANSING WASTEWATER COLLECTION SYSTEM FLOWS-0.5 INCH RAINFALL*

* Other passive structures may be necessary upstream in the combined sewer collectors to retard peak flow rates;

* A sewer connection from the Cedar West diversion to the connection with the Meridian Township sewer tributary to the Michigan State Interceptor;

* Reconstruction of unused aeration basins to provide additional storage at the plant; and,

* Off-line storage facilities for the Harrison East, Harrison West, and Charles Street CSSA.

High Water Control - Floodproofing

As illustrated in Chapter 2, the Main Interceptor lies in the 100-year flood plain from approximately outfall 009 west. The 30-inch Michigan State sanitary collector is also indicated to be in the flood plain. Treatment plant staff have indicated that influent flows to the treatment plant increase during periods of high levels in the Red Cedar River. River inflow was suggested as a source of increased flow. River inflow will take interceptor and treatment capacity as other clear water sources. To define the extent of river inflow, the following actions are recommended:

1) Record observed river inflow during the outfall monitoring. Record the cause; and,

2) Correlate observed river inflow to plant influent flows.

River inflow has been attributed by staff to debris jamming flapgates open. Measures for removing the debris, or keeping debris from the flapgates should be investigated.

Manholes in the flood plain may also be a source of river inflow. These manholes should be inspected and categorized as to flood potential. A program replacing interceptor manholes with bolt down floodproof covers should be implemented.

System Flow Monitoring

Flow monitoring data must be collected to refine estimates of system flow for wet and dry weather, and to characterize diurnal variations. This information will be necessary to implement the plan. Precipitation data should be collected in the area being monitored to correlate wet weather flows to the basin flows observed.

At a minimum the following sewers should be monitored to characterize the interceptor flow:

1) 36-inch Brody/Harrison Interceptor, south of river;

2) 48-inch MSU Interceptor, near the junction with the Main Interceptor;

3) 33-inch Main Interceptor west of IM siphon and junction with 30-inch MSU collector; and

4) 27-inch Main Interceptor upstream of diversion structure for Outfall 007.

For the Charles, Cedar, and Willmarth CSSAs, there is minimal interceptor capacity available beyond dry weather flow. Monitoring of wet weather flow in the major collectors just upstream of the diversion structures will approximate overflow volume.

The Harrison Road CSSA is more complex. Overflow volume for West Harrison could be determined by monitoring the 36-inch collector in Michigan Avenue, the 60-inch collector in Kensington, and the 60-inch collector in Harrison. The flow in the Brody/Harrison Interceptor, just south of the diversion in Michigan Avenue, is a function of the flow from three collectors plus flow from Woodingham Pump Station. Overflow at Outfall 010 would equal the total of the three collectors minus the Brody/Harrison total flow minus Woodingham Pump Station flow.

East Harrison flow could be estimated by monitoring flow in the two tributary collectors minus flow in the Harrison/Kellog Interceptor.

Additional monitoring upstream in the major collector should be conducted for design of the storage-release plan for each CSSA. This data would be used to confirm the outing and timing of flows through the collection system.

Monitoring data is essential to system control design. Diurnal flow variations are significant, so control strategies will have to recognize the varying capacities over the course of the day. System monitoring will identify these patterns for incorporation into the control strategy for CSO control.

CONCLUSION

The proposed control strategy recommends a combination of storage in the large diameter combined sewer collectors, rerouting of flows to the Michigan State Interceptor, and use of out-of-service aeration tanks for wet weather flow storage at the treatment plant to reduce overflows.

Off-line storage would further decrease the number and volume of overflows.

It is estimated that 46 to 58 events per year could be reduced or eliminated with this operational plan. The operational plan has the greatest effect on smaller volume, lower intensity events. Large volume, or high intensity events will continue to overflow, although some CSO capture would occur.

System monitoring is required to confirm and refine flows in the interceptor system, and the combined sewer service areas.

Additional analysis of long-term rainfall records is necessary to obtain an estimate of the overall reduction in CSO volume and occurrence which could be achieved utilizing the proposed operational plan. This reduction should then be assessed relative to cost of facilities and the additional operation and maintenance costs necessary to implement the plan. Detailed planning and additional hydraulic analysis of alternate rainfall volumes, intensities, and durations will be necessary before implementation as well.

Chapter 6

IMPLEMENTATION AND SCHEDULE

An implementation plan and proposed schedule have been prepared for the Combined Sewer Operational Plan for East Lansing. The plan has been divided into twelve major activities. These activities may be implemented over a period of about four and one-half years. It is anticipated that pollution abatement benefits would begin to accrue within 18 to 24 months of the initiation of activities.

A schedule for implementing the twelve major activities is shown in Figure 6-1. Certain activities are deferred until information is available from other related activities which is reflected in the schedule. The durations of activities are estimated based on project scope and continuous progress toward completion. While the start date for plan implementation has been set for September 1989, numerous factors such as budget, weather, and negotiations with other parties could alter the schedule duration as presented.

The detailed description of the twelve major activities provided in Table 6-1 includes sequential subactivities, approximate time frames, and commentary concerning the subactivities. More detailed tasks would be developed for implementation of each of the tasks.

The activities described here are intended to implement recommendations made in Chapters 3, 4 and 5. Short-term actions such as the changes to ordinances may be initiated immediately, and achieve benefits as soon as they are in place and enforced. Other activities, such as development of the in-line storage with wet weather diversion as proposed for Cedar Street and Willmarth CSSAs, are longer term activities. They require system monitoring, some facility planning and design and construction to be fully implemented. The following sections describe the general areas of the plan improvements.

SHORT-TERM ACTIONS

Initial activities include revisions to the sewer ordinance and service contract revisions (Activities 1 and 2). Some of these revisions, such as use of the MSU Interceptor are prerequisites to plan implementation.

Another early activity (No. 4) is revision of overflow diversion structure 010 to achieve greater in-line storage in the Harrison CSSA. Investigations to modify this structure in this way, possibly combining 010 with the diversion structure to Outfalls 011 and 012, have been initiated. The schedule proposes that these modifications be completed before monitoring is conducted in the Harrison CSSA. The diversion structure for Outfall 010 should be designed to be compatible with alternate in-line storage or off-line storage. The SWMM analysis indicated off-line storage would be desirable for this service area.

The schedule shows an analysis of existing separate sewer systems flow records from pump stations to better define the magnitude of infiltration and inflow in the collection system (Activity 9). Development of an I/I control program is included in this activity. This examination of records will supplement some of the interceptor monitoring.

Additions to the maintenance program may be initiated immediately upon plan adoption. This activity included the identification of structures in the flood plain and the long-term program to floodproof them.

LONG-TERM ACTIONS

A monitoring program is the first subactivity within the interceptor and CSSA activities. Interceptor monitoring (Activity 3) is scheduled first, to identify if assumptions on interceptor flows are correct. Monitoring would occur in spring and early summer of 1990. This time period would typically provide sufficient variable rainfall events to characterize the system flows. A later subactivity includes the separate sewer diversion at East Brookfield and Grand River Avenue.

Monitoring would then follow in the Cedar Street CSSA, where in-line storage appears to be most available (Activity 5). Monitoring and control structures with an operating system would be tested first here. Pollutant reduction would be achieved with initiation of overflow control in this service area.

Monitoring would then be conducted in the Harrison, Willmarth, and Charles Street CSSAs respectively (Activities 6 and 7). Spacing the monitoring provides the potential for city maintenance crews to conduct the program. It also means that less monitoring equipment needs to be purchased or leased. Rather, the equipment can be moved from one area to the next.

Treatment plant modifications can be completed independently of sewer system improvements although they should be in place before major wet weather diversions are begun. The schedule shows the additional storage in aeration basins being in place by mid 1991. This would allow the plant personnel to experiment with use of the storage before significant additional wet weather flows can be routed to the plant.

The latest activities on the schedule are the design and construction of the relief sewer from Cedar and Willmarth CSSAs to the MSU Interceptor, and the off-line storage for Harrison and Charles Street CSSAs. Both facilities are dependent on monitoring data. Design criteria for each of these could also be dependent on final requirements for CSO control to be issued by MDNR. Both facilities will require some facilities planning. For off-line storage, selection of a site will likely require alternative analysis with public involvement. Off-line storage design will likely have structural requirements which are site specific.

Summary

The Combined Sewer Operational Plan for East Lansing is implementable, provided the schedule recognizes the resources available to the City of East Lansing. Segments of the plan have been identified which can be initiated to provide early benefits of the plan. Detailed analysis of individual activities may indicate alternate schedule durations.

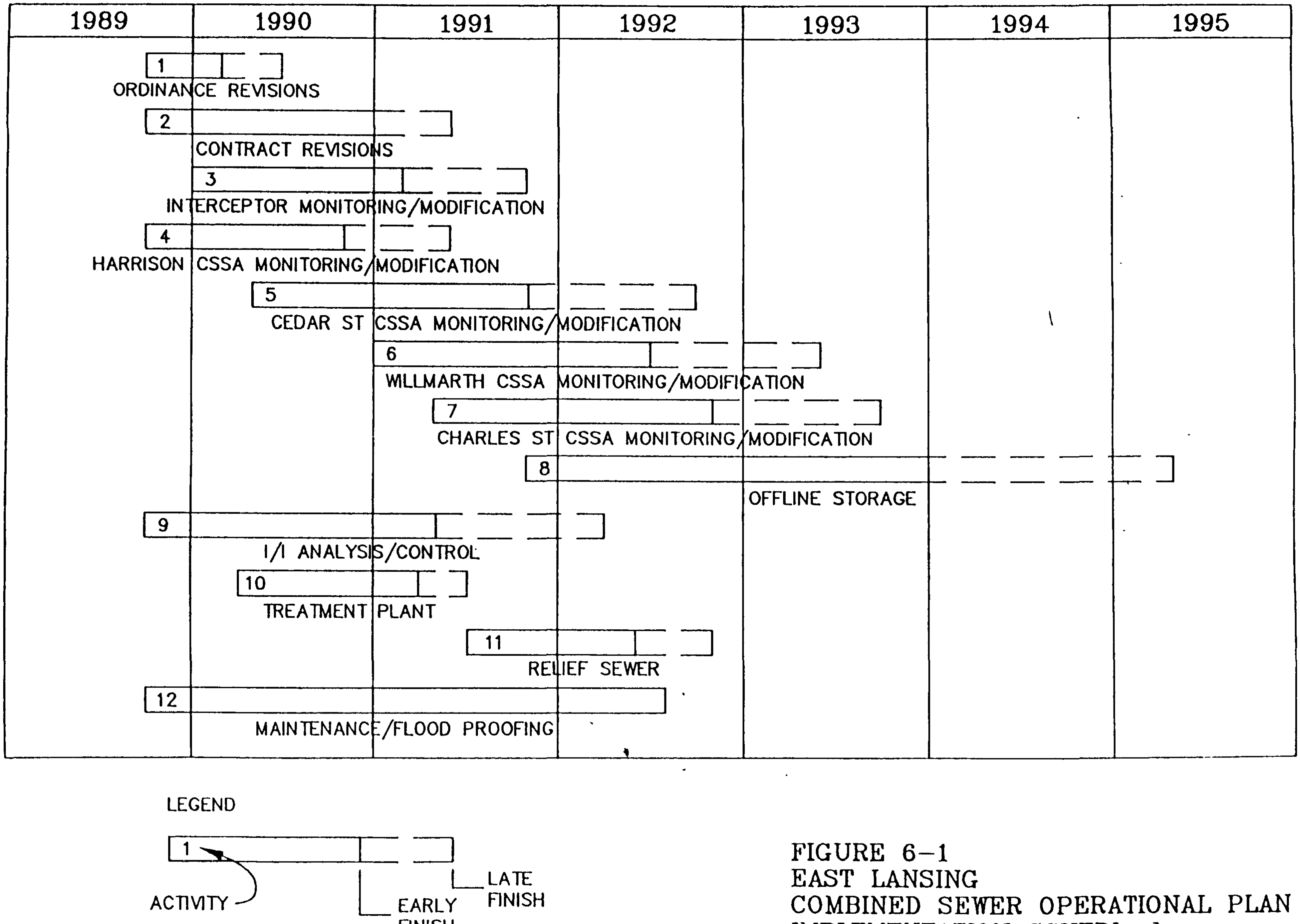


FIGURE 6-1
EAST LANSING
COMBINED SEWER OPERATIONAL PLAN

TABLE 6-1

Implementation Activities

Action		Approximate Subactivity	Time Frame	Comment
1. Sewer Ordinance Revision	a.	Draft proposed ordinances	1-2 months	Includes disconnection of roof drains in the CSSA, disconnection of sump pumps where practical, separate building laterals for redevelopment in the CSSA.
	b.	Public education	2-3 months	
	c.	Ordinance adoption and enforcement	2-4 months	
2. Service Contract Revision	a.	Draft proposed amendments to the current service contract	1-2 months	Includes clear water reduction requirements, new sewer construction performance criteria, sewer plan review records, and diversion to the Michigan State Interceptor at East Brookfield and Grand River Avenue.
	b.	Present amendments to Meridian Township and negotiate proposed changes	2-6 months	
	c.	Begin operation under the amended ordinance	1 year from start of negotiations	Individual items may be implemented independently if one proves difficult to negotiate.
	d.	Negotiate and revise contract with MSU Modifications	18 months	Concurrent with other negotiations. Includes use of MSU Interceptor and maintenance easements.
3. Monitoring of the Interceptor system	a.	Design monitoring program	2-4 months	Includes identification of monitoring locations, placement of weirs, etc. purchase or lease of monitoring equipment, and contracting for outside assistance if required. Monitoring in sewers not owned by East Lansing should be arranged. Rainfall records are required here.

TABLE 6-1 (cont.)

TABLE 6-1 (cont.)

Implementation Activities

Action		Subactivity	Approximate Time Frame	Comment
	b.	Conduct monitoring	2-4 months	Monitoring should be extended to define dry weather flow patterns in the interceptors, and flow patterns for a range of rainfall events.
	c.	Interpret data	1-2 months	Analyze flow data. Redefine interceptor capabilities.
	d.	Refine detailed operational plan for the interceptors data.	1 month	Refine the operational plan based on the monitoring
	e.	Design structure to divert separate sewer flow to MSU interceptor at East Brookfield and Grand River	4-6 months	
	f.	Construct diversion structure	4-6 months	
4. Monitoring/ Analysis/Modifications in the Harrison CSSA	a.	Design service survey and monitoring program	1-2 months	Includes a field survey and monitoring. Includes activities identified in 3.a.
	b.	Inventory service connections elevations	2-3 months	Location of service connections may limit in-line storage potential.
	c.	Field inspect structure 011/012	1 month	Determine potential for connection to 010.
	d.	Design new overflow at structure 010 control	2-3 months	Control structure should maximize in-line storage. A control structure in Michigan Street where the Harrison CSSA is connected to the Harrison Brody Interceptor will probably be required as well.

TABLE 6-1 (cont.)

Implementation Activities

Action		Subactivity	Approximate Time Frame	Comment
	e.	Install new overflow control trol in 010	2-3 months	This service area should be monitored after new overflow structure is in place.
	f.	Interpret data	1-2 months	Define flow patterns during rainfall events to determine additional storage potential or requirements.
	g.	Refine operational plan for Harrison CSSA	2 months	In-line storage potential refined based on observed wet weather flows. Off-line storage needs identified.
5. Monitoring/ Analysis of Cedar Street CSSA	a.	Survey of service area and design of the monitoring program	1-3 months	Monitoring should define/ confirm storage potential, and the wet weather flow patterns at overflow structure 009. Includes activities identified in 3.a. Survey of connections to evaluate back-up potential.
	b.	Conduct monitoring	2-4 months	Wet and dry weather flow characteristics should be identified.
	c.	Interpret data	1-2 months	Interpret flow patterns to define available in-line storage.
	d.	Refine operational plan for Cedar Street CSSA	2 months	Strategy for storage/release of wet weather flow utilizing in-line storage would be developed. Strategy flexible to utilize Main interceptor and eventual connection to MSU Interceptor. Identify necessary control structure.
	e.	Design control structures and control system	4-6 months	Design must consider potential from back-up as well as in-line storage. Discharge stored flows to interceptor system as capacity is available.

TABLE 6-1 (cont.)

Implementation Activities

Action		Subactivity	Approximate Time Frame	Comment
	f.	Construct control structures	8-12 months	Completed system provides in-line storage with a control system to maximize overflow reduction while protecting users from back-ups.
6. Monitoring/ Analysis/Modifications of Willmarth CSSA	a.	Survey of service area and design of monitoring program	1-3 months	Similar to 5.a.
	b.	Conduct monitoring	2-4 months	Similar to 5.b.
	c.	Interpret data	1-2 months	Wet and dry weather flow patterns at structure 013 should be defined, along with any in-line storage potential.
	d.	Refine operational plan for Willmarth CSSA	2 months	Determine what in-line storage capacity should be utilized, a plan for wet weather diversion to the MSU Interceptor.
	e.	Design control structure and control system	4-6 months	Similar to 5.e.
	f.	Construct control structures	8-12 months	Construction would be in conjunction with a wet weather relief sewer to the proposed diversion structure at East Brookfield and Grand River Avenue.
7. Monitoring/ Analysis/Modifications of Charles Street CSSA	a.	Survey of service area design monitoring program	1-3 months	Similar to 5.a.
	b.	Conduct monitoring	2-4 months	Similar to 5.b.

TABLE 6-1 (cont.)

Implementation Activities

Action		Subactivity	Approximate Time Frame	Comment
	c.	Interpret data	1-2 months	Wet and dry weather flow patterns at structure 007 should be defined, along with any in-line storage potential.
	d.	Refine operational plan for Charles Street CSSA	2 months	Determine in in-line storage may be available. Develop in-line storage strategy if it can be utilized.
	e.	Design control structures and control systems	4-6 months	Structures and controls for in-line storage. This task will be done only if sufficient storage potential is present.
	f.	Construction of control structures	8-12 months	As above.
8. Development of Off-Line Storage	a.	Review monitoring records for Harrison and Charles Street CSSA	1 month	Use monitoring data to refine system.
	b.	Determine design criteria for overflow capture	1-2 months	Long-term rainfall runoff records examined.
	c.	Facility plan for siting of off-line storage	6 months	
	d.	Design off-line storage	4-8 months	
e.	e.	Obtain sites for off-line storage	6-12 months	d and e concurrent activities.
	f.	Construction of off-line storage	12-24 months	

TABLE 6-1 (cont.)

Implementation Activities

Action		Subactivity	Approximate Time Frame	Comment
9. Analysis of Infiltration/ Inflow from Separate Areas	a.	Review wet weather/dry weather flow records for the Woodingham and Hamilton Road Pump Stations. Correlate precipitation records to flow records, and the interceptor monitoring program	1-2 months	Include any bypass information as well.
	b.	Evaluate impact of wet weather separate system on interceptor system flow	1-2 months	
	c.	Develop program for inflow reduction in all separate service areas	2-4 months	
	d.	Public involvement program	3-4 months	Education and voluntary compliance.
	e.	Inspection and mandatory compliance	12-18 months	
	f.	Monitor to determine effectiveness of program		
10. Aeration Basin Conversion at the Treatment Plant	a.	Develop wet weather storage/ treatment operational plan	2 months	
	b.	Design piping modifications and controls	3 months	
	c.	Construction	9-12 months	

TABLE 6-1 (cont.)

Implementation Activities

Action		Approximate Subactivity	Time Frame	Comment
11. Relief Sewer Connection: Cedar Street CSSA and Willmarth CSSA to Diversion at East Brookfield and Grand River Avenue	a.	Develop design criteria	1 month	Design based on monitoring data. It should consider conveyance and storage if desired.
	b.	Design sewer	4-6 months	Includes necessary controls.
	c.	Construct sewer	6-12 months	
12. Maintenance/ Flood Proofing	a.	Incorporate additional reporting recommendations	3 months	Recommendations from Chapter 4.
	b.	Inspect manholes and structures in flood plain	6 months	
	c.	List manholes and structures for floodproofing	1 month	
	d.	Floodproof structures in flood	24 months	

APPENDIX 1

LIST OF PREPARERS

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This Combined Sewer Operational Plan is published by the United States Environmental Protection Agency (USEPA) Region V. It was prepared by Triad Engineering Incorporated, Milwaukee, Wisconsin, for Science Applications International Corporation (SAIC), McLean, Virginia, under EPA Contract No. 68-04-5041, W.A. No. 33 from the Great Lakes National Program Office. Staff from USEPA, SAIC, and Triad Engineering involved in preparation of the Combined Sewer Operational Plan included:

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