

**LAWRENCE, KANSAS**

**STORMWATER MANAGEMENT**

**MASTER PLAN**



**Burns**  
**&**  
**McDonnell**

**MAY, 1996**

100% EMPLOYEE-OWNED



May 7, 1996

Mr. George Williams, P.E.  
Director of Public Works  
6 East Sixth Street  
Lawrence, Kansas 66044

City of Lawrence, Kansas  
Stormwater Management Master Plan

Dear Mr. Williams:

Burns & McDonnell Engineers is pleased to present this final report to the City of Lawrence setting forth our analysis of the performance capability of the existing major drainage system; recommendations for improvements to the existing facilities; recommendations for policy revisions; analysis of financing options available to the City; and recommendations on establishment of a stormwater utility and rate structure as the revenue source for the stormwater management program. In addition to this report, watershed maps and a Stormwater Management Criteria manual have been prepared as separate, companion documents to this report. The criteria manual was approved by the City Commission on January 23, 1996 and formal adoption by ordinance is pending.

We wish to thank you, Mr. Mike Wildgen, Ms. Terese Gorman and other members of the City staff as well as members of the City Commission, local consultants and residents of the community for input and assistance provided throughout the process. The information made available to us and the informed review and consultation as interim reports were presented were instrumental in the successful completion of the study.

We trust that this report and the companion drainage system computer models will be of continuing value to Lawrence in your management and improvement of the City's storm drainage system.

Sincerely,

Joel A. Cerwick, P.E.

Vice President

Dena E. Mezger

Dena E. Mezger, P.E.  
Project Manager

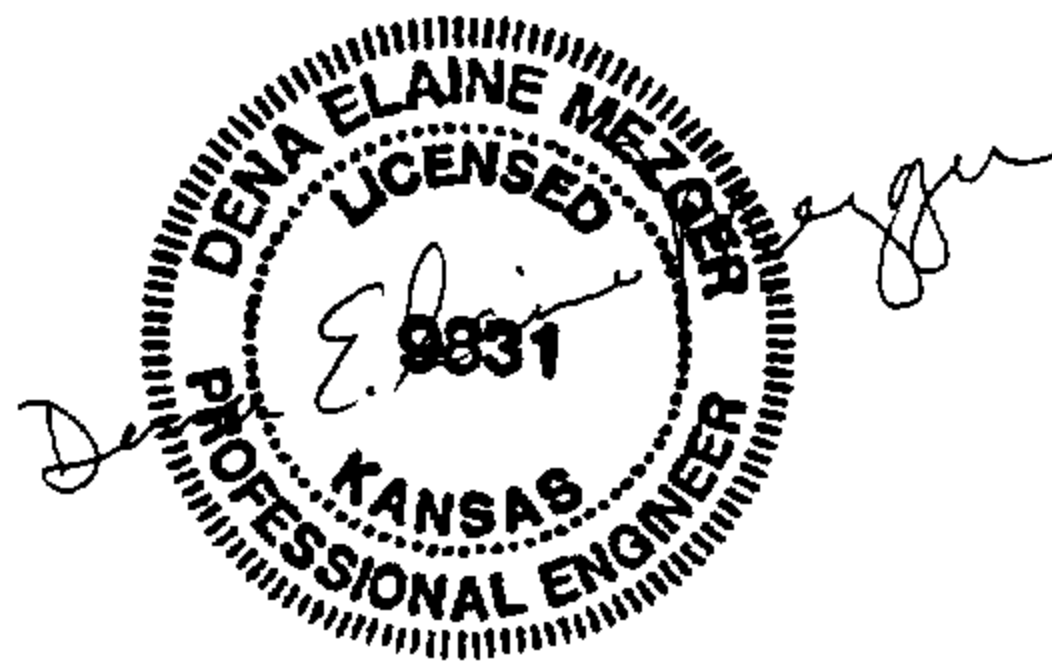
LAWRENCE, KANSAS  
STORMWATER MANAGEMENT MASTER PLAN  
PROJECT NO. 94-249-4

INDEX AND CERTIFICATION PAGE

REPORT INDEX

<u>PART NO.</u>	<u>PART TITLE</u>	<u>NUMBER OF PAGES</u>
I	Executive Summary	21
II	General Information	7
III	Technical Methods and Criteria	10
IV	Existing System Performance	45
V	Drainage Policy	8
VI	Recommended System Improvements	67
VII	Operation and Maintenance	11
VIII	Financial Plan	21

CERTIFICATION



5/1/96

LAWRENCE, KANSAS  
 STORMWATER MANAGEMENT MASTER PLAN  
 TABLE OF CONTENTS

	Page <u>No.</u>
PART I - EXECUTIVE SUMMARY . . . . .	I-1
A. Project Scope And Background . . . . .	I-1
B. General Information . . . . .	I-2
1. Definitions . . . . .	I-2
2. Area Information . . . . .	I-3
3. Technical Information . . . . .	I-3
C. Existing System Performance . . . . .	I-4
1. System Components . . . . .	I-4
2. Hydraulic Performance . . . . .	I-5
D. Drainage Policy . . . . .	I-6
1. Technical Standards . . . . .	I-6
2. Existing System Capital Improvements . . . . .	I-8
3. System Maintenance . . . . .	I-9
E. Recommended System Improvements . . . . .	I-10
1. Alternatives . . . . .	I-10
2. Recommended Capital Improvements . . . . .	I-10
F. Improvement Priorities . . . . .	I-12
1. General . . . . .	I-12
2. Priority Evaluation . . . . .	I-12
3. Recommended Plan Priorities . . . . .	I-13
G. Financial Plan . . . . .	I-15
1. Financing Methods . . . . .	I-15
2. Revenue Source . . . . .	I-17
3. Stormwater Utility Fees . . . . .	I-19
H. Recommendations . . . . .	I-20
 <u>List Of Tables</u>	
I-1 Existing System Performance . . . . .	I-4
I-2 Improved Major System Level of Service . . . . .	I-5
I-3 Recommended Capital Improvement Projects . . . . .	I-11
I-4 Phase I Capital Improvements Program Group I Projects And Priority Rankings . . . . .	I-14
I-5 Phase II Capital Improvements Program Group II Projects . . . . .	I-14
I-6 Phase III Capital Improvements Program Group III Projects . . . . .	I-15
I-7 Phase I Capital Improvements Program Cash Financing Costs . . . . .	I-16
I-8 Phase I Capital Improvements Program Bond Financing Costs . . . . .	I-16
I-9 Stormwater Utility Annual Costs . . . . .	I-17
I-10 Proposed Utility Rate Structure . . . . .	I-18
I-11 Stormwater Utility Rates And Total Revenues . . . . .	I-19
 <u>List Of Figures</u>	
Overall Watershed Map . . . . .	Following I-3
 PART II - GENERAL INFORMATION . . . . .	 II-1
A. Authorization And Scope . . . . .	II-1
B. Definition Of Terms . . . . .	II-2
C. Storm Drainage Systems . . . . .	II-4
D. Area Information . . . . .	II-5

	Page No.
PART III - TECHNICAL METHODS AND CRITERIA . . . . .	III-1
A. System Mapping . . . . .	III-1
B. Field Investigation . . . . .	III-1
C. Computer Modeling . . . . .	III-3
1. General . . . . .	III-3
2. Computer Models . . . . .	III-3
D. Rainfall . . . . .	III-7
E. Land Use . . . . .	III-8
F. Comparison To Previous Studies . . . . .	III-9

List Of Tables

III-1 Field Evaluation Standards for Roughness Coefficients . . . . .	III-2
III-2 Design Rainfall Events . . . . .	III-8
III-3 Land Use Runoff Parameters . . . . .	III-9

PART IV - EXISTING SYSTEM PERFORMANCE . . . . .	IV-1
A. General . . . . .	IV-1
B. Existing Drainage Problems . . . . .	IV-2
C. Basin Model Development . . . . .	IV-2
1. Model Arrangement . . . . .	IV-2
2. Hydraulic Capacity Rating . . . . .	IV-4
3. Level of Service . . . . .	IV-4
D. Existing System Performance . . . . .	IV-5
1. Yankee Tank West Watershed . . . . .	IV-5
2. Hidden Valley Watershed . . . . .	IV-7
3. Quail Creek Watershed . . . . .	IV-10
4. Yankee Tank East Watershed . . . . .	IV-13
5. Naismith Watershed . . . . .	IV-16
6. KLWN Watershed . . . . .	IV-20
7. Belle Haven Watershed . . . . .	IV-22
8. Broken Arrow Watershed . . . . .	IV-23
9. Haskell Watershed . . . . .	IV-25
10. Deerfield Watershed . . . . .	IV-27
11. Riverside Watershed . . . . .	IV-30
12. Country Club Watershed . . . . .	IV-31
13. Downtown Watershed . . . . .	IV-34
14. East Lawrence Watershed . . . . .	IV-36
15. Brook Street Watershed . . . . .	IV-39
16. Sunflower Watershed . . . . .	IV-40
17. North Lawrence Watershed . . . . .	IV-42

List Of Tables

IV-1 Existing System Model Description . . . . .	IV-3
IV-2 Improved System Level of Service . . . . .	IV-5
IV-3 Existing Improved System Performance - Yankee Tank West . . . . .	IV-7
IV-4 Existing Improved System Performance - Hidden Valley . . . . .	IV-9
IV-5 Existing Improved System Performance - Quail Creek . . . . .	IV-12
IV-6 Existing Improved System Performance - Yankee Tank East . . . . .	IV-14
IV-7 Existing Improved System Performance - Naismith . . . . .	IV-18
IV-8 Existing Improved System Performance - KLWN . . . . .	IV-21
IV-9 Existing Improved System Performance - Belle Haven . . . . .	IV-23
IV-10 Existing Improved System Performance - Broken Arrow . . . . .	IV-24
IV-11 Existing Improved System Performance - Haskell . . . . .	IV-26
IV-12 Existing Improved System Performance - Deerfield . . . . .	IV-29

	Page No.
IV-13 Existing Improved System Performance - Riverside . . . . .	IV-31
IV-14 Existing Improved System Performance - Country Club . . . . .	IV-32
IV-15 Existing Improved System Performance - Downtown . . . . .	IV-35
IV-16 Existing Improved System Performance - East Lawrence . . . . .	IV-38
IV-17 Existing Improved System Performance - Brook Street . . . . .	IV-40
IV-18 Existing Improved System Performance - Sunflower . . . . .	IV-42
IV-19 Existing Improved System Performance - North Lawrence . . . . .	IV-44

PART V - DRAINAGE POLICY . . . . .	V-1
A. General . . . . .	V-1
B. System Design Criteria Recommendations . . . . .	V-2
C. Lot Grading and Erosion Control Requirements . . . . .	V-3
D. Existing System Capital Improvements . . . . .	V-4
1. Major Drainage System Components . . . . .	V-5
2. Minor System Components . . . . .	V-5
E. System Maintenance . . . . .	V-6
F. Impact on Existing City Ordinances . . . . .	V-7

PART VI - RECOMMENDED SYSTEM IMPROVEMENTS . . . . .	VI-1
A. Alternative System Components . . . . .	VI-1
1. General . . . . .	VI-1
2. Nonstructural Elements . . . . .	VI-1
3. Structural Elements . . . . .	VI-3
4. Comparison Of Alternatives . . . . .	VI-4
5. Evaluation Of Alternatives . . . . .	VI-4
B. Capital Improvement Projects . . . . .	VI-6
1. Scope . . . . .	VI-6
2. Recommended Plan Summary . . . . .	VI-8
3. Discretionary Projects . . . . .	VI-52
C. Program Cost Estimates . . . . .	VI-60
1. Basis . . . . .	VI-60
2. Pricing . . . . .	VI-60
3. Estimates . . . . .	VI-60
D. Improvement Priorities . . . . .	VI-61
1. General . . . . .	VI-61
2. Priority Evaluation . . . . .	VI-61
3. Recommended Plan Priorities . . . . .	VI-65

List Of Tables

VI-1 Comparison of Alternatives . . . . .	VI-4
VI-2 Recommended Capital Improvement Projects . . . . .	VI-9
VI-3 Phase I Capital Improvements Program Group I Projects And Priority Rankings . . . . .	VI-65
VI-4 Phase II Capital Improvements Program Group II Projects . . . . .	VI-66
VI-5 Phase III Capital Improvements Program Group III Projects . . . . .	VI-66

List Of Figures

VI-1a Recommended Improvement Project Locations	
VI-1b Recommended Improvement Project Locations	
Following Recommended Improvement Project Descriptions	
VI-2 Proposed Improvements Project 1	
VI-3 Proposed Improvements Projects 2, 3, 5	
VI-4 Proposed Improvements Project 4	
VI-5 Proposed Improvements Projects 6,7	

VI-6	Proposed Improvements Projects	8, 10, 12	
VI-7	Proposed Improvements Projects	9, 11	
VI-8	Proposed Improvements Project	13	
VI-9	Proposed Improvements Projects	14, 15	
VI-10	Proposed Improvements Project	16	
VI-11	Proposed Improvements Projects	17, 18	
VI-12	Proposed Improvements Project	19	
VI-13	Proposed Improvements Projects	20, 21	
VI-14	Proposed Improvements Projects	22-26	
VI-15	Proposed Improvements Projects	27, 28, 32, 33	
VI-16	Proposed Improvements Projects	29, 30	
VI-17	Proposed Improvements Projects	31, 34, 35	
VI-18	Proposed Improvements Project	36	
VI-19	Proposed Improvements Projects	37-39, 41	
VI-20	Proposed Improvements Project	40	

PART VII - OPERATION AND MAINTENANCE		VII-1
A. General		VII-1
B. Maintenance Responsibility		VII-1
C. Organization And Equipment		VII-1
D. Maintenance Tasks		VII-2
1. Inspection		VII-3
2. Roadside Ditches		VII-3
3. Culverts On Open Channels		VII-4
4. Lined Open Channels		VII-4
E. Annual Maintenance		VII-5
F. Maintenance of Private System Facilities		VII-5
G. Specific Maintenance Needs		VII-6

List Of Tables

VII-1 Organization and Equipment for Storm Drainage Maintenance	VII-2
---	-------

PART VIII - FINANCIAL PLAN	VIII-1
A. Schedule Of Improvement Program	VIII-1
B. Financing Alternatives	VIII-1
C. General Revenue Sources	VIII-2
D. Establishment Of A Stormwater Utility	VIII-3
1. Utility Structure and Function	VIII-4
2. Utility Rates	VIII-7
E. Other Revenue Sources	VIII-10
F. Program Costs	VIII-11
1. Cash-Basis Financing	VIII-12
2. Bond Financing	VIII-13
G. Revenue Requirements	VIII-19
H. Recommendations	VIII-20

List Of Tables

VIII-1 Stormwater Utility Annual Costs	VIII-5
VIII-2 Average Units for Residential Property	VIII-8
VIII-3 Proposed Utility Rate Structure	VIII-10
VIII-4 Cash Financing Costs	VIII-12
VIII-5 5-Year Phase 1 Capital Improvements Program Financed By 10-Year General Obligation Bonds	VIII-14

	<u>Page</u> <u>No.</u>
VIII-6 10-Year Phase 1 Capital Improvements Program Financed By 10-Year General Obligation Bonds . . . . .	VIII-15
VIII-7 5-Year Phase 1 Capital Improvements Program Financed By 10-Year Revenue Bonds . . . . .	VIII-16
VIII-8 10-Year Phase 1 Capital Improvements Program Financed By 10-Year Revenue Bonds . . . . .	VIII-17
VIII-9 Comparison Of Bond Financing Costs . . . . .	VIII-18
VIII-10 Proposed Utility Rates . . . . .	VIII-19
VIII-11 Total Utility Revenues . . . . .	VIII-20

List Of Figures

VIII-1 Stormwater Utility Organization . . . . .	VIII-6
--	--------

APPENDICES

- APPENDIX A - Storm Drainage Questionnaire
- APPENDIX B - Existing Drainage System Inventory
- APPENDIX C - Erosion Control Principles & Plot Plan Requirements
- APPENDIX D - Summary of Existing Stormwater Utilities

COMPANION DOCUMENTS

- Stormwater Management Criteria Manual
- Stormwater Management Plan Watershed Maps

\* \* \* \* \*