



# City of Lincoln, NE

## Deadmans Run Watershed

### MASTER PLAN

December 2007

# Study Report

# CDM

In association with:

*Kirkham Michael  
Applied Ecological Services  
Mead & Hunt  
Heartland Center*







# CDM

---

9200 Ward Pkwy, Ste 500 | Kansas City, MO 64114 | 816.444.8270 | [www.CDM.com](http://www.CDM.com)

# Contents

<b>Executive Summary</b> .....	ES-1
<b>Section 1 - Introduction and Purpose</b>	
1.1 Introduction .....	1-1
1.2 Goals and Objectives .....	1-3
1.3 Public Participation Process .....	1-4
1.3.1 Open House Events .....	1-4
1.3.2 Citizen Advisory Committee .....	1-5
1.3.3 Information Sessions .....	1-6
1.3.4 Newsletter and Website .....	1-7
<b>Section 2 - Data Collection and Development</b>	
2.1 Watershed Inventory .....	2-1
2.2 Drainage Structure Field Survey .....	2-2
2.3 Base Mapping .....	2-3
2.4 Water Quality Evaluation .....	2-5
2.5 Geomorphic Investigation .....	2-5
<b>Section 3 - Hydrologic Model Development</b>	
3.1 Introduction .....	3-1
3.2 Hydrology Methodology .....	3-1
3.2.1 Subarea Delineation .....	3-1
3.2.2 Rainfall .....	3-1
3.2.3 Runoff Volume .....	3-2
3.2.4 Runoff Hydrographs (Lag Time) .....	3-7
3.2.5 Routing (Muskingum-Cunge) .....	3-9
3.2.6 Storage .....	3-9
3.2.7 Deadmans Run West Tributary .....	3-10
3.2.8 Flow Diversions .....	3-11
3.3 Model Calibration and Verification .....	3-11
3.4 Model Results .....	3-12
<b>Section 4 - Hydraulic Model Development</b>	
4.1 Introduction .....	4-1
4.2 HEC-RAS Model Development .....	4-1
4.2.1 Stream Network, Cross Sections, and Reach Lengths .....	4-2
4.2.2 Manning's n-Values .....	4-3
4.2.3 Roadway Crossings and Dams .....	4-4
4.2.4 Expansion and Contraction Coefficients .....	4-4
4.2.5 Boundary Conditions .....	4-5
4.2.6 Ineffective Flow Areas .....	4-5
4.2.7 Channel Bank Stations .....	4-5
4.3 Modeling Deadmans Run West Tributary .....	4-5

4.4	Steady Flow Water Surface Profiles .....	4-6
4.5	Floodway Determination.....	4-6
4.6	Model Calibration and Verification.....	4-6
4.7	Quality Control .....	4-6
4.8	HEC-RAS Product.....	4-7

**Section 5 - Floodplain Management Tools**

5.1	Floodprone Areas.....	5-1
5.1.1	Flood Insurance Certificates .....	5-1
5.1.2	Floodplain Delineation Process .....	5-1
5.1.3	Study Floodplain and Floodway Maps .....	5-2

**Section 6 - Water Quality**

6.1	Introduction .....	6-1
6.2	Regulatory Compliance.....	6-1
6.2.1	Stormwater Regulations.....	6-1
6.2.2	Surface Water Regulations .....	6-2
6.3	Evaluation Approach .....	6-3
6.4	Previous Water Quality Studies.....	6-4
6.4.1	Stormwater Quality Evaluation of Livestock Runoff .....	6-4
6.4.2	Dry Weather Stormwater Monitoring.....	6-4
6.5	Wet Weather Water Quality Assessment .....	6-4
6.5.1	Water Quality Sampling Program.....	6-4
6.5.2	Water Quality Sampling Results.....	6-5
6.6	Water Quality Recommendations .....	6-5
6.6.1	Nonstructural BMPs .....	6-6
6.6.2	Structural BMPs .....	6-6
6.6.3	Private Development Demonstration Projects.....	6-8
6.6.4	Additional Studies .....	6-8

**Section 7 - Fluvial Geomorphic Evaluation**

7.1	Introduction .....	7-1
7.2	Geomorphic Field Reconnaissance.....	7-1
7.3	Evaluation Results .....	7-2
7.3.1	Historical Background .....	7-2
7.3.2	Stream Stage Classification.....	7-5
7.3.3	Summary Discussion.....	7-8
7.4	Stream Improvements .....	7-9

**Section 8 - Capital Improvement Projects**

8.1	Introduction .....	8-1
8.2	Problem Identification.....	8-1
8.3	Evaluation Approach .....	8-2
8.3.1	Flooding Evaluation .....	8-2
8.3.2	Stream Erosion/Water Quality Evaluation.....	8-3

8.4	Recommended Improvement Projects.....	8-4
8.4.1	Stormwater Conveyance Projects.....	8-4
8.4.2	Stormwater Detention Projects.....	8-17
8.4.3	Local Flood Control.....	8-20
8.4.4	Water Quality Projects.....	8-21
8.5	Watershed Solution.....	8-26
8.6	Prioritization.....	8-26
8.7	Summary.....	8-28
8.8	Other Projects Evaluated.....	8-30
8.8.1	Other Stormwater Conveyance Projects.....	8-31
8.8.2	Other Stormwater Detention Projects.....	8-31
8.8.3	Other Water Quality Projects.....	8-32

## Section 9 - Benefit-Cost Analysis

9.1	Introduction.....	9-1
9.2	Benefit-Cost Analysis Approach.....	9-1
9.3	Benefit-Cost Ratio Calculation Process.....	9-2
9.4	Conclusions.....	9-4

## Section 10 - Implementation

10.1	Capital Improvement Project Implementation.....	10-1
10.1.1	Watershed Solution.....	10-1
10.1.2	Local Flood Control.....	10-3
10.1.3	Water Quality Projects.....	10-3
10.2	Maintenance Agreements.....	10-3
10.3	Coordination Efforts.....	10-3
10.4	Project Funding.....	10-3
10.5	Education Program.....	10-4
10.6	Additional Studies.....	10-4

## Section 11 - Glossary of Terms and References

11.1	Glossary of Terms.....	11-1
11.2	References.....	11-6

## Appendices

- Appendix A - Electronic Files*
- Appendix B - Public Participation Materials*
- Appendix C - Drainage Structure Design Data*
- Appendix D - Water Quality*
- Appendix E - Stream Reach Descriptions*
- Appendix F - Opinion of Probable Construction Costs*
- Appendix G - Prioritization*

## Tables

2-1	Drainage Structure Survey Data.....	2-4
3-1	Rainfall Duration Depths.....	3-2
3-2	Existing Land Use Percentages.....	3-4
3-3	Curve Numbers for Deadmans Run Watershed.....	3-5
3-4	Lancaster County Hydrologic Soil Groups.....	3-7
3-5	Sheet Flow and Shallow Concentrated Flow Values.....	3-8
3-6	100-Year Flow Comparisons.....	3-12
3-7	Drainage Area Comparisons.....	3-12
3-8	HEC-HMS Modeling Results.....	3-12
4-1	HEC-RAS Parameters Development.....	4-2
4-2	Land Surface Characteristics and Associated Manning’s n-Values.....	4-3
4-3	Channel Descriptions and Associated Manning’s n-Values.....	4-4
4-4	Expansion and Contraction Coefficients.....	4-4
6-1	Structural BMP CIP Projects.....	6-6
8-1	Stream Crossing Overtopping Flood Depths.....	8-1
8-2	Bridge Ratings and Status.....	8-3
8-3	Deadmans Run Priority Ranking Results.....	8-27
8-4	Recommended Improvement Project Costs.....	8-28
9-1	Categories of Avoided Damages.....	9-1
9-2	Benefit-Cost Ratio Procedures.....	9-2
9-3	Total Physical Damages <i>Before</i> Projects.....	9-4
9-4	Total Physical Damages <i>After</i> Projects.....	9-4

## Figures

1-1	Deadmans Run Watershed Area Map.....	1-1
1-2	City of Lincoln Comprehensive Watershed Management Plan.....	1-2
2-1	Water Quality and Geomorphic Assessment Locations.....	2-5
3-1	Deadmans Run Existing Conditions Land Use.....	3-3
3-2	Deadmans Run Hydrologic Soil Groups.....	3-6
3-3	Stormwater Detention Facilities.....	3-10
3-4	Deadmans Run West Tributary.....	3-11
5-1	Floodplain Map Tiles.....	5-3
5-2	Tile 1 Floodplain Map.....	5-4
5-3	Tile 2 Floodplain Map.....	5-5
5-4	Depth of 100-Year Storm.....	5-6
6-1	Water Quality Sampling Locations.....	6-4
6-2	Continuous Deflection Plan View.....	6-7
7-1	Geomorphic Evaluation Stream Segments.....	7-1
7-2	Segments 1 and 2 - Historical Photographs.....	7-3
7-3	Segment 3 - Historical Photographs.....	7-4
7-4	Channel Evolution Model (Simon 1989).....	7-6

7-5	Segment 3 – Existing Outfalls.....	7-8
7-6	Deadmans Run Knickpoints.....	7-9
8-1	Master Plan Existing Conditions 100-Year Floodplain.....	8-2
8-2	Conceptual Level Improvement Projects .....	8-4
8-3	Project 1, Location 1 Channel Improvements .....	8-7
8-4	Project 1, Location 1 Typical Channel Cross Section .....	8-7
8-5	Project 1, Location 2 Channel Improvements .....	8-8
8-6	Project 1, Location 3 Channel Improvements .....	8-10
8-7	Project 1, Location 3 Typical Channel Cross Section .....	8-10
8-8	Project 2, Improvement Locations .....	8-12
8-9	Project 2, Location 1 Typical Channel Cross Section .....	8-12
8-10	Project 2, Location 2 Typical Channel Cross Section .....	8-12
8-11	Project 3 Channel Improvements.....	8-14
8-12	Project 3 Typical Channel Cross Section.....	8-14
8-13	Project 4 Channel Improvements.....	8-16
8-14	Project 4 Typical Channel Cross Section.....	8-16
8-15	Project 5 Design Components .....	8-18
8-16	Project 6 Design Components .....	8-19
8-17	Project 7 Construction Limits .....	8-20
8-18	Recommended Water Quality Project Locations.....	8-21
8-19	Project 8 Pond Retrofits.....	8-22
8-20	Bethany Park Recommended Water Quality Feature.....	8-23
8-21	Russwood Basin Retrofits .....	8-24
8-22	Project 11 Water Quality Features .....	8-24
8-23	Project 12 Location of Hydrodynamic Separator .....	8-25
8-24	Project 13 Location of Stream Stabilization Measures .....	8-25
8-25	100-Year Floodplain Comparison.....	8-29
8-26	Other Projects Evaluated .....	8-30
9-1	FEMA Building Depth-Damage Curves.....	9-3
9-2	FEMA Contents Depth-Damage Curves .....	9-3
9-3	Street Flooding Depth-Damage Curves.....	9-3

# Acronyms

AES	Applied Ecological Services
BCA	benefit-cost analysis
BCR	benefit-cost ration
BMP	best management practice
C	coefficient
CDM	Camp Dresser & McKee Inc.
CFU	colony forming units
CIPs	capital improvement projects
City	City of Lincoln
CMP	corrugated metal pipe
CN	curve number
CTP	cooperating technical partnership
CUP	Community Unit Plan
CWA	Clean Water Act
DEM	digital elevation model
DFIRM	Digital Flood Insurance Rate Map
<i>E. coli</i>	<i>Escherichia coli</i>
EGL	energy grade line
EPA	U. S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIS	flood insurance study
GIS	geographic information system
GPS	global positioning system
HC	Heartland Center for Leadership Development
HEC-HMS	Hydrologic Engineering Center's Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HSG	hydrologic soil group
K&M	Kirkham Michael Consulting Engineers
lb/ft <sup>2</sup>	pounds per square foot
LOMA	Letter of Map Amendment
M&H	Mead & Hunt
Master Plan	Deadmans Run Watershed Master Plan
ml	milliliter
NDEQ	Nebraska Department of Environmental Quality
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRD	Natural Resources District
PER	preliminary engineering report
QMP-1	Quality Management Process Manual - 1
SCS	Soil Conservation Service
TIN	triangular irregular network
TMDL	total maximum daily load
TRC	technical review committee
TRM	turf-reinforced matrix
UDS	urban drainage study
USACE	U. S. Army Corps of Engineers
WQCV	water quality control volume