Northeast Kansas
Urbanization and the Environment

2003 Field Conference
June 4–6, 2003

Sponsored by
Kansas Geological Survey
Kansas Department of Wildlife and Parks
Kansas Water Office
Johnson County, Kansas
KANSAS FIELD CONFERENCE

FIELD GUIDE

2003 FIELD CONFERENCE

Northeast Kansas
Urbanization and the Environment
June 4-6, 2003

Edited by
Robert S. Sawin
Liz Brosius
Rex C. Buchanan
James R. McCauley

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KANSAS GEOLOGICAL SURVEY
Geology Extension
1930 Constant Ave. - Campus West
Lawrence, Kansas 66047-3726
Telephone: (785) 864-3965

KGS OPEN-FILE
REPORT 2003-37
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Acknowledgments

Many Survey staff members helped with the preparation of the 2003 Field Conference. In
particular, we want to acknowledge graphic artist Jennifer Sims for the preparation of the brochure,
the Field Guide cover, and many of the figures.
# Northeast Kansas

*Urbanization and the Environment*

## 2003 FIELD CONFERENCE

June 4–6, 2003

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### PARTICIPANTS LIST

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Affiliation</th>
<th>Business Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steve Adams</td>
<td>Natural Resource Coordinator</td>
<td>Kansas Department of Wildlife &amp; Parks</td>
<td>1020 S. Kansas Ave. Topeka, KS 66612 785/296-2281</td>
</tr>
<tr>
<td>Ray Aslin</td>
<td>State Forester</td>
<td>Kansas Forest Service</td>
<td>2610 Claflin Road Manhattan, KS 66502 785/532-3309</td>
</tr>
<tr>
<td>Tess Banion</td>
<td>Chief of Staff</td>
<td>House Minority Leader</td>
<td>1262 Collins Topeka, KS 66604 785/233-9864</td>
</tr>
<tr>
<td>Don Biggs</td>
<td>Retired State Senator</td>
<td>Kansas Senate</td>
<td>2712 Olde Creek Ct. Leavenworth, KS 66048 913/682-1802</td>
</tr>
<tr>
<td>Roger Boyd</td>
<td>Biology Professor</td>
<td>Baker University</td>
<td>P.O. Box 65 Baldwin City, KS 66006-0065 785/594-3172</td>
</tr>
<tr>
<td>Mary Compton</td>
<td>Representative 13&lt;sup&gt;th&lt;/sup&gt; District</td>
<td>Kansas House of Representatives / Agriculture Committee</td>
<td>Route 3, Box 242 Fredonia, KS 66736 785/296-7632</td>
</tr>
<tr>
<td>John Dykes</td>
<td>Chairman</td>
<td>Kansas Wildlife and Parks Commission</td>
<td>5641 Tahoe Lane Fairway, KS 66205 913/345-0500</td>
</tr>
<tr>
<td>Vaughn Flora</td>
<td>Representative 57&lt;sup&gt;th&lt;/sup&gt; District</td>
<td>Kansas House of Representatives / Environment Committee</td>
<td>431 SE Woodland Ave. Topeka, KS 66607 785/296-7647</td>
</tr>
<tr>
<td>Sheila Frahm</td>
<td>Chair</td>
<td>Kansas Natural Resources Legacy Alliance (KNRLA)</td>
<td>410 N. Grant Ave. Colby, KS 67701-2036 785/462-6948</td>
</tr>
<tr>
<td>Joann Freeborn</td>
<td>Representative 107&lt;sup&gt;th&lt;/sup&gt; District</td>
<td>Kansas House of Representatives/ Environment Committee</td>
<td>1904 N. 240&lt;sup&gt;th&lt;/sup&gt; Road Concordia, KS 66901 785/446-3675</td>
</tr>
<tr>
<td>Mary Galligan</td>
<td>Principal Analyst</td>
<td>Kansas Legislative Research Department</td>
<td>Rm 545-N, State Capitol Topeka, KS 66612 785/296-3181</td>
</tr>
<tr>
<td>Name</td>
<td>Title</td>
<td>Organization</td>
<td>Address</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------</td>
<td>-------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>Raney Gilliland</td>
<td>Principal Analyst</td>
<td>Kansas Legislative Research Department</td>
<td>Rm 545-N, State Capitol Topeka, KS 66612 785/296-7878</td>
</tr>
<tr>
<td>Bob Grant</td>
<td>Representative 2nd District</td>
<td>Kansas House of Representatives</td>
<td>407 W. Magnolia Cherokee, KS 66724 620/457-8496</td>
</tr>
<tr>
<td>Kathy Greenlee</td>
<td>Chief of Staff</td>
<td>Governor's Office</td>
<td>State Capitol, 2nd Floor 300 SW 10th Avenue Topeka, KS 66612 785/296-4052</td>
</tr>
<tr>
<td>Ken Grotewiel</td>
<td>Assistant Director</td>
<td>Kansas Water Office</td>
<td>901 S. Kansas Ave. Topeka, KS 66612-1249 785/296-3185</td>
</tr>
<tr>
<td>David Heinemann</td>
<td>Special Assistant to the Secretary</td>
<td>Kansas Department of Revenue</td>
<td>915 SW Harrison Topeka, KS 66625-0001 785/296-8458</td>
</tr>
<tr>
<td>Carl Holmes</td>
<td>Representative 125th District</td>
<td>Kansas House of Representatives / Utilities Committee</td>
<td>P.O. Box 2288 Liberal, KS 67905-2288 620/624-7361</td>
</tr>
<tr>
<td>Becky Hutchins</td>
<td>Representative 50th District</td>
<td>Kansas House of Representatives / Tourism &amp; Parks Committee</td>
<td>700 Wyoming Holton, KS 66436 785/364-2612</td>
</tr>
<tr>
<td>Dan Johnson</td>
<td>Representative 110th District</td>
<td>Kansas House of Representatives / Environment Committee</td>
<td>P.O. Box 247 Hays, KS 67601 785/625-6476</td>
</tr>
<tr>
<td>Dick Koerth</td>
<td>Assistant Secretary for Administration</td>
<td>Kansas Department of Wildlife &amp; Parks</td>
<td>1020 Kansas Ave. Topeka, KS 66612 785/296-2281</td>
</tr>
<tr>
<td>Annie Kuether</td>
<td>Representative 55th District</td>
<td>Kansas House of Representatives / Utilities Committee</td>
<td>1346 SW Wayne Ave. Topeka, KS 66604-2606 785/232-0717</td>
</tr>
<tr>
<td>Wayne Lebsack</td>
<td>President / Trustee</td>
<td>Lebsack Oil Production, Inc. / The Nature Conservancy, Kansas Chapter</td>
<td>603 S. Douglas Lyons, KS 67554 620/938-2396</td>
</tr>
<tr>
<td>Janis Lee</td>
<td>Senator 36th District</td>
<td>Kansas Senate / Natural Resources Committee</td>
<td>R.R. 2, Box 145 Kensington, KS 66951 785/476-2294</td>
</tr>
<tr>
<td>Robin Lehman</td>
<td>Director of Research, External Relations &amp; Special Projects</td>
<td>University of Kansas, Provost &amp; Center for Research</td>
<td>2385 Irving Hill Rd. University of Kansas Lawrence, KS 66045 785/864-3475</td>
</tr>
<tr>
<td>Judith Loganbill</td>
<td>Representative 86th District</td>
<td>Kansas House of Representatives / Economic Development Committee</td>
<td>215 S. Erie Wichita, KS 67211 316/683-7382</td>
</tr>
<tr>
<td>Name</td>
<td>Position</td>
<td>Organization/Note</td>
<td>Address 1</td>
</tr>
<tr>
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<td>---------------------------</td>
</tr>
<tr>
<td>Margaret Long</td>
<td>Representative 36th District</td>
<td>Kansas House of Representatives/Utilities Committee</td>
<td>1801 N. 126th St.</td>
</tr>
<tr>
<td>Brad Loveless</td>
<td>Senior Manager Biology &amp; Conservation Programs/ President</td>
<td>Westar Energy / KACEE (KS Assoc. for Conservation and Environmental Education)</td>
<td>122 SW 2nd St.</td>
</tr>
<tr>
<td>Cindy Neighbor</td>
<td>Representative 18th District</td>
<td>Kansas House of Representatives/Utilities Committee</td>
<td>10405 W. 52nd Terr.</td>
</tr>
<tr>
<td>Adrian Polansky</td>
<td>Secretary</td>
<td>Kansas Department of Agriculture</td>
<td>109 SW 9th St.</td>
</tr>
<tr>
<td>David Pope</td>
<td>Chief Engineer</td>
<td>Kansas Department of Agriculture, Division of Water Resources</td>
<td>109 SW 9th St., 2nd Floor</td>
</tr>
<tr>
<td>Doug Spangler</td>
<td>City Administrator</td>
<td>City of Edwardsville, KS</td>
<td>690 S. 4th St.</td>
</tr>
<tr>
<td>Don Steeles</td>
<td>Vice Provost</td>
<td>University of Kansas</td>
<td>250 Strong Hall</td>
</tr>
<tr>
<td>Tracy Streeter</td>
<td>Executive Director</td>
<td>State Conservation Commission</td>
<td>109 SW 9th, Suite 500</td>
</tr>
<tr>
<td>John Strickler</td>
<td>Chair</td>
<td>The Nature Conservancy, Kansas Chapter</td>
<td>1523 University Drive</td>
</tr>
<tr>
<td>Mary Torrence</td>
<td>Senior Assistant Revisor</td>
<td>Revisor of Statutes Office</td>
<td>300 SW 10th, Suite 322-S</td>
</tr>
<tr>
<td>Jim Triplett</td>
<td>Professor &amp; Chair</td>
<td>Biology Department, Pittsburg State University</td>
<td>1701 S. Broadway</td>
</tr>
<tr>
<td>Eric Wade</td>
<td>Deputy County Manager</td>
<td>Johnson County</td>
<td>111 S. Cherry St.</td>
</tr>
<tr>
<td>Hannes Zacharias</td>
<td>Assistant County Manager</td>
<td>Johnson County</td>
<td>111 S. Cherry St., Suite 3300</td>
</tr>
</tbody>
</table>
BIOGRAPHICAL INFORMATION

Steve Adams
Title
Natural Resource Coordinator
Affiliation
Kansas Department of Wildlife & Parks
Address and Telephone
1020 S. Kansas Ave.
Topeka, KS 66612
785/296-2281
stevea@wp.state.ks.us
Current Responsibilities
Natural Resource Coordinator, Wildlife & Parks
Experience
Fisheries Biologist, Florida Game & Fish; Aquatic Ecologist, Environmental Services, Kansas Department of Wildlife & Parks
Education
Northeastern State University – BS, 1980
Oklahoma State University – MS, 1983

Don Biggs
Title
Retired Kansas Senator
Affiliation
Retired
Address and Telephone
2712 Olde Creek Ct.
Leavenworth, KS 66048
913/682-1802
biggsnks@aol.com
Current Responsibilities
Member, State Board of Agriculture; various volunteer activities
Experience
Retired Savings & Loan management; Kansas State Senator, 3rd District, 1997–2000
Education
Kanas State University – BS, 1952

Ray Aslin
Title
State Forester
Affiliation
Kansas Forest Service
Address and Telephone
2610 Claflin Road
Manhattan, KS 66502
785/532-3309
raslin@oznet.ksu.edu
Current Responsibilities
Administer statewide forestry programs including Forest Stewardship, Forest Product Utilization & Marketing, Urban & Community Forestry, Rural Fire Protection, and Conservation Tree Planting
Experience
Education
University of Missouri, Columbia – BS, 1972
University of Missouri, Columbia – MS, 1975

Roger Boyd
Title
Biology Professor
Affiliation
Baker University
Address and Telephone
P.O. Box 65
Baldwin, KS 66066-0065
785/594-3172
Roger.Boyd@bakeru.edu
Current Responsibilities
Kansas Water Authority: representative on environmental and conservation issues; Professor and Chair of Biology Department, Baker University; consultant/contractor with U.S. Army Corps of Engineers to monitor least tern and piping plover on Kansas River
Education
Baker University – BS, 1969
Emporia State University – MS, 1972
Colorado State University – PhD, 1976

Teresa M. Banion
Title
Chief of Staff
Affiliation
House Minority Leader
Address and Telephone
1262 Collins
Topeka, KS 66604
785/233-9864
banionwanke@aol.com
Current Responsibilities
Chief of Staff for Kansas House Minority Leader and caucus
Experience
Director, Research & Constituent Services, Minnesota House of Representatives
Education
Pittsburg State University – BS, 1973
Pittsburg State University – MS, 1976
Mary Compton
Title
Representative, 13th District
Affiliation
Kansas House of Representatives
Address and Telephone
Route 3, Box 242
Fredonia, KS 66736
785/296-7632
Current Responsibilities
Agriculture, Environment, Transportation, and Utilities Committees
Experience
Retired Paraprofessional, Fredonia Elementary School (USD 484)
Education
Fredonia High School – 1951

Sheila Frahm
Title
Chair
Affiliation
Kansas Natural Resources Legacy Alliance (KNRLA)
Address and Telephone
410 N. Grant Ave.
Colby, KS 67701-2036
785/462-6948
frahmksa@cnetworks.com
Current Responsibilities
Executive Director, Kansas Association of Community College Trustees; KNRLA; 2 new grandchildren.
Experience
Kansas Senator; Lt. Governor; U.S. Senator
Education
Fort Hays State University – BS, 1967

John R. Dykes
Title
Chairman
Affiliation
Kansas Wildlife & Parks Commission
Address and Telephone
5641 Tahoe Lane
Fairway, KS 66205
913/345-0500
john_dykes@palmercay.com
Current Responsibilities
Chairman, Kansas Wildlife & Parks Commission, since 1994; investment consultant to retirement plans in the midwest
Education
Rice University – BA, 1973
University of Kansas – MBA, 1979

Joann Lee Freeborn
Title
Representative, 107th District
Affiliation
Kansas House of Representatives
Address and Telephone
1904 N. 240th Rd.
Concordia, KS 66901
785/446-3675
freeborn@house.state.ks.us
Current Responsibilities
Chair, House Environment Committee; Member, Agriculture and Federal & State Affairs Committees
Experience
School teacher (secondary); farmland owner, manager
Education
Kansas State University – BS, 1966

Vaughn Flora
Title
Representative, 57th District
Affiliation
Kansas House of Representatives
Address and Telephone
431 SE Woodland Ave.
Topeka, KS 66607
785/296-7647
vaughn37@prodigy.net
Current Responsibilities
Ranking Democrat on Environment Committee; Member, Financial Institutions, Taxation, Pensions, and Investments & Benefits (joint) Committees; Member, Select Committee on Pensions; asset manager
Experience
Ninth year in Kansas Legislature; farmer; real estate construction & developer; Kansas Rural Center; Kansas Organic Producers

Mary Galligan
Title
Principal Analyst
Affiliation
Kansas Legislative Research Department
Address and Telephone
Rm 545-N, State Capitol
Topeka, KS 66612
785/296-3181
maryg@klrd.state.ks.us
Current Responsibilities
Staff for Kansas Legislative Committees: House Utilities, Transportation, and Higher Education Committees
Experience
Legislative Research, 20 years; previous committee assignments include Senate Ways & Means, Senate and House Federal & State Affairs, Senate and House Redistricting, Special Committee on Natural Resources

Education
Southwest Missouri State University – BS, 1974
University of Arkansas – MA, 1976
University of Kansas – MPA, 1985

Raney Gilliland
Title
Principal Analyst
Affiliation
Kansas Legislative Research Department
Address and Telephone
Rm 545-N, State Capitol
Topeka, KS 66612
785/296-7878
raneyg@klrd.state.ks.us

Current Responsibilities
Staff for Kansas Legislative Committees: House and Senate Agriculture Committees, House Environment Committee, Senate Natural Resources Committee, Senate Utilities Committee; and Joint Committee on Administrative Rules and Regulations

Experience
Legislative Research, 25 years.

Education
Kansas State University – BS, 1975
Kansas State University – MS, 1979

Bob Grant
Title
Representative, 2nd District
Affiliation
Kansas House of Representatives
Address and Telephone
407 W. Magnolia
Cherokee, KS 66724
620/457-8496

Current Responsibilities
Member, Commerce & Labor, Education Budget, Financial Institutions, Insurance, State Buildings Construction (joint), and Special Claims against the State (joint) Committees

Education
Labette Community College – AA, 1971
Pittsburg State University

Kathy Greenlee
Title
Chief of Staff
Affiliation
Governor’s Office
Address and Telephone
State Capitol, 2nd Floor
300 SW 10th Avenue
Topeka, KS 66612
785/296-4052
Kathy.greenlee@gov.state.ks.us

Current Responsibilities
Chief of Staff for the Office of Governor Kathleen Sebelius

Experience
Chief Counsel, Kansas Insurance Department; Assistant Attorney General, Office of the Attorney General

Education
University of Kansas – BS, 1985
University of Kansas – JD, 1988

Ken Grotenwiel
Title
Assistant Director
Affiliation
Kansas Water Office
Address and Telephone
901 S. Kansas Avenue
Topeka, KS 66612-1249
785/296-3185
kgrotenwiel@kwo.state.ks.us

Current Responsibilities
Policy development and public information.

Experience

Education
Southern Illinois University – BA, 1971

David Heinemann
Title
Special Assistant to the Secretary
Affiliation
Kansas Department of Revenue
Address and Telephone
915 SW Harrison
Topeka, KS 66625-0001
785/296-8458
david.heinemann@kdoe.state.ks.us

Current Responsibilities
Special Assistant to the Secretary.

Experience
State Representative, 27 years; General Counsel, KCC, 2 years; Executive Director, KCC, 2 years
Carl Holmes
Title
Representative, 125th District
Affiliation
Kansas House of Representatives
Address and Telephone
P.O. Box 2288
Liberal, KS 67905
620/624-7361
785/296-8458
repcarl@ruraltel.net
Current Responsibilities
Chair, Utilities Committee; Chair, Joint Committee on Administrative Rules and Regulations; Member, Agriculture & Natural Resources Budget and Select Committee on Kansas Security Committees; Vice Chair, National Conference of State Legislators Committees (Energy and Electric Utilities and Advisory Council on Energy); Farm/Ranch owner and manager
Experience
Chair, House Energy & Natural Resources Committee; President, Kansas League of Municipalities
Education
Colorado State University – BS, 1962

Becky Hutchins
Title
Representative, 50th District
Affiliation
Kansas House of Representatives
Address and Telephone
700 Wyoming
Holton, KS 66436
785/364-2612
jhutchins@holtonks.net
Current Responsibilities
Chair, House Tourism & Parks Committee; Member, Education, Federal & State Affairs, and State-Tribal Relations (joint) Committees
Experience
Currently serving 5th term in Kansas House of Representatives, 50th District
Education
Washburn University – BA, 1986

Dan Johnson
Title
Representative, 110th District

Annie Kuether
Title
Representative, 55th District
Affiliation
Kansas House of Representatives
Address and Telephone
1346 SW Wayne Ave.
Topeka, KS 66604-2606
785/232-0717
keut@aol.com
Current Responsibilities
Ranking Minority Member, Utilities Committee; Member, General Government & Commerce Budget, Higher Education, and Economic Development Committees
Experience
Kansas Legislature, 7 years; Administrative Assistant to Kathleen Sebelius, 4 years; retail sales

Wayne Lebsack
Title
President / Trustee
Affiliation
Lebsack Oil Production Inc. / The Nature Conservancy
Address and Telephone
603 S. Douglas
Lyons, KS 67554
620/938-2396

Current Responsibilities
Chair, Stewardship Committee, The Nature Conservancy; petroleum exploration and development

Experience
Oil and gas exploration; ground-water exploration and pollution research

Education
Colorado School of Mines – Geol. Eng., 1949
Colorado School of Mines – Petrol. Geol., 1952
Colorado School of Mines – 2 years grad. studies

Janis Lee
Title
Senator, 36th District
Affiliation
Kansas Senate
Address and Telephone
R.R. 2, Box 145
Kensington, KS 66951
785/476-2294
jlee@ink.org

Current Responsibilities
State Senator; Ranking Minority Member, Natural Resources and Assessment & Taxation Committees; Member, Utilities, Agriculture, Education, Children’s Issues (joint), and Reapportionment Committees

Experience
Involved in family ranching and farming operation; USD #238 Board of Education

Education
Kansas State University – BS, 1970

Robin Lehman
Title
Director of Research External Relations & Special Projects
Affiliation
University of Kansas, Provost & Center for Research (KUCR)

Address and Telephone
2385 Irving Hill Rd.
University of Kansas
Lawrence, KS 66045
785/864-3475
rlehman@ku.edu

Current Responsibilities
Provost’s office: policy and proposal development, project management; KUCR: Director, external relations and special project development

Experience
President of Lehman Communications, Inc., a communications consulting & lobbying firm (since 1992)

Education
University of Kansas – BS, 1992

Judith Loganbill
Title
Representative, 86th District
Affiliation
Kansas House of Representatives
Address and Telephone
215 S. Erie
Wichita, KS 67211
316/683-7382
Judith.Loganbill@msn.com

Current Responsibilities
State Representative; Member, House Economic Development, Education, Federal & State Affairs, and Economic Development (joint) Committees; Elementary teacher in Wichita, KS

Education
Bethel College – BS, 1971

Margaret E. Long
Title
Representative, 36th District
Affiliation
Kansas House of Representatives
Address and Telephone
1801 N. 126th St.
Kansas City, KS 66109
913/721-2322

Current Responsibilities
Ranking Minority Member, Transportation Committee; Member, Tourism & Parks, Utilities, Pensions, Investments & Benefits (joint) Committees; Member Select Committee on Pensions

Experience
Administrative Accountant, TWA (40 years)

Education
Ward High School
Kansas City Kansas Community College
Brad Loveless
Title
Manager, Biology & Conservation Programs / President
Affiliation
Westar Energy / Kansas Association of Conservation and Environmental Education (KACEE)
Address and Telephone
122 SW 2nd St.
Topeka, KS 66603
785/575-8115
brad_loveless@wr.com
Current Responsibilities
President of KACEE; Coordinate conservation programs for Westar Energy and their Green Team
Experience
1985–1997, Manager, Environmental Management at Wolf Creek Generating Station; Green Team Steering Committee since 1991
Education
Ohio State University – BS, 1981
University of Kansas – MS, 1983

Cindy Neighbor
Title
Representative, 18th District
Affiliation
Kansas House of Representatives
Address and Telephone
10405 W. 52nd Terr.
Shawnee, KS 66203
913/268-9061
CindyNeigh@cs.com
Current Responsibilities
State Representative; Member, Utilities, Higher Education, Insurance, and Health & Human Services Committees; Member, School Board, USD 512
Experience
Retired medical administrator over 8 clinics and 25 physicians
Education
Kansas City Kansas Junior College
Johnson County Community College

Adrian Polansky
Title
Secretary
Affiliation
Kansas Department of Agriculture
Address and Telephone
109 SW 9th St.
Topeka, KS 66612
785/296-3902
ajpolansky@kda.state.ks.us
Current Responsibilities
Cabinet Secretary; Executive manager of Kansas Department of Agriculture and its regulatory programs; involved in agricultural legislative issues
Experience
Owner of Polansky Farms and Polansky Seed, Belleville, KS; State Executive Director of Kansas Farm Service Agency, 1993–2001
Education
Kansas State University – BS, 1972

David L. Pope
Title
Chief Engineer
Affiliation
Kansas Department of Agriculture, Division of Water Resources
Address and Telephone
109 SW 9th St., 2nd Floor
Topeka, KS 66612
785/296-3710
DPope@kda.state.ks.us
Current Responsibilities
Represent Kansas on all four interstate river compacts; Missouri Basin States Association; Kansas Water Authority; State Conservation Commission, and Kansas Geographic Information System Policy Board
Experience
Assistant Chief Engineer, KDA; Manager, GMD No. 3; Extension Irrigation Engineer, Garden City and Manhattan, KS
Education
Oklahoma State University – BA, 1970
Oklahoma State University – MS, 1971

Doug Spangler
Title
City Administrator
Affiliation
City of Edwardsville, KS
Address and Telephone
690 S. 4th St.
Edwardsville, KS 66113
913/441-3707
Current Responsibilities
City manager
Experience
City of Kansas City, KS; Kansas City, KS Public Housing Authority; Member, Kansas Legislature, 1995–2002
Education
Kansas State University – BS, 1985
University of Kansas – MPA, 1993
Don Steeles
Title
Vice Provost
Affiliation
University of Kansas
Address and Telephone
250 Strong Hall
University of Kansas
Lawrence, KS 66045
785/864-4904
don@ku.edu
Current Responsibilities
McGee Professor of Geophysics and Vice Provost for Scholarly Support, University of Kansas; responsible for space allocation on Lawrence campus
Experience
17 years at Kansas Geological Survey; 8 years as Associate Director and Deputy Director
Education
Kansas State University – BS, 1969
Kansas State University – MS, 1970
Stanford University – MS, 1974
Stanford University – PhD, 1975

Tracy Streeter
Title
Executive Director
Affiliation
State Conservation Commission
Address and Telephone
109 SW 9th, Suite 500
Topeka, KS 66612
785/296-3600
tstreeter@scc.state.ks.us
Current Responsibilities
Agency Head
Experience
Education
Highland Community College – AA, 1983
Missouri Western State College – BS, 1985
University of Kansas – MPA, 1993

John Strickler
Title
Chair / Vice Chair / Treasurer
Affiliation
Kansas Chapter, The Nature Conservancy / Kansas Natural Resources Legacy Alliance / KACEE
(Kansas Association for Conservation and Environmental Education)

Address and Telephone
1523 University Drive
Manhattan, KS 66502-3447
785/565-9731
jstrickl@oznet.ksu.edu
Current Responsibilities
Chair, Board of Trustees, The Nature Conservancy, Kansas Chapter; Vice Chair, KS Natural Resources Legacy Alliance; Treasurer, KACEE
Experience
Former Executive Director, KACEE; Special Assistant for Environment and Natural Resources to Governor Mike Hayden, 2 years; Acting Secretary, Kansas Department of Wildlife and Parks, 1987 and 1995; Kansas State and Extension Forestry, KSU, 33 years; U.S. Forest Service, 4 years
Education
University of Missouri – BS, 1957
Kansas State University – MS, 1968

Mary Torrence
Title
Assistant Revisor of Statutes
Affiliation
Revisor of Statutes Office
Address and Telephone
300 SW 10th, Suite 322-S
Topeka, KS 66612-1592
785/296-5239
maryt@rs.state.ks.us
Current Responsibilities
Legislative staff; drafting legislation; and legal advisor
Experience
Revisor of Statutes Office, 29 years
Education
University of Kansas – BA, 1971
University of Kansas – JD, 1974

James R. Triplett
Title
Chair
Affiliation
Biology Department, Pittsburg State University
Address and Telephone
1701 S. Broadway
Pittsburg, KS 66762-7552
620/235-4732
jtriplet@pittstate.edu
Current Responsibilities
Professor and Chair, Biology Department, PSU; Chair, Neosho Basin Advisory Committee
Experience
Assistant Professor, PSU; Assistant Professor, Ohio State University, 5 years; Officer, U.S. Navy, 1968–1971

Education
Kansas State College of Pittsburg – BA, 1966
Kansas State College of Pittsburg – MS, 1968
University of Kansas – PhD, 1976

Eric Wade
Title
Deputy County Manager
Affiliation
Johnson County
Address and Telephone
111 S. Cherry
Olathe, KS 66061
913/715-0730
eric.wade@jocoks.com
Current Responsibilities
Oversight of various county departments, including wastewater, public works, stormwater, and environmental
Experience
Nearly 20 years of local government management experience, including 11 years as a city administrator
Education
Park College – BA
Park College – MPA

Hannes Zacharias
Title
Assistant County Manager
Affiliation
Johnson County
Address and Telephone
111 S. Cherry St., Suite 3300
Olathe, KS 66061
913/715-0731
hannes.zacharias@jocoks.com
Current Responsibilities
Oversee and manage the 7 human services departments of Johnson County, including emergency communications, emergency management, public health, Med-Act, human services, and aging and corrections
Experience
City Manager, Hays, KS; City Administrator, Boonville, MO; Assistant to City Manager, Lawrence, KS; Assoc. Director and Chief Grants Officer, KS Arts Commission
Education
Wichita State University – BA, 1979
University of Kansas – MS, 1988

KANSAS GEOLOGICAL SURVEY STAFF

Lee Allison
Title
Director and State Geologist
Affiliation
Kansas Geological Survey
Address and Telephone
1930 Constant Ave.
University of Kansas
Lawrence, KS 66047-3726
785/864-2108
lallison@kgs.ku.edu
Current Responsibilities
Director of administration and geologic research.
Experience
Kansas Geological Survey, 4 years; Director and State Geologist, Utah Geological Survey, 10 years; Western Earth Science Technologies, Inc., 6 years; University of Utah Research Institute, 3 years; SOHIO, 3 years
Education
University of California, Riverside – BA, 1970
San Diego State University – MS, 1974
University of Massachusetts – PhD, 1986

Rex Buchanan
Title
Associate Director
Affiliation
Public Outreach, Kansas Geological Survey
Address and Telephone
1930 Constant Ave.
University of Kansas
Lawrence, KS 66047-3726
785/864-2106
rex@kgs.ku.edu
Current Responsibilities
Supervise publication and public outreach activities, media relations, and non-technical communications
Experience
Kansas Geological Survey, 25 years; University-Industry Research, University of Wisconsin, 3 years; Salina Journal, 4 years
Education
Kansas Wesleyan University – BA, 1975
University of Wisconsin-Madison – MA, 1978
University of Wisconsin-Madison – MS, 1982

Liz Brosius
Title
Research Assistant
Affiliation
Editing and Geology Extension, Public Outreach Section, Kansas Geological Survey
Jim McCauley
Title
• Assistant Scientist
Affiliation
Geologic Investigations Section, Kansas Geological Survey
Address and Telephone
1930 Constant Ave.
University of Kansas
Lawrence, KS 66047-3726
785/864-2192
jim_mccauley@kgs.ku.edu
Current Responsibilities
Geologic mapping, remote sensing, public inquiries
Experience
Kansas Geological Survey, 27 years; KU Remote Sensing Laboratory, 6 years
Education
University of Kansas – BS, 1970
University of Kansas – MS, 1973
University of Kansas – PhD, 1977

Bill Harrison
Title
Deputy Director and Chief Geologist
Affiliation
Kansas Geological Survey
Address and Telephone
1930 Constant Ave.
University of Kansas
Lawrence, KS 66047-3726
785/864-2070
harrison@kgs.ku.edu
Current Responsibilities
Plan and initiate major research programs; Assess scientific quality of current programs
Experience
Kansas Geological Survey, 6 years; Lockheed Martin Idaho Technologies; EG&G Idaho, Inc.; ARCO Exploration & Technology; University of Oklahoma/ Oklahoma Geological Survey, Faculty/Staff Geologist
Education
Lamar State College of Technology - BS, 1966
University of Oklahoma – MS, 1968
Louisiana State University – PhD, 1976

Bob Sawin
Title
Research Associate
Affiliation
Geology Extension, Public Outreach Section, Kansas Geological Survey
Address and Telephone
1930 Constant Ave.
University of Kansas
Lawrence, KS 66047-3726
785/864-2099
bsawin@kgs.ku.edu
Current Responsibilities
Geology Extension, Kansas Field Conference, geologic mapping
Experience
Kansas Geological Survey, 11 years; Petroleum Geology, 15 years; Engineering Geology, 6 years
Education
Kansas State University – BS, 1972
Kansas State University – MS, 1977
Welcome to the 2003 Field Conference, co-sponsored by the Kansas Geological Survey, the Kansas Water Office, the Kansas Department of Wildlife and Parks, and Johnson County, Kansas. Previous field conferences have focused on specific natural-resource issues, such as water or energy, or specific regions. This year the Field Conference moves to northeastern Kansas, an area where a growing population has put increasing pressure on natural resources.

Nearly all of the trip will be spent in the glaciated region of northeastern Kansas, that part of the state that was covered by a sheet of ice about 600,000 years ago. That ice brought with it large red boulders of Sioux quartzite that are still scattered about the landscape. Melt-water streams from the glaciers carried silt that was later blown into thick deposits by the wind. This finely ground silt, called loess, makes up many of the hills and bluffs, such as those that line the Missouri River around Atchison. Loess has the ability to form a steep cliff face, and is also visible in many of the roadcuts in the Kansas City area. This glacial material is much more recent than the underlying bedrock, which is Pennsylvanian in age, or about 300 million years old. Pennsylvanian seas left behind layers of limestone and shale. Sandstone and coal were also sometimes deposited in the area.

A Preview

Day 1.—Much of our first day will be spent in Johnson County, the most populous county in the state. The increasing urbanization of this area, and the county’s response to that urbanization, make for a good case study of the interaction between people, resources, and the environment. The county has 21 incorporated cities, including two of the largest cities in the state—Overland Park and Olathe, the county seat. Slightly over half of the 477 square miles of land in the county currently remains in farmland, a third is urbanized, and the remainder is predominantly woodland. The county’s population increased from 270,000 in 1980 to 476,000 in 2002. In the 1990’s alone it increased by 27%. From 2000 to 2030, the county’s population is projected to grow to 655,000, another increase of 40%. If that holds true, nearly a quarter of the state’s 2.7 million residents will live in this one county. Annual per capita income is about $43,000, the highest among the state’s counties.

Our first stop will be at the Sunflower Army Ammunition Plant, a deactivated facility in western Johnson County, adjacent to Kansas Highway 10. In this rapidly developing area, this land is obviously ripe for development, but any development faces a variety of issues related to environmental cleanup. From Sunflower we will move to more urban parts of the county and discuss the issues that accompany urbanization: planning, parks, storm-water runoff, urban wildlife, and floodplain development. We will then visit the Johnson County Landfill, operated by Deffenbaugh Industries, Inc.

We then move across the Kansas River into Wyandotte County, where Deffenbaugh operates a recycling center. Wyandotte County has a population of about 157,000, the fourth most populous county in the state. Although the county lost about 2.6 percent of its population during the last decade, some parts have recently undergone an economic resurgence. With the completion of the Kansas Speedway at the intersection of Interstates 70 and 435, other companies have moved into the area, including Nebraska Furniture Mart, Great Wolf Lodge and Waterpark, and the Kansas City T-Bones.
baseball team. We will visit another new facility there, Cabela's, to discuss nature-based and outdoor tourism.

*Day 2.*—On the second day, we return to Wyandotte County, to Kaw Point at the confluence of the Kansas and Missouri rivers, where we will discuss plans for a new park and the Unified Government of Wyandotte County and Kansas City, Kansas. We will also hear from the Mid-America Regional Council, an organization that takes on issues that cut across state lines, which is particularly important in a metropolitan area that covers two states but shares many common problems, such as air pollution or water quality. This location is also appropriate for discussing the Lewis and Clark expedition, which camped here almost 200 years ago on its way west and is being commemorated in a park. From here we go to a location along the Kansas River in Bonner Springs to discuss sand dredging.

The next stop is to the north, in Atchison County. We will discuss a variety of issues related to the Missouri River, including management of the river for barge traffic and the impact of that management on wildlife and other reservoirs in the state. We will see a new access point on the Missouri that is also playing a role in area tourism. At Benedictine Bottoms, we will tour an area that is being restored for wildlife.

*Day 3.*—On the final day, we cross the state line into Missouri to visit an underground limestone mine and cement plant in Sugar Creek, just north of Independence. This mine is unique to the area because it has gone relatively deep, about 700 feet, to recover high-quality limestone and to minimize environmental issues that often arise in urban areas. We will also visit a state-of-the-art cement factory operated by Lafarge North America.

**About the Kansas Field Conference**

The 2003 Field Conference is the ninth in the Survey’s annual field conferences. The purpose of the Field Conference is to provide first-hand, on-site experience on natural-resource issues to the state’s policy makers. Local and regional experts in resources will describe each site and the resource issues related to it. When possible, participants will interact with county, state, and regional officials, environmental groups, and citizens' organizations. This information base will provide participants with new and broader perspectives useful in formulating policies. In addition, this comprehensive Field Guide provides background on the sites and the issues, serving as a handy reference long after the Field Conference is over.

During the Field Conference, participants are expected to be just that—participants. You are encouraged to make contributions to the discussions, ask questions, and otherwise participate in deliberations. **The bus microphone is open to everyone, and everyone is encouraged to contribute.**

In the course of this Field Conference, we do not seek to resolve policy or regulatory conflicts. Instead, we try to provide opportunities to familiarize policy makers with resource problems and issues. By bringing together experts who examine the unique technical, geographical, geological, environmental, social, and economic realities of the region, we hope to go beyond merely identifying issues. We want this combination of first-hand experience and interaction among participants to result in a new level of understanding of the state’s natural-resource issues.

The Kansas Field Conference is an outreach program of the Kansas Geological Survey, administered through its Geology Extension Program. Its mission is to provide educational opportunities to individuals who make and influence policy about natural resources and related social, economic, and environmental issues in Kansas. The Survey’s Geology Extension program is designed to develop materials, projects, and services that communicate information about the geology of Kansas, the state’s natural resources, and the products of the Kansas Geological Survey to the people of the state.

The Kansas Field Conference was begun in 1995 with the support of Lee Gerhard, who was then Survey director and state geologist. The Field Conference is modeled after a similar program of
national scope, the Energy and Minerals Field Institute, operated by the Colorado School of Mines. The Kansas Geological Survey appreciates the support of Dr. Erling Brostuen, Director of the Energy and Minerals Field Institute, in helping develop the Kansas project.

In 2001, the Kansas Geological Survey’s Field Conference was recognized by the National Institute of Standards and Technology as among 50 Best Practices for Communication of Science and Technology to the Public. In 1998, the Field Conference received the Public Outreach Award from the Division of Environmental Geosciences of the American Association of Petroleum Geologists. Survey staff members appreciate the willingness of participants to attend the Field Conference and to share their insights for its improvement. Your input has helped make the Field Conference a model to be adopted by other state geological surveys.

**Kansas Geological Survey**

Since 1889, the Kansas Geological Survey has studied and reported on the state’s geologic resources and hazards. Today the Survey’s mission is to study and provide information about the state’s geologic resources and hazards, particularly ground water, oil, natural gas, and other minerals. In many cases, the Survey’s work coincides with the state’s most pressing natural-resource issues.

By statutory charge, the Survey’s role is strictly one of research and reporting. The KGS has no regulatory function. It is a division of the University of Kansas. The KGS employs about 70 full-time staff members and about 80 students and grant-funded staff. It is administratively divided into research and support sections. Survey programs can be divided by subject into water, energy, geology, and information dissemination.

**Water.**—Water issues directly affect the life of every Kansan. Water supplies are crucial for domestic and municipal use, and in much of the state’s economic activity. Western Kansas agriculture and industry rely heavily on ground water; in eastern Kansas, growing populations and industry generally use surface water. The Survey’s water research and service includes an annual water-level measurement program (in cooperation with the Kansas Department of Agriculture), studies of mineral intrusion in the Big Bend and Equus Beds areas, water quality in the Arkansas River, depletion of the Ogallala aquifer, the interaction between streams and aquifers, and a variety of other topics.

**Energy.**—Kansas produces more than $2 billion worth of oil and natural gas each year. Because much of the state has long been explored for oil and gas, maintaining that production takes research and information. The Survey studies the state’s coal resources and one newly developed source of energy, coalbed methane. The Survey does research on the state’s petroleum reservoirs, new methods of providing information (such as a digital petroleum atlas), and new methods of producing oil (such as the use of carbon dioxide flooding, a technique that was discussed during the 2001 Field Conference). The Survey is completing a multi-year study of the resources of the Hugoton Natural Gas Area and issues related to carbon dioxide sequestration. The Survey also has a branch office in Wichita, the Wichita Well Sample Library, that stores and loans rock samples collected during the drilling of oil and gas wells in the state. In 2002, the Survey played a leading role in the State’s Energy Resources Coordinating Council.

**Geology.**—Much of the Survey’s work is aimed at producing basic information about the state’s geology, information that can be applied to a variety of resource and environmental issues. The Survey develops and applies methods to study the subsurface, such as high-resolution seismic reflection, undertakes mapping of the surficial geology of the state’s counties, and studies specific resources, such as road and highway materials. The Survey reports on non-fuel minerals (such as salt, gypsum, aggregates, etc.) and is charged with studying geologic hazards, such as subsidence, earthquakes, and landslides.

**Geologic Information.**—To be useful, geologic information must be disseminated in a form that is most appropriate to the people who need it. The Survey provides information to the general public, to policy-makers, to oil and gas explorationists, water specialists, other governmental agencies, and academic specialists. Information is disseminated through a publication sales office, automated mapping, the state’s Data Access and Support Center, a data library, electronic publication, and Geology Extension.
Kansas Geological Survey Staff participating in the 2003 Field Conference:

M. Lee Allison, Director and State Geologist
Bill Harrison, Deputy Director
Rex C. Buchanan, Associate Director, Public Outreach
James R. McCauley, Assistant Scientist, Geologic Investigations Section
Liz Brosius, Research Assistant, Geology Extension/Editing
Robert S. Sawin, Research Associate, Geology Extension

Kansas Geological Survey
1930 Constant Ave.
Lawrence, KS 66047
785/864-3965
785/864-5317 (fax)

http://www.kgs.ku.edu

Kansas Department Of Wildlife And Parks

The Kansas Department of Wildlife and Parks is responsible for management of the state’s living natural resources. Its mission is to conserve and enhance the natural heritage of Kansas, its wildlife, and its habitats. The Department works to assure future generations of the benefits of the state’s diverse living resources; provide the public with opportunities for the use and appreciation of the natural resources of Kansas, consistent with the conservation of those resources; and inform the public of the status of the natural resources of Kansas to promote understanding and gain assistance in achieving this mission.

The Department’s responsibility includes protecting and conserving fish and wildlife and their associated habitats while providing for the wise use of these resources, and providing associated recreational opportunities. The Department is also responsible for providing public outdoor recreation opportunities through the system of state parks, state fishing lakes, wildlife management areas, and recreational boating on all public waters of the state.

In 1987, two state agencies, the Kansas Fish and Game Commission and the Kansas Park and Resources Authority, were combined into a single, cabinet-level agency operated under separate comprehensive planning systems. The Department operates from offices in Pratt, Topeka, five regional offices (including one in Lenexa), and a number of state park and wildlife area offices.

As a cabinet-level agency, the Department of Wildlife and Parks is administered by a Secretary of Wildlife and Parks and is advised by a seven-member Wildlife and Parks Commission. All positions are appointed by the Governor with the Commissioners serving staggered four-year terms. Serving as a regulatory body for the Department, the Commission is a non-partisan board, made up of no more than four members of any one political party, advising the Secretary on planning and policy issues regarding administration of the Department. Regulations approved by the Commission are adopted and administrated by the Secretary.

Kansas Dept. of Wildlife and Parks
Operations Office
512 SE 25th Ave.
Pratt, KS 67124-8174
316/672-5911
316/672-6020 (fax)

Secretary Mike Hayden
Landon State Office Building
1020 Kansas Ave.
Topeka, KS 66612
785/296-2281
785/296-6953 (fax)

Kansas City District Office
14639 W. 95th
Lenexa, KS 66215
Phone: 913/894-9113

http://www.ink.org/public/kdwp/

The Kansas Water Office

The mission of the Kansas Water Office (KWO) is to provide the leadership to ensure that water policies and programs address the needs of all Kansans for the present and into the 21st century. The KWO evaluates and develops public policies, coordinating the water-resource operations of
agencies at all levels of government. The KWO administers the Kansas Water Plan Storage Act, the Kansas Weather Modification Act, and the Water Assurance Act. It also reviews the plans of any state or local agency for the management of the water and related land resources of the state.

The KWO develops the Kansas Water Plan, which is revised annually and addresses the management, conservation, and development of the water resources of the state. Numerous water-related public and private entities, as well as the general public, are involved in its preparation and planning. The Kansas Water Plan is approved by the Kansas Water Authority, a thirteen-member board whose members are appointed to their positions, along with ten non-voting ex officio members who represent various state water-related agencies. In addition to approving the Water Plan, the Authority approves water storage sales, federal contracts, administrative regulations, and legislation proposed by the KWO. Much of the input for the Water Plan comes via twelve Basin Advisory committees. These committees are composed of volunteer members from each of the drainage basins in the state. During this year’s Field Conference, we will be in the Kansas-Lower Republican and Missouri basins.

The Kansas Water Plan is directly linked with the State Water Plan Fund (SWPF). This fund, which takes in and expends about $18 million annually, provides funding for water-related projects that have been identified in the Kansas Water Plan. Every fall the KWA makes recommendations to the Governor and the Legislature on distributing the funds to implement the State Water Plan.

Key Responsibilities of the Kansas Water Office

1. Administer the State Water Resources Plan Act. (K.S.A. 82a-901 et seq.)
2. Conduct public water supply planning. (K.S.A. 74-2616)
3. Administer the State Water Plan Storage Act (Water Marketing Program) (K.S.A. 82a-1301 et seq.)
4. Administer the Water Assurance Program Act. (K.S.A. 82a-1345 et seq.)
5. Manage the State Water Plan Fund. (K.S.A. 82a-951)

6. Administer the Weather Modification Program. (K.S.A. 82a-1411)
7. Coordinate water related activities of state, local and federal government. (K.S.A. 82a-931)
8. Negotiate water-related agreements with the federal government. (K.S.A. 82a-915 & 82a-933)
9. Coordinate water-related research. (K.S.A. 82a-941)
10. Issue water-related revenue bonds. (K.S.A. 82a-1316)
11. Collect and compile information pertaining to the water resources of the state. (K.S.A. 74-2608 et seq.)
12. Work out a plan of water resources management, conservation and development for water planning areas in the state. (K.S.A. 74-2608 e t seq.)
13. Develop and maintain guidelines for water conservation plans and practices. (K.S.A. 74-2608 et seq.)
14. Establish guidelines for conditions indicative of drought. When such conditions are met, advise the Governor, and recommend that the Governor’s Drought Response Team be assembled. (K.S.A. 74-2608 et seq.)

Kansas Water Office
901 S. Kansas Avenue
Topeka, KS 66612
785/296-3185
1-888/KAN-WATER
http://www.kwo.org/

Johnson County, Kansas

Johnson County was originally part of the Shawnee Indian reservation and was opened to settlement with the passing of the Kansas-Nebraska Act of 1854. The area was crisscrossed by a number of major westward migration routes, including the Santa Fe and Oregon-California Trails. Johnson County was established in 1855. One of the first 33 counties in the state, it was named for the Reverend Thomas Johnson, founder of the Shawnee Methodist Mission.
The first city in Johnson County was Olathe Town company, incorporated in 1857. Soon thereafter, the towns of Spring Hill, Gardner, De Soto, and Gum Springs (present day Shawnee) also were incorporated. In 1870, 13,000 people resided in the county. The population remained relatively stable and the economy agriculturally based until the 1910's when the northeastern section of the county began to develop. Lured by J.C. Nichols' innovatively designed communities, Mission Hills in the early 1910's and the Country Club District in the early 1920's, the population began to grow.

In 1904, W. B. Strang began construction of an interurban electric railroad between Kansas City and Olathe. It passed through his newly planned community, Overland Park, and the town of Lenexa. A second interurban railroad, the Hocker Grove Line, was constructed south and west through Merriam and Shawnee. Today Johnson County is the most populous county in Kansas. Overland Park, with 150,000 residents, is the second-largest city in the state.

A seven-member Board of County Commissioners exercises general authority over the County's business and affairs to ensure the general health, safety, and welfare of the public. The Board of County Commissioners has exclusive power to enact, amend, and repeal local legislation, to levy taxes and to make appropriations, to adopt budgets, and to make appointments to certain offices, boards, and commissions.

The county manager serves as the chief administrative officer of the County Government and directs, supervises, and provides continuity for the proper and efficient administration of its business and affairs. The county manager implements the policy and priority decisions and programs of the County Commissioners through a strategic management system. The county manager develops and administers an annual operating budget, which serves as policy document, financial plan, operations guide, and communications device of County Government.

The county manager is responsible for a number of activities and agencies including Park and Recreation, Library, Airports, Mental Health, Public Health, Corrections, Museum, Emergency Management, Emergency Communications, Human Services and Aging, Nursing Center, Appraiser, Planning and Codes, Environmental Department, and Wastewater Department. The County Treasurer, County Clerk, Elections Commission, Sheriff, Register of Deeds, District Attorney, and courts are also part of Johnson County government.

Johnson County Commission
111 South Cherry, Suite 3300
Olathe, KS 66061-3441
Phone: 913/715-0430
Fax: 913/715-0440
http://bocc.jocoks.com/default.htm
SCHEDULE & ITINERARY

Wednesday, June 4, 2002

7:00 am  Breakfast at the Holiday Inn, Lawrence

7:20 am  Conference Overview
       Lee Allison, Director, Kansas Geological Survey

8:00 am  Bus Leaves Holiday Inn for Site 1

8:30 am  SITE 1—Sunflower Army Ammunition Plant
       Tony Sparr, Sunflower Army Ammunition Plant
       Dean Palos, Johnson County Planning Dept.

10:30 am  Bus to Site 2

11:00 am  SITE 2—The Streamway Parks System and Johnson County
       Hannes Zacharias, Johnson County Manager’s Office
       Bill Maasen and Randy Knight, Johnson County Park and
       Recreation
       Chris Mammoliti, Kansas Dept. of Wildlife and Parks

11:45 am  Lunch at Shawnee Mission Park

12:30 pm  Bus to Site 2a

12:40 pm  SITE 2a—Mill Creek Floodplain Buyout Area
       Kent Lage, Johnson County Stormwater Management Program

1:00 pm  Bus to Site 2b

1:20 pm  SITE 2b—Mill Creek Regional Sewer Plant

2:00 pm  Bus to Site 3

2:15 pm  SITE 3—Johnson County Landfill
       Randy Alewine, Deffenbaugh Industries, Inc.
       Phil Askey, Johnson County Environmental Dept.

4:15 pm  Bus to Site 4

4:30 pm  SITE 4—Cabela’s and Nature-based Tourism
       George Potts, Kansas Nature-based Tourism Alliance
       Jerry Hover, Kansas Dept. of Wildlife and Parks
       John Castillo, Cabela’s

6:15 pm  Dinner at Cabela’s

7:45 pm  Bus to motel

8:00 pm  Holiday Inn, Mission/Overland Park
Glaciated Region

As the name suggests, the Glaciated Region is the part of Kansas that was glaciated—that is, it was covered by at least two of the eight or nine glaciers that encroached upon much of the northern United States during the Pleistocene Epoch, between 1.6 million and 10,000 years ago. The first of these covered just the northeastern corner of Kansas. The second, which encroached on Kansas about 600,000 years ago, extended almost to Manhattan and beyond Topeka and Lawrence in a line roughly parallel to the present-day Kansas River. In some places, this ice sheet was 500 feet thick.

The underlying bedrock in the Glaciated Region, Pennsylvanian and Permian limestones and shales, was deposited about 320 to 250 million years ago. These rocks, however, have been covered by thick glacial deposits—silt, pebbles, and boulders—that were left behind when the ice melted. In some places, the thick deposits, which geologists call glacial drift, have formed deep soils.

Except for the glacial drift, erosion has erased most of the evidence of glaciation from the Kansas landscape. In other parts of North America, such as Wisconsin, the glaciation was more recent and the landscape still bears the marks of the advancing and retreating ice sheet.

During the Pre-Illinoian glaciation in Kansas, the force of the advancing ice was strong enough to break large boulders off outcrops in South Dakota, Iowa, and Minnesota and carry them into Kansas. Rocks that have been transported into an area from far away are called erratics. Among the glacial erratics in northeastern Kansas, quartzite is one of the most common. Quartzite, a metamorphic rock, is quartz sandstone that is so thoroughly cemented with silica (SiO₂) that the rock breaks through the grains as easily as around them. It is harder than sandstone and can not be scratched by a knife. The quartzite boulders in the Glaciated Region, known as Sioux quartzite, come from the area around Sioux Falls, South Dakota, where Sioux quartzite occurs naturally and crops out at the surface.

Source
Sunflower Army Ammunition Plant

History

Sunflower Ordnance Works, now Sunflower Army Ammunition Plant, was established in 1941 on 9,065 acres in Johnson County, Kansas, as the world's largest powder plant. On March 23, 1943, Hercules Powder Company (now known as Hercules, Inc.) began the production of smokeless powder. During World War II, over 200 million pounds of powder and propellants were produced with peak employment reaching 12,067. An additional 10,000 people were employed in construction jobs.

In June 1946, parts of the plant were designated as standby (inactive), meaning the facilities were inspected and maintained for future production. By June 1948, Hercules Powder Company had vacated the premises. The entire installation was placed in standby, and the government took over plant maintenance and surveillance.

In 1951, Sunflower was activated to support the Korean Conflict, producing over 166 million pounds of weapons propellants. It remained open until 1960 with a peak employment of 5,374. In June 1960, Sunflower was again in standby status, until August 20, 1965, when facilities were activated to support the Vietnam War, producing over 145 million pounds of propellants and with a peak employment of 4,065. Production ceased in June 1971, with delivery of final propellant the following month.

In 1984, the plant became the sole domestic source of nitroglycerine, an explosive component of propellants used in artillery and tank ammunition. The plant produced 63 million pounds of nitroglycerine from 1984 to 1992. In January 1994, a Corps of Engineers contractor completed construction of an Industrial Wastewater Treatment Facility that was designed to treat wastewater resulting from nitroglycerine production. Hercules, Inc. took over operation of that facility in February 1994, and in September 1994 they began treating wastewater that had been stored in six lagoons. In May 1995 all wastewater had been treated, and the lagoons were declared empty.

Current Use

In 1997, the Army began the process of closing the plant. SpecPro, Inc. took over as the maintenance contractor on October 1, 2001. The Army continues to investigate and clean up contaminated soil, sediment, and ground water. Excess equipment is being transferred to other governmental agencies. Explosive-decontamination work awaits funding. Disposal of inactive transformers and cleanup of PCB oil spills is underway. Abatement of asbestos that insulated above-ground steam lines is underway. Remaining improvements include 1,600 buildings, 110 explosive storage magazines, 126 miles of roads, and 51 miles of railroads.

Sunflower has been the subject of claims by the Shawnee Tribe of Miami, Oklahoma. In the 1990’s and early 2000’s, Sunflower was considered as a location for the World of Oz Theme Park. Those plans fell through, however, and now the General Services Administration and the Army are working with the State of Kansas on an agreement to transfer the entire installation to Johnson County. Johnson County’s master plan for the county calls for a “community in the park” development at Sunflower (fig. 3-1), though other uses, such as a research park, have been proposed.

The 2003 session of the Kansas Legislature passed legislation allowing the creation of a seven-member redevelopment authority to oversee plans for the site. That authority has the power to issue development bonds and create sales tax and property-tax abatements in order to encourage development. All of these plans hinge, however, on the issue of the cleanup of toxic waste at the site. The Army, which continues to be responsible for cleanup, estimates that the cost of cleanup will range from $40 million to $130 million. If it is
Fig. 3-1—Proposed plan for Sunflower site.
determined that the Army is making suitable progress on the cleanup, the land could be transferred before cleanup is complete.

Sources


Resource Contacts

Tony Spaar
Commander’s Representative
Sunflower Army Ammunition Plant
P.O. Box 640
DeSoto, KS 66018
913/583-3000 x6789
tony_spaar@sfaap.net

Dean Palos
Johnson County Dept. of Planning and Development
111 South Cherry, Suite 3500
Olathe, Kansas 66061
913/715-2220
dean.palos@jocoks.com
Plan 2020

In September 1999, the Johnson County Park and Recreation District commissioned an analysis of existing District facilities and programs, and a guide for planning and financing the District into the 21st century. The resulting Master Action Plan, MAP 2020, is a comprehensive document designed to assist the District in building on its past while confronting the challenges of its future (see map on following page).

The District covers all of Johnson County, encompassing 477 square miles and a population of over 450,000 people. With the population expected to grow by 40% to more than 650,000 over the next two decades, the District is faced with several challenges in meeting the park and recreation needs of County residents. One of the District’s primary challenges is to provide facilities in the growth areas of the County where existing facilities are few. Another is the competition for available land as developers strive to meet the housing and commercial needs of the forecasted growth.

The District offers a variety of active and passive recreation opportunities. With facilities that include golf courses, athletic fields, aquatic facilities, marinas, a beach, and a nature center, the District provides over 4,000 recreation and interpretive programs annually. Due to space limitations, the District offers the majority of those programs at sites it operates but does not own. Of the District’s 6,396 acres of parkland, only 20% have been developed for active recreation endeavors.

Based on a nationally recognized standard of 40 acres of parkland per thousand residents, the District has adopted a standard of 22 acres per thousand as its contribution to the overall system to be provided in Johnson County. Municipalities, the State of Kansas, the federal government, and others will be challenged to supplement the standard in order to achieve the 40-acre minimum. The District currently provides 14.1 acres of parkland per thousand residents. The existing parkland ratio, coupled with population projections, make it necessary for the District to acquire more than 7,500 acres of additional land over the next 20 years. The acreage will be acquired in a manner that best provides regional access to park and recreation facilities for the growing population. To provide open space linkages throughout Johnson County, over 2,000 acres of the 7,500 acquired will be dedicated to the parks along streams.

Some areas of Johnson County offer limited opportunity for acquisition of additional land. In those areas, a high priority will be placed on improving existing facilities. System-wide, the District will endeavor to purchase all properties adjacent to existing park sites that are suitable for park use. A major focus in facility planning is the construction of four new multi-use centers and an extreme sports facility.

A $191.9 million Capital Improvement Plan is required to meet the County’s land acquisition and development needs. With an emphasis on acquiring additional parkland early in the implementation process, $133.2 million of the total will be required in the first ten years. Over the 20-year planning period, $88 million is to be utilized for land acquisition and $103.9 million for park development. Included in the development costs are $16.7 million for expansion of streamway parks and $24 million for construction of major facilities.

The major portion of land acquisition and capital improvement costs, $157.3 million, could be financed through a voter-approved 1/10 cent sales tax and a temporary mill levy increase. The remaining $34.6 million needed to implement MAP 2020 would be funded through a variety of other mechanisms. Grant funding for some improvements would be available from state and federal sources. Additional implementation tools would include funding through foundations and gifts, developer donations, the granting of easements or conservation easements, joint use of
Map 8
Plan for Parks
Master Action Plan 2020

Legend

- **Existing**
  - JCPRD Parks
  - Other Municipal Parks
  - State of Kansas Wildlife & Park
  - Public Golf Course
  - Semi - Public Golf Course
  - Private Golf Course
  - School Property
- **Proposed**
  - Potential Streamway
  - Park Addition W/ Proposed Trail
  - Streamway Trail Linkage
  - Potential Park Site
  - Proposed Wetland Bank & Restoration Site

Jackson County
Missouri

Cass County
Missouri

THOMPSON DYKE & ASSOCIATES, LTD.

899 Elston Blvd., Suite 515
Northbrook, Illinois 60062-4650
Telephone: 847.373.6260
E-mail: tda@intranetx.com
Fax: 847.373.9871
facilities, and other alternatives that reduce the need to purchase land. Site development costs would also be reduced through partnerships with public entities and cooperative agreements with the private sector.

Wildlife and Parks, Lenexa

The Kansas Department of Wildlife and Parks operates a regional office in Lenexa, a Johnson County suburb immediately north of Olathe. Because of the urban location of this office, it deals with issues that differ substantially from those in much of the rest of the state. The deer population in Johnson County, for example, is an important issue here because control by hunting is difficult in this heavily populated area; at the same time, car/deer accidents are common because of the heavy traffic in this area. Wildlife educational activities for an urban population and water-quality in local watersheds are also important issues here.

Source


Resource Contacts

Hannes Zacharias, Assistant County Manager
Johnson County
111 S. Cherry St., Suite 3300
Olathe, KS 66061
913/715-0731
hannes.zacharias@jocoks.com

Bill Maasen, Planning & Development Manager
Johnson County Park & Recreation District
7900 Renner Road
Shawnee Mission, KS 66219-9723
913/438-7275
bill.maasen@jocoks.com

Randy Knight, Community Relations Manager
Johnson County Park & Recreation District
17501 Midland Drive
Shawnee Mission, KS 66217
913/631-0016 X450
randy.knight@jocoks.com

Chris Mammoliti, Chief
Environmental Services
Kansas Department of Wildlife and Parks
512 SE 25th Avenue
Pratt, KS 67124
620/672-0744

Kerry Wedel
Kansas Water Office
901 S. Kansas Avenue
Topeka, KS 66612-1249
785/296-3185
kwedel@kwo.state.ks.us
Johnson County Stormwater Management Program

As Johnson County and cities have grown, so too have expectations for stormwater management systems. At the same time, flood-damage mitigation has become increasingly important. Consequently, the County, in partnership with the cities, has developed and implemented a practical and workable stormwater management plan to reduce or eliminate stormwater-related damage, inconvenience, and threat to life.

In 1988, the Kansas Legislature authorized Kansas counties to adopt a 0.10-cent sales tax for the purpose of funding stormwater management projects. Johnson County was the only county to implement the tax. Subsequent to the sales tax collection, the Board of County Commissioners created the Stormwater Management Advisory Council (SMAC) to help plan a program for the County. The Johnson County cities signed interlocal agreements that gave each city one voting member on the council. To ensure true "regional" coordination, the commissioners also requested that SMAC contain non-voting members such as the U.S. Army Corps of Engineers, the Federal Emergency Management Agency, and several of the cities and counties surrounding Johnson County. SMAC makes recommendations to the County Commissioners, who have the authority to approve recommendations. Additionally, the Commissioners created the Stormwater Management Program to manage and direct program funds and to work with the staff from the cities to implement Program policies and procedures.

In the first few years of the Program, $5 million in sales tax monies were collected annually. The County now is collecting approximately $10 million annually. To date, nearly $100 million of stormwater design and construction projects have been or are being completed through this Program. About $80 million of these projects have been paid for by the 0.10 cent sales tax, with the remainder funded by the cities.

Today, Johnson County and the cities are solving some problems by improving open channels and replacing inadequate culverts and bridges. Other problems are solved cost effectively by purchasing buildings that have a history of repetitive flooding. More importantly, and in an effort to minimize future flooding, countywide watershed studies are being completed to better define outdated Federal Emergency Management Agency (FEMA) floodplains and to estimate floodplain limits based on the continued growth and development in Johnson County. One of the primary goals of these studies is to limit development in areas that are likely to flood, and therefore limit the creation of future flooding problems that require taxpayer dollars to solve.

Two other significant and recent efforts include more proactive regional coordination and a focus on the environment. The Stormwater Management Program is a major player in the Kansas City metropolitan area's efforts towards consistent and appropriate stormwater management. Program staff are key steering team members on regional projects and efforts and the Program is one of the sources for cost-sharing of efforts that benefit the County, cities, and the region. The environmental focus is a result of the changing face of stormwater management—it is no longer acceptable to be concerned only with water quantity. There is also a need to consider environmental impacts of stormwater runoff as it relates to urban runoff, non-point source pollution, and development. The goal is to provide a holistic approach to stormwater management. This goal has been encapsulated in recently developed mission and vision statements. The Program's vision is safe, healthy, and sustainable Johnson County waterways that can be enjoyed by everyone. The Program's mission is to provide financial, technical, and other stormwater assistance services to encourage regional solutions for protecting human lives and property, conserving natural resources, and promoting appropriate public use of Johnson County stream corridors.


**Source**

Johnson County Park and Recreation District,

**Resource Contact**

Kent Lage, Manager
Stormwater Management Program
Johnson County Public Works
1800 West 56 Highway
Olathe, KS 66061
913/715-8333
kent.lage@jocoks.com
Located at the intersection of Interstate 435 and Holliday Drive in the town of Shawnee, the Johnson County Landfill receives solid waste from much of the greater metropolitan area of Kansas City. The landfill, operated by Deffenbaugh Industries, Inc., handles about 4,500 tons of trash a day from 12 counties in Kansas and Missouri and is one of the 25 largest public landfills in the country. The landfill currently covers about 600 acres, and recently received approval to expand by another 170 acres. As part of the agreement for that expansion, Deffenbaugh will pay the city of Shawnee a one-time fee of $1 million, as well as annual fees that escalate over the life of the landfill, which is scheduled to close in the year 2027.

**Landfill Construction**

The landfill is located in a quarry that is being excavated into limestones of Pennsylvanian age, including the Iola Limestone, Lane Shale, and Wyandotte Limestone (these same units are nicely exposed in the roadcut at the on-ramp from Holliday Drive to southbound I-435). Cells for the disposal of waste are lined with clay and a synthetic plastic liner that is 60 mils (or about 0.06 inches) thick (fig. 3-2). The water that seeps through the landfill (or leachate) is captured in a leachate collection system. Decomposition in landfills leads to the creation of landfill gas, which is about 45 percent methane. At the Johnson County Landfill, landfill gas is collected through a series of wells that have been drilled into the waste-filled cells. Gas from these wells is carried through pipes and collected at a compressor station where it is processed and pumped into a local pipeline, thus turning a pollutant into a resource.

**Landfill Regulation**

The Johnson County Landfill has an operational permit from the Johnson County Environmental Department (JCED) and the Kansas Department of Health and Environment (KDHE). The county permit is issued annually and contains both general and specific operating requirements. The first county permit was issued to the landfill on January 29, 1982. Starting in 1982, JCED has inspected the landfill quarterly. Currently, JCED and KDHE co-inspect the landfill twice a year.

![Fig. 3-2—New cell at Johnson County Landfill.](image)
Inspections are based on KDHE solid waste regulations and include visual inspection of landfill waste-disposal operations, such as working-face area, asbestos disposal, special waste disposal, tire shredding, white goods area with freon collection, composting site, medical-waste transfer station, the construction/demolition landfill, and the random-waste screening program. A review of records is also performed. An inspection letter is prepared by JCED specifying those areas needing attention or correction.

The leachate is sampled quarterly from collection tanks in the landfill. Hayes Creek flows through the landfill and is sampled quarterly at three locations: upstream of landfill activities, center of the landfill, and downstream of the landfill. A series of observation wells have been drilled around the property and are analyzed twice a year to monitor water-quality. The landfill gases are subject to regulation under the federal Clean Air Act, and the landfill is monitored quarterly to assure that it complies with these regulations.

**Deffenbaugh Industries**

Deffenbaugh Industries, Inc., was founded in 1957 and is headquartered in Shawnee Mission. Deffenbaugh is the largest privately owned refuse firm in the midwest, employing more than 1,500 people. Deffenbaugh operates from 14 locations in Kansas, Missouri, and Nebraska, operating 24 hours a day, seven days a week. In addition to collecting, transporting, and disposing of commercial and residential waste, the company handles commercial and residential recycling; portable toilets; quarrying; industrial waste services; and medical waste services. Deffenbaugh's recycling program was created in 1989, and is now the area's largest recycler of its type. The company owns and operates a recycling center in Wyandotte County that processes about 9,000 tons a month of recyclables. Deffenbaugh Recycling offers curbside collection service in most municipalities across the metropolitan area and operates the residential recycling program in Omaha, Nebraska. The company complements its curbside activities with an extensive network of drop-off recycling centers in and around Kansas City.

**Sources**

Betsy Betros and Mike Booth, 2003, The Clean Air Act and the Johnson County Landfill, Inc.: Fact Sheet, Johnson County Environmental Department, 4 p.


**Resource Contacts**

Cindy Kemper, Director
Johnson County Environmental Department
11180 Thompson Avenue
Lenexa, Kansas 66219
913/492-0402
Cindy.Kemper@jocoks.com

Randy Alewine
Deffenbaugh Industries, Inc.
18181 W. 53rd St.
Shawnee, KS 66217-9742
913/238-2531
rsa04@cs.com

Phil Askey
Johnson County Environmental Dept
11180 Thompson Ave.
Lenexa, KS 66219
913/492-0402
Phil.Askey@jocoks.com
Nature-Based Tourism

Kansas is one of the best places in the world to see the flowers and grasses of the tallgrass prairie, to see the shorebirds that migrate through North America each spring, or to get a clear view of the stars in the night-time sky. Over 450 species of birds and 800 species of wildflowers have been recorded in the state. The landscape is as varied as the Ozark Platteau of southeastern Kansas to the High Plains of western Kansas.

Some of the most-visited locations in Kansas are those that involve the natural world. According to the Kansas Travel and Tourism Division, Cabela’s (in Kansas City, Kansas) was the most popular tourist attraction in the state in 2002, with 2.4 million visitors. Hillsdale State Park, near Paola, was the most popular state park, with 1.6 million visitors, and Clinton Lake and State Park drew 1.5 million visitors. The Sedgwick County Zoo drew 429,000.

Based on the growing interest in the natural world, the Division of Travel and Tourism of the Kansas Department of Commerce and Housing helped bring together an alliance of groups and individuals with an interest in nature-based tourism. The alliance includes bed and breakfast operators, convention and visitors bureau staff, the state’s nature centers, state agencies, environmental organizations, and interested individuals.

With support from the Kansas Department of Wildlife and Parks, this Nature-based Tourism Alliance has created a web site that is an excellent source of information about the natural landscape in Kansas, along with information about opportunities and locations to view that landscape. That web site is hosted by the Great Plains Nature Center in Wichita and includes sections on wildlife viewing, upcoming nature-based events, scenic roads and hiking and biking trails, and books and other resources for learning about the natural world in Kansas. The Alliance meets quarterly and is developing plans for other ways to showcase nature-based tourism opportunities in the state.

Cabela’s

Cabela’s has labeled itself as the world’s foremost outfitter of hunting, fishing, and outdoor gear. In the fall of 2002, Cabela’s opened its most recent retail store in Kansas City, Kansas, near the intersection of Interstates 70 and 435. The Cabela’s site covers 83 acres, of which 46 are dedicated to the retail store. The store covers 188,000 feet of floor space, or about four acres. The store features a 65,000-gallon aquarium with fish native to the midwest and Kansas; a mule-deer museum that consists of the world’s largest collection of life-size trophy deer in their natural surroundings, including two world records and numerous state and provincial record deer; an outdoor bronze sculpture of three world-class mule deer, each standing 19 feet tall; and an archery range. Other highlights are a full-service marine department, laser arcade, archery range, art gallery, furniture department, gun library, restaurant, general store, fly fishing store, bargain cave, and gift shop. In the five months after opening, the store drew 2.4 million visitors.

Cabela’s started in 1961 when Dick Cabela began selling fishing flies through mail order from his home in Chappell, Nebraska. In 1969 the business was moved to Sidney, Nebraska. The company is perhaps best known for its catalog, which offers more than 500 pages of outdoor equipment and is shipped twice a year to customers in all 50 states and 125 countries. More than 90 million catalogs are mailed each year. The Cabela’s in Kansas City is one of seven retail outlets. The others are in Sidney, Nebraska; Kearney, Nebraska; Owatonna, Minnesota; Prairie du Chien, Wisconsin; East Grand Forks, Minnesota; and Mitchell, South Dakota. Plans call for the addition of two more stores: Hamburg, Pennsylvania, in late 2003, and Wheeling, West Virginia, in 2004.

In addition to catalog and retail operations, Cabela’s offers programs in corporate outfitting, government outfitting, an electronic newsletter, and a magazine and television program.
Sources


Resource Contacts

George Potts
Kansas Nature-Based Tourism Alliance
2040 N. Kessler
Wichita, KS 67203
316/943-4134
gdpotts@onemain.com

Jerry Hover, Director
Parks Division
Kansas Department of Wildlife and Parks
512 SE 25th Avenue
Pratt, KS 67124
620/672-0740

Ron Soucie, Manager
Cabela's
10300 Cabela Drive
Kansas City, KS 66111
913/328-3105
rsoucie@cabelas.com
SCHEDULE & ITINERARY

Thursday, June 5, 2003

7:00 am  Breakfast at the Holiday Inn, Mission/Overland Park

8:00 am  Bus Leaves Holiday Inn for Site 5

8:30 am  SITE 5—Kaw Point and Wyandotte County  
Shari Wilson, Wyandotte County Lewis and Clark Task Force  
Bob Roddy, Unified Government of Wyandotte County and Kansas City, Kansas  
David Warm, Mid-America Regional Council

9:20 am  Bus to Site 6

10:00 am  SITE 6—Holliday Sand and Gravel Company, Plant #7  
Mike Odell and Mark Mitchener, Holliday Sand and Gravel Company  
Robert Smith, U.S. Army Corps of Engineers  
Woody Moses, Kansas Aggregate Producers Association

12:00 pm  Bus to Lunch

12:15 pm  Lunch at Wyandotte County Park

1:15 pm  Bus to Site 7

2:15 pm  SITE 7—Missouri River Issues (Overlook at Benedictine College)  
Steve Adams, Kansas Dept. of Wildlife and Parks  
David Pope, Kansas Dept. of Agriculture, Division of Water Resources  
U.S. Army Corps of Engineers

3:00 pm  Bus to Site 8

3:15 pm  SITE 8—Benedictine Bottoms Fish and Wildlife Mitigation Site  
Kirk Thompson, Kansas Dept. of Wildlife and Parks  
Glen Covington and Kelly Ryan, U.S. Army Corps of Engineers

4:45 pm  Bus to Site 9

5:00 pm  SITE 9—Missouri River Access Site and Lewis and Clark Celebration  
Steve Adams, Kansas Dept. of Wildlife and Parks  
Karen Seaberg, Kansas Lewis and Clark Commission  
Greg Miller, U.S. Army Corps of Engineers

5:30 pm  Refreshments and Dinner at the River House Restaurant

8:00 pm  Bus to AmericInn, Atchison
Flooding in Kansas City

Kansas City is located at the juncture of two large rivers—the Kansas and the Missouri—and over the years has experienced numerous episodes of flooding. In 1821 François Chouteau established a fur-trading post near the mouth of the Kansas River called, appropriately, Kawsmouth. This was one of the first settlements in the area. Five years later, a major flood forced Chouteau to move his trading post to higher ground.

In 1844 a major flood occurred in the Kansas and Missouri rivers. Sparse settlement in the area resulted in few accurate appraisals of this flood’s magnitude; however, Indians living in what would become Kansas referred to this flood as “the big water.” Very high flood stages were recorded downstream on the Missouri and Mississippi. This is considered the largest flood on the Kansas River during historical times.

A major flood occurred on the Kansas River in 1903 destroying 12 bridges over the Kaw and cutting off the water supply to Kansas City for 12 days. A wet spring and early summer in 1951 set the stage for a major flood in much of eastern Kansas. Up to 16 inches of rain in the second week of July sent the Kansas River and many other streams in eastern Kansas out of their banks. Destruction in the large cities along the Kaw was particularly extensive. The Argentine, Armourdale, and Rosedale areas of Kansas City, Kansas, were inundated with up to 30 feet of water (fig. 4-1). The meat packing plants in the Kaw bottoms and the vast Kansas City stockyards were all flooded. Nineteen people died and 1,100 were injured in the 1951 flood. Property damage was estimated as high as $2.5 billion, making it the most destructive flood in the nation’s history up to that time. Flooding extended down the Missouri River to near St. Louis, covering up to 2 million acres.

In the years following the 1951 flood, new levees were built, existing ones were raised, and reservoirs were added in the Kansas basin. Today 18 federal reservoirs exist on Kansas River tributaries. These efforts paid off in 1993 when flooding occurred throughout the lower Missouri River basin. Kansas City was largely spared the

Fig. 4-1—Argentine Baptist Church, July 14, 1951 (Kansas State Historical Society photo).
extensive flooding that occurred in 1951, but flooding did occur upstream and downstream of Kansas City where levees were lower or nonexistent. The small town of Wolcott along the Missouri River in northern Wyandotte County was flooded. This was the last in the series of floods to affect Wolcott because all the homes in the town were bought out by FEMA after the 1993 flood and today Wolcott no longer exists. Flooding across the river in the Riverside area of Missouri has resulted in a levee expansion project that is in progress now.

The area around Kansas City can best be described topographically as a dissected plateau. The flat-lying resistant limestones of Pennsylvanian age that crop out in the area cap the level uplands. Elevations range from 1,080 feet in Overland Park down to 720 feet along the Missouri River, producing over 360 feet of topographic relief. Tributaries of the Kansas and Missouri rivers have carved a number of narrow valleys into the uplands. Streams in these valleys have steep gradients falling as much as 40 feet per mile in some stretches, which is comparable to the gradient of the Arkansas River in the Colorado Rockies. Urbanization has replaced much of the natural vegetation in the watersheds with impervious pavement and roofs. This has forever changed the dynamics of these streams when heavy precipitation occurs. These factors make the Kansas City area susceptible to flash flooding, and numerous floods have occurred in the last few decades with deadly results.

On September 12 and 13, 1977, two 100-year, 24-hour rain accumulations occurred 10 hours apart. The second rain fell on saturated ground and caused widespread flash flooding in the Kansas City area. Whereas the 1951 flood lasted several days and claimed 19 lives over a large area, the 1977 flash flood claimed 25 lives in a limited area in the matter of hours. Damage was extensive along Turkey Creek and Brush Creek as well as other streams. Brush Creek drew much national attention when it flooded the Country Club Plaza shopping area. Steps taken to prevent a repeat of this type of flooding include the widening and deepening of stream channels, the raising of bridges over streams to prevent impounding of flood waters, and, in the case of Brush Creek, the construction of retention basins to contain some of the excess runoff. These efforts continue today.

However, these corrections did not come soon enough. On Monday evening, October 4, 1998, millions of sports fans tuned in to watch the Monday night football game between the Kansas City Chiefs and Seattle Seahawks played at Arrowhead Stadium. Instead, they saw the rare sight of a football game delayed by torrential rain. What they didn’t see was another disastrous flash flood that claimed 11 lives.

Flash flooding will continue to be a problem in the Kansas City area. Attempts at solutions are difficult because of both the physical and the political geography. Turkey Creek, for instance, which has repeatedly flooded parts of Merriam and the Southwest Boulevard area near the State line drains parts of two states, three counties, and eight municipalities in the course of about 11 miles.

Rapid urbanization that began in northeast Johnson County after World War II continues today, expanding into the western and southern parts of the county, drastically changing the runoff characteristics of a large area in the last 50 years. The watersheds of a number of flood-prone streams such as Turkey Creek, Brush Creek, Indian Creek, Tomahawk Creek, and the Blue River begin in the high ground of Johnson County and extend downstream into Kansas City, Missouri, where much of the death and destruction of flash flooding is concentrated. Thus, with each damaging flood, fingers of blame often point in the direction of Kansas.

Source

Kaw Point and Wyandotte County

Kaw Point is the name given to the confluence of the Kansas and Missouri rivers in eastern Kansas City, Kansas (fig. 4-2). It is also the place where, nearly 200 years ago, the members of the Lewis and Clark expedition camped for three days in June 1804 on their way up the Missouri.

To commemorate that campsite, the Wyandotte County Lewis and Clark Task Force wants to build a park at Kaw Point (fig. 4-3). The park will be built on land owned by the Unified Government of Wyandotte County and Kansas City, Kansas. The site is located in the Fairfax Industrial District in Kansas City, Kansas.

The task force, in partnership with the State of Kansas, the Unified Government, local Convention and Visitors Bureau, various community organizations, and private funders, is planning a threefold approach to the Lewis and Clark Bicentennial:

- legacy projects that will enhance the commemorative event and remain after the bicentennial activities are completed;
- site preparation and enhancement/restoration of infrastructure to ready the Kaw Point area for large numbers of visitors; and
- education and marketing efforts to involve students and the community, including Native American students at Haskell Indian Nations University in Lawrence, Kansas.

Together, these efforts and activities will preserve and interpret a portion of the Lewis and Clark Trail for the public.

Plans for the park at Kaw Point include an open-air education center that will tell the story of the encampment, a boat ramp with river access, trails, and a replica of the temporary fort the expedition built at the site. A plaza will honor people who lived in the area or passed through on their way west.

So far, the task force has raised roughly half of the $1 million needed to complete the first phase of the project. This first phase is to be completed by June 26, 2004, in time to mark the bicentennial of Lewis and Clark’s arrival there. The second phase of the plan, which is also estimated to cost about $1 million, includes more landscaping, the construction of an overlook, and the creation of an endowment for ongoing maintenance.

While camped at Kaw Point, the men in the Lewis and Clark expedition hunted and repaired

Fig. 4-2—The confluence of the Kansas and Missouri rivers at Kaw Point.
their boats—flat-bottomed wooden boats called pirogues that were shaped like canoes. They also built a temporary fort from logs and brush. In his journal, Clark reported the sighting of some now-extinct Carolina parakeets and noted that “the waters of the Kansas is very disagreeably tasted to me.”

Unified Government of Wyandotte County and Kansas City, Kansas

In 1997, voters approved a city-county government consolidation, now known as the Unified Government of Wyandotte County and Kansas City, Kansas. The Unified Government consists of a Mayor/CEO, currently Carol S. Marinovich, and an elected Board of Commissioners, consisting of eight district and two at-large commissioners.

Wyandotte County is the smallest county in Kansas but has the third largest population in the state. The Unified Government of Wyandotte County and Kansas City, Kansas is the only unified city-county government in Kansas or Missouri.

The Mayor/CEO and the Board comprise the Executive and Legislative Branches of the Unified Government respectively. The Mayor/CEO presides over the Board of Commissioners, has veto power, and serves as the eleventh member of the Commission, casting a vote only in the case of a tie or as otherwise required. The Board of Commissioners has policy-making authority for the Unified Government, and is committed to fulfill its mission to provide policy guidance and direction in providing quality services to citizens. Through strategic planning, the Board sets goals and objectives that address issues within the organization and throughout the community.

Mid-American Regional Council (MARC)

The Mid-American Regional Council (MARC) serves as the association of city and county governments and the metropolitan planning organization for the bi-state Kansas City region. MARC is a voluntary association that strives to foster better understanding and cooperation on issues that extend beyond the jurisdiction of a single city, county, or state. These issues include transportation, child care, aging, emergency services, environmental issues, and many others.

MARC seeks to build a stronger regional community by providing:

- a forum for addressing regional objectives and diverse community issues,
- long-range planning and public policy coordination, and
- technical assistance and services to enhance the effectiveness of local government.

The 30 members of MARC’s Board of Directors are locally elected leaders, representing the eight counties and 114 cities in the bi-state metropolitan Kansas City region (fig. 4-4). Currently, Dr. Charles A. Eddy, Councilmember, Kansas City, Missouri, is the MARC Board Chair. The work of the Board is assisted by MARC’s department directors and staff of approximately 90 professionals and support personnel.

Sources


Resource Contacts

Shari Wilson, Chair
Wyandotte County Lewis and Clark Task Force
51 South 64th Street
Kansas City, KS 66111-2002
913/287-6879
wilson-shari@swbell.net

Robert D. Roddy, P.E.
Assistant County Administrator
Unified Government of WyCo/KCKs
701 North 7th Street, Room 712
Kansas City, KS 66101
(913) 573-5400
broddy@wycokck.org

Scott Oldham
Unified Government of Wyandotte County
Buildings and Logistics
701 N. 7th Street
5th Floor Room 532
Kansas City, KS 66101
913/573-5337
soldham@wycokck.org

David Warm, Executive Director
Mid-America Regional Council
600 Broadway, Ste. 300
Kansas City, MO 64105-1554
816/474-4240
dwarm@marc.org
Aggregate

At this site Holliday Sand and Gravel Company operates both a river dredge and a pit or floodplain dredge to mine sand and gravel for use as aggregate (fig. 4-5). An aggregate is any hard, inert material used for mixing with a cementing or bituminous material to form concrete, mortar, asphalt or similar product, or used alone as in railroad ballast, road covering, or fill. Although aggregates are inexpensive and an abundant natural resource in places, they are like most of the earth’s resources and are not distributed in a uniform or equitable manner.

The two main types of aggregates used in Kansas are sand and gravel and crushed stone. Most of the crushed stone in Kansas is produced from the limestones that crop out from the Flint Hills eastward. In the Kansas River valley there are roughly 75 named limestone units. However, only a few of these meet the rigid specifications of the Kansas Department of Transportation (KDOT) and other aggregate users for purity and physical character for use in concrete construction. Recent problems with crumbling concrete in the Kansas City area have been blamed on the use of crushed limestone from eastern Kansas. Today, more sand and gravel is being substituted for crushed stone. The average mixture in highway concrete is 65% sand and gravel to 35% crushed limestone. KDOT estimates that one mile of two-lane concrete highway, nine inches thick, uses 3,400 tons of sand and gravel. Twenty-five percent of the sand and gravel produced in the Kansas River corridor is used by KDOT.

Primary Sources of Sand and Gravel

The primary sources of sand and gravel in eastern Kansas are the Kansas River (and also the lower tributaries of the Kansas River such as the Republican, Big Blue, and Smoky Hill); the Arkansas River, which is extensively mined in the Wichita area and other places; and the Missouri River, which has a drawback in that much of its sand contains lignite, a form of brown coal that causes dark spots in the concrete that can lead to

Fig. 4-5—River dredge in Kansas River, near Bonner Springs, operated by Holliday Sand and Gravel Company.
cavities and make it susceptible to attack by the elements. The Neosho River is mined for cherty gravels that are found along its course.

Kansas River Alluvium

The Kansas River has formed a deep bedrock trench that is partially filled with silt, sand, and gravel—material collectively known as alluvium. In places, this alluvium is as much as 95 feet thick. The upper surface of this alluvial fill is known to geologists as the floodplain. The average width of the Kansas River floodplain is 2.6 miles. However, it is 3 miles or wider in numerous places above Eudora. The widest stretch of the flood plain is in the Wamego to Rossville area where it is 4 miles or slightly more in width. The narrowest stretch of the Kansas River is from Eudora to its mouth at Kaw Point where it is less than a mile and a half in width and in some places less than a mile. At this Bonner Springs location, the floodplain is 1.1 miles wide.

Types of Dredging

The Kansas River is a major source of sand and gravel in northeastern Kansas. Sand and gravel is produced by two dredging processes: river dredges and floodplain or pit dredges. Numerous exclusion zones—mostly built structures, such as bridges and water intakes, that the U.S. Army Corps of Engineers wants to protect—in the lower portion of the river significantly limit the amount of sand-and-gravel resources.

River dredges are the main method of dredging in the Kansas City area, particularly with respect to tonnage. They mine the bed material of the river, which is generally sand and small gravel. In general, the Kansas River contains very little mud or clay; therefore, there is very little waste. Nearly all the material taken from the river can be used as a commercial product. This results in some of the best-quality, least-expensive sand in the United States.

Floodplain dredges or pit dredges operate on the floodplain of the river at some distance from the river and mine the alluvial fill of the river valley. The uppermost part of the floodplain and much of the terrace deposits are composed of over-bank deposits, generally consisting of fine-grained materials such as clays and silts that were deposited at times of flood at some distance from the river channel itself. The soil and these fine-grained materials represent overburden that must be removed and can be used as fill or possibly as topsoil. There is a limited market for this material. The next material commonly encountered is a fine-grained sand. Much of that is also unusable; however, a small amount can be used and sold as masonry sand. The deeper layers on down to bedrock commonly contain large amounts of medium- to coarse-grained sand and gravel, and this is the desired material. However, within this sand and gravel sequence may be lenses of clay or silt that again have very little market value. The overburden must be removed down to the water table in order to float the dredge that will then dig up the sand and gravel.

Pit Dredging Versus River Dredging

Pit dredges are permitted by the State Conservation Commission and the Division of Water Resources (DWR) of the Kansas Department of Agriculture with approval from the appropriate county commission. In some cases, pit-dredge operations may need a water right because of the evaporation created by exposing the aquifer. River dredges are permitted by the U.S. Army Corps of Engineers with approval of plans by the DWR. In addition, county commissioners approve areas where the plant and handling facilities are located.

A pit dredge requires much more land. At a minimum, about 100 acres are required for a successful pit-dredge operation, and this land is commonly expensive bottom land. A river dredge requires only about 10 acres of land necessary for the screening and storage of material, and this is generally located along the river bank. A pit-dredge operation generally requires drilling or some sort of exploration program to ensure that adequate supplies of sand and gravel are available for mining. This generally is not necessary for the river dredge. With a pit dredge, overburden must be removed at some cost and the pit must be excavated down to the water table, which may be at a considerable depth below the surface. On a river dredge, there is no overburden, and no unnecessary excavation is needed. Unused material produced by pit dredging incurs some
cost for removal or disposal. With a river dredge, there is very little in the way of unusable material. Pits also require reclamation. There are no reclamation expenses involved in river dredging. In addition, when a pit dredge is shut down, a large hole is left in the floodplain in which the water table is exposed, creating a potential avenue of pollution and also loss of water resources through evaporation. In general, in the lower Kansas River area, sand produced by pit dredging is 50% more expensive than sand produced by river dredges.

Sources


Resource Contacts

Mike Odell
Holliday Sand and Gravel Company
9660 Legler Rd,
Shawnee Mission, KS 66219
913/236-5920

Mark Mitchener, Superintendent
Holliday Sand and Gravel Company
P.O. Box 254
Bonner Springs, KS 66012
913/422-4000

Edward A. "Woody" Moses
Kansas Aggregate Producers Association
800 S.W. Jackson Street, Ste. 1408
Topeka, KS 66612-2214
785/235-1188
emoses@ink.org

Robert Smith, Special Projects Manager
Regulatory Branch
U.S. Army Corps of Engineers
601 E. 12th Street
Kansas City, MO 64106
816/983-3656
robert.j.smith@nwk02.usace.army.mil
The Missouri River is the nation's longest river, and its watershed includes one-sixth of the continental United States. The Missouri River basin has an area of 529,000 square miles, including about 9,700 square miles in Canada. The basin spans 10 states, including all of Nebraska; most of Montana, Wyoming, North Dakota, and South Dakota; about half of Kansas and Missouri; and smaller parts of Iowa, Colorado, and Minnesota (fig. 4-6).

Basin topography varies from the Rocky Mountain area in the West, to the Great Plains area in the middle of the basin, to the Central Lowlands of the lower basin. Elevations in the basin range from over 14,000 feet in the Rocky Mountains to 450 feet above sea level near the river's mouth at St. Louis, Missouri. Major tributaries of the Missouri River include the Yellowstone River, which drains over 70,000 square miles; the Platte River, with a 90,000-square-mile drainage area; and the Kansas River, which drains approximately 60,000 square miles. Three reservoirs on tributaries of the Kansas River—Tuttle Creek, Perry, and Milford—are operated by the U.S. Army Corps of Engineers.

Average annual precipitation ranges from 8 inches just east of the Rocky Mountains to about 40 inches in the southeastern part of the basin and the higher elevations of the Rocky Mountains. Normal seasonal maximum precipitation occurs during the spring and early summer months throughout the basin. Roughly 48 percent of the

Fig. 4-6—The Missouri River basin.
annual runoff comes in the months of May, June, and July as a result of snow melt and spring and summer rains. Runoff averages 25.2 million acre-feet (MAF) annually above Sioux City, Iowa. Records dating back to 1898 indicate runoff has varied from a high of 49.0 MAF in 1997 to a low of 10.6 MAF in 1931.

The six large dams that span the Missouri River control runoff for approximately half of the basin. Those six dams—Fort Peck in Montana; Garrison in North Dakota; Oahe, Big Bend, and Fort Randall in South Dakota; and Gavins Point along the Nebraska-South Dakota border—make up the largest system of reservoirs in the United States. The combined storage capacity of all six reservoirs is 73.4 MAF, about three times the annual runoff. The system became fully operational in 1967.

The U.S. Army Corps of Engineers releases water from the dams to allow navigation for barges from Sioux City, Iowa, to St. Louis, Missouri; however, barge traffic has decreased steadily since 1977. Management of the system for navigation has put the Corps in the middle of controversy between those who want to maintain the current system and those who want greater amounts of natural flow. Environmentalists generally want the Corps to allow greater natural flow to restore the river’s ecosystem and more nearly mimic flow conditions before the dams existed; recreational users and the tourist industry say low water levels affect fishing, swimming, and boating; farmers say more water will cause flooding of their crops.

**Master Manual**

Congress authorized the operation of the six dams on the Missouri River for flood control, recreation, irrigation, water supply and water quality, navigation, hydropower generation, and fish and wildlife. The system is operated by the U.S. Army Corps of Engineers using guidelines published in the Missouri River Main Stem Reservoir System Master Manual (or Master Manual), which describes the regulation of the six Missouri River main stem dams as a system. The Master Manual presents a highly technical description of the guidelines that govern long-term water management of the system. A review of the guidelines presented in the Master Manual is currently underway. The purpose of the review, which began in 1989, is to identify a water control plan that serves the contemporary needs of the basin, complies with current environmental laws, and serves Congressionally authorized project purposes.

**Flood Control.**—Flood control is the only authorized project function that requires the availability of empty storage space rather than impounded water. Flood events are generally unpredictable; therefore, detailed routing of specific major flood flows is accomplished when floods occur. The high risk flood season begins about March 1 and extends through the summer. Storage levels are gradually lowered throughout the fall and winter months to levels at or below the base of the annual flood control zone by March 1. During all but excessively dry years, water stored in the reservoirs will increase during the March-July season.

**Navigation.**—The Missouri River navigation channel extends for 735 miles from its mouth at St. Louis, Missouri, to Sioux City, Iowa. Navigation on the river is limited to the normal ice-free season with a full length season normally extending from April 1 to December 1 at its mouth. To permit a viable navigation industry, it is desirable to maintain navigable flows throughout this 8-month period. System reservoir releases are scheduled to provide adequate flows for navigation according to established minimum and full-service flow targets at Sioux City, Omaha, Nebraska City, and Kansas City. The target flows increase downstream because of the increased flow requirements needed to maintain similar flow depths with naturally increasing channel dimensions. Target flows are evaluated and adjusted periodically to ensure compatibility between available water supply and current navigation channel conditions. The three Kansas River Corps reservoirs are authorized to provide additional water to meet the Kansas City flow target, but at times, the State wants to keep that water in the reservoirs.

**Water Quality Control.**—Downstream water requirements for water quality were established by
the Federal Water Pollution Control Administration in 1969 and reaffirmed by the Environmental Protection Agency in 1974. Minimum daily flow requirements are established to maintain water quality.

**Water Supply.**—Numerous water intakes are located along the Missouri River. These intakes are primarily for municipal water supplies, nuclear and thermal electric powerplant cooling, and for irrigation supplies withdrawn directly for the river. Operation guidelines call for a minimum daily average release that is satisfactory for municipal water supply. These rates also supply ample water to meet most irrigation demands.

**Power Production.**—Western Area Power Administration markets hydroelectric energy and capacity from the system. Energy is marketed on both an annual and seasonal basis, recognizing the seasonal pattern of releases made for navigation and required for flood control. The hydroelectric powerplants provide power in parts of Montana east of the Continental Divide, North and South Dakota, eastern Nebraska, western Minnesota, and western Iowa.

**Fish and Wildlife.**—Construction of large reservoirs on the Missouri River system has increased sport fishing in the basin. Because of extensive management, the big reservoirs produce more sport fish than the Missouri River did before impoundment. However, the construction and operation of the system has altered the natural streamflow of the river. An early spring rise and a late spring-summer rise characterized the natural flow. High flows resulted from the plains snowmelt, from March and April rains, and from the mountain snowmelt and rains in May, June, and July. Low flows typically occurred in late summer and fall. Regulation of flows has reduced spring flows and increased fall and winter flows, thus altering the habitat of native riverine fish species and some nesting birds. Currently, five species are listed or are candidates for listing as Federal threatened or endangered species: interior least tern (endangered); piping plover (threatened); pallid sturgeon (endangered); sturgeon chum and sablefin chub (candidates). Waterfowl management takes place on the Charles M. Russel, Audubon, and Pocasse National Wildlife Refuges. Under intense management, wildlife production on the refuges has been substantial. Large numbers of migrating waterfowl use the reservoirs, open water reaches on the river, and nearby refuge areas.

**National Research Council Study**

A two-year study that examined how the Missouri River system is managed, sponsored by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency, was released in January, 2002. The study was conducted by the National Research Council, an operating arm of the National Academy of Sciences, and the National Academy of Engineering, a private, nonprofit institution that provides science and technology advice under a congressional charter. The report (*The Missouri River Ecosystem: Exploring the Prospects for Recovery*) says the Missouri River and its floodplain ecosystem experienced significant environmental and hydrologic changes (construction of dams and levees, channelization, and other human activities) over the last century and is clearly in a serious state of decline, and degradation will continue unless the river’s natural water flow is substantially restored.

The Research Council report calls for a moratorium on further revisions of the Master Manual until such changes reflect a science-based approach known as adaptive management. The adaptive-management strategy considers environmental and economic goals equally, and enables natural resources managers to adapt decisions to changing social and economic situations and the latest scientific information. The study says this effort should be directed by a formal group of stakeholders that should include the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Department of Energy, the U.S. Bureau of Reclamation, the U.S. Fish and Wildlife Service, the National Park Service, American Indian tribes, state governments, local municipalities, farmers, environmental and recreational groups, and the barge industry. The stakeholder group should receive input from an independent panel of scientists to help resolve questions and ensure that the group is adhering to adaptive-management principles.
In addition, the Research Council report recommends that Congress enact legislation to ensure that federal officials manage the Missouri River in a way that improves ecological conditions.

Sources


Resource Contacts

Steve Adams, Natural Resources Coordinator
Kansas Dept. of Wildlife and Parks
1020 S. Kansas Ave.
Topeka, KS 66612-1327
785/296-2281
stevea@wp.state.ks.us

David Pope
Chief Engineer - Director
Division of Water Resources
Kansas Department of Agriculture
901 S.W. 9th Street, 2nd Floor
Topeka, KS 66612
(also Kansas Representative to the Missouri River Basin Association)
785/296-3710
dpope@kda.state.ks.us

Earl Lewis
Kansas Water Office
901 S. Kansas Avenue
Topeka, KS 66612
785/296-3185
elewis@kwo.state.ks.us

Larry Myers, Executive Assistant
U.S. Army Corps of Engineers
601 E. 12th Street, Room 700
Kansas City, MO 64106
816/983-3205
larry.l.myers@usace.army.mil
Missouri River Mitigation Project—Benedictine Bottoms

Introduction

The Missouri River Mitigation Project is designed to mitigate, or compensate, for fish and wildlife habitat losses that resulted from past channelization efforts on the Missouri River. The project extends from Sioux City, Iowa, to the mouth of the Missouri River near St. Louis, a length of 735 river miles.

The purpose of this mitigation effort is to acquire, restore, and preserve aquatic and terrestrial habitat on individual sites found along the project length. New wildlife areas will be created, existing areas improved, and other river features may be returned to historic conditions. The project will develop approximately 166,750 acres of land in separate locations along the river in Nebraska, Iowa, Kansas, and Missouri.

Preservation or restoration will be accomplished by means of land acquisition from willing sellers, dredging filled-in areas, reopening historic chutes, bank stabilization, dike notching, pumping, dike/levee construction, vegetative plantings, and vegetation and land management.

The Corps is working with a coordination team, composed of state and federal fish and wildlife agencies, to construct this mitigation project. In addition, the Corps also works with interested State and local groups on a site-by-site basis for successful project implementation.

Project History

Prior to 1900, the Missouri River channel was uncontrolled. It was free to meander back and forth across the river valley. The river continually eroded the banks and deposited the eroded material in new locations to form bars, shoals, and new banks downstream.

At all times, the channel occupied roughly 300,000 acres and consisted of numerous islands, channels, chutes, sandbars, and slack water supporting vegetation in various stages of succession. This vegetation reflected the natural processes of erosion deposition and consisted primarily of willow and cottonwood.

Efforts to stabilize the Missouri River and provide a navigation channel started in the early 1900’s. Since 1912, seven separate acts of Congress provided for the construction and maintenance of a navigation channel and bank stabilization works. The collection of projects, constructed and maintained by the U.S. Army Corps of Engineers, is known as the Missouri River Bank Stabilization and Navigation Project (BSNP).

The BSNP projects included placing revetments on the riverbanks, closing off sloughs and side channels, and constructing pile dikes. Later work included dredging and rock dike construction. Construction and long-term operation and maintenance of the BSNP created an inland navigation system and provided many benefits such as protecting utilities, transportation networks, bridges, and adjacent landowners and farms.

However, the highly controlled, narrow channel has reduced the amount of fish and wildlife habitat that used to be supported from the natural channel and meander belt. Consequently, the fish and wildlife populations have seen a significant reduction along with the loss of recreational opportunities that they provided.

In the early 1980’s, the Kansas City District of the U.S. Army Corps of Engineers completed a study of the feasibility of Missouri River Mitigation Project. The study determined that it was economically feasible to mitigate fish and wildlife resources lost to the construction of the BSNP project and enhancing fish and wildlife resources.

Implementation

In 1986, Congress authorized construction of the Mitigation project, and passed another bill in 1999 that brought the total amount of land autho-
rized for purchase from willing sellers and/or public interests to 166,750 acres. The U.S. Army Corps of Engineers began implementation of the Mitigation project in 1991. Since that time, approximately 24,900 acres of land have been purchased from private and willing sellers and set aside for fish and wildlife. Easements have also been obtained on another 5,800 acres of existing public lands in which mitigation efforts have taken place. To date, 28 different mitigation sites are in various stages of acquisition and development.

**Benedictine Bottoms**

The Benedictine Bottoms mitigation site, located two miles northeast of Atchison, Kansas, is 2,111 acres in size (fig. 4-6). The site was purchased from willing sellers in 1996. Design of the mitigation features at this site were coordinated with the Kansas Department of Wildlife and Parks, the Kansas Forest Service, and the U.S. Fish and Wildlife Service. The project features 550 acres of native upland habitat, 750 acres of native grassland habitat, and 450 acres of wetland habitat.

Construction of the project was completed in 1998. The native upland habitat was created by planting more than 175,000 tree and shrub seedlings. Shrubs were planted at the edges of the trees to provide a transition zone between the woodland and wetland prairie habitats. The combination of bottomland hardwoods and shrubs will provide food as well as escape and winter cover. The grasslands were created from a

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**Fig. 4-6**—Benedictine Bottoms mitigation site, Atchison County.

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mixture of big bluestem, Indian, eastern gama, and switch grasses along with wildflowers and legumes. The wetland prairie habitat will provide valuable nesting and escape cover as well as a source of food. The wetlands were built using low-profile earthen fill levees, three wells and distribution piping, and water-level control structures. Some wetland cells will be operated as permanent marshes which will contain shallow water habitat year-round. Others will be managed as seasonal wetlands for migratory waterfowl.

The Benedictine Bottoms mitigation site is currently managed by the Kansas Department of Wildlife and Parks. The site is available to the public for a variety of outdoor activities including bird watching and hunting when in season.

Sources


Resource Contacts

Steve Adams, Natural Resources Coordinator
Kansas Dept. of Wildlife and Parks
1020 S. Kansas Ave.
Topeka, KS 66612-1327
785/296-2281
stevea@wp.state.ks.us

Kirk Thompson
Atchison State Fishing Lake
Kansas Dept. of Wildlife and Parks
Box 113
Lancaster, KS 66041
913/367-7811

Ray Aslin, State Forester
Kansas Forest Service
2610 Claflin Road
Manhattan, KS 66502-2798
785/532-3309
raslin@oz.oznet.ksu.edu

Glen Covington, Project Manager
Planning Branch
U.S. Army Corps of Engineers
601 E. 12th Street, Room 700
Kansas City, MO 64106
816/983-3141
William.g.covington@usace.army.mil

Kelly Ryan, Program Manager
Civil Programs
U.S. Army Corps of Engineers
601 E. 12th Street, Room 700
Kansas City, MO 64106
816/983-3324
kelly.ryan@usace.army.mil
Lewis and Clark in Kansas

The Expedition

Early in 1803, at the request of President Thomas Jefferson, Congress authorized funds for an expedition from the Missouri River to the Pacific Northwest, the primary objective of which was to discover an all-water route to the Pacific Ocean (the so-called Northwest Passage). Jefferson also wanted the expedition to collect plant, animal, and mineral specimens; record weather data; study native cultures; and create a permanent map of the route. He appointed his secretary, Meriwether Lewis, to lead the expedition. Lewis, in turn, chose his friend William Clark to be co-commander of what soon became known as the Corps of Discovery.

That spring, on April 30, 1803, representatives of the United States and France completed arrangements for the sale of Louisiana to the U.S. The Louisiana Purchase doubled the nation’s size (adding 838,000 square miles). Most of this new territory was unknown (except of course to the Native Americans who had lived there for centuries and fur traders who had traveled up the Missouri into what is now North Dakota).

In Kansas

From June 26 until July 10, 1804, the Lewis and Clark expedition followed the Missouri River along the northeastern edge of today’s Kansas. Of all the states (or, rather, of all the Louisiana Purchase that eventually became states) that they saw, they spent less time in Kansas than any other place. Nonetheless, it was an eventful time—one member of the crew was bitten by a snake, two men were court-martialed and punished, and the company celebrated the 4th of July. Though Lewis and Clark were in Kansas only slightly more than two weeks, their records provide a sense of the land’s appearance, prior to white settlement.

Lewis and Clark left St. Charles, Missouri, on May 21, 1804. Slightly more than a month later, they camped at the mouth of the Kansas River, in present-day Wyandotte County, Kansas. They stayed here for three nights. While the courses of both rivers have changed considerably since 1804, the camp was probably very near the present confluence of the two rivers, an area that is now known as Kaw Point and part of Kansas City, Kansas, and lies just across the Missouri River from Kansas City, Missouri.

“Came to ... Camped in the Point above the Kansas River,” wrote William Clark (Moulton, vol. 2, 1986, p. 324). The next day, Clark described the country around them. “A high Clift, on the upper Side of the Kansis 1/2 a mile up,” he wrote (Moulton, vol. 2, p. 325). This is probably the first reference to the loess hills of northeastern Kansas. These loess bluffs, which line both sides of the Missouri above the mouth of the Kansas River, are thick deposits of brown, tan, and buff-colored silt generally thought to have been the result of wind deposition during various glaciations in the midcontinent. Lewis and Clark made repeated references to the loess bluffs, though they only identified them by color and not by rock (or soil) type.

Also on that first day in Kansas, Clark measured the mouth of the Kansas River as “230 yds 1/4 wide” (Moulton, vol. 2, 1986, p. 325). The following day, Meriwether Lewis compared the weight of the water from the two rivers, and found that the Missouri was the siltier of the two. Clark, however, reported that “the waters of the Kansas is very disagreeably tasted to me” (Moulton, vol. 2, 1986, p. 327). Lewis and Clark were only vaguely aware of the headwaters of the Kansas, believing that it began in the Black Hills.
Lewis and Clark were more accurate, however, in associating the Kansas River with the Indian tribe that gave the river its name. Though they saw no Kansa Indians during their time in Kansas—"This nation is now out in the plains hunting the Buffalo" (Moulton, vol. 2, 1986, p. 327)—they knew that two Kansa villages were nearby, and later noted the location of former Kansa villages as the expedition moved farther north. They knew that the Kansa had abandoned their villages in Doniphan County, Kansas, to move out onto the plains to the west (Unrau, 1971).

On the afternoon of June 29, 1804, after drying out their boats and provisions, and allowing their hunters to return with meat, the expedition headed upriver. Their departure had been delayed by the court martial of John Collins and Hugh Hall, the first for drinking while on sentinel duty, the second for drinking whiskey without permission. The men were punished with lashes, then the expedition broke camp and moved back into the river. Today, the proposed park at Kaw Point will commemorate the location where Lewis and Clark camped.

By July 1, Lewis and Clark were near today's Leavenworth, and on July 3 the expedition was in Atchison County. On the 4th, one of the men was bitten by a snake, and Lewis treated the wound. That night they camped on a previously unnamed stream and christened it Independence Creek; they also named another stream "4th of July 1804 Creek," now known as White Clay Creek. On the night of July 4, 1804, the men fired off a cannon, undoubtedly the first 4th of July celebration in today's Kansas.

During their 16 days in Kansas, Lewis and Clark commented about the large numbers of deer they saw, along with elk, ducks, geese, whip-poor-wills, Carolina parakeets, pelicans, wood rats, pike, swans, buzzards, crows, hawks, and a great horned owl. They saw grapes, wild roses, wild rye, Indian potatoes, paw-paws, cottonwoods, sycamores, ashes, mulberries, elms, walnuts, hickories, willows, and even a native pecan tree (at the far northern edge of its range).

**Bicentennial Commemorations**

From 2003 through 2006, communities throughout the U.S. will observe the bicentennial of Lewis and Clark's journey (fig. 4-7). In June and July of 2004, Kansas communities along the Missouri River will participate in "A Journey Fourth," designated by the National Council of the Lewis and Clark Bicentennial as a Signature Heritage event. This event will commemorate the

![Fig. 4-7—The route of the Corps of Discovery (outbound route shown in red, inbound in blue).](image)
first Independence Day celebration in the American West.

The principal events will take place on the weekend of July 3–4 in the cities of Kansas City, Missouri, and Leavenworth and Atchison, Kansas. From June 22 to July 11, a wide range of activities tied to the Lewis and Clark bicentennial are planned throughout the region.

Sources

Heart of America—A Journey Fourth, Lewis & Clark National Signature Event (brochure).
Lewis and Clark Bicentennial Commission, Lewis and Clark in Kansas (brochure).


Resource Contacts

Karen Seaberg, Chair
Kansas Lewis and Clark Commission
1501 Arrowhead Drive
Atchison, KS 66002
913/367-8412
karen@travelcenterofatchison

Greg Miller, Natural Resources Specialist
Lewis and Clark Bicentennial Coordinator, KC District
601 E. 12th Street
Kansas City, MO 64106
816/983-3644
gregory.a.miller@usace.army.mil
SCHEDULE & ITINERARY

Friday June 6, 2003

7:00 am    Breakfast at the AmericInn, Atchison
8:00 am    Bus Leaves AmericInn for Site 10
9:15 am    SITE 10—Sugar Creek Underground Limestone Mine and Cement Plant
            Bob Elliott, Lafarge North America
            Woody Moses, Kansas Aggregate Producers Association
12:00 pm   Bus to Motel
1:00 pm    Arrive Holiday Inn, Lawrence
Sugar Creek Underground Limestone Mine and Cement Plant

In Kansas, limestone is as an ingredient in asphalt, as gravel on roads, in building construction, and in making cement (which is mixed with sand, stone, and water to make concrete). In Kansas, limestone is generally mined from quarries at the surface. In the Kansas City area, it is mined from shallow quarries and from shallow underground mines (generally less than 100 feet deep). Open space from these shallow underground mines is then used for storage, for office space, and for a variety of other uses throughout the metropolitan area.

The cement plant in Sugar Creek, Missouri, is unusual because the limestone used in making cement comes from a relatively deep mine, about 700 feet underground. Even though this mine produces limestone, in some ways it has more in common with underground salt mines (such as the one in Hutchison that we visited during the 2002 Field Conference) than the surface quarries that produce limestone in Kansas. By going deep underground here, Lafarge North America is able to reach a rock unit that produces high-quality limestone that is desirable in making cement. The company also avoids some of the environmental issues that arise from operating a surface quarry in an urban area.

Mining

The Kansas City Portland Cement Company began operation in this location in 1905, quarrying a rock layer of Pennsylvanian age called the Iola Limestone as the raw material for making cement. From the 1930s until the 1960’s, the plant also used the slightly lower Bethany Falls Limestone as a raw material, quarrying it from shallow underground mines. In 1991, Lafarge North America acquired this plant and in 1998 began construction on a new cement plant that was completed last year at a cost of roughly $200 million.

The production process begins in the underground mine, where explosive charges are used to break up huge chunks of limestone (fig. 5-1). Those pieces of limestone are then taken to a crusher (also underground) where they are broken into pieces of five inches or smaller. The rock is then hauled up a vertical shaft in 10-ton loads (about 500 tons per hour), then to a covered storage shed. From there the limestone is mixed with other ingredients and fed into a roller mill, where the rock is ground into a fine powder, known as kiln feed.

Cement Plant

The limestone mixture is moved to the preheater/precalceriner tower, about 415 feet high. Inside this structure the kiln feed is heated to 2,000 degrees Fahrenheit. Here the heat drives off about 95 percent of the carbon dioxide in the raw materials, a process known as calcination. The kiln feed then enters the kiln, a 164-foot long, 14 foot-diameter rotating tube that is heated with coal. The kiln heats the feed to 2,700 degrees, until it becomes nearly molten. This material is then cooled and forms “clinker,” small black cement rocks.

From here the clinker moves to a finish mill where it is mixed with gypsum and ground into the finished product—Portland cement (“Portland” is not a brand name, but instead comes from the Isle of Portland off the English coast, which produces a type of building stone that resembles finished concrete). The finish mill is a steel cylinder that is 13 feet in diameter and 39 feet long. Inside, 220 tons of steel balls crush the clinker into a fine powder at the rate of 80 tons per hour. The cement is then pumped to storage silos, from which it can be loaded onto river barges or trucks. Up to 150 30-ton tanker trucks and one 3,600-ton barge can be loaded per day at this facility.

This plant can produce 1 million tons of cement per year. It employs about 100 people with an annual payroll of more than $9 million.

Lafarge North America

Lafarge North America is the largest supplier of cement and concrete in the United States and Canada. It is also a major producer of construction aggregate (crushed stone and sand and
Fig. 5-1—The cement manufacturing process.

gravel), and gypsum drywall. In 2002, Lafarge sold more than 19 million tons of cement and cement-related products. The company has 20 cement manufacturing plants and 90 distribution facilities. In Kansas, it operates a cement plant and terminal in Fredonia. Lafarge North America, headquartered in Herndon, Virginia, has about 1,000 operations in 46 states and all Canadian provinces, employing more than 15,000 people. Its net sales in 2001 were $3.32 billion.

Lafarge North America is part of the Lafarge Group, a $12.3 billion company that operates in 75 countries and has 83,000 employees. The Lafarge Group has four divisions—Cement, Aggregates and Concrete, Roofing, and Gypsum. The Lafarge Group is headquartered in Paris.
Sources

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Resource Contacts

Bob Elliott
Lafarge North America
600 S.W. Jefferson Street
Lee’s Summit, MO 64063
800/245-8164
816/251-2153
Cell: 811/225-8999
bob.elliott@lafarge-na.com

Edward A. “Woody” Moses
Kansas Aggregate Producers Association
800 S.W. Jackson Street, Ste. 1408
Topeka, KS 66612-2214
785/235-1188
Fax: 785/235-2544
emoses@ink.org
Natural Gas from Coal in Eastern Kansas

Robert S. Sawin
Public Outreach, Kansas Geological Survey

Lawrence L. Brady
Geologic Investigations, Kansas Geological Survey

Introduction

Methane, the main component of natural gas, has been a product of the petroleum industry for years. Many of us use natural gas in our homes—in our furnaces, water heaters, and stoves. Now, a relatively new and unconventional source of natural gas—methane from coal beds—has generated interest in eastern Kansas.

Coalbed methane is natural gas that occurs in coal beds. The geological process that turns plant material into coal generates methane gas. This gas was a deadly nuisance that produced explosions in underground coal mines, so the mines had to be ventilated to remove the gas. In the early 1980’s, the mining industry began to capture and sell this gas rather than release it to the atmosphere. Thus, a new industry was created—the commercial production of methane from subsurface coal beds.

Coalbed methane now accounts for about 7 percent of the total annual gas production in the United States. In areas of the San Juan basin in New Mexico and Colorado, parts of the Black Warrior basin in Alabama, and basins in the central Appalachians, large quantities of methane are being developed from coal beds. This gas is now being exploited in other areas of thick, coal-bearing rocks such as the Powder River basin in Wyoming and Montana.

In Kansas, most of the activity has been in the southeastern part of the state, primarily Montgomery, Wilson, western Labette, and eastern Chautauqua counties; however, other parts of eastern Kansas that are underlain by coal beds also have potential for coalbed methane production (fig. 1). Coal beds that have potential to produce methane occur in eastern Kansas east of the Nemaha uplift, a subsurface geologic structure that runs from Oklahoma City, Oklahoma, north through El Dorado, Kansas, and just east of Manhattan, Kansas.

This circular describes coal and coalbed methane, gas production from coal, leasing and landowner mineral rights, and the potential for coalbed methane production in Kansas.

Coal and Coal Gas

Coal is the most abundant energy source in the world. Coal deposits have been mined in Kansas for nearly 150 years, mostly in southeastern Kansas, where surface and subsurface mines have produced over 300 million tons of coal. Bituminous (soft grade) coal resources of Pennsylvanian age, deposited about 300 million years ago, are widespread in eastern Kansas and constitute nearly all the coal resources in the state. Coal production in Kansas peaked during World Wars I and II. Today, however, only one small mine operates in Kansas, near Prescott, in Linn County.
Coal forms from plant material that was accumulated in ancient swamps and bogs at rates fast enough to prevent decay. Upon burial, the material is first converted to peat. Through time, as temperature and pressure increase with further burial, peat is converted to coal (it takes about 10 feet of peat to make 1 foot of coal). During this process, large quantities of methane-rich gas are generated and stored within the coal. Coal can store surprisingly large volumes of gas, up to six or seven times as much gas as a conventional gas reservoir (typically sandstone or limestone) of equal rock volume. The amount of gas in coal depends on the degree of alteration the coal has undergone in the burial process, the depth below the surface, and the pressure of the reservoir.

Coalbed gas is mainly composed of methane (the principal constituent of natural gas). Coalbed methane is what geologists call a sweet gas because it typically contains very few impurities such as hydrogen sulfide, nitrogen, or carbon dioxide, all normally found in natural gas. Coalbed methane, when burned, generates as much heat as petroleum-based natural gas.

**Producing Gas from Coal**

Coal contains gas and large amounts of water. Once the confining pressure on the coal is relieved (for example, by drilling and pumping), the gas is slowly released from the coal. Naturally occurring fractures, called cleats, provide the plumbing system within the coal that allows water and gas to travel through the coal to the well. For gas to be released from the coal, the pressure must be reduced by removing water from the coalbed, a process called dewatering. Dewatering brings large quantities of water (usually saltwater in Kansas) to the surface, which is reinjected deep underground.

Initial development of coalbed methane wells can take several months because of the large quantities of water that need to be pumped from the coal bed. In general, coalbed methane wells go through three stages during their production history (fig. 2). During the dewatering stage, water production initially exceeds that of methane, but as production continues, the volume of water decreases as the volume of methane increases. A stable production stage is reached when methane production reaches its maximum and water production levels off. During the decline stage, water production remains low and the amount of methane declines until methane becomes uneconomical to produce.

![Production stages of a coalbed methane well (adapted from Rice, 1997).](image)

**Mineral Rights and Leases**

An increasing level of interest in coalbed methane has spurred activity in eastern Kansas. Local landowners may benefit economically if they own the mineral rights beneath their property. Mineral rights are defined as the right of ownership of the mineral resources that underlie a tract of land.

Both the land surface and the resources below the surface can be owned and are considered property. The mineral rights can be owned in total or can be owned by the specific mineral commodity; for example, one company can own the mineral rights to the coal, while another company owns the oil and gas rights. Coalbed methane is natural gas and is considered part of the oil and gas minerals.

The owner of the mineral rights can be different than the surface owner. In Kansas, the landowner usually owns the subsurface rights, but sometimes these rights have been severed, or separated from the surface ownership. Severance of mineral rights occurs when the owner of both the surface and mineral rights sells or grants by deed the mineral rights underlying their property. The landowner may also reserve, or retain, all or a portion of the mineral rights upon sale of the property. Mineral deeds and mineral reservations are recorded with the county register of deeds and are included in any abstract of title to the land involved.

Mineral owners have the right to access and develop their minerals. Landowner rights are preserved, whether or not they participate in development of the mineral rights. Regulations are in place to stop operators if their activities are irresponsible or damaging to the surface. Landowners are entitled to compensation for loss of use or damage to their land. Most operators are willing to work with the landowner to reach a fair settlement for damages, but if this fails, state and federal regulations protect the landowner.
Before companies can begin an exploration and development program, they must obtain a lease to the mineral rights (in the case of coalbed methane, an oil and gas lease). An oil and gas lease is a legal agreement between the mineral-rights owner (the lessor) and the oil and gas operator (the lessee) that grants the operator the right to explore and develop the oil and gas resources which may underlie the area described in the lease. Some general stipulations that are usually part of a lease agreement are listed below:

- A legal description of the area and the number of acres.
- The primary term of the lease. This can be for any period of time, but is usually five or ten years.
- A provision for lease rental payments (usually annual) by the operator to the mineral-rights owner. Rental payments maintain the lease in effect throughout the primary term. If oil or gas is found, the lease will remain in effect as long as production continues, even beyond the primary term of the lease.
- A royalty clause that stipulates the mineral-rights owner's share of the oil or gas production. The royalty may be any amount mutually agreed to by the operator and the mineral rights owner, but is usually one-eighth (12.5 percent) of the oil or gas produced from the lease. Usually the operator sells the oil or gas to a refiner and the mineral-rights owners receive payment for their share from the operator.

Coalbed Methane Potential in Kansas

The bituminous coals of eastern Kansas have great potential for large quantities of methane. In areas where the coals are deeper than 500 feet, and the gas has been trapped in the coals by thick overlying shales, economic quantities of methane gas may exist. Many other factors, such as the market price for natural gas, also determine the economic feasibility of exploring for coalbed methane in eastern Kansas.

Although the coal beds in eastern Kansas tend to be widely distributed, and several beds (up to 14) could be encountered in a well, the primary concern is the thinness of most of the coal beds and the correspondingly smaller volumes of gas. Evaluation of approximately 600 geophysical logs in eastern Kansas indicates that about 96 percent of the coal occurs in beds 14 to 42 inches thick (fig. 3) and only about 4 percent occurs in beds greater than 42 inches. The main strategy for exploring for coalbed methane in eastern Kansas will be to locate thicker coals or multiple coal beds to warrant viable economic development (fig. 4).

Most of the coals in eastern Kansas are less than 2,500 feet deep, so drilling costs should be relatively low. Many gas pipeline networks already exist, and Kansas has recognized disposal zones for the water that is produced with the methane. All these factors suggest that eastern Kansas is an important area for potential development of coalbed methane.

Figure 3—Outcrop of a thin coal bed in Cherokee County.
Agencies to Contact About Coalbed Methane

Kansas Corporation Commission  
Conservation Division  
Finney State Office Building  
130 S. Market, Room 2078  
Wichita, KS 67202-3802  
316-337-6200  
www.kcc.state.ks.us

Kansas Geological Survey  
1930 Constant Ave.  
Lawrence, KS 66047-3726  
785-864-3965  
www.kgs.ku.edu

Sources


Figure 4—Coalbed methane well in Montgomery County, Kansas.