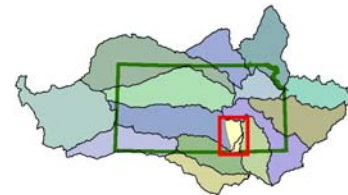


## Walnut Basin



- County Seat
- MDS Gage\*
- ~ Hydrology
- ~ Interstate Highway
- ~ US Highway
- ~ Kansas Highway
- ~ Federal Lake
- ~ County
- ~ Walnut Basin

\* Minimum Desirable Streamflow



10 5 0 10 Miles

Kansas Water Office, February 2008

### General Description

The [Walnut River basin](#) covers approximately 2,380 square miles and encompasses most of Butler and Cowley counties, as well as small portions of five other counties in south central Kansas ([HUCs](#) 11030027 and 11030018). The Walnut River rises in the northeastern part of Butler County, joining the Arkansas River at Arkansas City in Cowley County, about 120 miles to the south, and just north of the Kansas-Oklahoma state line.

Other major streams in the basin are the Whitewater River, Timber Creek, Little Walnut River, West Branch Walnut River (all tributaries to the Walnut River), and Grouse Creek. Both the Walnut River and Grouse Creek join the Arkansas River just before it leaves the State of Kansas.

There are two major reservoirs on the river system: [El Dorado Reservoir](#) and Winfield City Lake. El Dorado

Reservoir is formed by damming four headwater tributaries to the Walnut River in the northern part of the basin: Satchel Creek, Durechen Creek, Bemis Creek, and Cole Creek. Winfield City Lake is built on Timber Creek in the southern part of the basin, northeast of the City of Winfield.

Elevations range from 1,625 ft. at the top of the basin to 1,148 ft. in the Walnut River valley. Major cities in the basin include county seat El Dorado in Butler County and county seat Winfield in Cowley County. Other communities in the basin include Augusta and Andover in eastern Butler County and Arkansas City in southern Cowley County.

### Population and Economy

There were an estimated 95,925 residents in Butler and Cowley counties in the year 2000.

According to the Kansas Division of Budget, the total [population](#) in these two counties is projected to increase to 129,243 by the year 2040.<sup>(9)</sup> This basin illustrates major demographic changes taking place in Kansas. In the past 40 years, two trends have dominated the state and the basin. Rural counties have lost population, sometimes more than 10 percent every decade. While the population of Butler County is projected to increase by 36,756 by 2040, the population of Cowley County is projected to decrease by 3,441 during the same period of time.

The major [crops](#) are wheat, soybeans, cotton, hay, sorghum and corn. Crop value was estimated by the U.S. Department of Agriculture, (USDA) to be \$83,149,500 in 2006. [Livestock](#) production is also an important part of the area's agriculture with beef cattle the predominant livestock raised in the basin. USDA estimates the value of this production to be \$88,236,400.<sup>(5)</sup>

Farm related employment is a small part of total employment in the basin, even though the majority of the land use is for agricultural purposes. The northern part of the basin, generally in Butler County, is one of the fastest growing areas in the state, with Butler County as a whole ranked ninth in population growth between 2000 and 2005. While the rural farm based population is generally declining, there is continued growth in rural areas of non-farm residences outside of city limits in which residents generally commute to employment in either El Dorado, Wichita, or the surrounding suburban communities.

Although Sedgwick County and Wichita are in the Lower Arkansas River basin to the west, the western part of the Walnut basin is influenced by the Wichita metropolitan area economy and population. The influence of the Wichita Metropolitan area on population in the Walnut basin, especially in Butler County, has been apparent

since the 1950s. Growth in the western parts of the counties can be attributed to an eastward expansion of the Wichita industrial and metropolitan area. This is enhanced by the well developed transportation system shown on the basin map. For more information on this issue, see the [Regional Planning for Urbanization](#) section.

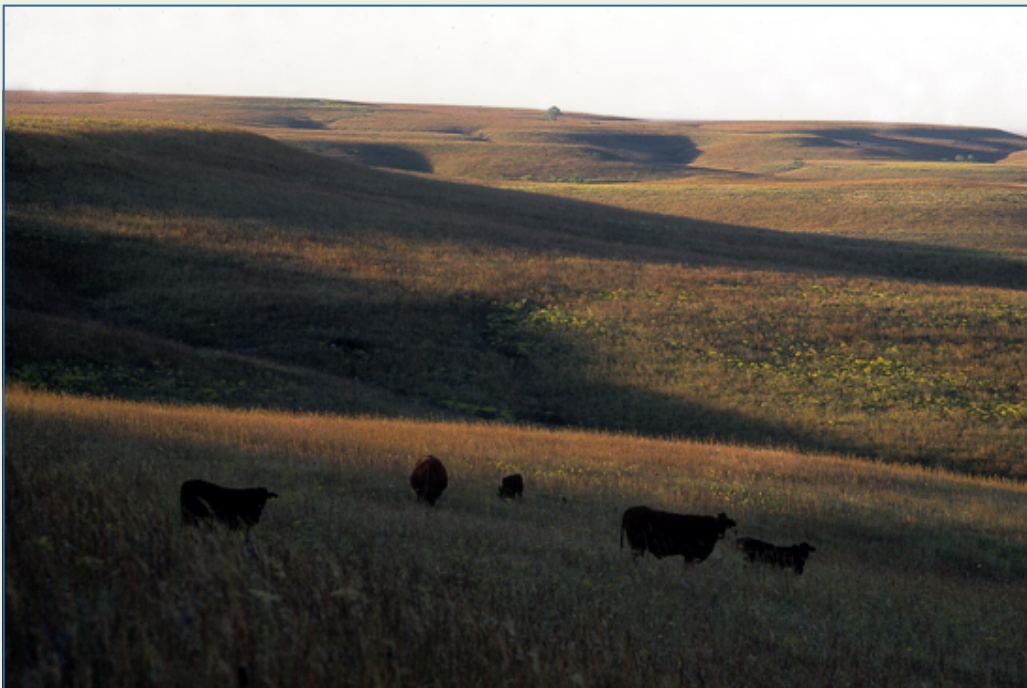
Petroleum production and refining also supports the basin economy. Several pipelines run through the upper area of the basin. The state correctional facilities and light industry are growing segments of the economy. In addition, construction, wholesale trade, retail, finance, insurance, educational and health care services, arts, entertainment and recreation, and the accommodation and food service industries account for major economic growth sectors. Butler and Cowley County Community Colleges provide opportunities for advanced education.

The Walnut and Whitewater rivers are not considered to be navigable under Kansas law and are generally not accessible to the public for water based recreational activities. See the [Recreational Use of the Walnut River Basin Priority Issue](#). However, El Dorado Reservoir provides an important water based economic resource in the upper part of the basin. El Dorado Reservoir was constructed by the U.S. Army Corps of Engineers (Corps) and was completed in June of 1981.

The reservoir consists of approximately 8,000 surface acres of water, 4,500 acres of park lands and 3,500 acres of wildlife

area. The Kansas Department of Wildlife and Parks (KDWP) manages these areas.

Close to one million people visit El Dorado State Park each year. Recreation opportunities include fishing, hunting, camping, boating and observing wildlife.



Open Range on the Flint Hills. Photo courtesy Kansas Geological Survey

Reservoir and park visitors also stop in El Dorado and other Butler County communities and purchase products, goods and services which generates around \$15 million annually, an estimate that is considered to be conservative. Winfield City Lake provides similar economic benefits in the southern part of the basin.

Zebra mussels, an aquatic invasive species, have populated both of these reservoirs in recent years. Zebra mussels have razor sharp shells and upset the ecological balance of the waters. It is not known at this time what impact the presence of Zebra mussels may have on visitation rates and fisheries production at these area reservoirs. The Zebra mussel, *Dreissena polymorpha*, is a bivalve mussel native to freshwater lakes of southeast Russia. Zebra mussels get their name from the striped pattern on their shells, though not all shells bear this pattern. They are usually about the size of a fingernail, but can grow to a maximum length of nearly two inches.

Its native distribution is in the Caspian Sea. Zebra mussels are considered an invasive species in North America and in Sweden.



Zebra Mussel build up on wet well trash rack , El Dorado Lake

### Physical Characteristics

#### Geology and Soils

The topography of the Walnut basin features a series of east-facing escarpments or hills, including the southern section of the Flint Hills belt which bisects the state from the Nebraska to the Oklahoma borders. The limestone beds in the Flint Hills contain large amounts of flint or chert. Where these beds mantle the uplands, erosion of the underlying soft shales has been reduced. The

streams in the Flint Hills upland area characteristically have deep and narrow valleys, lined with outcropping limestone ledges.<sup>(2)</sup>

The rocks that crop out at the surface in the basin belong to geologic formations of Permian age that were formed about 200 million years ago. The rocks consist of alternating beds of limestone, cherty limestone and shale. Unconsolidated deposits of more recent geologic age occur locally in the uplands and in the valleys of major streams. Chert gravels were deposited in the uplands by ancient streams that traversed the area before the present drainage pattern was established. The unconsolidated



Limestone cave & spring, Butler Co.  
Photo courtesy KGS

valley deposits consist of chert gravel, sand, silt, and clay. Thin, discontinuous deposits of loess or windblown silt also occur locally in the uplands and in the major stream valleys. In most areas, loess deposits are only a few feet thick, but along the Arkansas River in Cowley County east of Arkansas City, the loess is about 30 feet thick.

Soils were developed from the underlying limestones and shales and in most parts of this predominantly hilly area the soils are relatively shallow, making them best suited for native pastures. Upland soils are subject to extensive sheet and gully erosion. This makes the already thin topsoils particularly vulnerable to being washed from the surface contributing to downstream [sedimentation in streams and reservoirs](#).

Conservation treatment of agricultural lands is a major strategy in reducing erosion. Before European settlement, the soils were held in place by deep rooted tall grasses and forbs. Grazing impacts were minimal as the native bison herds moved throughout the expansive grasslands. As a result of more recent intensive cattle grazing, much of the prairie is overgrazed, exposing the soil to erosive forces.

### Land Use/Land Cover

West of the Whitewater River, land use is predominately crop land; east of the Whitewater River the land use is predominately grassland except for along the floodplains of the Walnut River and its tributaries. Overall, grassland covers about 66% of the basin, crop land covers about 23% and woodlands cover 5 percent. Subbasins dominated by grassland are the Little Walnut River (82%), Timber Creek (72%), and the Walnut River upstream from El Dorado Lake (81%). Cropland is dominant in the Whitewater River subbasin (65%).<sup>(3)</sup> (USGS). Less than 3 percent of the basin is urban and less than 2 percent is water.

In 2006 there were an estimated 2,310 farms, covering 1,382,000 acres in the two counties. The average farm size was 608 acres.<sup>(5)</sup>

According to the 2003 Assessment of Riparian Areas Inventory by the Kansas Geological Survey (KGS), of the 14,887 bank miles of riparian area within 100 ft. of the streams in the basin, the dominant riparian cover is pasture/grassland (41%). The second most common cover is forestland (20%) , and third most common cover is crop land (16%). The remaining riparian cover types, in descending order of dominance, are pasture/tree mix, crop land/tree mix, shrubland, urban, urban/tree mix, and barren land.

### **Climate**

The climate is characterized as humid continental with cold winters and hot summers. Annual [precipitation](#) varies from 32 inches in the western part to 34 inches in the eastern part of the basin. Approximately 72% of this precipitation falls between April and September. In an average year snowfall varies between 10 and 15 inches. Table 1 summarizes climate conditions in El Dorado and Winfield for the period between 1971 and 2000.

Table 1					
Climate Summary Walnut Basin					
	Average Annual <sup>1</sup>		Freeze Dates (32 F.) <sup>2</sup>		
Location	Precipitation (inches)	Temperature (deg. F.)	Last in Spring	First in Fall	Frost Free Days
El Dorado	35.51	55.5	Apr. 17	Oct. 17	183
Winfield	37.64	56.4	Apr. 14	Oct. 20	189

<sup>1</sup> Source: National Climatic Data Center (1971-2000 data)

<sup>2</sup> Source: KSU Weather Data Library (1961-1990 data)

### **Wildlife and Habitat**

The basin is home to numerous species of fish and wildlife. Approximately 70 species of butterflies have been identified in Butler County alone. The El Dorado Reservoir watershed is located within the Central Flyway for migratory birds. The entire area is part of the Flint Hills Ecoregion. The Flint Hills Tall Grasslands is the smallest grassland ecoregion in North America and is distinguished from other grassland associations by the dominance of tallgrass species—and from the Central Tall Grasslands to the north by its more limited biota and a thin soil layer spread over distinct beds of limestone. These flinty beds of limestone, from which the name of this ecoregion is derived, rendered large areas unsuitable for corn or wheat farming. Today, the Flint Hills Tall Grasslands is an anomaly—an essentially unplowed (although heavily grazed) remnant of the tallgrass prairie. Historically, fire, drought and grazing by bison and other ungulates were the principle sources of habitat disturbance in this ecoregion.

The dominant grass species in this ecoregion are big bluestem, switchgrass and Indian grass. Like other ecoregions of this section of North America, bison and elk once roamed these tallgrass prairies, where they were hunted by the prairie wolf. These species are now gone, although bison are being reestablished in this ecoregion.

There are 14 threatened or endangered species in the basin. Seven are birds, five are fish, one is a mammal and one is a mussel. Butler County has critical habitat for the bald eagle and Topeka shiner, and Cowley County has critical habitat for the Arkansas darter, the Arkansas River shiner, the Arkansas River speckled chub, and the silver chub. Grouse Creek is considered a reference stream in Kansas meaning that it has geomorphic, biologic, and chemical conditions characteristic of pre-settlement conditions.



Arkansas River Shiner. Photo courtesy Gerald Sneegas

## Water Resources

There are no natural lakes in the basin but numerous manmade surface water impoundments have been constructed. Reservoirs in the watershed include Augusta Lake, Winfield City Lake and El Dorado Reservoir. El Dorado Reservoir is operated by the Corps for the primary purpose of [flood control](#). At the top of the conservation pool, the lake is approximately 8,000 acres and has 98 miles of shoreline. Community and other lakes include Fox Lake, Lake Clymer, Rogers Pond, Cowley County Lake, Harvey County East Lake, and Santa Fe Lake. All counties also have state fishing lakes.

The Walnut basin contains 6,830 miles of streams; 5,729 miles of these are intermittent and 1,101 miles are perennial. Stream density in the basin is 2.8 stream miles/square mile area, making it the basin with the highest stream density in the state.

The major streams in the basin are the Walnut River and its tributaries, the Whitewater River and Little Walnut Creek; and Grouse Creek. Grouse Creek is actually a direct tributary of the Arkansas River and is not hydrologically connected to the Walnut River; however, for planning purposes, the Kansas Water Office (KWO) includes the Grouse Creek drainage with the Walnut River basin. Both the Walnut River and Grouse Creek join the Arkansas River just before it leaves the State of Kansas.

Ground water is present in alluvial deposits along major streams. Real-time water level information can be found at the U.S. Geological Survey (U.S.G.S.) website.<sup>(11)</sup>

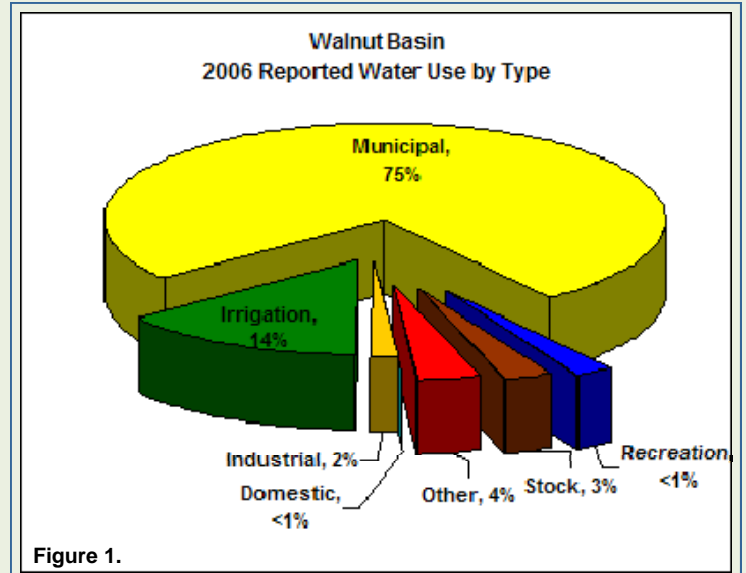
[Surface water](#) makes up over 85% of the water used in the basin. The major [use of water](#) in the basin is for municipal purposes, at over 75% and 96% of this is from surface sources. Irrigation uses about 14% (77% from surface water) and recreation, industrial, stockwater and other uses account for the remaining 11% (Figure 1).

## Water Management

[Surface water management and conservation](#) is a priority issue for this basin.

The major streams in the basin are closed to new appropriations during the May to September timeframe. There are two sites where minimum desirable streamflows (mfs) have been set (see [Basin Map](#)).

Significant [water management](#) entities in the basin include the conservation districts in Butler and Cowley counties and eight [watershed districts](#), which cover approximately 95% of the land area of the basin. The



Corps, responsible for the operation of El Dorado Reservoir, is an important water manager in the basin. The City of El Dorado contracts with the Corps for all of the public water supply storage space in El Dorado Reservoir, making the City another important water manager.

Some communities and rural water districts (RWDs) in the Walnut basin get their public drinking water supply from Wichita.

The cities of Winfield, El Dorado and Arkansas City are permitted, since 2004, under the Kansas Department of Health and Environment Stormwater Program. These municipalities are responsible for managing the quality and quantity of stormwater runoff within their boundaries.

[Watershed Restoration and Protection](#) (WRAPS) teams are an emerging water management entity in the basin.

**Resources**

1. *Kansas Water Plan 2003—Walnut Basin Section*
2. Kansas Water Resources Board Geology and Soils Preliminary Assessment reports; Ecoregion descriptions
3. United States Geological Survey 2000. K. E. Juracek. Report No. 00-4177 "Estimation and Comparison of Potential Runoff Contributing Areas in Kansas Using Topographic, Soil, and Land Use Information.
4. Kansas Water Office. 2008. Reservoir Fact Sheets
5. U.S. Department of Agriculture, Kansas. 2006-2007 County Farm Facts, Agricultural Statistics and Ranking.
6. Wilson, Brownie. 2003. Assessment of Riparian Areas Inventory, State of Kansas. [http://hercules.kgs.ku.edu/geohydro/ofr/2003\\_55/riparian/ofr\\_2003\\_55e.htm](http://hercules.kgs.ku.edu/geohydro/ofr/2003_55/riparian/ofr_2003_55e.htm).
7. Water Rights Information System. Kansas Department of Agriculture-Division of Water Resources, December 13, 2007.
8. U.S. Census Data—2000.
9. Kansas Division of Budget. 2007. County Population Estimates.
10. Kansas Water Resources Board Water Plan Studies. Verdigris Unit Report.
11. <http://waterdata.usgs.gov/ks/nwis/rt>

### Walnut River Feasibility Study

A Walnut River Basin Reconnaissance Study and an El Dorado Reservoir Feasibility Study/Watershed Management Plan have recently been completed by the Tulsa District Corps. The Reconnaissance Study was initiated in 2001 and the Feasibility Study was initiated in 2004.

The scope of the Feasibility Study began as an examination of the Walnut River basin and potential ecosystem restoration opportunities that would use the state's established best management practices (BMPs). Eventually, the study was re-focused to evaluate just the area above El Dorado Reservoir and the reservoir operations and processes, and ultimately to develop a Watershed Management Plan. The purpose of the plan is to identify and evaluate solutions to in-reservoir and watershed problems identified by the State of Kansas and the City of El Dorado that could be implemented in small steps all leading toward long term watershed objectives.

Development of the watershed management plan was guided by two long term restoration and protection goals and twelve specific objectives formulated by the state and the city. The goals were: 1. Identify effective reservoir restoration and protection measures to ensure long range availability of storage space for public water supplies in federal reservoirs, using El Dorado Reservoir as a pilot (with 8 objectives); and 2. Identify watershed restoration and protection needs and determine opportunities to implement effective management practices (with 4 objectives).

The Plan provides valuable information for near term restoration and preservation planning and implementation. A software watershed model was developed using the Soil and Water Assessment Tool (SWAT) to satisfy several of the watershed objectives. Additional data were collected as part of the study, such as a bathymetric survey to determine the current storage in El Dorado Reservoir.

For a complete copy of the report, contact the Kansas Water Office at 785-296-3185.