

WATER QUALITY

Beneficial Use Attainment

All classified streams within the Gasconade River watershed are designated as warm-water aquatic life protection and fishing, and livestock and wildlife watering (MDNR 1994). Additional designations are assigned to individual streams and to tributaries of the main stem Gasconade River. The main stem Gasconade River, approximately 271.0 miles from the mouth to headwaters in Wright County, is classified with aquatic life protection and fishing (AQL), livestock and wildlife watering (LWW), cool water fishery (CWF), whole body contact recreation (WBC), boating and canoeing (BTC), and drinking water supply (DWS). Little Piney Creek has all of the same uses as the main stem Gasconade River except drinking water (DWS) for six miles of stream in Phelps County. In addition, the Little Piney Creek has a cold-water fishery (CWF) designated use for approximately 20 discontinuous miles in Phelps County. Another major tributary, Roubidoux Creek, has all of the same uses as the main stem Gasconade River except drinking water (DWS) for 38 miles of stream from Phelps to Texas counties. An additional four miles of stream in the Roubidoux Creek main stem are designated for cold-water sport fishery (CWF) uses. Spring Creek is also designated as a cold-water sport fishery (CWF) for 6.5 miles from the mouth. Lastly, Mill Creek in Phelps County has a cold-water sport fishery for five miles to Yelton Spring.

There are a number of municipal sewage discharges to receiving streams in the watershed that have the potential to affect designated uses. Several discharges that have been identified by the Missouri Department of Natural Resources have the potential to impact water quality during low flow conditions. The City of Mountain Grove's Waste Water Treatment Facility, City of Waynesville Waste Water Treatment Facility, Newburg Waste Water Treatment Plant, Niangua Municipal Waste Water Treatment Facility, and Rolla-Vichy Road Waste Water Treatment Plant and Rolla SW Waste Treatment (see Point Source Pollution subsection) have the potential to threaten aquatic life and fishing designation with municipal treated sewage for several miles downstream of the respective receiving stream (MDNR 1984, 1997).

Other threats to beneficial uses are point and non-point source pollutants. Although water quality in the area is good, activities at the Fort Leonard Wood Army complex have the potential to affect Roubidoux Creek with non-point source pollution. This same general area has numerous small sewage treatment facilities that have been earmarked by the Missouri Department of Natural Resources as a threat to local groundwater between Fort Leonard Wood and the Gasconade River. Numerous SALT projects in the Upper Gasconade River watershed are addressing nutrient problems that have plagued these areas for several years, the source of the problem being cattle manure (see Land Use Section). Finally, sand and gravel mining in sensitive watersheds has the potential to impact fish spawning areas and the cool- and cold-water fisheries (see Land Use Section, Mining).

Outstanding State Water Resources

Sensitive areas as defined by the MDNR State Water Quality Standards include watersheds that are state outstanding water resources. Little Piney Creek, for 25 miles from the mouth to Section 21, Township 35N, Range 8W, has been designated an Outstanding State Water Resource in Missouri.

In the Missouri Unified Watershed Assessment Final Report, September 28, 1998, the Missouri Watershed Assessment Steering Committee, composed of the University of Missouri and federal and

state government agencies, identified watersheds that did not meet clean water and other natural resource goals. Each United States Department of Interior Geological Survey (USGS) 8-digit Hydrologic Unit (HU) was prioritized using a numerical ranking system (Final Missouri Unified Watershed Assessment Map). Each HU was scored based on 21 data criteria, selected because the importance and data availability.

According to this assessment, Category I watersheds are in need of protection because of water bodies on the 303(d) list or degraded aquatic system conditions, and category II watersheds have no 303(d) pollutant discharges and have neither moderate nor severe biological impairment nor loss of wetlands. The Lower Gasconade River watershed (HU# 10290203) is considered a Category II watershed; therefore, it is low priority for future watershed restoration efforts. On the other hand, the Upper Gasconade River watershed (HU# 10290201) is a Category I watershed. In a water quality priority ranking system (zero points as the lowest and 227 points as the highest ranking watershed), the upper watershed scores 115 points for the long-term watershed restoration schedule, although the Upper Gasconade River watershed did not score high enough for immediate restoration.

Springs make important contributions to the river flow and are sources of cold and cool water refuge to fish. Spring water chemistry in the Gasconade River watershed is calcium magnesium bicarbonate, which is derived from the local dolomitic geology (Vineyard 1982). Hardness ranges, depending on the spring and geology, from 135 to 300 mg/l as calcium carbonate.

The Gasconade River watershed, including the Big Piney River, has 76 reported springs (Vineyard 1982). Several springs in the watershed remain undocumented. According to Vineyard (1982), the Gasconade River watershed has one of the largest concentrations of big springs in the state. Most significant springs are found in the middle and narrow portion of the watershed (Figure 7). The dolomite formations in the area are conducive to the formation of springs.

A major concentration of springs is found in the Little Piney Creek watershed (Figure 10). Yancy Mills Spring (Table 11) and Piney Spring yield about 1.9 and 3.2 million gallons per day (mgd), respectively, and are major suppliers to cold-water stream segments (shown on Figure 16 & 17 of the Habitat Section). These stream segments were assessed by MDC Fisheries Research for their potential to support rainbow trout populations. These segments were selected based on their ability to produce thermal refuge to trout during low flow periods.

Several other stream segments receive cold water from springs. Roubidoux Spring discharges approximately 37.7 mgd of cold water to Roubidoux Creek (Table 11). Mill Creek has a number of springs in its watershed. The largest spring in Mill Creek's watershed is Wilkins Spring, which discharges approximately 3.7 mgd (Figure 10). Several smaller springs include Mill Creek Camp Spring and Ousley Creek Spring.

Dye-trace techniques are used to provide evidence of hydraulic connectivity between groundwater recharge areas and groundwater discharge points, such as springs. The Big Piney River, Roubidoux Creek, Gasconade River, and several of their tributaries were the perennial stream detection locations. Historically, the losing portion of Roubidoux Creek was identified as the groundwater recharge area for Roubidoux Spring. In the July 6, 1995 injection conducted by the USGS, losing stream Hurd Hollow, tributary to Roubidoux Creek, was identified as an additional recharge area for Roubidoux Creek. The dye travel time was estimated to be 8-15 days. Based on historical dye tests, the probable catchment area

for several springs is illustrated in the water resources report (Imes et al. 1996). Furthermore, the Imes et al. water resources report contains further information about other dye tests that can not be covered in the scope of this inventory.

Surface water quality is collected at Gage Station # 06930800 on the Gasconade River above Jerome, MO by the USGS. The period of record for this station is from January 1978 to the current year.

Selected ranges for water quality parameters for water years 1978, 1983, 1988, and 1998 are presented for the Gasconade River in Table 12. During this period water temperature reached a maximum of 34°C on August 11 and 17, 1980, which exceeded the state standard of 32.2°C for warm-water fish and as low as 0.0°C during winter. In the selected water years listed in Table 12, temperature did not exceed the state standard for cold-water or warm-water fish. Specific conductance reached a daily maximum of 588 microsiemens per centimeter (um/cm) on September 23, 1981, and a low of 132 um/cm on November 8, 1996. Over the past 20 years, specific conductance rarely fell below 240 um/cm or exceeded 360 um/cm. Some of the major ions that constitute conductance are the dissolved Mg, Ca, and HCO₃ ions. A dynamic chemical equilibrium exists with the cations and the anions that constitute the hardness of the water. Because of the karst geology of the Gasconade River watershed, hardness is relatively high (130-200 mg/l as CaCO₃ over the 20-year period). This hardness affects the ability of soap to lather, thus the derivation of the term.

Nitrate in drinking water supplies may reduce the oxygen carrying capacity of the blood (cyanosis) if ingested in sufficient amounts by infants less than six months of age. The EPA maximum contaminant level (MCL) and the Missouri State Standard for nitrate is 10 mg/l. Nitrate levels in the Gasconade River watershed have not exceeded state standards during the collection period of 1978-98.

A maximum of 200 fecal coliform colonies/100ml of water is the standard for whole-body-contact recreation (swimming) in Missouri. The gage station at Jerome exceeded the state limited for fecal coliform in 1978 and 1988 with 1,900 colonies/100ml and 680 colonies/100ml, respectively. Both fecal coliform and fecal streptococci are found together in water. The presence of one bacterium will indicate the presence of the other. No state standard is listed for fecal streptococci. When levels exceed the state standard, contamination could be from two sources: human or animal (Eubank et al. 1993). Because levels of coliform were much greater than streptococci, a human source may have been the cause in 1978. In 1988, levels of streptococci were far greater than levels of coliform, which may indicate the presence of animal contamination.

Health Advisories, Fish Kills, and Contamination Levels

Health advisories from the Missouri Department of Health, working in conjunction with the Missouri Department of Conservation, Missouri Department of Natural Resource, and the EPA to monitor fish tissue chemical contaminants, state that fish are safe to eat within the Gasconade River watershed. Fish kills and pollution investigations are accomplished through cooperative effort of the Missouri Department of Conservation and the Department of Natural Resources.

The Gasconade River, one of the last free-flowing rivers contained entirely in the Missouri, has the dubious status of having suffered the largest pipeline oil spill in the nation. The oil pipeline break that occurred December 24, 1988 poured over 863,000 gallons of crude oil into Shoal Creek, and eventually to the Gasconade River and the Missouri River (Table 13). Surveys and studies of the pollution effects were conducted on birds, reptiles and amphibians, mussels, benthic macroinvertebrates, larval and adult

fish populations, sediment toxicity, tissue contamination, fish flesh palatability (Duchrow 1992). The total cost to Shell Oil Company was 22 million dollars for fines, environmental cleanup, and federal allegations. No fish were killed at the time of the pollution event.

Hog manure contaminated Cedar Creek in April of 1990, killing an estimated 43,118 organisms (Table 13). During biochemical decomposition, manure uses oxygen, creates ammonia, and thus, can be toxic in high concentrations to fish.

The MDNR and the United States EPA maintain a fish tissue contaminant database. MDNR and the United States EPA analyzed whole body samples of river redhorse, common carp, sunfish, largemouth bass, black redhorse, and black sucker for fish tissue contaminant levels within the Gasconade River from 1979 to 1994 and in 1998 (Table 14). No fish sampled were beyond action levels during the given time period. Missouri Department of Conservation (MDC) supplied fillets of requested fish in 1989 and in 1998. (Table 14).

Separate fish tissue contaminant sampling was performed by MDC during 1994, 1996, and 1997 on sites within Missouri. No fish tissue samples were taken from the Gasconade River watershed in 1994 and 1996. However, on a statewide basis, Chlordane and DDE were detected in 80% and 94% of the samples, respectively. In addition, mercury was the most frequently found heavy metal (Buchanan 1995). Food and Drug Administration action levels for Chlordane are 0.3 mg/kg. Food and Drug Administration and the World Health Organization (WHO) have identified action levels for lead as 0.3 mg/kg, mercury as 1.0 mg/kg, and PCBs as 1.0 mg/kg. Several inch groups of carp, suckers, and bass were collected from the Gasconade River at Highway 50 for tissue contaminant sampling in 1997 (Buchanan 1998). Processed in 1998, fish tissue samples were not above the action limits, although mercury, dieldrin, chlordane, and lead were found in the samples (Table 14).

Water use refers to "water used for any purpose" (MDNR 1986). Total water use in Missouri exceeded 8.65 trillion gallons in 1993 (Ducharme and Todd 1996). All *classified* streams within the Gasconade River watershed are designated as warm-water aquatic life protection and fishing (AQL), and livestock and wildlife watering (LWW). Table 15 lists the major water uses for counties within the Gasconade River watershed.

Public water supply with river intakes are few within the Gasconade River Watershed. The only river intake is within the Big Piney River watershed (MDNR 1986). The remaining public water is supplied by groundwater. Safe Drinking Water Information System (SDWIS) within the Lower Gasconade River watershed (HU# 10290203) and the Upper Gasconade River watershed (HU# 10290201) lists municipal drinking water facilities regulated by EPA.

In the 1974 Missouri Stream Pollution Survey, Frank Ryck noted that the Gasconade River watershed was one of the least polluted river systems in Missouri (Ryck 1974). However, at that time water quality was being impaired by point source discharges to the Big Piney River, a tributary that influences the Lower Gasconade River watershed, from several sources. Fort Leonard Wood (FLW) area has several losing streams that provide flow to springs. For example, Ryck (1974) noted that the FLW sewage treatment plant was discharging to Dry Creek, a losing stream tributary to the Big Piney River. At that time Shanghai Springs, which receives flow from Dry Creek, was being contaminated by sewage. Although conditions have improved since this report, FLW area with its many losing streams was reported to have several poorly constructed sewage treatment facilities that could impair water quality (MDNR 1994b). The most recent sampling of Shanghai Springs by the USGS in 1995 showed probable

effects from septic contamination (Imes et al. 1996). Also, the USGS noted that Shanghai Springs had larger than background concentrations of NA, CL, NO₂ and NO₃, NH₃, and SO₄. The USGS also verified, using dye tracings, that the probable catchment area for Shanghai Springs extends into Fort Leonard Wood Military Reservation portion of Roubidoux Creek, especially Smith Branch and Bard Hollow Creek.

During low flow conditions, several point source discharges have the potential to impact water quality for several miles down stream. A 1.2 million gallon per day (mgd) discharge from the City of Mountain Grove affects about one mile of receiving stream (MDNR 1984, 1997). Also, a discharge of smaller size from the City of Waynesville, listed on the Permit Compliance System, affects about one-half mile of Roubidoux Creek. Other discharges include the Newburg, Niangua, the Rolla Vichy Road, and Rolla SW waste water treatment plants that have the potential to affect between 0.2-0.5 miles of stream (MDNR 1984, 1997).

Improvements in the chemical composition of discharges to receiving streams are achieved through monitoring and sewage treatment upgrades. According to Ryck (1974), Waynesville Waste Water Treatment Facility (WWTF) was impacting Roubidoux Creek, and serious algae growth was developing downstream of the discharge. As a result, upgrades to the plant were made. In 1987 and 1995, the water pollution survey conducted by the Missouri DNR, Waynesville WWTF was not impacting Roubidoux Creek (MDNR 1984, 1997).

CAFOs are agricultural enterprises that keep and raise animals in confined situations. CAFOs congregate animals, feed, manure and urine, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures or fields.

CAFOs can pose a number of risks to water quality and public health, mainly because of the amount of animal manure and waste water they generate. Manure and waste water from CAFOs have the potential to contribute pollutants such as nutrients (e.g., nitrogen, phosphorus), sediment, pathogens, heavy metals, hormones, antibiotics, and ammonia to the environment.

Within the Gasconade River watershed, 22 CAFOs (Table 17) can be found in Gasconade, Laclede, Maries, Texas, Webster, and Wright counties (MDNR 1999). The waste types for all CAFOs, as defined by the Missouri Department of Natural Resources, are from the dairy milking or cow, hog, poultry, and beef feeding operations. Several dairy-milk operations are located in the Upper Gasconade River watershed, especially in the vicinity of Beaver Creek, West Piney Creek, and Whetstone Creek. The hog operations are found in both the Upper Gasconade River watershed and the Lower Gasconade River watershed.

All watersheds defined as critical watersheds by the MDNR in the Clean Water Commission, Chapter 6--Permits, Title 10 CSR 20-6.3 paragraph 9 and Section C are excluded for construction of Class IA concentrated feeding operations (MDNR 1996). Within the Gasconade River watershed, a river drinking water intake is within the Big Piney River watershed (MDNR 1986), which is considered a critical watershed and excludes it from CAFO construction under the above rule.

Pipeline Oil Spill

Several pipelines cross the Gasconade River watershed, and if ruptured, they could cause harmful effects on the environment. On December 24, 1988 a break in a 22-inch pipeline operated by Shell Pipe Line

Corporation poured an estimated 863,000 gallons of crude oil into Shoal Creek and into approximately 65 miles of the Gasconade River. A major evaluation of the Gasconade River took place as result. The effects of the oil spill were monitored by studying fish and benthic invertebrate communities and by testing the toxicity of the stream sediment.

Several studies were conducted to determine the spill's impact on the fish of the Gasconade River. William Pflieger, MDC Ichthyologist, evaluated the fish fauna of the Gasconade River by seining six sites on the River in 1989. These collections were compared to samples collected during the period between 1942 and 1980. Species composition of the lower Gasconade River has been relatively stable during the 1942 - 1989 period. However, spotted bass became established in the 1970s. Faunal differences between 1980 and 1989 collections involved an increase in species richness, a reduction in species diversity, and changes in relative abundance of some species. These changes probably are natural responses to year-to-year fluctuations in environmental conditions that affect recruitment, and none were attributed to impacts of the oil spill (Pflieger 1990).

Another study evaluated the adult fish community after the oil spill. George Kromrey, MDC Fisheries Regional Supervisor, sampled four sites, one above and three within the oil spill area during the same week in September 1989. Species diversity was assessed using Simpson's Diversity Index, abundance using catch per unit effort, and condition using length-weight relationships. Statistical analysis revealed few significant differences between pools at each site or among the four sites. The study demonstrated the presence of a diverse and healthy population of fish below the oil spill site (Kromrey 1990).

Collections of the benthic invertebrate community and tests of the toxicity of the stream sediment were done to determine the effects of the oil spill. Preliminary invertebrate samples were collected in March 1989 by the MDNR, and as a result of this sampling, a one year study was started in July 1989 by the Fisheries Contaminant Research Center. Using kick net samples from riffle habitats and Ponar grab samples from backwater habitats upstream and downstream from the spill site, abundance, taxa richness, and total number of pollution tolerant and intolerant invertebrates were quantified (Finger et al. 1990). Water quality and total petroleum hydrocarbons (TPH) of stream sediment were collected. The study indicated a change in abundances and community composition of the riffle community that may have occurred immediately after the oil spill, but a May 1990 flood likely impacted both riffle and backwater habitats. Therefore, no effects to the riffle benthic community were attributed to the oil spill. In backwater areas, some invertebrate groups showed reduced abundances. These areas had longer retention of TPH than riffle habitats, but concentrations of TPH decreased over time.

Non-point source (NPS) pollution is the leading source of surface water and ground water quality impairments. Runoff from farms, mining operations, construction sites, forest operations, residential septic tanks, impervious surfaces in urban areas are considered non-point pollutant sources. At the Jerome USGS Gage Station in Phelps County and the Rich Fountain USGS Gage Station (Vandike 1995), the annual runoff is 12.49 inches and 12.66 inches, respectively.

In a 1978 Water Quality Survey report by the Missouri Department of Conservation, the Osage Fork of the Gasconade River was noted to be affected by excessive aquatic plant growth and habitat reduction (Duchrow 1978). In the same survey, the author observed reductions in habitat quality on the Gasconade River from NPS pollution at the Highway 89 crossing for 1 mile and also at the Route J crossing for 8 miles. Today, cursory observation of these sites indicates that the watershed problems associated with the tributary streams near Highway 89 are still loading nutrients. The Route J and Route D area has been

under bridge construction for several years and conditions in the area have not improved. Increased fine sediments and loss of riparian corridor from road and bridge construction are symptoms of the degraded water quality.

More recently, the 1997 DNR Water Quality Basin Plan identified numerous dairy calf, milking, or feeding operations as sources of potential non-point source pollution areas in Wright, Webster, Texas, and Gasconade counties. Within this same area (Upper Gasconade River, Roubidoux Creek, and Woods Fork) the NRCS has a Special Area Land Treatment project to reduce nutrients from these operations. Also, several hog operations in Wright and Laclede counties have the potential to impair water quality (MDNR 1997).

Urban development can contribute to the sediment supply when erosion control structures are not used properly during construction. A construction site in Waynesville in March 1997, discharged muddy water into a tributary of Roubidoux Creek following rainfall events (Duchrow 1997). Investigation by MDC Fisheries Division personnel determined that developers at the construction site were negligent in the use of Best Management Practices (BMPs) to reduce erosion during rainfall events. In this incident, developers were required to comply with BMPs and the Missouri Clean Water Law.

Sanitary Landfills

Sanitary landfills permitted by MDNR can be a source of water pollutants if not properly maintained by the owner. The only landfill permitted in the Upper Gasconade River watershed is found within Wright County near Hartville. No active landfills are found in the Lower Gasconade River watershed. No landfill-related water quality problems from active sites are noted by the Missouri Department of Natural Resources, however several closed landfills and inactive landfills are being monitored by the MDNR. Two landfills, the Wright County Landfill and the McDowell Landfill, in Wright and Phelps counties, respectively, are potential NPS pollution areas (MDNR 1997). No new landfills are proposed by the MDNR within the upper or lower watersheds (MDNR 1999b).

The Chemical Sites Database (CARES 1999a) is a combination of 105 databases that were reviewed for the presence of the 54 chemicals monitored by MDNR. Staff at the Center for Agricultural, Resource and Environmental Systems (CARES) made trips to the regional offices of MDNR, and the regional staff located the sites on USGS 1:24,000 scale topographic maps. CARES digitized the locations and entered the attribute data into ESRI database software. Sites that had an area of greater than 10 acres were put in this map layer, all other were put in the SCHEMCOV point layer.

The chemical sites (from CARES) that are known to exist in the Gasconade River watershed are potential sources of non-point pollution. Approximately 35 sites are known to exist in the Gasconade River watershed. The highest concentration can be found in Texas County of the Upper Gasconade River watershed.

303(d) Pollutant Discharges

Section 303(d) of the Federal Clean Water Law requires that states identify those stream segments lacking proper pollution control measures. In addition, Total Maximum Daily Load (TMDL) studies are needed for those waters to determine measures needed to remove the water quality impairment. In 1998, two streams in the Upper Gasconade River watershed were identified by the Missouri Department of Natural Resources as Section 303 (d) Category 1 streams (Table 16). In Wright County, a 2-mile segment of Whetstone Creek was ranked high for TMDL studies because of the BOD problems. In addition, a

0.1-mile segment of Little Beaver Creek was affected by Rolla South West WWTF, but was lower in priority for TMDL studies.

Table 11. Location and discharge of major springs (>1,000,000 gal/day) into the Gasconade River watershed. Rate of flow represents records for dates ranging from 1924-72 (Vineyard and Feder 1982).

Spring	Nearest Town/County	Twnshp-Rge-Sec	Rate of Flow	
			Sec. Ft. (cfs)	1,000 gal./day
Bartlett Mill	Waynesville/ Pulaski	36N-12W-16-SWSE	15.6	10,100
			68.0	44,200
			0.31	200
Boiling	Pulaski	32N-10W-24-SWSW	65.0	42,000
Roubidoux	Pulaski	36N-12W-25-NENW	58.3	37,700
			192.0	124,000
Yancy Mills	Phelps	36N-8W-32-SESW	1.5	1,000
			3.0	1,960
Lane Spring	Phelps	36N-8W-32-SWNW	17.9	11,600

Table 12. Selected water quality data for the Gasconade River watershed at Phelps County, Hydrologic Unit #10290203, Gage station #06930800 for water years (USGS 1978 - 1998; Code of Regulations 10 CSR 20.7). Mean values are presented with year.

Parmeter	State Standard of Uses				Water Year (means)			
	I	III	VI	VII	1978	1983	1988	1998
Water Temperture (°C)	32.2° Max ¹ 28.9° Max ²				2.0-28.0	5.0-28.0	2.5-26.0	5.0-25.0
Specific Conductance (us/cm)					264.0-360.0	264.0-351.0	240.0-338.0	277.0-340.0
O₂, Dissolved (mg/l)	5 ¹ 6 ²				6.1-15.8	5.6-12.4	6.8-14.2	6.0-11.8
pH	#				7.7-8.3	7.8-8.3	7.9-8.3	7.9-8.2
Hardness, Total (mg/l CaCO₃)					160-190	130-190	120-200	150-170
Calcium, Dissolved (mg/l as Ca)					29-39	27-36	24-40	31-34
Magnesium, Dissolved (mg/l as Mg)					19-24	16-23	14-25	17-19
Fluoride, Dissolved (mg/l as Fl)		4		4	<0.1-0.2	<0.1	<0.1-0.2	<0.1
Sulfate, Dissolved (mg/l as SO₄)		250			3.9-11	6.3-9.2	5.5-13.0	4.7-7.0
Nitrogen, Total Ammonia (mg/l as NH₄)					<0.01-0.1	--	<0.01-0.06	--
Nitrate-N (mg/l N)		10		10	.08-.81	.11-.33 ^A		.01-.05 ^B
Phosphorus, Total P (mg/l as PO₄)					.01-.12	.01-.04	<.01-.09	-

Coliform, Fecal (colonies/100ml)			200		4-1900	1-200	1-680	2-180
Streptococci, Fecal (colonies/100ml)					4-1600	21-540	<1-4200	1-77
Iron Dissolved (mg/l FE)					20-30	5-50	<3-10	<10-31

I: Protection of aquatic life. ¹ For warm-water fisheries.

III: Drinking water supply. ² For cold-water fisheries.

VI: Whole-body-contact recreation. # H₂O contaminants should not cause

VII: Groundwater pH fall out of 6.5-9.0 range.

^A1981 water year ^B1997 water year

Table 13. Fish kills for the last 10 years in streams of the Gasconade River watershed sorted by year within county (Missouri Department of Conservation Environmental Services and East Central files).

Date	Stream Name	CNTY-TNSP-RGE-SEC	Discharge Substance	Number of Organisms	Fine \$
12-24-88	Shoal Creek/ Gasconade River	Maries-40N-8W-29	Oil	undetermined	7 million
08-28-89	Woods Fork	Wright-29N-15W-01	Unknown	186	261.10
04-28-90	Cedar Creek	Osage-44N-08W-18&19	Hog Manure	43,118	3,555

Table 14. Contaminants in fish tissue (mg/kg) within sampling sites of the Gasconade River. Sample sites ³ were at Jerome, MO (1), Mt. Sterling, MO (2), Gasconade River @ Highway 50 (3).

YR	Site ³	Species	RF ¹	P ²	Chlordn	Dieldrn	DDT/MTB	PCBs	PB	HG
79	1	Red	12	W	0.052	0.008		Trace		0.15
79	1	Carp	12	W	0.026	Trace		Trace		0.17
79	1	L Bass	12	W	0.025	0.005		Trace		0.430
79	1	Red	12	W	0.041	0.009		Trace		0.1
79	1	Sun	12	W	0.017	0.005		Trace		0.14
79	1	Red	12	W	0.005	0.010		Trace		0.15
80	1	Red	11	W	ND	ND	ND	ND		0.04
81	1	Carp	11	W	ND	ND	ND	ND		0.05
82	1	Red	11	W	ND	ND	0.024	ND		0.06
83	1	Carp	11	W	0.23	0.10	0.077	0.25		0.03
84	1	B Red	11	W	ND	ND	0.030	ND		0.07
84	1	B Red	11	W	ND	ND	0.014	ND		0.06
84	1	B Red	11	W	ND	ND	0.009	ND		0.06
85	1	G Red	11	W	0.04	ND	ND	ND		0.06
85	1	B Red	11	W	0.05	ND	ND	ND		0.05

86	1	B Red	11	W	0.038	LT 0.001	0.041	0.27		0.075
87	1	B Red	11	W	0.02	0.007	0.033	LT 0.183		0.088
88	1	G Red	11	W	0.027	0.012	0.053	LT 0.210		0.306
89	2	G Red	18	F	LT 0.20			LT 0.050		
89	2	CH Cat	18	F	0.109			LT 0.050		
89	2	CH Cat	18	F	0.062			LT 0.050		
89	1	B Red	11	W	0.036	LT 0.007	0.033	LT 0.120		0.288
90	1	Carp	11	W	0.04	0.019	0.024	LT 0.160		0.092
92	1	B Red	11	W	ND	ND	ND	ND	LT 0.500	0.153
93	1	G Red	11	W	0.047	LT 0.002	0.038	0.060	LT 0.170	0.159
94	1	B Red	11	W	LT 0.03	LT 0.002	0.025	LT 0.050	LT 0.170	0.074
94	1	B Red	11	W	LT 0.03	LT 0.002	0.035	LT 0.058	LT 0.170	0.144
97	3	Carp	18	F	LT 0.020	LT 0.002	ND	ND	LT 0.01	0.144

97	3	Red	18	F	0.036	LT 0.002	ND	ND	LT 0.01	0.260
97	3	Bass	18	F	ND	ND	ND	ND	LT 0.01	0.494

Levels of Concern: FDA and the World Health Organization (WHO) have identified action levels for chlordane as 0.3 mg/kg, (HG) mercury as 1.0 mg/kg, and PCBs as 1.0 mg/kg. National Academy of Sciences action levels for DDT, dieldrin, chlordane (sum total)--0.3 mg/kg; and 5 mg/kg for DDT.

¹RF 11,12=DNR/EPA, 18=MDC; ²P W=Whole, F=Fillet; Species -- Red=redhorse, Carp=carp, Sun=sunfish, L Bass=Largemouth bass, B Red=black redhorse, G Red=golden redhorse, CH Cat=channel catfish, BL Red=black sucker.

Table 15. Major water users (greater than 100,000 gallons of water or more daily) registration summary for counties within the Gasconade River basin. Use totals are shown as 1000 gallons per year rounded to the nearest 1000th. (Reference: Missouri Major Users Database, Missouri Department of Natural Resources, Ducharme and Todd 1996).

County	Domestic	Muni-cipal	Irrig-ation	Recre-ation¹	In-dustrial	Fish & Wildlife²	Total Water Use
Dent			43,824			9,406,780	9,450,604
Gasconade		324,861	15,168				340,029
Howell	108,280	902,367		400	10,327		1,021,354
Laclede		871,335			96,801	7,300,000	8,268,136
Maries	1,642	27,301		704,000	3,690		736,632
Osage		171,314					12,020,874
Phelps	53,773	901,955		2,020		2,595,938	3,553,687
Pulaski	1,379,683	621,785	5,000	5,326	60,000		2,071,794
Texas	36	434,524	214,834		206,830		856,224
Webster		330,170	259,584				589,754
Wright		328,898		800	11,042		340,742
Totals	1543414	4914510	538410	712546	388690	19302718	392,49,830
Percent	3.9	12.5	1.4	1.8	1.0	49.2	100.0

¹ Recreation: Water used for recreational purposes, such as swimming and fishing. Water used for aesthetic purposes is also included under the recreational water use category.

² Fish and Wildlife: Uses which require water for the maintenance of fish and wildlife habitat, as well as subsistence of fish and wildlife populations. Water used for aquaculture is also registered under this category.

Table 16. 303(d) pollutant discharges list by the Missouri Department of Natural Resources in the Final 1998 303(d) List for Missouri. Category 1 recommended Section 303(d) waters required to have TMDLs analysis.

Water	County	Miles/Acres Affected	Pollutant	Source	Priority for Analysis
Little Beaver Creek	Phelps	0.1	NFR	Rolla SW WWTP	Low
Whetstone Creek	Wright	2	BOD	Mountain Grove WWTPs	High

BOD--Biological oxygen demand

NFR--Non-filterable residue

Table 17. Location of permitted animal waste facilities within the Gasconade River Watershed as of October 1, 1999 (MDNR 1999). * Section is from smallest to largest area.

Operation Type	Amount of Units	Location Twn-Rng-Sec*	County
hog operation	1,650	41N-6W-SWNE 1	Gasconade
hog operation	4,800	39-9W-NESE 5	Maries
hog operation	3,200	39-10W-NWNW 34	Maries
dairy milking or cow	250	29-11W-NWNW 3	Texas
dairy milking or cow	280	33-14-NWSE 36	Laclede
dairy milking or cow	250	32-14W-SESE 1	Laclede
dairy milking or cow	300	33-15W-SWSW 23	Laclede
dairy milking or cow	200	31-16W-NESW 12	Webster
poultry operation	280,000	30-16W-NWNE 29	Webster
poultry operation	280,000	30-16W-NWNE 29	Webster
poultry operation	280,000	30-16-NWNE3 29	Webster
dairy milking or cow	300	30-17W-SWSE 14	Webster
dairy milking or cow	300	30-17-SWNE 14	Webster
dairy milking or cow	100	30-12W-SWNE 08	Wright
dairy milking or cow	470	29-15W-NW 2	Wright
dairy milking or cow	150	29-13W-NENE 20	Wright

hog operation	40	31-15-NENE 14	Wright
hog operation	3,000	31-15-SWSE 11	Wright
hog operation	3,000	31-15W-NENE 14	Wright
hog operation	3,000	31-15W-NENE 14	Wright
hog operation	3,000	31-15W-SWSE 11	Wright
beef feeding operation	500	29-12W-SWSE 33	Wright