Minnesota Pollution Control Agency

Minnesota River Basin

Hawk Creek-Yellow Medicine Watershed.

This report reflects the number and boundary delineations of earlier work done by the Minnesota River Assessment Project (MRAP), in which the Minnesota River Basin was divided into thirteen major watersheds. The majority of these watersheds contain the drainage area of only one of the Minnesota River's major tributaries, while the others contain a given reach of the Minnesota River as well as the tributaries and creeks joining the Minnesota along that reach.

Among the latter is the Hawk Creek-Yellow Medicine River Watershed, classified as a major watershed of the Minnesota River it is actually two separate sub-watersheds, Hawk Creek on the north side of the Minnesota, and Yellow Medicine on the south side of the river. In addition, the Hawk Creek-Yellow Medicine Watershed also includes the section of the Minnesota River mainstem extending between the Lac Qui Parle Reservoir to just below the mouth of the Redwood River. Several smaller creeks draining their respective minor watersheds also join the section of the Minnesota River mainstem within the Hawk Creek-Yellow Medicine Watershed, it is assumed, land use, geology, water quality, etc. within these minor watersheds is comparable to that within the Hawk Creek Watershed on the north side of the Minnesota River, or the Yellow Medicine Watershed on the south side of the river. Without installing monitoring equipment at each of the smaller tributaries, collective inputs from these minor watersheds can be calculated as being the residuals of Hawk Creek-Yellow Medicine Watershed (Minnesota River inflow load plus Hawk Creek-Yellow Medicine load minus Minnesota River outflow load).

Physiography And Description

The 2,020 square mile Hawk Creek-Yellow Medicine sub-basin can be broken into three broad physiographic units, the Hawk Creek watershed, the Yellow Medicine River watershed, and the Minnesota River valley that extends within the boundaries of the basin. Approximately 85 miles of the Minnesota River flow through the Hawk Creek-Yellow Medicine Watershed. Winding through the great valley carved when the River Warren drained glacial Lake Agassiz during the end of the Wisconsin Glaciation, the Minnesota River appears vastly undersized for this wide expansive vale. Till depths within the river valley are reduced to a thin veneer or are entirely absent, as outcroppings of igneous rocks are common along this stretch of the Minnesota River. Located along the stretch of river within the Hawk Creek-Yellow Medicine Watershed are several natural geo-fluvial assemblages, uncharacteristic for the otherwise placid Minnesota River. Near the city of Granite Falls are the River's only set of rapids and two natural waterfalls. From Granite Falls; the rapids are located upstream, one waterfall is located in the city and the second is 2.5 miles downstream. Although not high enough to be classified among waterfalls of great significance, they nevertheless are the Minnesota River's only waterfalls. Both waterfalls have been modified by man-made dams for the production of hydroelectric power, but only the upper one in Granite Falls still operates. In addition to Hawk Creek and the Yellow Medicine River, several other "lesser" streams join the Minnesota River within the watershed, including: Palmer, Sacred Heart, Middle, and Beaver creeks from the north and Boiling Spring from the south.

Draining an area of 973 square miles within sections of Chippewa, Kandiyohi, and Renville counties, Hawk Creek and its major tributary, Chetomba Creek, do not rise in the high moraines as do the Pomme De Terre and Chippewa Rivers. Instead, they originate on a marshy till plain, not much above the level of the Minnesota Valley bluffs. Hawk Creek flows southwest through the Western Corn Belt Plains Ecoregion for approximately 65 miles before joining the Minnesota River below Granite Falls. Glacial till deposits cover the entire watershed and form the present land surface. With the exceptions of the northern tip (lying in the Alexandria Moraine Complex) and the southwestern corner (lying in the Benson Lacustrine Plain), the majority of Hawk Creek watershed falls within the geomorphic setting of the Olivia Till Plain. Soils of the Olivia Till Plain are mostly loamy and silty, with roughly two thirds of these being well drained and the remainder poorly drained but improved by tiling. Landscapes within the till plain are characterized as undulating to rolling in steepness (6-12 %) , with roughly 55% of the lands classified as having the potential for moderate water erosion.

The Yellow Medicine River, so named by the Sioux for the bitter, yellow roots of the moonseed plant, growing as lush vines in thickets along the stream banks, rises on the Coteau des Prairies (meaning Highland of the Prairies, so named by French explorers). The Coteau is a morainal plateau within the Northern Glaciated Plains Ecoregion that acts as an important drainage divide and occupies the headwaters of several of the Minnesota River's major tributaries. The Yellow Medicine River originates in three branches: the North

Branch, main stem, and the South Branch. The main stem originates at Lake Shaokatan in western Lincoln County and winds northeast along the highland as a temporary stream. Between Ivanhoe and Taunton it descends the slope of the Coteau, drops 250 feet in about five miles, and enters the Western Corn Belt Plains Ecoregion. The North Branch comes off the slope near Porter, and the South Branch, just south of Minneota in Lyon County. The three join north of Minneota, and the Yellow Medicine proper begins its lowland plains course, essentially east, toward its mouth at the Minnesota River. It falls eighty-five feet in its final ten-mile drop into the Minnesota River Valley. Like the Lac Qui Parle, the Yellow Medicine courses through wooded valleys in both the upper and lower reaches, but its channel across the low plains is treeless except for an occasional stream-bank willow or cottonwood. In addition to the North and South branches, the Yellow Medicine's other major tributaries include Mud Creek and Spring Creek, both draining from the west. Many other small (often ditched) tributaries also enter the Yellow Medicine and its main branches. In all, the Yellow Medicine and its branches drain 1,047 square miles. The main stem flows about eighty miles from Lake Shaokatan to the Minnesota River, dropping more than 850 feet at an average gradient of slightly more than ten feet per mile. The Yellow Medicine River Watershed lies within portions of Lac Qui Parle, Lincoln, Lyon, Redwood, and Yellow Medicine counties.

Lands within the southern tip of the Yellow Medicine River Watershed fall within the geomorphic setting of the Coteau des Prairies. The Coteau des Prairie is a region of gently undulating plains, the result of recent glacial activity. The landscape is characterized by long northeast facing slopes of moderate steepness (4-6%), and loamy well drained soils. The majority of the land within this setting (72%) is classified as having a high water erosion potential. Except for a few isolated wetlands set aside by state and federal agencies, many of the Coteau's wetlands have been drained and converted to cultivated fields. In addition, a large proportion of the Coteau's small creeks and streams have been ditched and straightened, permitting earlier planting and allowing more acres to be placed into production.

Lands within the remainder of the watershed lie within the geomorphic setting of the Blue Earth Till Plain. The till plain is represented by flat sloped lands, ranging from 0-6% in steepness. Soils are predominantly loamy, with landscapes having a complex mixture of well and poorly drained soils. Depressional drainage within the till plain is often poor, and tile drainage is common. Water erosion potentials are moderate on the majority of these lands.

Geology And Land Use

The oldest (and deepest) rocks in the Hawk Creek-Yellow Medicine River Watershed are Precambrian in age. These hard, low permeability, crystalline rocks are of igneous (granites) and metamorphic origins. Overlying the Precambrian rocks are shales and sandstones of the Cretaceous age. Covering these deposits and extending over the entire watershed, lay deposits of glacial drift, including: till, clay, silt, sand, and gravel. With the exception of bedrock outcrops along the Minnesota River, drift deposits within the watershed generally

range in depth from over 300 feet in the headwater areas to less than 100 feet near the outflows along the Minnesota River.

Land use within the Hawk Creek-Yellow Medicine Watershed is primarily agricultural, accounting for approximately 81% of the available acres. Corn and soybeans are grown on approximately 82% of cropped lands; small grains, hay, and grasslands enrolled in the Conservation Reserve Program (CRP) make up the majority of the balance. Early 1996 estimates were that 7.7% of the agricultural acres within the watershed were enrolled in the CRP program, the majority in the Yellow Medicine Watershed (5.8%). The Conservation Reserve Program is a voluntary federal program that offers annual rental payments to farmers in exchange for planting areas of grass and trees on lands subject to erosion. Crop lands are generally classified as moderately productive (90%) throughout the watershed.

1996 figures estimated there were roughly a million cattle and three million hogs in the Minnesota River Basin. Of the cattle, approximately 30% occur in the southwestern portion of the Minnesota River Basin and an additional 30% in the southeastern portion. Approximately half of the hogs are raised in the southeastern section of the basin with an additional 25% in the southwestern section.

Climate

The climate within the Hawk Creek-Yellow Medicine River Watershed is continental, with cold dry winters and warm wet summers. Temperatures within the Yellow Medicine Watershed range from -40 to 110 0 F. Average monthly temperatures range from 9.90 F in Jan., to 72.50 F in July. An annual average of 25 inches of precipitation fall in the Yellow Medicine Watershed and 27.4 inches in the Hawk Creek Watershed. Two thirds of this precipitation normally falls in the five months from May through September. The effect of low average precipitation combined with high rates of evapotranspiration (approximately 25 inches over the entire watershed) result in this watershed having low annual runoff averages of 2.1 and 2.8 inches for the Yellow Medicine and Hawk Creek sections of the watershed respectively.

Water Quality

Ground Water

Throughout the Hawk Creek-Yellow Medicine River Watershed, groundwater is available in sand and gravel aquifers within the glacial deposits. Only locally, where deposits are thin, do water users have to rely upon supplies from the under-lying sedimentary and crystalline rocks. However, where Cretaceous (sedimentary) aquifers are available, they are generally preferred for their softer, sodium chloride type water. Water from surficial and buried aquifers in the calcareous glacial drift is generally very hard, calcium sulfate type water, often high in iron. Within both Hawk Creek and Yellow Medicine Watersheds, shallow wells (less than 100 feet) have been found to contain waters with nitrate concentrations well

above the federal maximum contamination standard of 10 mg/l. Many residents within the headwaters area of the Yellow Medicine River rely on the Lincoln-Pipestone Rural Water System as their source of potable water. This system provides water supplies for approximately 80% of Lincoln County residents as well as to 25 towns within eight counties surrounding the area. Additional groundwater sources within the Yellow Medicine River Watershed, include alluvium, outwash, and ice-contact deposits. These deposits generally provide good yields at shallow depths.

Surface Water

Today, pollution of surface waters in the Minnesota River's major watersheds is a moderate to severe problem. Constituents of concern often include: suspended sediments, excess nutrients (primarily nitrogen and phosphorus), pesticides, pathogens, and biochemical oxygen demand. High concentrations and loads of suspended sediments and nutrients can often be linked to artificial drainage patterns (ditches, tile, etc.) and wetland reductions. Alone or in combination, these landscape alterations have effectively increased the hydraulic efficiency and magnitude of storm and snowmelt runoff events. Estimates vary, but about 80 percent of the wetlands in the Minnesota River Basin have been drained and converted to other uses. High nutrient levels in lakes and streams often result from over-land runoff across erodible soils. Eroded soils and the runoff which transport these particles often carry pesticides and excess nutrients to receiving waters. Increased discharges and elevated flood peaks also erode streambanks, destroy shoreline vegetation and deposit sediment on floodplains, in streams, and in downstream receiving waters. Sediment in water often leads to impaired habitat for aquatic life, decreased photosynthetic activity, and reduced recreational quality. Excessive levels of nutrients often promote eutrophication; defined as nutrient rich oxygen poor water. Elevated nutrient levels often promote abundant algal populations which in turn can cause large diurnal fluctuations in dissolved oxygen concentrations (photosynthesis being responsible for daytime highs, respiration for nighttime lows). In addition, algal decomposition is often a major factor responsible for high biochemical oxygen demand (BOD) levels. BOD is the amount of oxygen consumed-biologically and chemically-over a five day period. The BOD test reflects the effect of easily decomposed organic materials on oxygen depletion. Other sources of organic materials include eroded organic materials associated with sediment or manure, and discharges from faulty wastewater treatment plants, and faulty septic systems. The presence of water-borne pathogens is often characterized by determining the population of fecal coliform in water quality monitoring samples. Fecal coliform are a subset of bacterial populations, and generally arise from the fecal excrement of humans, livestock, and water fowl. Common sources of fecal coliform include feedlots, faulty wastewater treatment plants, and faulty septic systems.

Volume two of the Minnesota River Assessment Project (MRAP II) states, "The rivers and tributaries in the Hawk Creek-Yellow Medicine River Watershed undergo more rapid fluctuations in flow rate and water quality than the other major watersheds of this section of the Minnesota River Basin." Stage records for the Yellow Medicine show rises in stage within one to four hours after the onset of rainfall. Stage measurements of Hawk Creek during runoff indicate that it also responds rapidly to rainfall. Drainage patterns within the

sections of the watershed falling within the Blue Earth Till Plain geomorphic setting have been severely altered through the years with the elimination of numerous wetlands and extensive channelization. Over sixty miles of Hawk Creek and it's major tributary, Chetomba Creek, for example, have been channelized by excavating wider, deeper, and straighter stream courses. Although the purpose of channelizing was to alleviate local floods by allowing water to run off faster, it produced greater flows and raised flood crests, thereby intensifying downstream floods. Furthermore, this channelization made it possible to drain many private wetlands, and in the channeled portion to the Hawk Creek watershed over half the marshes and wetlands were drained. Wetland losses in the channeled portion of the watershed were nine times that in the unchanneled portion. Major losses of wildlife habitat and production occurred as a result.

A 1994 water quality assessment by the Minnesota Pollution Control Agency (MPCA) classified the majority of the lakes within the Hawk Creek-Yellow Medicine Watershed as having threatened or impaired water quality. Located primarily within the "morainal" headwaters region, are situated the major lakes of the Hawk Creek Watershed. Lakes within this area include: Solomon, West Solomon, Long, Twin, Eagle, Skataas, and Wilmer. Many other small lakes are located within the Yellow Medicine River Watershed, MPCA's assessment found all of these lakes to have impaired water quality.

Table 4.16

Mean Total Phosphorus Concentrations Yellow Medicine-Hawk Creek Watershed		
		Mean Annual TP Concentration (mg/l)
Yellow Medicine-Hawk Creek Watershed	annual	NA
Yellow Medicine-Hawk Creek Watershed	summer only	NA
Northern Glaciated Plains Ecoregion	annual	0.218
Western Corn Belt Ecoregion	annual	0.304
Minnesota River Basin	annual	0.251

Table 4.17

Water Quality Characteristics Yellow Medicine-Hawk Creek Watershed Phosphorus and Total Suspended Sediment	
Yellow Medicine-Hawk Creek Mean Annual Flow Minnesota River Mean Annual Flow	227cfs[a] 4,266 cfs
Total Phosphorus Estimated TP Load (March - Aug)[a] % of MN R Basin TP Load[b]	 52.92 tons[a] 4.48%[a]

Total Suspended Sediment Estimated TSS Load (March - Aug)[a] % of MN R Basin TSS Load[b]	20,414 tons 4.32%[a]

[a] - Estimated by the University of Minnesota's Department of Soil, Water and Climate [b] - Hawk Creek and Yellow Medicine River Watersheds combined

Eventually, through basin management, a basinwide phosphorus loading reduction goal can be established. Through a collaborative process involving local, state and federal government, in addition to watershed residents and other stakeholders, this whole-basin load-reduction goal can be allocated among the 13 major watersheds. Within each major watershed, in turn, the total watershed load-reduction goal can be further allocated among point and nonpoint sources.

In preparation for such a process, several kinds of information on phosphorus pollution sources, concentrations and loads have been collected. This includes an estimate of phosphorus loads from point sources within the major watershed (Table 4.19), together with watershed specific monitoring data on recent phosphorus concentrations, flows, total phosphorus load estimates, ecoregion specific phosphorus values, and basin wide ecoregion weighted phosphorus values (Table 4.16 & 4.17).

As mentioned, Livestock feedlots are a major potential source of several pollutants: phosphorus, nitrogen, and pathogens in particular. Considerable progress has been made through the state feedlot program in recent years. Below is a map (Figure 4.06) of feedlots in the Haw Creek-Yellow Medicine River Watershed that have received certificates of compliance, often referred to as feedlot permits *(coming soon)*.

Seasonal patterns often influence flow discharge patterns in the Hawk Creek-Yellow Medicine River Watershed; the general trend is for flows to increase in spring, peak in late spring to early summer, and decline through late summer. Higher soil moisture contents, undeveloped crop canopies, and lower evapotranspiration rates, are the most likely factors influencing the observed trends. The mean annual discharge rate for Hawk Creek and the Yellow Medicine River are 102 cfs and 123 cfs respectfully. For the Yellow Medicine River, flows average 282 cfs from April through June, while lesser flows averaging 68 cfs are the norm from July through August. The maximum recorded discharges for both Hawk creek and the Yellow Medicine River was 11,800 cfs.

As with discharge, seasonal patterns of turbidity and fecal coliform are evident in the Yellow Medicine River. Levels of these parameters are generally greater for the July through August period than for the April through June period. Monitoring data collected periodically over the last 30 years was compiled and summarized by the University of Minnesota's Department of Soil Water and Climate according to the percent of samples in the entire record that exceed state or federal water quality standards (Table 4.18). State standards for turbidity are expressed in terms of nephelometric turbidity units (NTU's), which is a measure of light scattered by suspended sediment and organic particles. The state standard for turbidity is exceeded in water with turbidities greater than 25 NTU's. For

swimming areas and sewage effluent, state standards for bacteria are exceeded when fecal coliform counts are greater than 200 organisms per 100 ml of water as a geometric mean of not less than five samples in a calendar month, or if more than ten percent of all samples taken during and calendar month individually exceed 2,000 organisms per 100 milliliters. The presence of fecal coliforms indicates of recent fecal contamination from warm blooded animals and the possible presence of enteric (intestinal) pathogens.

In February of 1997, grant approval was given by the Minnesota Pollution Control Agency to the Yellow Medicine River Watershed District for a Clean Water Partnership-Phase I Investigation Study. The area covered under the grant includes the entire Yellow Medicine River Watershed. Clean Water Partnerships are generally two phase projects (assessment and implementation) in which financial and technical assistance are provided from the State level (MPCA) to local units of government for projects that provide for the protection and improvement of surface and ground water from nonpoint sources of water pollution. The Watershed District hopes to protect ground and surface waters through the installation of agricultural waste systems, increasing the implementation of best management practices and conservation tillage systems, and through upgrading current septic systems. The Yellow Medicine Watershed District has also implemented management practices in the Lake Shaokatan Watershed area (located within the Yellow Medicine Watershed) through a separate CWP grant. With grant moneys, three agricultural waste systems have been completed.

Table 4.18: Water Quality Standards Exceedances Yellow Medicine Watershed (data not available for Hawk Creek)

Parameter	**Percent of Samples Exceeding Assigned Water Quality Limits**		
	Standards	**April - June**	**July - August**
Turbidity	25 NTU	31%	44%
Fecal Coliform*	200 org./100 ml	47%	69%

* - percent of samples in violation do not meet the frequency of sampling requirements of state law (see above), but represent the percentage of pre-1997 samples collected over the last thirty years, which have exceeded 200 organisms/100 ml.

Table 4.19: Estimates of Point Source Phosphorus Loads for the HawkCreek-Yellow Medicine Watershed (1996)

7020004	Hawk Creek-Yellow Medicine Watershed				
NPDES# (National Pollutant Discharge Elimination Number)	Permittee	Ave. Annual Flow (MGD)	Discharge Facility	Total Phos. Conc. (mg/L)	Total Phos. Load (lbs./yr.)
MN0024775	SAINT LEO	0.017	POTW*-	2.00	103

			pond		
MN0040398	PORTER	0.019	POTW-pond	2.00	115
MN0047414	TAUNTON	0.0024	POTW-pond	2.00	15
MN0021351	HANLEY FALLS	0.0295	POTW-pond	2.00	179
MN0025305	WOOD LAKE	0.0158	POTW-pond	2.00	96
MN0025607	DANUBE	0.0676	POTW-pond	2.00	411
MN0023825	IVANHOE	0.0163	POTW-pond	2.00	99
MN0045446	RAYMOND	0.0425	POTW-pond	2.00	258
MN0023272	ECHO	0.0448	POTW-pond	2.00	272
MN0024708	SACRED HEART	0.1287	POTW	4.00	1,565
MN0049557	COTTONWOOD	0.1318	POTW-pond	2.00	801
MN0022781	BELVIEW	0.0501	POTW-pond	2.00	305
MN0056588	MAYNARD	0.0673	POTW	4.00	818
MN0020737	RENVILLE	0.3449	POTW	4.00	4,193
MN0057479	MINNEOTA	0.1496	POTW-pond	2.00	909
MN0022829	BIRD ISLAND	0.3117	POTW-pond	2.00	1,895
MN0022306	CLARKFIELD	0.211	POTW-pond	2.00	1,283
MN0023035	CLARA CITY	0.1551	POTW	4.00	1,886
MN0020907	OLIVIA	0.3548	POTW	4.00	4,313
MN0021211	GRANITE FALLS	0.5624	POTW	4.00	6,837
MNG640004	ALEXANDRIA WTP	0.024	water	1.00	73
MN0062324	BELVIEW WTP	0.0015	water - est flow	1.00	5
MN0063151	MINNESOTA	0	boiler bd,	1.00	0

	ENERGY		future		
MN0000906	NSP-MINN. VALLEY	0.1539	power plant	1.00	468
MN0050245	OLIVIA CANNING	0.0503	NCC+ dr.tile,seas	1.00	153
MN0040665	SO. MINN. SUGAR	0.6971	non-contact cooling water	0.36	2,119
				Total	29171

Recreation

Near the lower end of the Yellow Medicine is the Upper Sioux Agency State Park, site of a bloody Indian war in the summer of 1862; this was also known as the Yellow Medicine Agency. Although the emphasis in this park is on the historical importance of the Indian agency, the Yellow Medicine River contributes its wild-water scenic beauty to the site.

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General

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More Information

For questions about the Minnesota River Basin management framework, contact Norm Senjem at 507-280-3592.