Science Museum of Minnesota

St. Croix Watershed Research Station

SCWRS Fact Sheet, 2012

Changes in phosphorus loading in the Sunrise River watershed from projected population increases

Issue and Approach

The loading of phosphorus from our lands to our water resources is commonly the single largest cause of eutrophication, where excess algal growth degrades water quality. Population growth will change phosphorus loads (a) by changing point-sources loads released by waste-water treatment plants and (b) by changing nonpoint-sources loads from different land uses. Future point-source loads were estimated by assuming current waste-water treatment efficiencies (kg phosphorus per capita served) applied to projected populations. To estimate nonpoint sources of phosphorus, a computerized watershed model was constructed for the Sunrise River watershed by using the Soil and Water Assessment Tool (SWAT).

Population and Land-Use Change

The population within the Sunrise River watershed totaled about 66,000 as of about 2005 (2000-10 average). Data from the state demographer's office and the Metropolitan Council indicate that population could rise to 103,000 by 2020 and to 120,000 by 2030 (Table 1). Developed land area (urban and rural residential) would increase from 16% (current) to 24% (2030) of the watershed area, surpassing agricultural land area. Most of the watershed area, however, would remain as other land uses such as forest, grassland, wetland, and open water (Figure 1, Table 1).

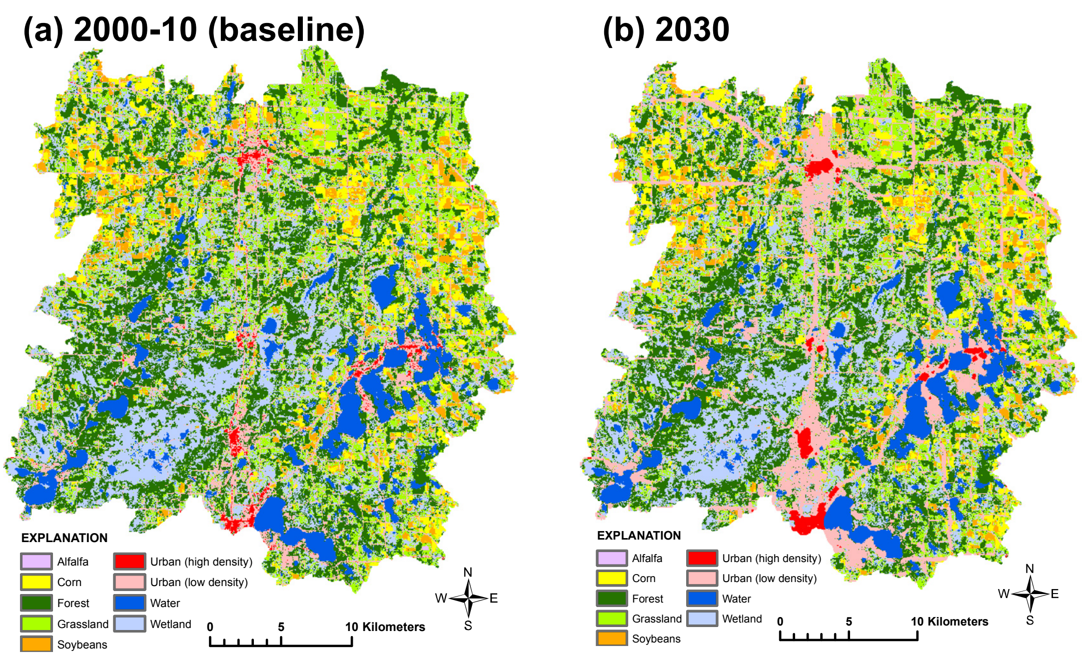

Figure 1. Land use in the Sunrise River watershed, for (a) baseline (2000-10) and (b) projected (2030) conditions.

Table 1. Projected population growth and relative land-use areas in the Sunrise River watershed.

	Area (% of watershed)		
Land Use	**Base (2000s)**	**Year 2020**	**Year 2030**
Developed	16%	21%	24%
Agricultural	21%	19%	18%
Other	63%	60%	58%
Population	*66,000*	*103,000*	*120,000*

Point and Nonpoint Loads of Phosphorus

Population growth in the communities served by waste-water treatment plants could increase point-source phosphorus loads by 45% by 2030, from about 1000 kg/yr to about 1450 kg/yr. However, these loads are only a small fraction (4-5%) of the estimated total phosphorus load due to human activity in the watershed (Figure 2).

Most of the phosphorus appears to come from nonpoint sources, namely agricultural and developed (urban and residential) land uses (Figure 2). Under conventional agriculture and urban settings as modeled in SWAT, agriculture will remain the dominant source of phosphorus even though the area of developed land will exceed farm land by 2030. The model calculated similarly high phosphorus yields (load per unit area) for agricultural and urban land, but rural residential land yielded much less.

Watershed Export of Phosphorus and Loads to Lakes

Loading from the land into rivers and lakes in the Sunrise River watershed would increase about 7% by 2030, from about 31,900 kg to 34,300 kg (bars, Figure 2). However, some of this phosphorus gets trapped by sedimentation in lakes, and so the total phosphorus load delivered to the St. Croix River is substantially less (plus symbols inside of bars, Figure 2). These total watershed loads would increase only 5%, from 21,700 kg to 22,700 kg.

Lakes receiving drainage from urbanizing land will experience the largest increases in phosphorus loads by 2030. Lakes whose phosphorus loads are projected to increase by more than 10% include Comfort, Chisago, North and South Lindstrom, North and South Pools (in Carlos Avery Wildlife Management Area), Green, and Forest lakes. Lakes with projected phosphorus-load increases below 10% include Bone, Typo, Linn, Sunrise, Martin, Linwood, Kroon, Coon, and North and South Center lakes.

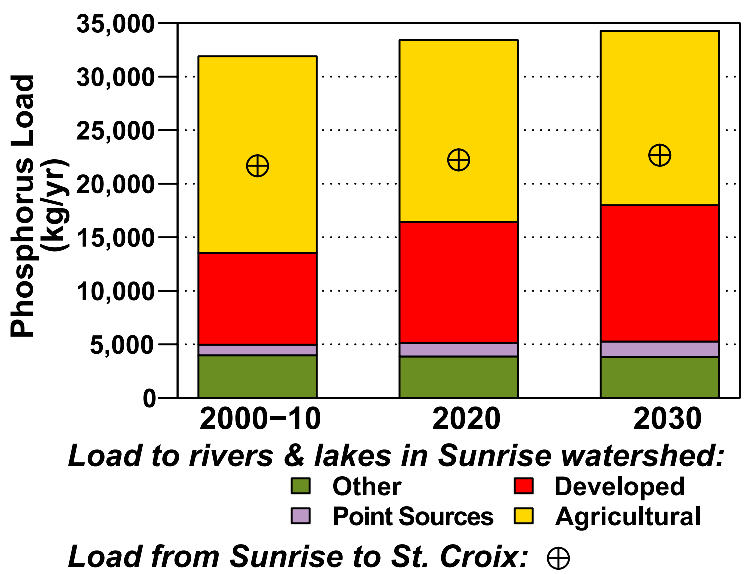

Figure 2. Phosphorus loads from selected land use categories to rivers and lakes in the Sunrise River watershed (bars) and loads exported from the Sunrise to the St. Croix River (symbol), for baseline (2000-10) and projected (2020-2030) conditions.

Funding Partners
Minnesota Pollution Control Agency
National Park Service
Chisago County

Acknowledgments:
Jason Ulrich, Univ. of Minn., Dept. of BBE
Susan Ribanszki, SCWRS

For further information:
Dr. Jim Almendinger
St. Croix Watershed Research Station
16910 152nd St. N
Marine on St. Croix, MN 55082
651-433-5953
www.smm.org/scwrs