International Souris River Study Board

Review of Artificial Drainage Impacts

Public Fact Sheet

There is significant public interest in how agricultural drainage is impacting water quantity and quality in the Souris River basin. Artificial drainage is occurring in all three jurisdictions (Saskatchewan, North Dakota, and Manitoba) influencing the flow both locally and cumulatively on a watershed scale. This fact sheet summarizes basic information about the management and impacts of drainage in the Souris River Basin.

Drainage Legislation and Regulation

Drainage is regulated by state and provincial legislation. Potential impacts and approval from impacted stakeholders are considered by legislation in all the three jurisdictions in the Souris River Basin. Drainage legislation and regulations can change to address current water management priorities and public concerns. Contact your state and provincial regulators for the most up to date information.

Drainage 101

Drainage of surface water helps to increase farmable acres, minimize maneuvering of large equipment, and provides economic gain. However, it can have negative impacts on water quality, quantity, and wildlife habitat. There are two types of artificial drainage:

- Surface drainage moves excess water off fields by constructed swales and ditches. The purpose of using surface drainage is to minimize crop damage from water ponding after a precipitation event, and to control runoff without causing erosion.
- Subsurface (tile) drainage is installed underground to remove groundwater from the root zone of crops or from low-lying wet areas. Subsurface drainage is typically done through the use of buried pipe. The purpose is to lower the water table in order to increase the productivity of the drained land.

International **Souris River** Study Board

August 2020

Moose Mountain Creek near Saskatchewan Highway 9 – Credit: Saskatchewan Water Security Agency

How does artificial drainage impact the hydrology of a watershed?

In a prairie watershed, there are many areas that normally do not contribute runoff to the outlet of the watershed. The runoff gathers in temporary or seasonal wetlands and infiltrates into the ground or evaporates. As conditions in a watershed become wetter, more areas become connected and contribute runoff to the watershed outlet. Artificial drainage increases the connectivity of wetlands and water courses in a watershed and increases the area contributing flow.

There are a few key terms that are important to understand the impact of artificial drainage on a basin:

- **Gross drainage area** is the total catchment area of a watershed enclosed by its drainage divide. The entire gross drainage area would be expected to contribute runoff under extremely wet conditions.
- **Effective drainage area** is the area that is expected to contribute runoff in a year of average runoff. It excludes marsh and slough areas and other natural storage areas which would prevent runoff from reaching the main stream in a year of average runoff.
- **Contributing drainage area** is the area that contributes to a specific flow event and fluctuates by year, by season, and by runoff event because of the glacial landscape and the climate, i.e. the fill and spill mechanisms of prairie potholes.

Scientific investigations of the impact of drainage can be based on field studies or models. The impact of artificial drainage is affected by geography, climate, and soil types. Applying the results of one study to another watershed should be done with care and will likely be misleading. Broadly summarizing the scientific literature, the primary potential impacts of artificial drainage include:

Surface Drainage impacts:

- Artificial surface drainage increases the contributing drainage area which results in increased seasonal and annual water yields. However, the percentage increase in contributing drainage area decreases with the severity of the flood event.
- Artificial drainage has the greatest impact on the more frequent flood events.
- In extreme flood events, artificial drainage has an insignificant impact on the peak flow.
- Annual nutrient load is a function of flow. The increase in the contributing drainage area will result in increased nutrient loads.

Subsurface Drainage impacts:

- In most situations, subsurface drainage will likely cause a minor increase in water yield.
- For small or moderate precipitation events, subsurface drainage may reduce downstream peak flows.
- For large or extended precipitation events when the infiltration ability of the soil is exceeded, subsurface drainage has minimal impact on downstream flow and flooding.
- In clay soils peak flows tend to be decreased, whereas, in sandy soils peak flows can be increased.
- Subsurface drainage may reduce surface runoff pollutants, but may increase dissolved components such as salts and nitrates. Subsurface drainage may either decrease phosphorus loads losses due to decreased surface runoff and soil erosion, or may increase total phosphorus loads due to increased total flow.

What is the impact of artificial drainage in the Souris River Basin?

When effective drainage areas were determined in the 1970s, the effective drainage area of the Souris River basin was 36% of the gross watershed area. Quantifying the amount of artificial drainage in a large basin and its impact on effective drainage area is difficult. Ducks Unlimited Canada has analysed the historical and recent drainage networks to estimate how the effective drainage area has changed over time. In areas where wetland inventories and recent aerial photography is available for analysis, the density of drainage features were used to estimate effective drainage areas. For the areas with data available, the method resulted the effective drainage area increasing by approximately 26%, but varied greatly between individual watersheds. Caution should be used in interpreting the results, but the analysis gives an idea of the magnitude of change due to drainage at the basin scale.

By increasing the contributing drainage area for a runoff event, drainage increases the amount of water leaving the watershed. In a normal or moderate flood year, the increase in contributing area from drainage can be significant. However, in a large flood the natural contributing drainage would be increasing and drainage has a reduced impact. In an extreme flood, the proportional impact of drainage is much less than a moderate flood as much of the watershed would be naturally contributing drainage area. In an extreme flood such as the June 2011 event, the contributing area was nearly the entire gross drainage area.

Some possible impacts of artificial drainage that are impacting the Souris River basin are:

- In the 1989 agreement, the volume of water to trigger flood operation was estimated to occur once every ten years on average. Given the same hydrologic inputs, artificial drainage will increase how frequent the same volume of water occurs.
- Artificial drainage increases the volume in the main stem of the Souris River. The apportionment agreement partially accounts for the increase in observed flow for a few particular projects, but does not account for all potential increases across the landscape.
- Artificial drainage increases the volume of water and total amount of nutrients leaving the watershed.

Quantifying the severity of the impacts with certainty is not possible with the tools and data currently available. However, as data such as LiDAR and the GIS tools and hydrologic models increase in complexity, the scientific understanding of how artificial drainage impacts a basin with continue to increase.

Stay connected.

Be involved.

Online

Visit us at ***ijc.org/en/srsb*** and sign up to receive Study news, such as notices of public meetings, consultations, reports and other publications, including this fact sheet series.

Email us

Send your questions or comments to ***srsb@ijc.org***

Social Media