Harvesting Winter and Spring Stream Flows for Irrigation

Fact Sheet

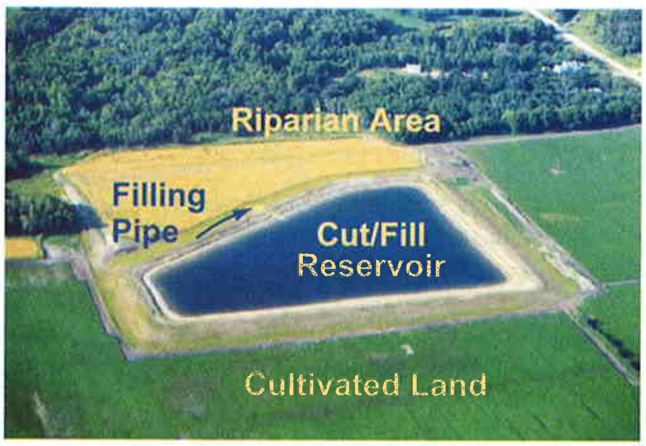
Irrigation Water for Nova Scotia

A reliable source of good quality water for irrigation is dependent on a healthy watershed. A healthy and productive watershed is ensured by implementing water and land management strategies which:

- promote infiltration of runoff and groundwater recharge
- promote soil conservation and healthy riparian zones
- ensure that in-stream water needs, such as those required to maintain aquatic habitat, are met
- ensure that crop water demands are met

This Fact Sheet Will Address:

✓ assessing stream hydrology
✓ establishing irrigation water needs
✓ siting, construction and filling of storage ponds
✓ obtaining regulatory approvals



In Nova Scotia, potential exists to minimize the impact of irrigation withdrawals on streams by timing the withdrawals to periods of higher flow.

Storage of water can be an important component of any successful irrigation strategy. Water which is harvested during winter and spring high flows could be stored in ponds for use during the growing season.

This option provides more flexibility with respect to where storage ponds can be located. Ponds can be placed in areas which are the most suitable, and cost effective, for pond construction.

Nova Scotia Surface Water Hydrology

Nova Scotia receives, on average, 52" (1,300 mm) of precipitation, annually. About 24" (600 mm) of this water is returned to the atmosphere through the processes of evaporation and plant transpiration. Excess precipitation (28" or 700 mm) contributes to streamflow or groundwater recharge.

Unfortunately, this precipitation is not uniformly distributed throughout the year. Precipitation totals are highest during the winter and spring and lowest throughout the summer.

The annual pattern of streamflow for Sharpe's Brook, which drains an 2175 acre (880 ha) rural watershed, is shown on the next page.

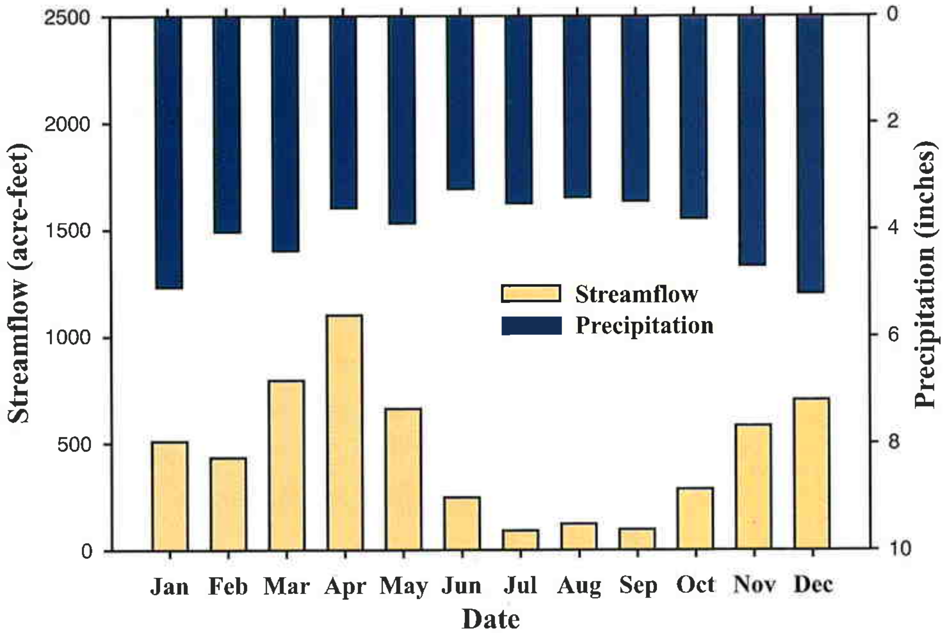
This pattern of streamflow is typical of streams located in rural regions of Nova Scotia. The largest flows occur in the late winter/early spring due to a combination of snowmelt and precipitation. Flows are lowest during the summer months.

Streams receive water from two primary sources:

- groundwater inflow, typically termed baseflow
- surface runoff due to precipitation and snowmelt

During the summer the majority of streamflow is comprised of baseflow. Significant surface runoff usually only occurs during the winter and spring seasons.

Agriculture and Fisheries NOVA SCOTIA
Nova Scotia Agricultural College
Canada
Agriculture and Agri-Food Canada Agriculture et Agroalimentaire Canada



USEFUL CONVERSIONS

1 inch = 25 mm
1 USgpm = 3.785 L/min
1 acre-foot = 12 acre-inches
1 acre-inch = 103 m^3
1 m^3 = 35 ft^3

Average monthly streamflow (1967-1995) for Sharpe's Brook and average monthly precipitation (1971-2000) recorded at Kentville, NS

Harvesting Winter and Spring Streamflow

Harvesting water from streams during the late winter and early spring would ease the demand which is placed on many small streams during low flow summer periods.

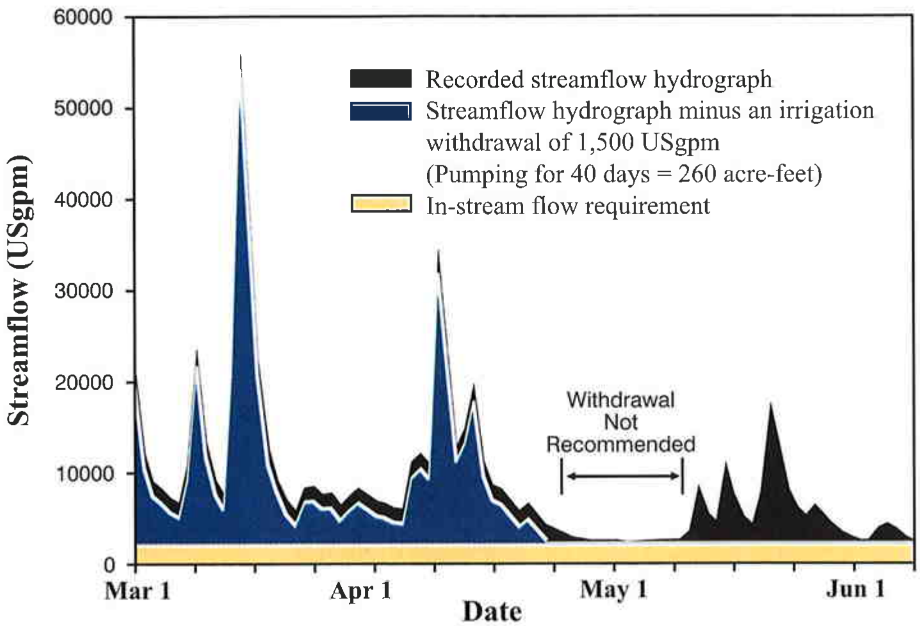
Streamflows recorded on Sharpe's Brook during March, April and May of 1994 are shown below. The figure illustrates that water extraction during high flows in the spring have relatively small impacts on in-stream flow needs.

The federal Department of Fisheries and Oceans (DFO) recommends a minimum in-stream flow that is 75% of the median flow over the specific time period of the proposed water extraction.

The three main things to consider are:

1) How much water do I need, where do I store it and is the construction of a storage pond feasible?
2) Can the stream safely provide enough water to meet my irrigation needs?
3) How will I transfer the water from the stream to the reservoir?

Water Availability on Sharpe's Brook in the Spring of 1994



ESTABLISHING STORAGE REQUIREMENTS

The volume of water needed to meet growing season irrigation requirements must be carefully assessed. Water requirements will be specific to the crop, soil type and management system. However, as an example, consider a situation in which 6" (150 mm) of supplemental irrigation is needed on 50 ac (20 ha) of land. This would represent 300 ac-inches (30,000 m^3) of storage.

With a cut/fill dyked reservoir construction (i.e. excavated material is used to construct berms for additional above ground storage) the amount of earth to be moved would be approximately 50% of the total storage volume, or 15,000 m^3 in this case.

By placing these reservoirs away from streams, the impact on riparian zones will be reduced. In some cases, cultivated land could be set aside for the reservoir.

More information on reservoir construction can be found in the Atlantic Committee on Land and Engineering (ACAE) publication "Farm Ponds."

STREAMFLOW ANALYSIS

A surface water availability analysis should be conducted to determine if the anticipated streamflows are sufficient to meet all irrigation needs. Other stream water uses (e.g. hydro-power, drinking water) and in-stream-flow needs should be accounted for.

Environment Canada has collected streamflow data throughout Nova Scotia which could be used by a professional engineer in assessing stream hydrology.

FILLING THE RESERVOIR

In the headwaters of a watershed, water could be gravity fed from the stream to the reservoir via a pipe inlet, thus eliminating pumping costs. If this is not feasible, the specification of the appropriate pump and pipeline required to move the water from the stream to the reservoir is important.

The same pump used for irrigation could be used to fill the reservoir. Therefore, the time required to fill the reservoir by pumping will be approximately equal to the amount time the crops will be irrigated. As an example, it would take approximately 550 hours, at a pumping rate of 325 USgpm (1,230 L/min), to harvest 400 acre-inches (41,200 m^3) of water.

Regulatory / Environmental Considerations

Under the *Nova Scotia Environment Act* a Water Approval must be obtained from the Nova Scotia Department of Environment and Labour for:

i) the withdrawal or diversion of more than 23,000 L/d (6,000 USgpd) of water from a source of surface water or groundwater

ii) the storage of more than 25,000 m^3 (883,000 ft^3) of water

The federal *Fisheries Act*, which is enforced by DFO, requires that all water intakes in fish bearing habitats include an appropriate fish guard or screen. As well, permitted surface water users should ensure that downstream fish maintenance flows are met. All projects that receive federal funding must also comply with the Canadian Environmental Assessment Act (CEAA). Applicable regulatory agencies should be consulted in the project planning stage to ensure these requirements are met.

Other environmental management issues which should be considered include:

- proper fuel handling procedures
- minimizing riparian zone impacts
- limiting erosion and streambank degradation
- soil suitability for irrigation
- engineering standards for embankment safety

Water Quality Considerations

The quality of water used for irrigation is also important. Most sources of surface water in Nova Scotia are, generally, acceptable for irrigation. Many streams in rural areas however, often possess bacteria levels which exceed irrigation water quality guidelines. For more information please see the NS Department of Agriculture and Fisheries (NSDAF) fact sheet "What You Should Know About Irrigation Water Quality."

Water quality in streams is highly variable. It is influenced by streamflow conditions (baseflow vs. high flow) and the land-use practices which are occurring within the contributing watershed area.

During baseflow conditions, there is less dilution, therefore water quality can degrade if there is a contaminant source.

On the other hand, high flows can potentially mobilize sediments from land surfaces and streambeds. Contaminants, such as bacteria, pesticides and nutrients are typically attached to sediment particles.

Some specific issues associated with poor water quality include:

- pathogenic microorganisms could be applied to crop surfaces
- irrigating with water containing high salt concentrations can cause salinity and damage crops
- excess nutrients, such as nitrogen and phosphorus, can promote the growth of aquatic weeds and algae in reservoirs

There are several water treatment options which could be employed to improve reservoir water quality, including aeration and disinfection (e.g. chlorination, ultra-violet light). Also, concentrations of bacteria in reservoirs will decrease with time as they die off or settle with sediments.

Engineering / Cost Considerations

Good irrigation projects start with sound engineering. A professional engineer can assess stream hydrology and provide least cost solutions. Project components which require engineering include:

- intake and screen specifications
- pump sizing and power options (e.g. diesel vs. electric)
- size and pressure ratings for pipe used for filling reservoir and irrigating land
- geotechnical investigations (assessment of geologic setting, water table location, water retention characteristics, slope stability, and resistance to erosion)
- pond construction specifications

Costs can be reduced by using the same pumps and pipeline for water harvesting and irrigation activities. A gravity pipeline intake may be an option for minimizing pumping costs. A fish screen would still be required on a gravity intake.

The construction of off-stream reservoirs is, typically, less complicated than in-stream reservoirs. Additional engineering and capital costs associated with in-stream reservoirs or dams include:

- allowing for fish passage
- compensating for loss of fish habitat due to upstream flooding of habitat
- allowing for the safe passage of flood flows

As such, off-stream reservoirs can be less costly in the long run. Engineering and cost considerations for off-stream structures, not including pumps and piping, are about $100 per ac-inch stored.

For more information, contact:
Resource Stewardship Division,
NS Department of Agriculture and Fisheries
P.O. Box 550, Truro, Nova Scotia
Tel: 902-893-6575

Acknowledgements
This fact sheet was prepared by the Resource Stewardship Division of NSDAF and Agriculture and Agri-Food Canada (AAFC). The publication of this fact sheet was funded by AAFC.