Groundwater Dependant Plant and Animal Communities

Indicator #7103

This indicator report was last updated in 2005.

Overall Assessment

Status: **Not Assessed**
Trend: **Not Assessed**
Note: This indicator report uses data from the Grand River watershed only and may not be representative of groundwater conditions throughout the Great Lakes basin. Additionally, there is insufficient biological and physical hydrological data for most of the streams in the Grand River watershed to report on many of the selected species reliant on groundwater discharge; hence this discussion focuses on brook trout (Salvelinus fontinalis) as an indicator of groundwater discharge.

Lake-by-Lake Assessment

Separate lake assessments were not included in the last update of this report.

Purpose

- To measure the abundance and diversity as well as presence or absence of native invertebrates, fish, plant and wildlife (including cool-water adapted frogs and salamanders) communities that are dependent on groundwater discharges to aquatic habitat
- To identify and understand any deterioration of water quality for animals and humans, as well as changes in the productive capacity of flora and fauna dependant on groundwater resources
- To use biological communities to assess locations of groundwater intrusions
- To infer certain chemical and physical properties of groundwater, including changes in patterns of seasonal flow

Ecosystem Objective

The goal for this indicator is to ensure that plant and animal communities function at or near maximum potential and that populations are not significantly compromised due to anthropogenic factors.

State of the Ecosystem

Background

The integrity of larger water bodies can be linked to biological, chemical and physical integrity of the smaller watercourses that feed them. Many of these small watercourses are fed by groundwater. As a result, groundwater discharge to surface waters becomes cumulatively important when considering the quality of water entering the Great Lakes. The identification of groundwater fed streams and rivers will provide useful information for the development of watershed management plans that seek to protect these sensitive watercourses.

Human activities can change the hydrological processes in a watershed resulting in changes to recharge rates of aquifers and discharges rates to streams and wetlands. This indicator should serve to identify organisms at risk because of human activities and can be used to quantify trends in communities over time.

Status of Groundwater Dependent Plant and Animal Communities in the Grand River Watershed

The surficial geology of the Grand River watershed is generally divided into three distinct regions; the northern till plain, central moraines with large sand and gravel deposits, and the southern clay plain (Figure 1). These surficial overburden deposits are underlain by thick sequences of fractured carbonate rock (predominantly dolostone).

The Grand River and its tributaries form a stream network housing approximately 11,329 km of stream habitat. The Ontario Ministry of Natural Resources (OMNR) has classified many of Ontario's streams based on habitat type. While many streams and rivers in the Grand River watershed remain unclassified, the MNR database currently available through the Natural Resources and Values Information System (NRVIS) has documented and classified about 22% of the watershed's streams (Figure 2). Approximately 19% of the classified streams are cold-water habitat and therefore dependent on groundwater discharge. An additional 16% of the

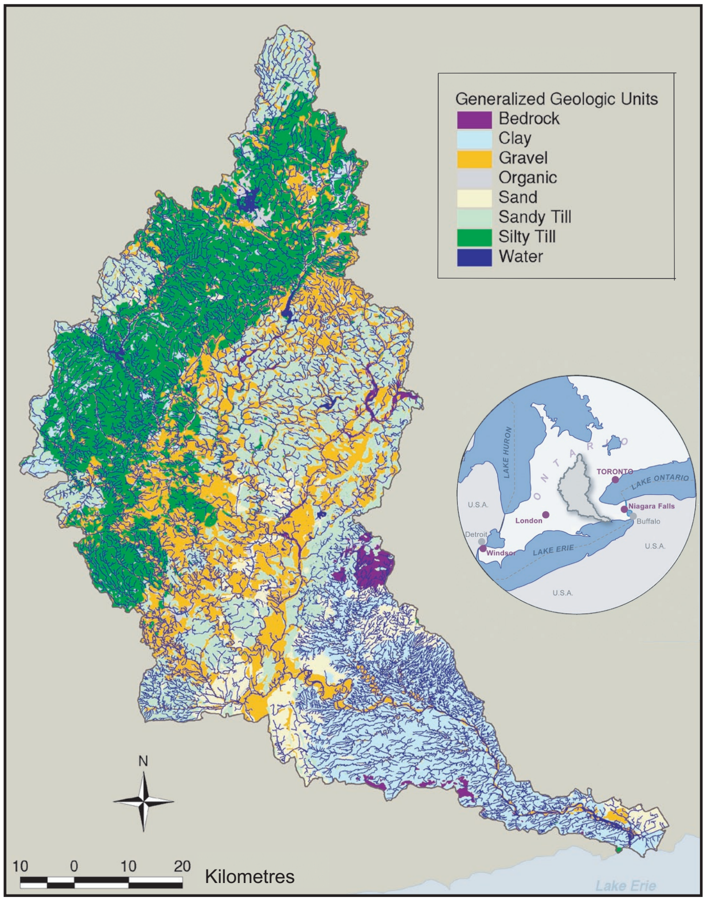

Figure 1. Surficial geology of the Grand River watershed.
Source: Grand River Conservation Authority

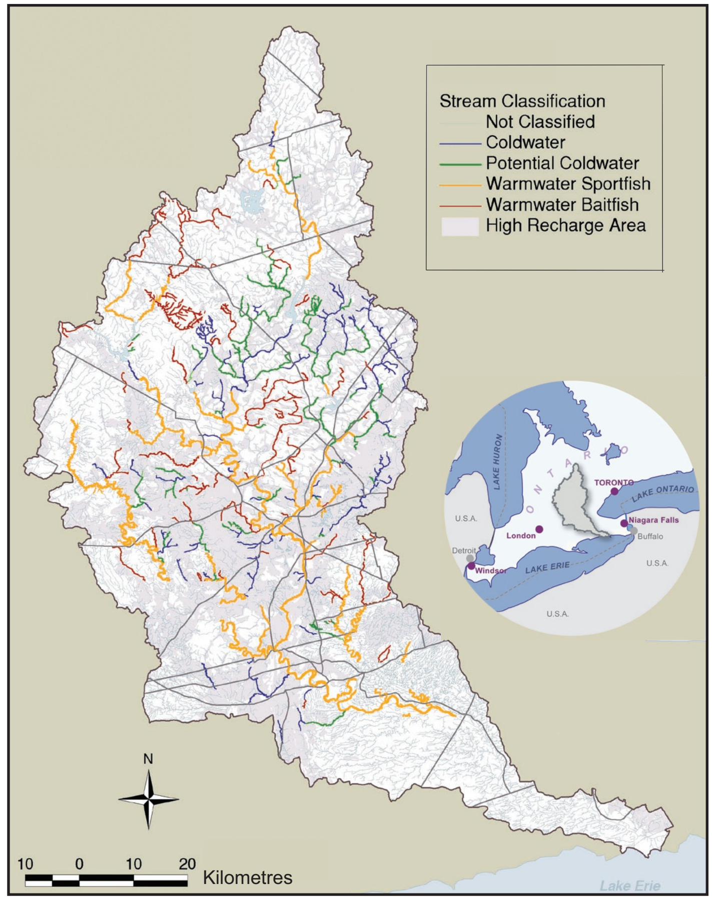

Figure 2. Streams of the Grand River watershed.
Source: Grand River Conservation Authority

classified streams are considered potential cold-water habitat. The remaining 65% of classified streams are warm-water habitat.

A map of potential groundwater discharge areas was created for the Grand River watershed by examining the relationship between the water table and ground surface (Figure 3). This map indicates areas in the watershed where water well records indicate that the water table could potentially be higher than the ground surface. In areas where this is the case, there is a strong tendency toward discharge of groundwater to land, creating cold-water habitats. Groundwater discharge appears to be geologically controlled with most potential discharge areas noted associated with the sands and gravels in the central moraine areas and little discharge in the northern till plain and southern clay plain. The map suggests that some of the unclassified streams in Figure 2 may be potential cold-water streams, particularly in the central portion of the watershed where geological conditions are favorable to groundwater discharge. Brook trout is a freshwater fish species native to eastern Canada. The survival and success of brook trout is closely tied to cold groundwater discharges in streams used for spawning. Specifically, brook trout require inputs of cold, clean water to successfully reproduce. As a result, nests or redds are usually located in substrate where groundwater is upwelling into surface water. A significant spawning population of adult brook trout generally indicates a constant source of cool, good quality groundwater.

Locations of observed brook trout redds are shown on Figure 3. The data shown are a compilation of several surveys carried out on selected streams in 1988 and 1989. Additional data from several sporadic surveys carried out in the 1990s are also included. These redds may represent single or multiple nests from brook trout spawning activity. The results of these surveys illustrate that there are significant high quality habitats in several of the subwatersheds in the basin.

Cedar Creek is a tributary of the Nith River in the central portion of the watershed. It has been described as containing some of the best brook trout habitat in the watershed. Salmonid spawning surveys for brook trout were carried out over similar stretches of the creek in 1989 and 2003 (Figure 4). In 1989 a total redd count of 53 (over 4.2 km (2.6 miles)) was surveyed while in 2003 the total redd count was 59 (over 5.4 km (3.4 miles)). In both surveys, many of the redds counted were multiple redds meaning several fish had spawned at the same locations. Redd densities in 1989 and 2003 were 12.6 redds/km (20.3 redds/mile) and 10.9 redds/km (17.5 redds/mile) respectively. From Figure 4 it appears that in 2003 brook trout were actively spawning in Cedar Creek in mainly the same locations as in 1989. While redd density in Cedar Creek has decreased slightly, the similar survey results suggest that groundwater discharge has remained fairly constant and reductions in discharge have not significantly affected aquatic habitat.

Pressures

The removal of groundwater from the subsurface through pumping at wells reduces the amount of groundwater discharging into surface water bodies. Increasing impervious surfaces reduces the amount of water that can infiltrate into the ground and also ultimately reduces groundwater discharge into surface water bodies. Additionally, reducing the depth to the water table from ground surface will decrease the geological protection afforded groundwater supplies and may increase the temperature of groundwater. Higher temperatures can reduce the moderating effect groundwater provides to aquatic stream habitat. At local scales the creation of surface water bodies through mining or excavation of aggregate or rock may change groundwater flow patterns, which in turn might decrease groundwater discharge to sensitive habitats.

In the Grand River watershed, groundwater is used by about 80% of the watershed's residents as their primary water supply. Additionally, numerous industrial and agricultural users also use groundwater for their operations. Growing urban communities will put pressure on the resource and if not managed properly will lead to decreases in groundwater discharge to streams. Development in some areas can also lead to decreased areas available for precipitation to percolate through the ground and recharge groundwater supplies.

Management Implications

Ensuring that an adequate supply of cold groundwater continues to discharge into streams requires protecting groundwater recharge areas and ensuring that groundwater withdrawals are undertaken at sustainable rates. Additionally, an adequate supply of groundwater for habitat purposes does not only refer to the quantity of discharge but also to the chemical quality, temperature and spatial location of that discharge. As a result, protecting groundwater resources is complicated and generally requires multi-faceted strategies including regulation, voluntary adoption of best management practices and public education.

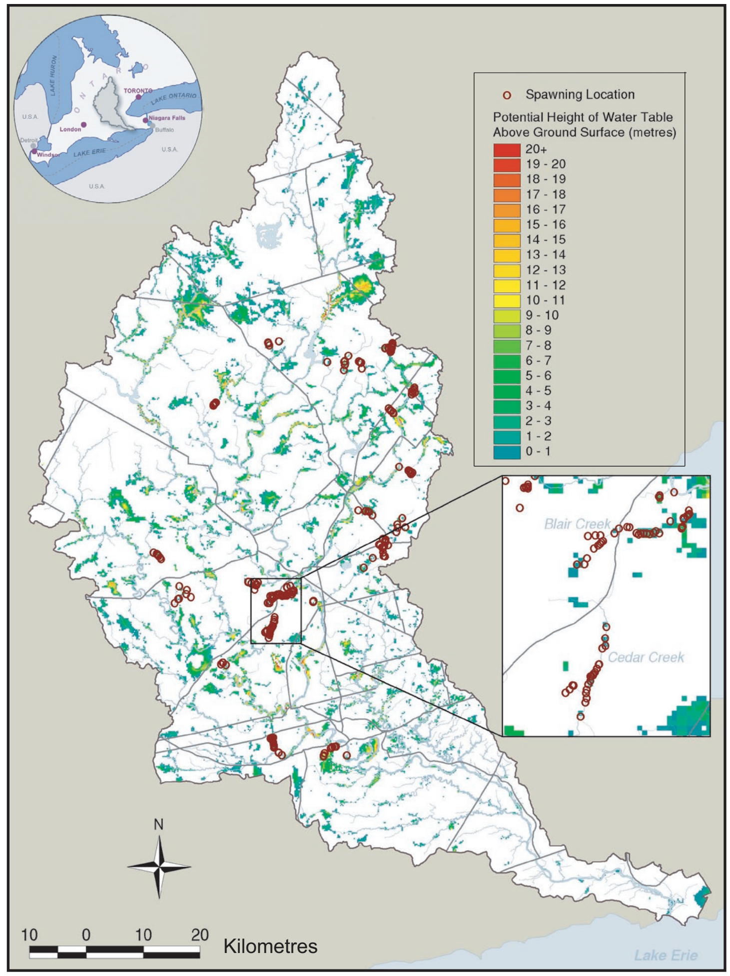

Figure 3. Map of potential discharge areas in the Grand River watershed.

Source: Grand River Conservation Authority

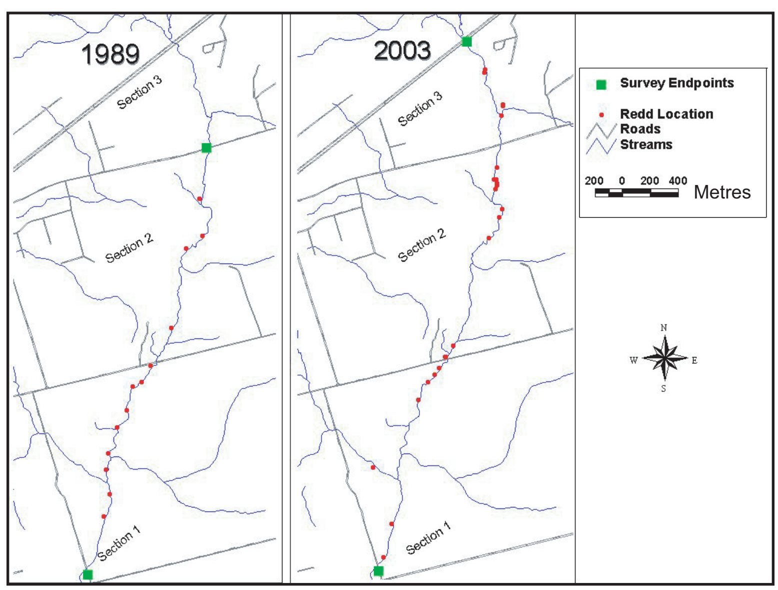

Figure 4. Results of brook trout spawning surveys carried out in the Cedar Creek subwatershed in 1989 and 2003.

Source: Grand River Conservation Authority

Comments from the author(s)
This report has focused on only one species dependent on groundwater discharge for its habitat. The presence or absence of other species should be investigated through systematic field studies.

Acknowledgments
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Alan Sawyer's position was partially funded through a grant from Environment Canada's Science Horizons internship program. The assistance of Samuel Bellamy and Warren Yerex of the Grand River Conservation Authority, as well as Harvey Shear, Nancy Stadler-Salt and Andrew Piggott of Environment Canada is gratefully acknowledged.

Sources
Grand River Conservation Authority. 2003. Brook Trout *(Salvelinus fontinalis)* Spawning Survey – Cedar Creek.

Grillmayer, R.A., and Baldwin, R.J. 1990. *Salmonid spawning surveys of selected streams in the Grand River watershed 1988-1989.* Environmental Services Group, Grand River Conservation Authority.

Holysh, S., Pitcher, J., and Boyd, D. 2001. *Grand River Regional Groundwater Study.* Grand River Conservation Authority, Cambridge, ON. 78pp. + figures and appendices.

Scott, W.B., and Crossman, E.J. 1973. *Freshwater fishes of Canada*. Bulletin 184, pp. 208-213. Fisheries Research Board of Canada, Ottawa, ON.

Last Updated
State of the Great Lakes 2005