



Grand River
Conservation
Authority



The Grand:
A Canadian
Heritage River



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Cover photo

This unusual view shows the inside of the Devil's Well pothole near Rockwood. The photo was provided by Dr. Alan Morgan and first reproduced in *Wat on Earth*, fall 2001.

GLACIAL POTHOLES AT ROCKWOOD

By Dr. Alan Morgan, Quaternary Sciences Institute, University of Waterloo.

Potholes are quite numerous within and outside the conservation area at Rockwood, northeast of Guelph, and also in the area immediately south of Everton, about 5 km north of Rockwood. My first visit to Rockwood was made in 1971 and I have visited the Eramosa Valley, including the potholes in the Everton area several times since then. However, in this article, much of the information on the Devil's Well is derived from Kershaw (1973) and Kunert (1997).

The earliest ideas on the creation of potholes are that they were associated with "moulins de glacier" (glacier mills) — formed where surface streams on glaciers and ice sheets fall into holes in the ice. Water entering these surficial holes was believed to impact on the bedrock beneath creating a large pothole. The "Moulin Hypothesis", first suggested in 1874, continued to be accepted by many authors until the 1950s. However, commencing in the 1930s, other authors have suggested dissatisfaction with the moulin hypothesis, largely on the

grounds that it failed to explain how ice could remain stable long enough for the "giant" potholes to form and why many potholes (like those at Rockwood) were present in large numbers.

In summary "glacial" potholes are similar to more normal (or at least, more frequently encountered) "fluvial" potholes. A walk along a dry riverbed, particularly one that runs over bare expanses of soft or soluble or well-jointed bedrock will reveal potholes. Certainly the Rockwood potholes are glacio-fluvial in origin, probably formed by subglacial or latero-glacial (ice-marginal) streams.

There seems to be general agreement amongst Quaternary workers that the Eramosa Valley is part of a complex series of meltwater channels that drained the ice margins retreating both into the Huron and Ontario Basins. The potholes that are found at Everton and at Rockwood appear to be associated with the floods of meltwater associated with the

POTHOLES

from page one

retreating Wisconsin ice about 13,000 to 12,000 years ago. Potholes are found at many different elevations within both GRCA area and in the adjacent University of Waterloo-owned area. Given the altitude of the tops of the highest potholes they are obviously not associated with modern (or even near-modern) fluvial activity. Even those close to the level of the present day Eramosa River are likely the products of glacial meltwater.

Since well over 300 potholes have been recorded in the GRCA and adjacent areas at Rockwood, it seems appropriate just to concentrate on the most spectacular of these, the pothole known as the Devil's Well and the adjacent valley system.

The Devil's Well is located on a rocky bluff over 25 m above Richardson Creek in the southeastern part of the University of Waterloo property. It is not signposted and is difficult to find, however, it is spectacular (as potholes go!) and is believed to be one of the largest described potholes in the world. It is just possible that it is the largest pothole by volume, and claims have been made in the Guinness "Book of Records" that this is the case. The pothole lies just beyond a small blind valley that runs from the cliff face which drops 10 m into Richardson Creek. The terrain is hazardous with steep slopes and vertical drops (up to 25 m)! Because trees shade the area many rock surfaces are coated with moss and algae and can be extremely slippery. Researchers and visitors must use extreme caution in this area.

It has been suggested that the valley represents the former position of a sequence of coalesced potholes aligned along a master joint system in the bedrock. The Devil's Well would represent the last in the sequence of potholes, fortunately created (and abandoned) before the thin rock wall that separates it from the blind valley

could collapse. A sequence of potholes might have existed within the valley. Traces of smoothed and circular areas along the walls of the small valley suggest that this likely was the case.

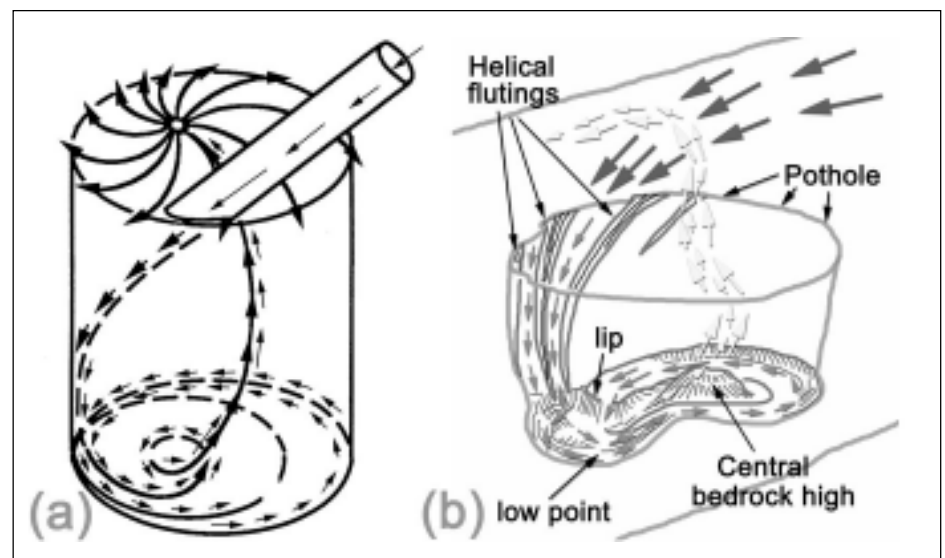
The Devil's Well is a volumetrically huge pothole. It measures 13.1 m deep by 6.4 m wide at the top and 4.9 m wide at the base. Put in a somewhat different fashion, it is large enough to take two city busses side by side — admittedly a bit "squeezed" — but it would have room to spare in the vertical dimension.

So, how were the potholes formed? The generally accepted belief is that high volumes of rapidly-flowing water, probably in an ice-marginal, or possibly sub-glacial river enlarged weak points in the bedrock and established the site for a pothole. A number of authors have indicated that massive bedrock (of virtually any lithology) is more suitable for the creation and retention of pothole forms. In the Rockwood potholes, virtually all are formed in the Amabel Formation, a fairly massive medium crystalline dolostone. Detritus carried in the water as bedload, created the "cutting tools" for a downward attrition of the rock surface. Large boulders that are normally assumed as the principal cutting tool, probably played a lesser role than smaller (perhaps fist size and smaller) naturally broken fragments of

rock (clasts) as cutting tools. The scientific excavation of a small pothole at Rockwood (Kunert 1997) produced highly-rounded and polished Precambrian clasts, that appear to be mostly in the 8 cm to 18 cm range.

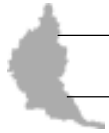
In 1932, H. S. Alexander created an experiment to simulate water flow in a pothole. This might make a useful classroom project. The apparatus, a glass beaker with water entry inside a tube, is sketched below. The circulation pattern is illustrated with black arrows. Obviously an experiment in a glass cylinder cannot replicate the morphologies observed in relatively soft sandstone. However, there are remarkable similarities. It should be easy enough to copy Alexander's experiment using a large glass beaker with some marbles (or lentils) acting as the "grindstones" and to observe water flow (see illustration below). Perhaps some food colouring added to the water might help to clarify flow patterns within the artificial "pothole".

This newsletter article is a much-abridged version of the original published in Department of Earth Sciences newsletter, *Wat on Earth*, Fall 2001. The original PDF file can be downloaded from <http://www.science.uwater.ca/earth/waton/>



waton.html and permission is given to duplicate this material for classroom use. Please cite the source.

Alan Morgan is a professor in the Earth Sciences Department at the University of Waterloo. He is interested in travel and photography and is currently trying to assemble teams of teachers to contribute to "Geoscape Grand River" a project that explores the "geo" aspects of the river basin.



MILESTONES

Milestones are progress or products of The Grand Strategy Joint Work Plan.

Rural Water Quality Update

Farmers and watershed municipalities are teaming up to make our water resources cleaner and safer for us all. Remedial measures to prevent contamination of rural waterways are being taken all over the Grand River watershed. Implementing these "best management practices" often involves additional expense for already-pressed farmers, and small communities do not always have the resources to address the problems alone. However, teamwork between many levels of government and property owners has resulted in some impressive results in our watershed. Projects funded in Waterloo and Wellington alone include 56 manure storage facilities, 51 fences to exclude livestock access to watercourses, and the planting of more 50,000 trees along 32 kilometres of watercourse.

The Rural Water Quality Program is a source water protection program that provides financial and technical assistance to rural landowners to undertake best management practice that will improve and protect surface water and groundwater. In the mid 1990's, the GRCA membership made



Before remedial measure were taken, the banks of this farm stream were badly eroded, introducing silt, land runoff and cattle waste directly into the waterway.

the commitment to deliver a Rural Water Quality Program across the watershed. In 2002 this goal has been accomplished.

Watershed municipalities and other levels of government have committed almost \$5 million to implement agricultural best management practices to improve and protect water quality. Funding sources are varied and in some cases are used to expand or increase coverage of existing programs. To date, \$1.4 million in grant money has been provided to assist the implementation of over 350 projects. Landowners have contributed more than \$2 million and provided approximately \$300,000 worth of in-kind labour and materials to the projects. Unfortunately many sources of funding are only available for this year and therefore the coverage of the watershed cannot be sustained. A summary of some of the program areas follows:

Region of Waterloo

The Region of Waterloo initiated the Rural Water Quality Program in 1998 when it committed \$1.5 million from its user rate budgets to a five-year program to protect source water. The program provides financial and technical assist-

ance to farmers to take action to improve and protect water quality, and approximately \$850,000 has been provided to date to more than 200 projects. There are over 100 approved projects that will be completed in 2002. On February 5, 2002, the Minister of Agriculture, Food and Rural Affairs announced that the Healthy Futures for Ontario Agriculture Program will be providing \$348,000 to the Waterloo Healthy Waters project during 2002. This project will expand the delivery of the Rural Water Quality Program into all areas of the Region of Waterloo.

The original five-year commitment from the Region of Waterloo ends in December 2002. Regional staff have allocated funds in their 10-year forecast for another 5-year program subject to approval of Regional Council.

Wellington County and the City of Guelph

In 1999, the County of Wellington and City of Guelph initiated a Rural Water Quality Program for agricultural landowners. • See page 4

RURAL WATER *from page three*

The County contributed \$900,000 and the City contributed \$450,000 to the five-year program. In May 2001 the Minister of Agriculture, Food and Rural Affairs committed \$740,000 to the Wellington Healthy Waters Project. This funding is available until December 2002. To date the Rural Water Quality Program has provided \$400,000 to over 100 projects. Through the Healthy Waters Project over \$80,000 has been provided to 50 projects. There are over 200 projects approved in Wellington that will be completed in 2002.

Oxford, Perth and Middlesex Counties

The Upper Thames Conservation Authority is administering a multi-partner Clean Water Project in the Counties of Oxford, Perth and Middlesex. Numerous municipalities have contributed to this project and Healthy Futures has committed over \$2 million. The GRCA delivers this project within our watershed in these counties. This funding is available for 2002.

County of Brant and City of Brantford

The County of Brant and City of Brantford have initiated a Rural Water Quality Program in Brant. Each of these partners has committed \$50,000 to the program for 2002. The Brant Millennium Grow Green Committee has provided an additional \$10,000 to this initiative. A Healthy Futures application is being made on their behalf and it is hoped that this will provide \$715,000 for this project.

Dufferin and Haldimand

Through the Agricultural Environmental Stewardship Initiative of Agriculture, and Agri-Food Canada, the GRCA has been granted \$209,900 to deliver a Rural Water Quality Program to all other areas of the watershed. Approximately \$180,000 will be made available to agricultural landowners in primarily in the County

of Dufferin and Haldimand County.

The true measure of success of the Rural Water Quality programs comes in the type and number of projects completed by landowners and the pride that they have in their projects. Unfortunately the coverage of the watershed has been achieved for a very limited time period and the challenge is to develop long-term programs that will provide a sustainable funding source to fund best management practices on rural lands in the watershed.

WHAT'S HAPPENING?

Environmental Day Camps

The GRCA's Environmental Day Camps are all about kids having fun and learning to appreciate and protect the natural resources of the Grand River watershed. These camps are run during the summer at the Apps' Mill Nature Centre near Brantford and Guelph Lake Nature Centre near Guelph.

The Environmental Day Camp is open to children six to ten years old at the Apps' Mill and Guelph Lake Nature Centres. Children ten to thirteen years

old can join the Adventure Camp at the Apps' Mill, or the Advanced Environmental Day Camp at Guelph Lake.

A typical camp week at Guelph Lake Nature Centre's Advanced Environmental Day Camp includes captive animal care, habitat rehabilitation projects, leadership, bug hunts, water studies, a visit to the Rockwood Conservation Area, and canoeing on Guelph Lake.

The Apps' Mill Nature Adventure Camps include overnight trips to Kanata Indian Village, a Rail-Trail bike trip to Pinehurst Lake Conservation Area, and a day-long rafting adventure on the Grand River. For more information contact: Apps' Mill at (519) 752-0655. Email: appsmillnc@grandriver.ca or Guelph Lake at (519) 836-7860. Email: guelphlakenc@grandriver.ca

Wetlands Policy Update

During April, the GRCA received numerous comments relating to its draft Wetlands Policy. The Policy suggests broad principles, goals, objectives, and policies to guide a



The stream shown on page 3 shows significant improvement in water quality after livestock was fenced out of the waterway. Grasses and other plants provide a filter for any field runoff.

range of GRCA programs and provides a proposed framework for implementation. These policies are intended to encourage a stronger level of protection for non-provincially significant wetlands and unevaluated wetlands in the Grand River watershed and to complement the current Provincial Policy Statement regarding Provincially Significant Wetlands.

The comments are currently being compiled and will form the basis for further discussion and revisions. A final draft of the Wetlands Policy is expected to be completed this summer for review by municipal councils this fall. For more information, contact Barbara Veale. Phone: (519) 621-2763 ext. 274. Email: bveale@grandriver.ca

Water Forum

The GRCA in conjunction with the Grand River Conservation Foundation and the Water Managers Working Group is planning a 2nd Annual Water Forum on September 20, 2002, to be held at the GRCA Administration Office in Cambridge. Further details will be posted on the GRCA's website at www.grandriver.ca in late May.

Presidents' Dinner

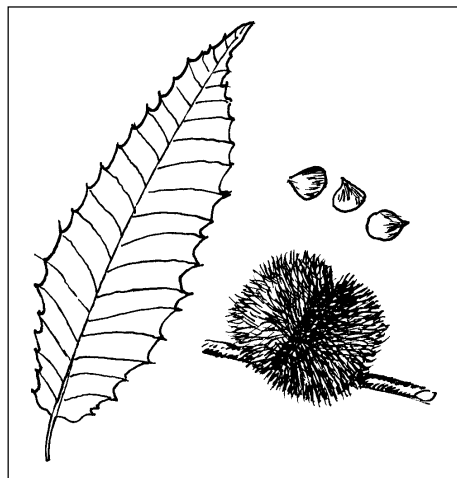
On Thursday, June 20th, the Grand River Conservation Foundation's Third Annual "Presidents' Dinner" returns to Bingeman Park in Kitchener. Supporters from communities throughout the Grand River watershed will be updated on the accomplishments of the past year; they will be a part of the exciting plans for the future, and will be introduced to the Foundation's incoming President, Tom Land of Cambridge. Attendees will enjoy a gourmet meal and entertainment by renowned Canadian and award-winning comedian Dave Broadfoot.

Proceeds will be placed in the Grand Champions Endowment Fund,



Popular Canadian humorist Dave Broadfoot will entertain for the environment at the Grand River Foundation's Presidents' Dinner.

to aid in the Foundation's support of environmental projects in the Grand River watershed. Tickets are \$150 per person, and include a charitable donation receipt for part of the ticket price. For information contact the Grand River Conservation Foundation at (519) 621-2763, ext. 213. Email: foundation@grandriver.ca



The American chestnut has beech-like leaves, a spiny husk and small flat-sided nuts. Drawing by Liz Leedham.

Chestnut News

Older generations in the farm community may remember the spread of the chestnut blight epidemic of the 1920s to 1940s. The disease entered from the United States and spread across southern Ontario at an average rate of 50 kilometres annually. Virtually all chestnut trees were attacked and killed. Only a few blight-free trees, perhaps numbering in the hundreds (some ranging up to 50 years old), have escaped infection. A few of these bear nuts. Because of the distance separating most trees, cross-pollination does not occur or occurs rarely.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the American chestnut as a threatened species in 1987. For each threatened or endangered species listed, expert teams from government, universities and wildlife groups are coaxed to develop recovery plans for that species. Once a recovery plan is prepared, it is forwarded to the Recovery of Nationally Endangered Wildlife (RENEW), which serves as a link between individual recovery teams, government agencies, and the public.

The American chestnut recovery plan has three objectives:

1. Identify and work with landowners to protect populations of American chestnut within its native range, and promote self-sustainability in at least fifteen core populations;
2. Identify blight-free stands outside its native range, and protect and monitor at least seven stands;
3. Develop and assess management strategies for chestnut blight. The third objective is by far the most challenging and several strategies have been planned to learn to manage the chestnut blight.

One project, coordinated by Dr. Adam Dale, a plant breeder with the University of Guelph, involves a

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CHESTNUT

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breeding program to develop blight-resistant chestnuts of Canadian origin. According to Dr. Dale, up to forty "mother trees" across Ontario will be selected. Pollen from known blight-resistant hybrid trees, obtained from researchers in the United States, will be crossed with the mother trees. The resulting nuts will be collected, planted, and the trees inoculated with chestnut blight in five to seven years' time. It is hoped that by backcrossing through generations, blight resistance will be produced within twenty years.

Two years ago, 24 Ontario farmers were selected to host demonstration planting sites for the American chestnut tree, as part of a restoration effort coordinated by the Ontario Soil and Crop Improvement Association. The farmers worked with local foresters from conservation authorities or stewardship councils to develop planting plans. Some mixed the American chestnut with other species in windbreak designs, others added the chestnuts to existing hardwood forests or conifer plantations.

The planting sites are spread out across Ontario from Essex County in the southwest, to Glengarry County in eastern Ontario. Most of the 24 farm sites initially received fifty American chestnuts. The seedlings were grown at the GRCA nursery near Burford in Brant County. The seed source was nuts obtained from trees in farm woodland adjacent to the nursery. Two of the farm sites actually received seedlings grown from nuts harvested in New York State as these were deemed to be a better climatic 'fit' for selected farms service.

All 24 sites are making a unique contribution to a coordinated, full team effort involving researchers, other organizations, and scores of individuals who are passionate about restoring the American chestnut.

Environmental Sustainability Awards

The 4th Annual Environmental Sustainability Awards Ceremony will be held on June 6, 2002, at Kitchener City Hall at 5.30 p.m.

This event celebrates individuals, groups and businesses within the Region of Waterloo who have demonstrated an outstanding commitment to conserving or enhancing our natural heritage; who have positively inspired others to undertake good environmental stewardship; and who exemplify the values that will help us to achieve a sustainable society. There are several categories of awards and everyone is welcome to attend the presentations.

This year, the event is presented by the Cambridge Chamber of Commerce, T. D. Friends of the Environment, Greater Kitchener Waterloo Chamber of Commerce, Regional Municipality of Waterloo, City of Cambridge, City of Kitchener, City of Waterloo, Township of Wellesley,

Township of Wilmot, Kitchener Waterloo Field Naturalists, OCETA, GRCA, Kitchener Waterloo Field Naturalists, CRESTech, Waterloo Citizen's Environment Committee, and Woolwich Healthy Communities.

The awards ceremony follows the Energy and Environment Forum held earlier that day at the City Hall.

The Mighty Grand

In honour of the GRCA winning the prestigious *Riverprize 2000*, Ken Murray commissioned local young composer Eric Schwindt to write an orchestral composition to celebrate the occasion. *The Mighty Grand* will premier at the Kitchener-Waterloo Symphony Fire in the Sky concert on Sunday May 19, 2002 at Victoria Park, Kitchener at 8.00 p.m. Raindate is Monday, May 20. For more information contact Marianne Leach at (519) 745-4711, ext. 282. Email: mleach@kwsymphony.on.ca



The Curtin family of Paris, (left to right), Benjamin, Kathleen, and Connor, were among Toyota volunteers who pitched in to clean up the environment at Shade's Mills Conservation Area.

NOW AVAILABLE

Guelph Stewardship Handbook

In the City of Guelph a condition of subdivision draft plan approval is the creation of an Environmental Implementation Report (E.I.R.). This report incorporates detailed information and strategies of the Environmental Impact Study, the Stormwater Management Study, other reports and comments from local utilities, area residents and property owners. It is submitted by the developer for approval by the City prior to plan registration.

The Public Education section of the E.I.R. outlines actions the developer will take to educate home purchasers with respect to the significance of the natural areas and wetlands near their new homes. This information has usually been provided through a public information brochure.

Several years ago, the Guelph Environmental Advisory Committee (EAC) took the initiative, with support from City Planning and Engineering staff, to create a more consistent and comprehensive booklet providing the latest information on environmental consciousness, not only on a subdivision basis, but also from a citywide and community perspective.

The resulting handbook includes explanations and illustrations to help homeowners understand and care for their environment. The handbook was compiled by ESG International of Guelph and will be updated as new information becomes available.

The Guelph Residents' Environmental Handbook is supported by the Guelph Development Association and the City of Guelph and will be distributed to all homeowners in Guelph. For more information contact Shannon Smith, (519) 837-5616, ext. 2283. Email: ssmith@city.guelph.on.ca



Southwest Optimist Park in Kitchener has a forest in its future thanks to the work of hundreds of volunteers who attended the Sunoco Earth Day tree planting.

LOOK WHO'S TAKING ACTION

Sunoco Earth Day

The sun shone, a thousand trees were planted, and Earth Day was well and truly celebrated at Southwest Optimist Park in Kitchener. The annual Sunoco Earth Day event on April 20 attracted six to eight hundred people. This year, the event also heralded the launch of a three day Kitchener-wide Earth Day Festival. Event festivities included the Clean Air Fair, nature shows, a falcon display, crafts, bird box building and much more.

Local schools competed to see which school would have the most participants at the event. Sixty-four schools entered the competition, with 194 entrants between them. Brigadoon Public School was the winner and a very big tree (worth \$1,000) will be planted at their school by Fast Forest Inc. of Kitchener.

Each child that planted a tree was also offered a free pass to African Lion Safari,

the Wings of Paradise (Butterfly Emporium), or a GRCA park.

This highly successful community event was made possible by generous contributions from Sunoco/Suncor Energy Foundation. Other major partners were Earth Day Canada, the City of Kitchener and the Regional Municipality of Waterloo. Many other local organizations and businesses donated materials and prizes and helped to make a day to remember for the families who came to plant trees.

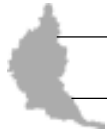
Toyota Employees Pitch In

It may have been cold and rainy on April 26, but that didn't stop more than 80 people showing up at Shade's Mills Nature Centre to spruce up the grounds and trails. The event involved employees and family members of Toyota Motor Manufacturing in Cambridge. They spent the afternoon picking up litter and putting wood chips in some of the low spots of the grounds and trail. Following that,

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TOYOTA *from page seven*

nature centre staff held interpretive programs for the visitors. The day was capped off with a barbecue.



DID YOU KNOW?

- Powered by the sun, the earth's water cycle transfers 10.296 quadrillion gallons from the oceans to the land every year.
- Once evaporated, a water molecule spends about ten days in the air.
- Evenly distributed, earth's annual rainfall could cover every 929 cm² (square foot) of land to a depth of about one metre (3 feet).
- Hammurabi was the ruler who chiefly established the greatness of Babylon, the world's first metropolis. Many relics of Hammurabi's reign (1795-1750 BC) have been preserved, including his Laws. The following are excerpts from the Code of Hammurabi dealing with water and rivers.
- If any one open his ditches to water

his crop, but is careless, and the water flood the field of his neighbor, then he shall pay his neighbor corn for his loss.

- If any one be too lazy to keep his dam in proper condition, and does not so keep it; if then the dam break and all the fields be flooded, then shall he in whose dam the break occurred be sold for money, and the money shall replace the corn which he has caused to be ruined.
- If a tavern-keeper (feminine) does not accept corn according to gross weight in payment of drink, but takes money, and the price of the drink is less than that of the corn, she shall be convicted and thrown into the water.



THE GRAND STRATEGY CALENDAR

Saturday, May 25, 2002, Waterloo-Wellington Canoe Club Annual Grand River Cleanup, Breslau to Freeport. Check the website ca.geocities.com/wwcaneoclub or call (519) 658-8955 for more details.

May 30 to June 2, 2002, the 3rd Annual Caring for Creation Conference, Redeemer University College, Ancaster. The theme is Faith and Earthkeeping: Rebuilding a Value Framework for Action. More information is available at www.caringforcreation.ca or by phone at (905) 528-3095. E-mail: info@caringforcreation.ca

June 6, 2002, the 4th Annual Environmental Sustainability Awards Ceremony at Kitchener City Hall at 5.30 p.m.

Saturday, June 01, 2002, Speed River Clean Up at Riverside Park, Cambridge. Call (519) 658-5209 for details.

Saturday, June 8, 2002, Cambridge Riverfest and Dragon Boat Races, Riverbluffs and Dickson Park, Cambridge. 10 a.m. to 12 noon. Free. Call (519) 623-3151 for details.

July 27 to 28, Grand River PowWow, Six Nations of the Grand River, at Chiefswood Tent and Trailer Park, Ohsweken.

August 2 to 3, Mill Race Festival, Cambridge. Traditional music and dancing. For information contact Brad McEwen at (519) 621-7135. Email: mill_race@yahoo.com

August 9 to 11, Brantford Riverfest 2002. Contact Leslie Rachar, (519) 758-5579. Email: les.koop@sympatico.ca

August 9 to 11, Fergus Scottish Festival and Highland Games, Fergus. Email: info@fergusscottishfestival.com for more information.

September 20, 2002, 2nd Annual Water Forum, GRCA Administration Centre, Cambridge. Details to be announced later.

ABOUT THIS NEWSLETTER

This newsletter is produced as a communications tool by the Grand River Conservation Authority on behalf of the partners in *The Grand Strategy*. This newsletter can be seen on the Internet at www.grandriver.ca

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For newsletter submissions

Contact the Editor, Liz Leedham, c/o Barbara Veale at the above address. Newsletter submissions must be made by the 15th of the month prior to publication, and may be subject to editorial change. Tax deductible donations and sponsorships toward the cost of producing this newsletter are always welcome.

Publications Mail

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