



CANADIAN WATER NETWORK

Connecting Water Resources...Bringing Research to Life



ANNUAL REPORT 2002 | 2003

OUR MISSION: To ensure Canada's leadership role in the management and sustainable use of water resources, in the protection of human and aquatic ecosystem health and in sustaining economic growth in the water technology and services sector.

Connecting Water Resources...Bringing Research to Life!

Water is a precious resource and clean, safe water is a fundamental determinant of health and quality of life. The effective management and stewardship of this vital resource requires the integration of a wide variety of concerns, interests and expertise.

The Canadian Water Network is all about bringing together considerable and varied expertise in water issues across Canada, to fundamentally improve our ability to manage and protect both human and environmental health.



The Canadian Water Network-Réseau canadien de l'eau (CWN-Rce) is a consortium of university researchers and industry and government partners who share a vision of providing Canadians with the cleanest, safest water possible.

What the CWN does

The Network develops and supports diverse, multidisciplinary projects that address the critical water issues facing our nation. The program is national in scope, void of political agenda and emphasizes the importance of addressing the socio-economic aspects of water management in conjunction with a scientific approach. The Canadian Water Network (CWN) is founded on the existing research expertise across Canada, in the various water-related study areas, and functions to unite these world-renowned researchers with representatives from private industry, government and public sector organizations. This network of participants serves to effectively address Canada's water-related issues on a regional, national and global scale.

Leading researchers from various fields related to water, economics and health have been brought together to form multi-regional, multidisciplinary collaborations. In addition to the financial support provided by the federal government's Networks of Centres of Excellence (NCE) program, the CWN receives funding and in-kind support from partners in private industry, academia, non-governmental organizations and various government and public agencies at the municipal, provincial and federal level.

Important products of network activities include:

- ▶ innovative clean water technologies that will be marketed worldwide by our industrial partners;
- ▶ a comprehensive and integrated understanding of water resources, water allocations and water supply systems;
- ▶ enhanced detection techniques for water-borne pathogens, disinfection byproducts and environmental contaminants;
- ▶ the development of technological advances in the management of water resources, water supply issues and wastewater treatment; and
- ▶ highly qualified personnel with interdisciplinary training in water resources and technology development.



Letter From Bill Borland, Chair of the Board

The Canadian Water Network (CWN) has completed a most productive second year of operation, marked by important research accomplishments, a very successful National Symposium and significant strengthening in staffing and leadership. A truly bright future lies ahead. The CWN will continue to fulfil its mandate as a Network of Centres of Excellence. As Chair of its Board of Directors, I am pleased to present the Network's 2002/2003 Annual Report.

The world welcomed 2003 as the United Nations International Year of Freshwater. Issues raised during the year, along with the UN's global water vision of thinking globally and acting locally, have helped to strengthen our mandate.

In March 2003, the CWN held its inaugural National Symposium in Saint John, New Brunswick. The Symposium program was full and the sessions were well attended. Presentations on the Network's 28 research projects, in addition to presentations on industrial, federal and provincial initiatives, highlighted the level of excellence in research that the CWN embodies.

As the Network looks to the future, it will continue to build on this momentum by conducting innovative, leading-edge research and effectively communicating how our achievements impact Canadians and the world. The first full review of CWN research projects was completed in 2003. The assessments were very favourable and provided important feedback.

The CWN proudly welcomed Dr. Mark Servos as Scientific Director this past year. Dr. Servos was formerly Project Chief with Environment Canada's National Water Research Institute, Aquatic

Ecosystem Protection Research Branch. His research concentrated on pharmaceuticals and related chemicals in water, an emphasis that will continue in his research at Waterloo. Dr. Servos replaced Dr. R.W. Gillham, the Network's first Scientific Director. The CWN also welcomed a new Executive Director, Bernadette Conant, and a new Communications Officer, Katarina Pintar. In addition, new faces were added to the Board of Directors and the Research Management Committee, widening industry and government representation within its governing bodies.

To develop new strategic direction, the CWN has initiated a challenge dialogue process which will incorporate input from primary stakeholders (including industry, government and NGOs). The result will be a strategic plan that addresses water issues facing Canadians; stimulates research excellence and multi-regional collaboration; increases the potential for technology transfer; and enhances policy development and implementation in Canada.

Water issues continue to have a high priority in Canada. In the next year we will strive to maintain excellence in research, while broadening our scope and exploring new areas. We will fortify our existing network while looking for new partners to complete an expanded vision.

William Borland
Chair, CWN Board of Directors

J.D. Irving Ltd. SAINT JOHN, NB

Letter from Dr. Mark R. Servos, Scientific Director



The creation of the Canadian Water Network (CWN) just two years ago came at a critical time for Canadians. The challenges facing policy makers, managers and the water industry have never been greater. In response to the Walkerton tragedy, we are now faced with the very difficult challenge of learning from the past and using our knowledge to ensure future tragedies are avoided. Canadians are now acutely aware of the importance of safe drinking water and they also recognize how complex and vulnerable our systems can be. It will be a test of our societal values to maintain our vigilance and ensure all Canadians have access to clean, safe water.

Almost every jurisdiction in Canada has recently prepared a review and developed policy for the protection and delivery of safe drinking water. Implementing these policies using sound science as a basis will be a challenge that we cannot afford to ignore, and one that the CWN can positively impact. Clean water will not be achieved easily. Our attention and commitment to developing innovative solutions will be rewarded through improved health, an enhanced environment and new economic opportunities. The CWN is a critical contributor to the development and application of new knowledge and innovation to address these problems, through partnerships with industry, governments and other stakeholders.

The first CWN Symposium, held in Saint John, New Brunswick this spring, was a huge success. As our first major event, the Symposium was a unique opportunity to link academia, industry

and government and open the lines of communication. It was an opportunity to share new science and develop further networks and partnerships. There was an overwhelming sense of optimism and support among the researchers, partners and many stakeholders who attended. The CWN clearly provides a much-needed national forum that includes a diverse group of people with similar challenges, for addressing and managing water issues in Canada.

After only two short years as one of Canada's Networks of Centres of Excellence, the CWN is emerging as a leader in water protection and management. There is no doubt that the Network's influence will continue to develop in the future, resulting in enormous benefits to Canadians. We can already see a significant impact on water science, policy and opportunities. We have made an initial splash and the wave is moving across the country as we continue "connecting water resources" and "bringing research to life."

A handwritten signature in dark ink, appearing to read 'Mark R. Servos'.

Dr. Mark R. Servos
Scientific Director
Canadian Water Network
University of Waterloo, WATERLOO, ON

The Network's research focuses on SEVEN key themes:

1. Policy and Governance
2. Water Resources Management
3. Safe Drinking Water
4. Water and Public Health
5. Wastewater Management
6. Infrastructure
7. Groundwater and Sediment: Protection and Remediation

1

Policy and Governance

Building the capacity to provide clean water.

As responsibilities for managing water issues continue to shift to the local level, understanding the factors that shape local capacity for water and wastewater management is crucial.

Policy and Governance was originally defined as a separate research theme at the outset of the Canadian Water Network, while acknowledging that the research is closely connected to other themes. The objective of the *Policy and Governance* theme is to develop comprehensive, effective instruments for managing water quality; quantity and allocation; sustainability in aquatic ecosystems; water-related health issues; and commercialization of water resources.

On a broad scale, researchers are evaluating governance "instruments" at both provincial and federal levels, comparing their effectiveness in providing sustainable water management in Canada. Issues addressed include access to reliable water supplies and the development and evaluation of capacity enhancement mechanisms that reflect local challenges of the study watershed communities. These include the Grand River, Maitland River, Annapolis Valley and Oldman River watersheds.

One project examines governance issues in the North American Great Lakes – systems that contain approximately 20 per cent of the world's fresh surface water. These governance arrangements span two countries, nine state and provincial governments and thousands of local governments. The project addresses the regulation of toxic chemical pollution; lake levels and water quantity management; governance of

water export; lakewide and basinwide planning; and the management of exotic and predatory species. Another project examines analytical models for dispute resolution as a result of bulk water export conflicts.

In addition, an interdisciplinary group of economists and biologists is examining the value of tap water as a commodity to Canadians and determining the extent to which consumers would be willing to pay for better quality drinking water in order to reduce their risk of exposure to pathogens and harmful chemicals in their water.



Managing the watershed...not just the water.

Water Resources Management

2

Using a “watershed approach,” the *Water Resources Management* theme integrates multidisciplinary and multi-regional research across Canada through the study of watersheds. This approach, also embraced in the six other CWN themes, involves various watersheds across Canada, including the Lower Fraser Valley (British Columbia), Grand River (Ontario), Annapolis Valley (Nova Scotia), the St. John River basin (New Brunswick), Saskatchewan River (Saskatchewan), Oldman River (Alberta), Maitland River (Ontario) and others. Research in the *Water Resources Management* theme considers how natural and human activities in a watershed impact both water quantity and quality. The projects address a range of systems, from pristine to heavily impacted watersheds.

One CWN project, for example, examines the impact of agricultural and urban activities in the Red Deer, Bow and Oldman river systems in Alberta and Saskatchewan. Each of the three watersheds has a major urban centre between the foothills and the prairie region. They also support forestry, grazing, grain production and livestock operations. The CWN project integrates ecologists, physicists and economists into an expert system to examine links between water quality, quantity and land use. The objective is to determine the potential impact of land use changes and the spatial extent of these changes on the provision of a clean water source.

The Lower Fraser Valley (LFV) in British Columbia is one of the fastest growing regions in Canada and water pollution problems are increasing just as rapidly. A study of the impact of

land use activities is being conducted as part of another CWN project. Excess nutrients, trace metals and antibiotics are being traced through seven sub-watersheds in the LFV system to determine the effectiveness of best management practices for reducing agricultural impacts.

Multidisciplinary CWN projects are also examining the impact of metal toxicity, mining activity, winter snow accumulation and increased spring and summer runoff due to forecasted climate warming and the potential for surface water quality changes. Identification and potential resolutions of these problems are the ultimate goals of these projects.



3

Safe Drinking Water

From the source to the tap!

Drinking water utilities that treat surface water have begun to recognize the important role the watershed plays in the planning and operation of delivering safe drinking water to Canadians. Water supplies are limited and authorities are challenged with meeting the growing demands for domestic, recreational, industrial and agricultural water. The spread of water-borne pathogens in drinking water has resulted in a series of major infections, a number of deaths, serious health warnings, boil water orders and temporary shutdowns of municipal water treatment facilities.

Source water protection is an important step in achieving improved water quality at the tap for the Canadian consumer and reducing the risk of water-borne disease. This research theme examines the need for source water quality assessment and watershed management in addition to the provision of adequate treatment.

Events of the last decade have emphasized the need for adequate disinfection of drinking water to inactivate pathogens such as *Giardia* and *Cryptosporidium*. In response to these needs a CWN project, in co-operation with research partners in industry, government and the health sector, is developing better molecular-based methods to detect *Cryptosporidium* in environmental water samples. Another CWN project is developing a rapid yet accurate method to detect pathogens in water in order to improve public health protection. The technology is based on bacterial DNA identification to determine pollution sources and types.

At the watershed level, one study examines local initiatives to protect the Grand River watershed in southern Ontario – a drinking water source for up to 500,000 people. It is also one of the most heavily impacted watersheds in Canada. The project is evaluating a recently initiated Rural Water Quality Program, developed to protect the Grand River watershed by educating farmers and providing subsidies for various measures to improve source water characteristics.



Water is life!

Water and Public Health

4

Closely allied with the *Safe Drinking Water* theme in the CWN, these research projects focus more specifically on the links between the quality of water and public health. This research examines ways to better assess compounds in our water and evaluate to what degree they present a health concern. Collaborators include investigators from British Columbia, Alberta and Ontario, as well as leading water quality experts in Australia, California and China.

Since the turn of the last century, chemical disinfection of drinking water has been instrumental to improved protection of public health. However, the disinfection byproducts (DBPs), produced as a result of chemical disinfection, have sparked concerns of adverse human health effects. The possibility that DBPs might cause health problems has resulted in increased investments in water treatment and monitoring worldwide. While efforts to identify DBPs have been limited by available analytical methods, new technology is being developed to address this.



CWN researchers are pursuing the identification of DBP profiles from chemical water disinfection with

advanced analytical technology (High-Field Asymmetric Waveform Ion Mobility Spectrometry) and comparing the results with alternative disinfectants, including ultraviolet radiation. Ultimately, accurate predictions of DBP formation and how they impact human health will reduce public health concerns.

Another water quality issue of concern on a national and global scale is arsenic – a toxicant and cancer-causing agent. In some areas of Canada, well waters contain arsenic levels above the Canadian guideline level. Effective removal of arsenic demands effective monitoring methods. One CWN research group is developing a reliable, cost-effective technology for the identification of arsenic in water, thereby assisting in the development of new technology to remove arsenic from our water supplies.

Identification methods are the basis of effective community and public health monitoring efforts. One CWN project is bringing together teams of public health workers and scientists and carrying out a community study on the prevalence of *Cryptosporidium* – an important pathogen with dramatic consequences to a community when water-borne outbreaks occur. The team is collecting data on weather events, land use, turbidity levels, *Cryptosporidium* concentrations in drinking water and prevalence of the parasite in select communities. This information will help identify and understand the relationship between watershed events and the water-borne spread of *Cryptosporidium*.

5

Managing the impacts on our water cycle...

Wastewater Management

Wastewater management is of concern to all Canadians; in particular, the threat of water-borne pathogens and chemical contamination to our drinking water and aquatic ecosystems. Projects in this theme address monitoring and treatment technologies and risk assessment approaches, all in the context of how industrial and agricultural activities affect our water resources.

Although much of the Canadian population is concentrated in urban areas, the majority of water supplies serve smaller communities, often in rural settings where supporting expensive, sophisticated treatment systems is difficult. The primary wastewater sources in these areas are agricultural operations, individual residences and small commercial or industrial operations.

One CWN project focuses on identifying realistic options for small communities by defining the treatment characteristics of lower-cost natural treatment technologies, such as constructed wetlands. Another project is tackling waste management, evaluating the effectiveness of “best management practices” (BMPs) related to the storage and handling of manure on livestock farms. Potential pathways for water contamination on farm operations are being examined to determine the nature of the risks to water supplies and the effectiveness of BMPs. On-farm characterization protocols for evaluating risks to surrounding waters are being developed for several provinces.

Water-borne pathogens are a significant concern for all Canadian water users. CWN researchers

are examining the relationship between pathogens and indicator microorganisms during water and wastewater treatment that might provide improved measures for treatment plants. Another CWN project is investigating advanced oxidation processes in drinking water treatment – an innovative technology with the potential to help meet new chemical and microbiological drinking water standards.

In some areas, industrial wastewater streams are a major concern. The oil sands industry in Alberta produces crude oil by extracting bitumen from oil sands. As a result, large amounts of tailings and process water (containing naphthenic acids, NAs) are produced as waste. Acute toxicity of surface waters to aquatic organisms has been attributed to NAs released during the processing of oil sands. CWN researchers are working to determine the real impacts of these compounds, examining how NAs may affect the respiratory, metabolic and reproductive functions of fish, phytoplankton and invertebrate communities, as well as the migration potential of contaminated process waters in surface and groundwater.



The essential connections in water delivery!

6

Infrastructure

The *Infrastructure* theme within the CWN deals with the critical issue of how safe water supplies are delivered to end users. It focuses on management and innovation for municipal infrastructure of water systems across Canada. Investments in water infrastructure are urgently needed. These include both drinking water treatment plants and distribution systems, as well as wastewater treatment and disposal. For instance, in Eastern Canada sewer systems and water treatment facilities were developed concurrently with the cities – in some cases over 150 years ago. Many are now ailing and require an injection of millions of dollars to meet current standards.

CWN projects are integrating academic research with the local needs of municipalities to incorporate improved infrastructure management plans in their long term goals. The research is developing better monitoring methods and an improved understanding of the potential for pathogen intrusion in municipal drinking water systems related to infrastructure deterioration – a known and major source of contamination outbreaks.

CWN researchers are partnering with Canadian water utilities in these studies and the collaborations are fundamental to the success of the program. Projects now involve utilities in Quebec, New Brunswick, Saskatchewan, Alberta and Ontario, as well as international utilities in the United States, United Kingdom, Japan, Australia, Hong Kong, China, Italy and France. In addressing national concerns, a global perspective of sustainable water resources is

being developed. Through the *Infrastructure* research, and closely related projects in the *Policy and Governance* theme, the issues of privatization and public-private sector participation in the management of water utilities are being examined.

Other areas of investigation include: temporal and geographical analyses of utility databases and distribution system interventions; determination of the causes of turbidity complaints; and the investigation of the role that transient low pressures play in contamination events. By addressing these areas, various utilities are providing answers to the very real questions that are being faced across the country – what is the impact of infrastructure operations on the potential for contamination of treated drinking water by pathogens?



7

Groundwater and Sediment: Protection and Remediation

"We never know the worth of water 'til the well is dry." - English proverb

To provide the necessary link between municipal, agricultural and industrial activities and their impact on the safety of our water supply, a fully integrated approach to managing water resources is critical. As such, there is a need for the characterization of both surface water and groundwater in a watershed system. CWN researchers are addressing the need for a more comprehensive understanding of Canada's watersheds. Research teams are currently investigating physical, geochemical, microbiological and water supply management issues related to contaminated systems, river valley aquifers and fractured rock subsurfaces.

Many watersheds across Canada are characterized by a subsurface system of fractured rock. As a source of clean water, these systems are unfortunately vulnerable; they are also a potential host for long-term threats to our water supply. Potential contaminant sources include mine tailings, municipal solid waste, pathogens and accidental spills. Until now, there has been little incentive for the development of integrated methodologies to ensure the future sustainability of fractured rock systems. A CWN project aims to demonstrate the applicability of modelling tools and further the understanding of complex chemical, physical and biological processes that occur in watersheds with a subsurface fractured rock system. The project integrates the characterization of the watershed to include both surface water and groundwater. It involves a multidisciplinary group of scientists with the ultimate goal of ensuring the sustainability of Canada's water resources.

If a groundwater system is contaminated, using conventional pump and treatment technologies can be costly and potentially ineffective. One CWN project is investigating an alternative solution to remediation – permeable reactive barriers (PRB). These systems involve excavation of aquifer materials and replacement by geochemically reactive materials. Once installed, natural flow processes direct the contaminated groundwater through the PRB and removal of the contaminant occurs. Pilot and full-scale field installations to evaluate the long-term performance of PRBs under field conditions will be conducted. The goal is to develop improved PRB designs. The findings will be implemented at contaminated sites and by regulatory agencies in Canada and internationally.



“Water is the driver of Nature.”

~ Leonardo Da Vinci

“If there is magic on the planet, it is contained in water.”

~ Loren Eisley

CWN Projects

1 | POLICY AND GOVERNANCE

THEME LEADER – [Graham Daborn](#), ACADIA UNIVERSITY

Building Local Capacity to Provide Clean Water

[Rob de Loë & Reid Kreuzwiser](#), UNIVERSITY OF GUELPH
[Graham Daborn](#), ACADIA UNIVERSITY

Multiple Objective and Multiple Stakeholder Decision Making in Water Resources Management

[Keith Hipel](#), UNIVERSITY OF WATERLOO

Governance and Policy Making for the Great Lakes Basin

[Mark Sproule-Jones](#), McMASTER UNIVERSITY

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[Diane Dupont](#), BROCK UNIVERSITY
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2 | WATER RESOURCES MANAGEMENT

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Forecasting Climate Change Impacts on Regional Hydrology and Water Supply in Canada

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Understanding Potential Impacts of Development in Pristine Arctic Environments on Water Quality Using Nested Hydrological Studies

[Mike English](#), WILFRID LAURIER UNIVERSITY
[Sherry Schiff](#), UNIVERSITY OF WATERLOO

Human Impacts on Water Quantity and Quality, the Implications for Ecological and Socio-Economic Processes and Policy Development: From Glaciers to Oceans in the Saskatchewan River Basin

[Leland Jackson](#), [Edward McCauley](#) & [John Post](#), UNIVERSITY OF CALGARY

Non-Point Sources of Pollution, Cumulative Effects and Mitigation in Urban/Rural Fringe Watersheds

[Ken Hall](#) & [Hans Schreier](#), UNIVERSITY OF BRITISH COLUMBIA

The Influence of Agricultural and Industrial Emissions on Metal Toxicity in the Great Lakes and the Grand River Basin

[David Lean](#), UNIVERSITY OF OTTAWA
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Estimating the Assimilative Capacity of the Saint John River

[Kelly Munkittrick](#), UNIVERSITY OF NEW BRUNSWICK

3 | SAFE DRINKING WATER

THEME LEADER – [Raymond Desjardins](#), ÉCOLE POLYTECHNIQUE DE MONTRÉAL

Agriculture, Ecology and Urban/Industrial Activities - Cause and Effect Associations in the Occurrence of Water-Borne Pathogens

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Improving Disinfection Process Controls for Pathogen Inactivation Through the Use of Integrated Disinfection Design Framework and Standardized Bench-Scale Assays

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Pathogen Loadings at Drinking Water Intakes on a Heavily Impacted River: Assessing Urban and Agricultural Inputs

[Peter Huck](#), UNIVERSITY OF WATERLOO

Molecular-Based Detection of Water-Borne Pathogens: Cryptosporidium parvum

[Hung Lee](#) & [Jack Trevors](#), UNIVERSITY OF GUELPH

Innovative Methods for the Detection of Pathogens and Evaluation of the Fecal Indexes of Microbial Pollution

[Pierre Payment](#), INRS-INSTITUT ARMAND-FRAPPIER
[Roland Brousseau](#), NRC-BIOTECHNOLOGY RESEARCH INSTITUTE

“All the water that will ever be is right now.”

~ National Geographic

“We never know the worth of water 'til the well is dry.”

~ English Proverb

CWN Projects

4 | WATER AND PUBLIC HEALTH

THEME LEADER – [Steve Hrudehy](#), UNIVERSITY OF ALBERTA

Novel Polar Disinfection Byproducts and Health Risk Tradeoffs for Drinking Water Disinfection

[Steve Hrudehy](#), UNIVERSITY OF ALBERTA

Watershed Events and Water-Borne Transmission of Cryptosporidiosis.

[Judy Isaac-Renton](#), UNIVERSITY OF BRITISH COLUMBIA

Speciation of Arsenic in Drinking Water and Health Effects from Arsenic Exposure

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5 | WASTEWATER MANAGEMENT

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Water-Borne Pathogens: Occurrence in Wastewater, Removal by Treatment and Risk Assessment of Their Effect on Public Health

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6 | INFRASTRUCTURE

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Impact of Infrastructure Management on the Contamination of Drinking Water with Pathogens

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7 | GROUNDWATER AND SEDIMENT: PROTECTION AND REMEDIATION

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[David Blowes](#), UNIVERSITY OF WATERLOO

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Contaminant Fate and Transport in Integrated Fractured Rock Subsurface and Surface Water Systems

[Jon Sykes & Edward Sudicky](#), UNIVERSITY OF WATERLOO

“A Network is really born when the dialogue grows exponentially. The Symposium was a kick start for that growth.”

WILLIAM CAIRNS, Chief Scientist, Trojan Technologies, Inc.

The Canadian Water Network 2003 Highlight

Inaugural National Symposium Connecting Water Resources 2003

SAINT JOHN, NEW BRUNSWICK

The Symposium program was full, fast-paced, and all sessions were well attended. Presentations of the 28 research projects currently underway within the CWN, along with invited presentations of other federal and provincial water initiatives, underscored the excellence of water research happening in Canada. Panel discussions with question-and-answer sessions provided an opportunity for stakeholders from different sectors to express their viewpoints and react to what they heard.

Symposium discussions touched on many topics of current interest for water: problems with identification, detection and treatment of pathogens and other contaminants in drinking water; balancing the many competing priorities in the management of water quantity and quality; and the massive job ahead in infrastructure renewal both in Canada and globally.

“I felt very encouraged by the depth and breadth of work sponsored by the Canadian Water Network, and the scope of involvement by water professionals across Canada in solving local, national and international problems. Canadians and the Canadian environmental industry will benefit greatly by this initiative,” says Hadi Husain, Director, Process R&D, Zenon Environmental, Inc.

A major focus of future CWN initiatives will be to build on this momentum and to continue to address, from a practical standpoint, how we can both achieve good science and its functional communication and application to water issues.

For a list of Symposium sponsors and more information, visit www.cwn-rce-symposium.org



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Yang, W

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Payment, P

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Byrne, J
Gannon, V
Kienzle, S
Selinger, B
Thomas, J

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WINNIPEG, MB
Woodbury, A

McMaster University,
HAMILTON, ON
Sproule-Jones, M
Smith, J

Université de
Montréal,
MONTRÉAL, QC
Brousseau, R

Memorial University,
ST. JOHN'S, NF
Gale, J

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TRURO, NS
Gordon, R

University of Ottawa,
OTTAWA, ON
Lean, D

University of Prince
Edward Island,
CHARLOTTETOWN, PEI
VanLeeuwen, J
Teather, K

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KINGSTON, ON
Kyser, K

University of Regina,
REGINA, SK
Sauchyn, D

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College,
KINGSTON, ON
Reimer, K

Ryerson Polytechnic
University,
TORONTO, ON
Fang, L
Johns, C
Twiss, M

University of
Saskatchewan,
SASKATOON, SK
Habibi, S
Hendry, J

Simon Fraser
University,
VANCOUVER, BC
Holbrook, A

University of Toronto,
TORONTO, ON
Adams, B
Karney, B
Kennedy, C
Peltier, W

University of
New Brunswick,
SAINT JOHN, NB
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Butler, K
Cunjak, R
Curry, A
Haralampides, K
MacLatchy, D
MacQuarrie, K
Munkittrick, K
Ridler, N

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Bols, N
Butler, B
Dixon, G
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Hipel, K
Huck, P
Michaels, S
Power, M
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Rudolph, D
Schiff, S
Smith, R
Sudicky, E
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Werker, A

University of Windsor,
WINDSOR, ON
Ciborowski, J

Wilfrid Laurier
University,
WATERLOO, ON
English, M
Lee, L
Kilgour, M

Partners

INDUSTRIES

Komex Inc.
CALGARY, AB

**Syncrude
Canada Ltd.**
EDMONTON, AB

Suncor Inc.
FORT MCMURRAY, AB

Albian Sands
FORT MCMURRAY, AB

**PERM
Environmental**
CALGARY, AB

Golder Associates
CALGARY, AB

**TrueNorth
Energy LP**
CALGARY, AB

**Canadian Natural
Resources Limited**
CALGARY, AB

**Alberta Heritage
Foundation for
Medical Research**
EDMONTON, AB

Placer Dome Ltd.
VANCOUVER, BC

**Joule Microsystems
Canada**
DELTA, BC

**MWH Global/MWH
Soft Inc.**
COLORADO, USA

ADI Group
FREDERICTON, NB

J.D. Irving Ltd.
SAINT JOHN, NB

Fraser Papers Inc.
EDMUNSTON, NB

NEXFOR
EDMUNSTON, NB

**TerrAtlantic
Engineering Limited**
FREDERICTON, NB

**FracFlow
Consultants**
ST. JOHN'S, NF

**Broken Hill
Property Limited**
YELLOWKNIFE, NWT

Ajax WSP
AJAX, ON

**Centre for Research
in Earth and Space
Technology**
TORONTO, ON

**CH2M Hill Canada
Limited**
TORONTO, ON

**Ontario Power
Generation Inc.**
TORONTO, ON

Falconbridge Ltd.
TORONTO, ON

Placer Dome Ltd.
TORONTO, ON

ICI Forest Products
TORONTO, ON

Cougar Automation
TORONTO, ON

IPEX
DON MILLS, ON

**GAP
EnviroMicrobial
Services**
LONDON, ON

**Trojan
Technologies Inc.**
LONDON, ON

**XCG
Consultants Ltd.**
OAKVILLE, ON

**ZENON
Environmental Inc.**
OAKVILLE, ON

**Michael Hunter
Certified Crop
Advisor**
RIPLEY, ON

C-3 Environmental
BRESLAU, ON

Earth Tech Canada
ST. CATHARINES, ON

**Water and Earth
Sciences Associates**
WATERLOO, ON

**CRA
Engineering Inc.**
WATERLOO, ON

**Syngenta Crop
Protection**
GUELPH, ON

**Bio-Rad
Laboratories**
MISSISSAUGA, ON

Golder Associates
TORONTO, ON

Calgon Carbon Corp
PENNSYLVANIA, USA

Cambior
LONGUEUIL, QC

TRIAx
LAVAL, QC

John Meunier Inc.
SAINT-LAURENT, QC

OTransit inc.
MONTREAL, QC

Noranda
POINTE CLAIRE, QC

Genex Swine Group
REGINA, SK

**River Ridge
Cattle Company**
REGINA, SK

**FEDERAL
DEPARTMENTS
AND AGENCIES**

Health Canada
LETHBRIDGE, AB

**Environment
Canada**
VANCOUVER, BC

**Fisheries and
Oceans Canada,
Pacific Biological
Station**
NANAIMO, BC

**Fisheries and
Oceans Canada -
Gulf Region**
MONCTON, NB

**Canadian
Wildlife Branch**
SACKVILLE, NB

**Geological Survey of
Canada (Atlantic)**
DARTMOUTH, NS

**Agriculture and
Agri-Food Canada**
TRURO, NS

**Indian and Northern
Affairs Canada**
YELLOWKNIFE, NWT

**Canada Research
Chair Secretariat**
OTTAWA, ON

Health Canada
OTTAWA, ON

**National Research
Council Canada**
OTTAWA, ON

**National Research
Council /
Biotechnology
Research Institute**
MONTREAL, QC

**Agriculture and
Agri-Food Canada**
GUELPH, ON

**Agriculture and
Agri-Food Canada**
OTTAWA, ON

**National Water
Research Institute,
Environment
Canada**
BURLINGTON, ON

**Natural
Resources Canada**
OTTAWA, ON

**Environment
Canada**
DOWNSVIEW, ON

**Fisheries and
Oceans Canada,
Oceans Stewardship
Branch**
OTTAWA, ON

**Agriculture and
Agri-Food Canada**
CHARLOTTETOWN, PEI

**National Water
Research Institute,**
SASKATOON, SK

**Agriculture and
Agri-Food Canada**
REGINA, SK

**Human Resources
Development
Canada**
HULL, QC

**PROVINCIAL
DEPARTMENTS
AND AGENCIES**

AB Health
EDMONTON, AB

AB Environment
EDMONTON, AB

AB Environment
FORT MCLEOD, AB

AB Environment
LETHBRIDGE, AB

**BC Ministry of
Environment**
SURREY, BC

BC Municipal Affairs
VICTORIA, BC

**BC Department of
Fisheries and
Oceans**
NANAIMO, BC

**Ministry of
Community,
Aboriginal &
Women's Services**
VICTORIA, BC

**BC Centre for
Disease Control**
VANCOUVER, BC

BC Hydro
VANCOUVER, BC

**Innu Nation
Labrador**
DAVIS INLET, LABRADOR

**MB Water
Resource Branch**
WINNIPEG, MB

MB Conservation
WINNIPEG, MB

**NB Office of
Human Resources**
FREDERICTON, NB

**NB Department of
Environment and
Local Government**
FREDERICTON, NB

**NB Department of
Natural Resources
and Energy**
FREDERICTON, NB

**NB Science
Mentorship program**
SAINT JOHN, NB

**New Brunswick
Office of Human
Resources**
SAINT JOHN, NB

**NS Department of
Agriculture and
Fisheries**
TRURO, NS

NS Soils Institute
TRURO, NS

Partners

NS Federation of Agriculture TRURO, NS	Saskatchewan Agricultural Development Fund REGINA, SK	Atlantic Coastal Action Program -Saint John SAINT JOHN, NB	Maitland River Conservation Authority WROXETER, ON	Agricultural Adaptation Council GUELPH, ON
NS Department of Environment HALIFAX, NS	Saskatchewan Pork SASKATOON, SK	Clean Annapolis River Project ANNAPOLIS RIVER, NS	Climate Change Action Fund OTTAWA, ON	City of Boisbriand, BOISBRIAND, QC
Pork Nova Scotia TRURO, NS	Yukon Conservation Society WHITEHORSE, YT	Acadia Centre for Estuarine Research WOLFVILLE, NS	Town of Goderich GODERICH, ON	City of Oka OKA, QC
NS Environmental Farm Plan Program TRURO, NS	Maine Department of Environmental Protection MAINE, USA	Centre for Research in Earth and Space Technology TORONTO, ON	County of Huron GODERICH, ON	City of Deux-Montagnes DEUX-MONTAGNES, QC
ON Ministry of the Environment TORONTO, ON	LOCAL GOVERNMENTS AND OTHERS	Ontario Cattlemen's Association GUELPH, ON	City of Hamilton HAMILTON, ON	City of Terrebonne TERREBONNE, QC
Ontario Power Generation TORONTO, ON	Oldman River Water Quality LETHBRIDGE, AB	Canadian Institute for Environmental Law and Policy TORONTO, ON	Hamilton Health Sciences Corporation HAMILTON, ON	City of Mascouche MASCOUCHE, QC
ON Ministry of Agriculture GUELPH, ON	Lethbridge Northern Irrigation District LETHBRIDGE, AB	International Joint Commission on Great Lakes WINDSOR, ON	Ontario Pork AYR, ON	City of Ste-Thérèse STE-THÉRÈSE, QC
ON Federation of Agriculture BOWMANVILLE, ON	Chinook Health Region LETHBRIDGE, AB	Environmental Defense Canada TORONTO, ON	The Council of Canadians OTTAWA, ON	Water Environment Research Foundation VIRGINIA, USA
Premier's Research Excellence Award TORONTO, ON	Bow River Basin Council CALGARY, AB	International Council for Local Environmental Initiatives TORONTO, ON	Crop Life Canada ETOBICOKE, ON	Landcare Research New Zealand HAMILTON, NEW ZEALAND
ON Innovation Trust Fund TORONTO, ON	City of Calgary Waterworks CALGARY, AB	Grand River Conservation Authority CAMBRIDGE, ON	County of Oxford Department of Public Works WOODSTOCK, ON	Disaster Prevention Research Institute, Kyoto University, Japan KYOTO, JAPAN
ON Ministry of Natural Resources PETERBOROUGH, ON	City of Chilliwack CHILLIWACK, BC	City of Brantford BRANTFORD, ON	City of Montreal MONTREAL, QC	Tohoku University, Japan SENDAI, JAPAN
Mushua Nation DAVIS INLET, LABRADOR	District of Kent AGASSIZ, BC	Regional Municipality of Waterloo KITCHENER, ON	City of Laval LAVAL, QC	Cooperative Research Center for Water Quality and Treatment SALISBURY, AUSTRALIA
Fisheries, Aquaculture and Environment CHARLOTTETOWN, PEI	City of Burnaby BURNABY, BC	Regional Municipality of Niagara THOROLD, ON	Communauté urbaine de Québec QUÉBEC, QC	Resources for the Future WASHINGTON DC, USA
Holland College SUMMERSIDE, PEI	Greater Vancouver Regional District VANCOUVER, BC	Water Utilities Thunder Bay THUNDER BAY, ON	City of Repentigny REPENTIGNY, QC	Black & Veatch GEORGIA, USA
Ministère de l'environnement du Québec MONTREAL, QC	Ducks Unlimited Canada STONEWALL, MB	Water Utilities Toronto TORONTO, ON	City of Rosemère/Lorraine ROSEMÈRE, QC	United States Geological Survey VIRGINIA, USA
Communauté Urbaine de Québec QUÉBEC, QC	Dunn Wildlife Fund SAINT JOHN, NB	Water Utilities Ottawa-Carleton OTTAWA, ON	City of Saint-Eustache SAINT-EUSTACHE, QC	Abruzzo Science Park ABRUZZO, ITALY
QC Municipal Affairs MONTREAL, QC	City of Fredericton FREDERICTON, NB	Water Utilities Fredericton FREDERICTON, NB	Canadian Network of Toxicology Centres GUELPH, ON	Atlantic Environmental Science Network SACKVILLE, NB
Prairie Farm Rehabilitation REGINA, SK	City of Saint John SAINT JOHN, NB			



Auditors' Report

To the Board of Directors
of the Canadian Water Network

We have audited the statement of financial position of the *Canadian Water Network* ["CWN"] as of March 31, 2003 and the statements of operations and net assets and cash flows for the year then ended. These financial statements are the responsibility of the CWN's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we plan and perform an audit to obtain reasonable assurance whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation.

In our opinion, these financial statements present fairly, in all material respects, the financial position of the Canadian Water Network as at March 31, 2003 and the results of its operations and its cash flows for the year then ended in accordance with Canadian generally accepted accounting principles.

Kitchener, Ontario
August 26, 2003

Ernst & Young LLP

Chartered Accountants

Canadian Water Network Financial Statement

Canadian Water Network STATEMENT OF FINANCIAL POSITION

As at March 31	2003	2002
	\$	\$
ASSETS		
Current assets		
Funds held by the University of Waterloo	2,245,428	2,487,403
Accounts receivable	76,094	25,000
Total assets	2,321,522	2,512,403
LIABILITIES AND NET ASSETS		
Current liabilities		
Accounts payable	183,902	92,558
Due to the University of Waterloo	374,491	317,420
Total current liabilities	558,393	409,978
<i>Deferred contributions [note 3]</i>	1,659,142	2,101,876
	2,217,535	2,511,854
NET ASSETS		
Unrestricted	103,987	549
Total liabilities and net assets	2,321,522	2,512,403

See accompanying notes

Canadian Water Network Financial Statement

Canadian Water Network STATEMENT OF OPERATIONS AND NET ASSETS

Year ended March 31	2003	2002
	\$	\$
REVENUE		
Amortization of Network	3,663,734	2,980,124
Centres of Excellence grants		
Other grants and conference fees	111,273	25,000
	3,775,007	3,005,124
EXPENSES		
Research projects <i>[note 4]</i>	3,016,134	2,609,597
Salaries and benefits	120,809	100,763
Consultants	112,711	90,529
Office overhead	79,020	95,204
Communications/networking/meetings	337,641	85,258
Miscellaneous	5,254	23,224
	3,671,569	3,004,575
Net income	103,438	549
Net assets, beginning of year	549	—
Net assets, end of year	103,987	549

See accompanying notes

Canadian Water Network Financial Statement

Canadian Water Network STATEMENT OF CASH FLOWS

Year ended March 31	2003	2002
	\$	\$
OPERATING ACTIVITIES		
Excess of revenue over expenses	103,438	549
Changes in operating assets and liabilities		
(Increase) in accounts receivable	(51,094)	(25,000)
Increase in accounts payable	91,344	92,558
Increase in due to the University of Waterloo	57,071	317,420
(Decrease) in deferred contributions	(442,734)	(445,124)
Cash (applied to) operating activities	(241,975)	(59,597)
Funds held by the University of Waterloo, beginning of year	2,487,403	2,547,000
Funds held by the University of Waterloo, end of year	2,245,428	2,487,403

See accompanying notes



Notes to Financial Statement

1. DESCRIPTION

The Canadian Water Network ["CWN"] is one of 22 research networks funded by the Canadian Network of Centres of Excellence ["NCE"] program. The CWN mission is to ensure Canada's leadership role in the management and sustainable use of water resources, in the protection of human and aquatic ecosystem health and in sustaining economic growth in the technology and services sector. The CWN fulfils its mission by developing, supporting and publicizing research initiatives on water-related issues important to Canada. The research is carried out by university investigators at numerous Canadian universities; financial support for the research is transferred from the Administrative Centre based at the University of Waterloo, to the investigators' universities. As allowed within the NCE guidelines, the CWN has not been incorporated as a separate legal entity, but functions as a unit within the University of Waterloo. The CWN does maintain separate reporting and management functions from the University of Waterloo.

The CWN develops and supports diverse, multidisciplinary research projects addressing critical water issues. Research undertaken by the CWN is grouped into seven theme areas: *Policy and Governance, Water Resources Management, Safe Drinking Water, Water and Public Health, Wastewater Management, Infrastructure, and Groundwater and Sediment: Protection and Remediation*. There is an emphasis on the importance of considering the socio-economic aspects of water management in conjunction with scientific research.

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

The following is a summary of the significant accounting policies followed in the preparation of the accompanying financial statements.

Funds held by the University of Waterloo

The CWN deposits its cash funds with the University of Waterloo. Funds are disbursed by the University of Waterloo on behalf of the CWN. Administrative expenses are paid originally by the University of Waterloo. These are repaid annually by the CWN and are presented as a due to the University of Waterloo in these financial statements.

Revenue recognition

The CWN follows the deferral method of accounting for contributions, which include donations and Network of Centres of Excellence program grants. Unrestricted grants or fee contributions are recognized as income in the year when received or receivable if the amount to be received has been committed in the year, can be reasonably estimated and collection is assured. Restricted NCE grants and other restricted contributions are recognized as income in the year in which the related expenses are incurred.

Research project expenses

Research projects are recorded as an expense in the year that the funds are disbursed to the various research institutions.

Notes to Financial Statement

Use of estimates

The preparation of the financial statements, in conformity with Canadian generally accepted accounting principles, requires management to make estimates and assumptions that affect the amounts reported in the financial statements and accompanying notes. Actual results could differ from those estimates.

3. DEFERRED CONTRIBUTIONS

	2003 \$	2002 \$
Balance, beginning of year	2,101,876	2,547,000
Add amounts received in the year	3,221,000	2,535,000
Less amounts amortized to revenue in the year	(3,663,734)	(2,980,124)
Balance, end of year	1,659,142	2,101,876

4. RESEARCH PROJECTS

During the fiscal year ending March 31, 2003, the CWN distributed research funds in the amount of \$3,016,134 [2002 - \$2,609,597]. Funds were distributed in accordance with the Board of Director's approval and the Research Management Committee's review and approval of research projects.

5. RELATED PARTIES

The University of Waterloo ["UW"] is party to the NCE funding agreement and functions as the Network Host for purposes of administration of the grant funding.

- a. The UW provides accounting and administrative support services as well as office space without charge to the CWN.
- b. The CWN paid a total of \$568,452 [2002 - \$555,992] in research project grants to the UW for approved research activities.
- c. As detailed in the Funding Agreement signed among the CWN, the UW and the NCE, external funds received by the CWN are held in trust by the UW.

6. INCOME TAXES

The CWN operates as a unit within the University of Waterloo. The University of Waterloo is a registered charity under Section 149 of the Income Tax Act and is, therefore, exempt from income taxes.



**CANADIAN WATER NETWORK
ADMINISTRATIVE CENTRE**

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ACKNOWLEDGEMENTS



Networks of Centres of Excellence
NCE Program Directorate
[Jean-Claude Gavrel](#), Director
[Jean Saint-Vil](#), Program Administrator



University of Waterloo,
Host Institution
[David Johnston](#), President
[Paul Guild](#), Vice President,
University Research