



ECO CANADA

Environmental Careers Organization



# Careers in Water Quality

Current Job Trends and Future Growth

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Canada

Funded by the Government of Canada's Sector Council Program

## ECO CANADA

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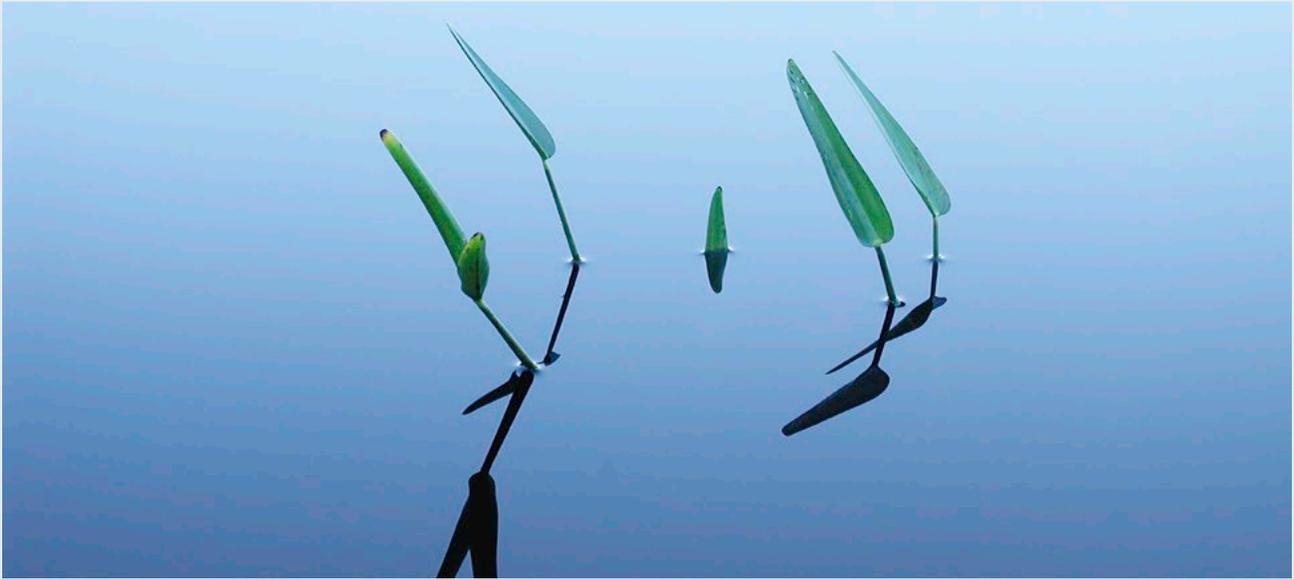
## ACKNOWLEDGMENTS

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Finally, this research would not have been possible without the participation of the thousands of individuals who contributed their time to speak with researchers and complete the survey.



## FOREWORD

Clean water is essential to every habitat on Earth, making the management of water quality and water quantity a critical aspect of many environmental jobs. This includes work that is purely focused on water quality management, such as careers in municipal water systems, groundwater well maintenance, or watershed management. It also includes work related to human activities that impact water quality, such as site assessment and reclamation, green urban design for living streams, and surface water protection for agriculture, forestry, and mining. Water quality management also plays a significant role in environmental education and policy work, as many non-profit environmental organizations and conservation groups perform tasks to protect water quality.

Careers in water quality are not just in high demand – they are also undergoing rapid changes. Climate change, population growth, and urbanization create new challenges that professionals must address to reduce negative impacts on water resources. These and other changes are driving demand for new water technologies and techniques in fields as diverse as hydraulic engineering, flood control and protection, storm water management and water resource infrastructure.

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A forester has just as much of a role in addressing water quality issues as some of our staff whose degrees focused purely on water. We encourage working together in a watershed plan because it encompasses urban land, agricultural lands, forest lands, wetlands, and other habitats.

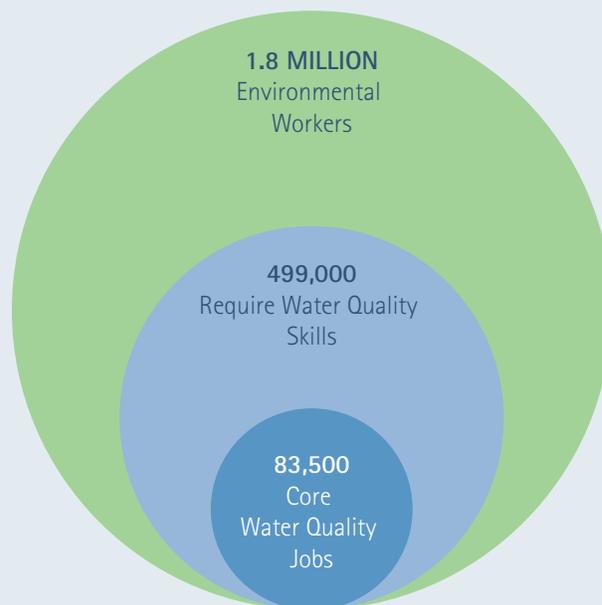
JO-ANNE RZADKI, MSC.,  
WATERSHED STEWARDSHIP COORDINATOR,  
CONSERVATION ONTARIO

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Many environmental jobs require at least some skills related to water quality. In 2013, Canada had an estimated 1.8 million workers who used environmental skills as part of their work activities. About 27.7% of these workers (499,000 employees) required water quality knowledge and skills for their work. This report focuses on core water quality occupations, a subset of approximately 83,500 professionals in Canada who perform a significant portion of work tasks directly related to water quality.



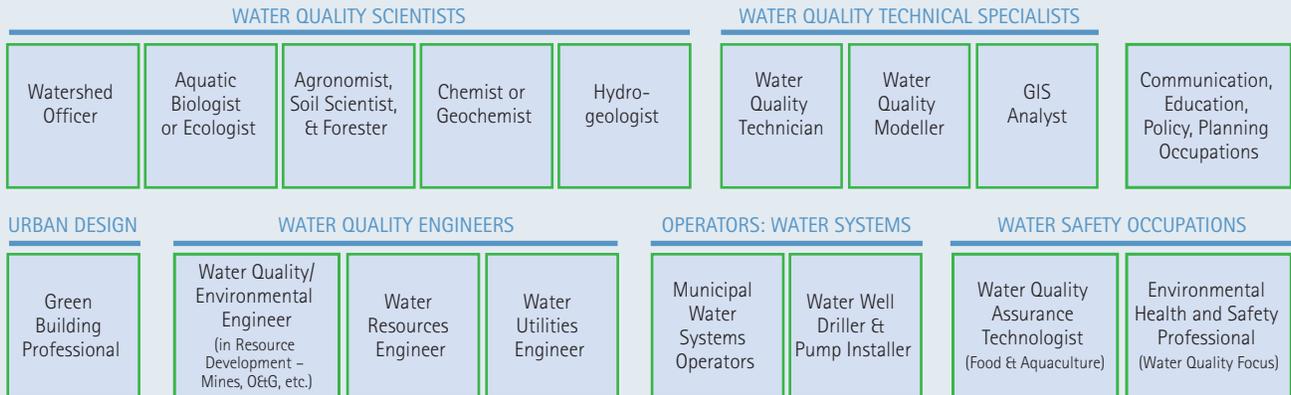
**Figure 1**  
Water Quality Core Occupations,  
Water Quality Skills, and Environmental  
Employment in Canada



The number of environmental workers was taken from ECO Canada's 2013 *Survey of Environmental Employers*. Core jobs were extrapolated from an analysis of job vacancies and Statistics Canada's 2011 *National Household Survey*. Analysis by the author.

# RESEARCH FINDINGS

**Figure 2**  
Common Occupations in Water Quality



Sources: ECO Canada, *Survey of Water Quality Employers and Expert Interviews*, 2013.

**Figure 3**  
Water Quality Labour Force by Occupation Category



Sources: Statistics Canada, *National Household Survey*, 2011. ECO Canada, *Job Vacancies Database*, n=7,027, 2013. Analysis by the author.

Water quality practitioners protect water from contaminants including sediments, nutrients, toxic contaminants and chemicals, and pathogens that adversely affect the health of people, animals and plants. These contaminants affect the quality of surface water (e.g. streams, rivers, lakes, and wetlands), groundwater (e.g. aquifers and other underground water movement), and marine waters. They also affect municipal water systems, food supply chains, and other factors that affect human health. The ways in which contamination is managed, remediated, and prevented are diverse, so these water quality skills are required for a wide variety of jobs.

In Canada, there are approximately 499,000 workers who use water quality skills in their job<sup>1</sup> and approximately 83,500 water quality workers who are employed in core water quality occupations.<sup>2</sup> Workers in core water quality occupations include:

- **Approximately 16,800 professionals and technicians in natural and physical sciences.** These occupations span a wide variety of water-related specializations, such as water quality chemists, biologists, marine biologists, aquatic ecologists, toxicologists, limnologists (study of lakes), geochemists, hydrogeologists (groundwater flow), hydrologists (surface water flow), oceanographers, and other professionals and technicians in physical and life sciences. This category also includes foresters, agronomists, terrestrial ecologists, and other occupations in fields where water quality and quantity is analyzed and managed.
- **Over 15,400 municipal water systems operators and related managers.** This group includes operators of water treatment, water distribution, wastewater collection, and wastewater treatment workers as well as water utility managers, water well drillers, water meter installers, water main maintenance workers, and other waterworks maintenance workers.

- **About 12,600 engineering workers.** Water quality competencies are required for many civil engineers, environmental engineers who work in site assessment or reclamation, water resources engineers who perform work on the source of water resources, dam engineers, sanitation engineers, water systems engineers, water treatment engineers (civil engineering), industrial waste treatment engineers (chemical engineering), hydrological engineers, coastal engineers, ocean engineers, piping/pipeline engineers (pipes that cross water bodies), irrigation and drainage engineers, mining engineers, and other engineers.
- **Over 11,000 green building and sustainable design workers who reduce water use or manage rain water runoff.** The occupations include LEED architects, landscape architects and architectural technologists/technicians, urban and land use planners, land surveyors and land survey technologists/technicians, landscape and horticulture technicians and specialists, and drafting technologists and technicians
- **Approximately 11,500 managers, supervisors, contractors, and other in resource industries.** This category includes over 4,200 workers in agriculture, forestry and horticulture, as well as over 7,200 workers in mining, oil and gas, and other resource industries.
- **Around 5,000 jobs in water quality communications, education, policy development and enforcement.** These workers can be found in governments, conservation organizations, and environmental Non-Governmental Organizations (NGOs).

Water quality workers may also work as managers of water for recreational use (over 3,000 workers), water quality specialists in food and aquaculture (2,700 workers), and other areas such as sales of water quality goods and services.

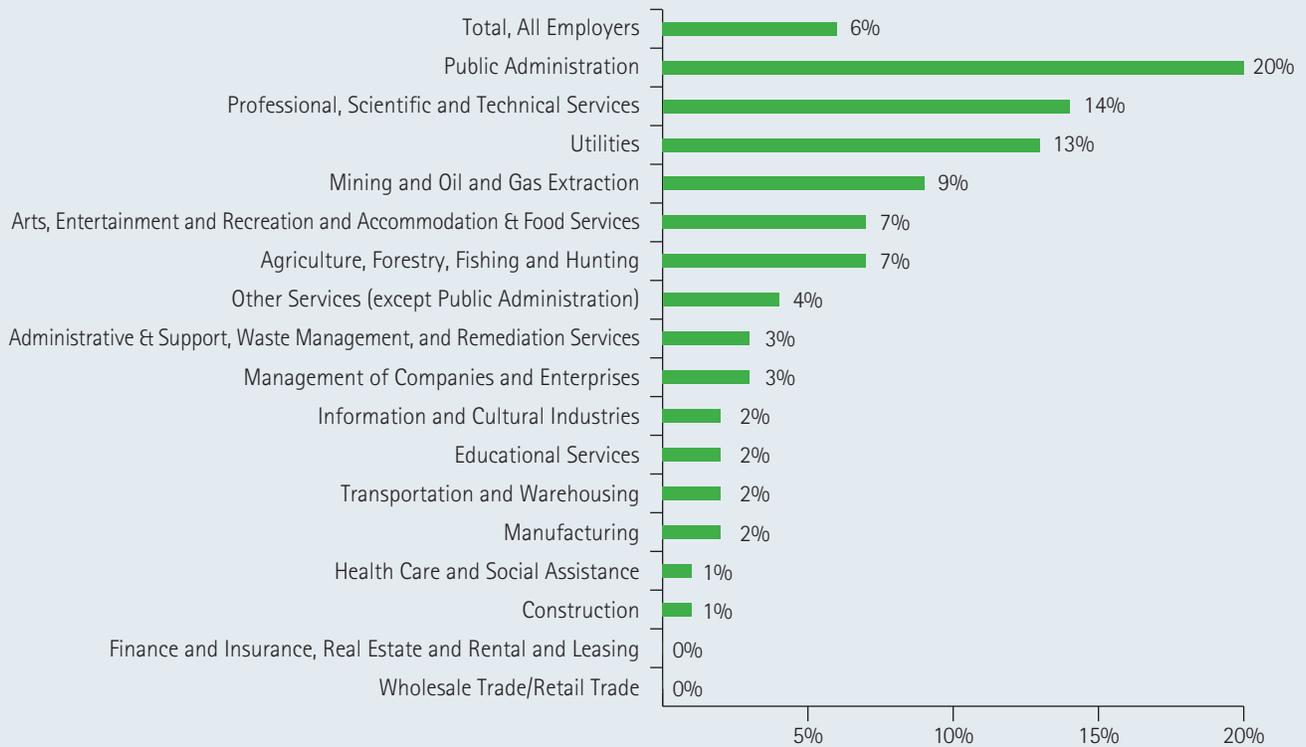
<sup>1</sup> ECO Canada, *Survey of Environmental Employers*, 2013.

<sup>2</sup> Based on our analysis of environmental job vacancies (n=7,027) and Statistics Canada's *2011 National Household Survey*.

## Employers and Practice Areas for Water Quality Practitioners

**Figure 4**

Percentage of Employers that Employ Water Quality Workers, 2013:  
Government, Consulting, and Industry



Source: ECO Canada, *Survey of Environmental Employers*, n=3,492, 2013.



Most industries have a demand for water quality practitioners. Government, consulting firms and water utilities are the three industries that are most likely to hire water quality practitioners.<sup>3</sup> Although water quality workers perform diverse types of work, most water quality jobs involve eight broad practice areas:

1. **Integrated water resources and watershed management.**

This includes management of water sources, management of sources of contamination, management of factors that affect water quantity and quality, and other characteristics of a watershed. This practice area also encompasses overall water planning and utilization, water supply management and water quality monitoring, water quality protection from point sources of pollution such as mines or industrial facilities, drainage, or storm water runoff, water quality protection from nonpoint source pollution sources such as forestry, agricultural, or municipal sources, regulations on water use, and other activities to manage water resources across the watershed.

2. **Protection of groundwater from contamination.** These activities are driven mainly by regulations that require developers, industry, and landfills to implement water protection plans, monitor groundwater for contamination, and take other protective measures to prevent or remediate groundwater contamination. Workers protect groundwater by assessing risks for projects, monitoring groundwater quality, implementing measures to prevent contamination, and remediating any contamination that occurs.

3. **Protection of surface water.** These diverse jobs are linked to point sources of pollution, such as effluents from municipal, industrial, septic, and other water systems, as well as non-point sources such as rainwater runoff from agriculture, mining, forestry, and other resource industries that carry contaminants into streams, rivers, lakes, and wetlands. Some jobs in surface water protection involve directly monitoring, collecting data, and distributing information on surface water quality. Other jobs are related to bio-monitoring to protect aquatic ecosystems and fisheries. Workers that protect aquatic life assess threats to fresh water quality and aquatic ecosystems,

establish science-based guidelines for water, fish, and sediment, identify emerging issues and threats, and track the results of remedial measures, regulatory decisions, and other activities. The use of surface water for recreation (swimming, boating, and fishing in lakes and streams) is dependent on maintaining a quality of water that is safe for these activities, so recreational workers also monitor water quality.

4. **Marine water quality.** There are 30 federal departments and agencies that manage marine-related development. Eight provinces and all three territories have some authority for managing coasts and oceans.<sup>4</sup> In addition, Aboriginal peoples in Canada have a number of treaty and non-treaty rights related to ocean and coastal activities. Jobs in marine water quality management span policy development and enforcement, prevention of contamination and spill response at ports, marinas and other marine operations, consulting for firms, universities and colleges, and industry-related activities.

5. **Aquaculture and food processing.** Aquaculture and food processors in Canada are required to test water for such contaminants as bacteria, viruses, parasites, and other biological chemical and physical agents. Health Canada plays an important role in water quality and safety standards, such as regulating the safety and quality of pre-packaged ice and water used in food processing. The Canadian Food Inspection Agency (CFIA) and similar provincial health authorities verify compliance and enforce food safety standards, including water safety. Similar testing is required for freshwater aquaculture operations. Workers in this practice area include technicians that inspect food and water quality, as well as analysts that set water quality regulations.

6. **Municipal water systems, including (1) water treatment, (2) water distribution, (3) wastewater treatment, and (4) wastewater collection.** Municipal water careers include operators and supervisors at these four types of water management systems, as well as engineers, planners, and other professionals who analyze, design, and construct these systems.

<sup>3</sup> Source: ECO Canada, *Survey of Environmental Employers*, 2013.

<sup>4</sup> Source: Fisheries and Oceans Canada, *Role of Canadian Government in the Oceans Sector*, 2009.

7. **Green Building.** Much of the design for built environments now includes water management practices. Some examples include green roofs, designs to reduce contamination of urban streams that can occur from parking lot rainwater runoff, water conservation designs, floodplain planning, and other designs that protect water quality. Designers, architects, engineers and development construction managers perform these activities to protect water quality in the built environment.
8. **Water quality education, communication, policy and planning.** NGOs, governments, conservation organizations, and other organizations contribute to education and policy development to protect water quality. Many of these jobs focus on educating and communicating to diverse audiences about water issues. In addition, some of these jobs involve water policy, water quality research, and education about water quality protection issues.

## Environmental Skills for Core Occupations in Water Quality

Water quality practitioners require similar environmental skills and competencies across most water quality occupations. According to a survey of water quality employers (n=122):

- Approximately 93% of core water quality jobs require collecting samples and data for environmental purposes and 92% require competencies for analyzing or interpreting environmental samples and data.
- 86% of water quality jobs involve liaising and partnering with stakeholders.
- Presenting expert information on environmental matters is required for 84% of water quality jobs.
- 77% of water quality jobs need skills in developing sustainable development indicators, plans or strategies, and implementing or monitoring sustainable development strategies or programs.
- Conducting environmental assessments is required for 72% of water quality jobs.
- Developing or implementing environmental communications and awareness programs is required for 66% of water quality jobs.

Green building professionals need a different set of environmental skills. Their work involves less of a focus on collecting, analyzing and interpreting samples. Instead, these professionals need skills related to identifying and implementing activities for commercialization of environmental technologies, systems, or equipment, as well as developing, coordinating, and implementing energy efficiency programs.

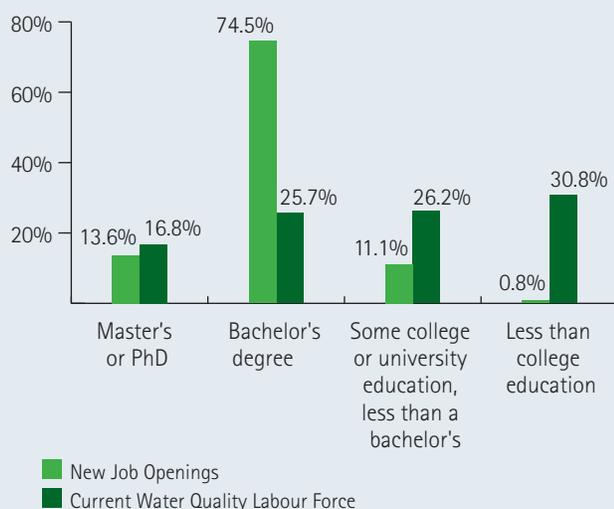
When it comes to professional development, most water quality employers are focused on the skills that their workers currently use. However, several employers mentioned a need for these new competencies:

- **Identifying and mitigating climate change.** While employers report that a minority of water quality professionals (39%) use skills in this area now, 59% of employers believe that their workers need to know more about this competency.
- **Developing, coordinating, and implementing energy efficiency programs.** These skills are used by a third (32%) of water quality professionals currently. Approximately 44% of employers think that their workers need to build this skill further.



## Career Pathways in Water Quality

**Figure 5**  
Educational Attainment of the Water Quality Labour Force and Minimum Educational Requirements for New Job Openings in Water Quality



Sources: ECO Canada, *Survey of Environmental Employers*, n=614 and *Environmental Job Vacancies Database*, n=7,027, 2013.

The water quality job market is shifting to higher educational requirements. While approximately one quarter of the water quality labour force in Canada has a bachelor's degree as the highest level of educational attainment, nearly 75% of new job openings in water quality require a bachelor's degree.

For water quality technicians, interview participants report that governments and consulting firms prefer to hire workers who have completed a bachelor's degree. These employers are also looking for workers who can combine hands-on, field sampling skills gained from a technical school or direct work experience, with the analytical skills typically gained through a bachelor's degree program.

Water quality technicians, water resources engineers, water quality scientists, and professionals in water quality communications, education, policy and planning often begin with a bachelor's degree or at least a 3-year diploma for technicians. Typically, these

professionals then make lateral career moves between different types of roles and employers, such as NGOs, governments, private industry, or consulting.

Environmental engineers, engineers in water utilities, water systems operators, and green building professionals, follow more vertical career pathways. These workers progress from entry-level to senior level positions and through progressive management roles.

Municipal water systems operators follow a more narrowly defined career path through four classes of certification. Based on their certification level and experience, these practitioners move up into system supervisor, operations manager, or facility manager positions.

## Trends Affecting Demand and Future Hiring Expectations

Geographically, the demand for water quality practitioners in Canada reflects the size of the total labour force, but there's a higher concentration of workers near both of Canada's coasts and in Alberta. British Columbia, Alberta, and the Atlantic Provinces each represent 13.4%, 12%, and 6.5% of Canada's total labour force, respectively. However, these regions represent 16% (British Columbia), 15.3% (Alberta), and 7.6% (Atlantic Provinces) of Canada's water quality labour force.<sup>5</sup> Since the provinces have different drivers of demand for water quality practitioners, the types of available water quality jobs vary regionally in these ways:

- Employers in the Atlantic Provinces employ 12.5% of water quality scientists and technicians and nearly a quarter (23%) of water quality workers in aquaculture and food.<sup>6</sup>
- Resource development in Québec has led the province to employ a comparatively higher percentage of water quality managers, supervisors, and contractors in resource industries. Québec also has a high representation of workers in the green building sector, representing over a quarter (25.5%) of Canada's green building professionals.<sup>7</sup>
- Ontario accounts for 34% of Canada's water quality labour force, but has a higher percentage of workers in water quality policy, research, communications and planning (44.3% of the national labour force).<sup>8</sup>
- Alberta's oil and gas industry has driven high demand for water engineering occupations, water quality managers in natural resources, and water quality scientists and technicians.

<sup>5</sup> Sources: Statistics Canada, *National Household Survey*, 2011. ECO Canada, *Database of Environmental Job Vacancies*, 2013. Analysis by the author.

<sup>6</sup> Ibid.

<sup>7</sup> Ibid.

<sup>8</sup> Ibid.

Alberta accounts for 18.4% of water quality engineering workers, 17.4% of managers, supervisors, and contractors in resource industries, and 14% of water quality managers, supervisors, and contractors in agricultural, forestry, and horticulture.<sup>9</sup>

- British Columbia employs 35% of water quality managers, supervisors, contractors, and other workers in agriculture, forestry, and horticulture. The province also accounts for over a quarter (26.7%) of Canada's water quality labour force in aquaculture and food, and 17.1% of green building professionals.<sup>10</sup>

Based on interviews with water quality professionals, climate change is the most commonly cited trend affecting the water quality job market and skills requirements.<sup>11</sup> The effects of climate change place new stressors on water bodies, creating a greater demand to mitigate changes in water quantity and quality. Precipitation events are expected to become more extreme in the future, increasing the levels of rainwater runoff and pollutant loads, intensifying the variability of stream flow and sedimentation, and expanding flood risk.<sup>12</sup> Warmer air temperatures are also heating surface water temperatures in lakes and wetlands to levels that decrease the water's ability to hold dissolved oxygen. This leads to the growth of harmful algal blooms and hypoxia.

All of these changes pose huge challenges for water resource engineers, as they must design sustainable infrastructure and anticipate long-term changes in water resources. As ocean levels rise, climate change also increases the demand for coastal engineering in delta regions.<sup>13</sup> Community design must adapt as well, with a greater need for green, low-impact water use design. Finally, as storms become more severe, there will be growing demand for emergency preparedness and response professionals, along with greater investments in infrastructure to prevent or reduce flooding.

These additional factors will shape the demand for water quality professionals:

- **Increasing investment and development in resource industries.** Increased investment in new mines, oil sands, conventional oil and gas development, and forestry will drive the demand for land management planning, monitoring, site assessment,

remediation and reclamation at project sites. These activities will be vital to ensure compliance with regulations on contamination of groundwater and surface water quality.

- **Retirements of water quality professionals.** Approximately 18% of workers in core water quality occupations (15,120 workers) were age 55 or older in 2011. As these experienced workers retire over the next decade, there will be a significant impact on future hiring demand.
- **Changes in water quality standards.** In potable drinking water, most water quality standards are designed to reduce harmful chemicals in water. However, new regulations and technologies may address biological agents (pathogens) in water that cause disease. These changes will mean that water quality practitioners must adapt their skills and knowledge accordingly.

Based on our survey of water quality employers and an analysis of recent environmental job vacancies, the demand for water quality professionals is increasing.

- In March 2013, there were an estimated 915 advertisements for job vacancies in Canada that required water quality skills – a 61% increase from March 2012.
- In July and August 2013, 59% of water quality employers had vacant positions in the past two years and 34% had current water job vacancies at the time of the survey.
- Green building employers were the most likely to have job openings. Ninety-one percent of these employers reported job vacancies in the past two years.
- Over two thirds of employers of water quality biologists, ecologists, technicians, environmental engineers, municipal water systems (utilities) engineers, and water systems operators also reported job vacancies in the past two years. Employers of utilities engineers had the highest level of current job vacancies (67% of them had current job vacancies).
- In the next two years, more than half (55%) of water quality employers expect their staffing levels to remain the same. Approximately one third (34%) expect staffing levels to increase. The remaining 11% of employers were uncertain about future hiring expectations, but none of the employers reported that they expect staffing levels to decrease.
- Employers of chemists, hydrogeologists, green building professionals, water utility engineers and environmental engineers are the most likely to expect their staffing levels to increase in the future.

<sup>9</sup> Ibid.

<sup>10</sup> Ibid.

<sup>11</sup> Source: ECO Canada, *Expert Interviews*, 2013.

<sup>12</sup> United States EPA National Water Program, *2012 Strategy: Response to Climate Change, Climate Change and Water Quality*, 2012.

<sup>13</sup> For a more complete discussion of climate change and coastal engineering, see *Climate Change and Shoreline Protection*, Atlantic Climate Adaptation Solutions Association. Last Accessed November 2013 at <http://atlanticadaptation.ca/sites/discoveryspace.ypei.ca.acasa/files/Climate%20Change%20and%20Shoreline%20Protection%20in%20Atlantic%20Canada.pdf>

## Earnings for Water Quality Practitioners

Earnings for water quality workers vary significantly, both for entry level positions and for workers with experience. These wage variations are linked to different types of employers and practice areas. Employers in mining, oil and gas, and environmental consulting offer the highest paying positions, while annual

earnings are lower for workers employed by governments, conservation organizations, watershed management organizations and other NGOs. The figure below summarizes salary ranges for workers who are just starting out versus those with five years of experience.

**Figure 6**  
Mean Annual Base Salaries by Occupation, 2013:  
Starting Salaries and Top Salaries for Workers with Five Years Experience

OCCUPATION CATEGORY	STARTING SALARY RANGES			AVERAGE EARNINGS WITH 5 YEARS EXPERIENCE		
	LOW	MEAN	MAX	LOW	MEAN	MAX
Watershed Officer	40,000	63,485	90,000	60,000	81,729	120,000
Biologist, Ecologist	29,000	48,365	75,000	35,000	83,163	115,000
Agronomist, Soil Scientists, and Forester	26,000	53,154	90,000	64,800	89,542	150,000
Chemist (Water Quality)	27,000	46,333	65,000	40,000	70,833	100,000
Hydrogeologist	40,000	74,100	120,000	80,000	114,800	160,000
Communication, Education, Policy, Planning Occupations	20,000	53,019	95,000	35,000	68,575	150,000
Environmental Health and Safety Professional (Water Quality Focus)	40,000	65,111	90,000	60,000	86,000	105,000
Water Quality Technicians (Monitoring, Sampling, Lab Analysis)	26,000	42,095	69,000	37,000	63,588	120,000
Water Quality Modeller	n.a.	50,000	n.a.	n.a.	85,000	n.a.
GIS Analyst	49,000	55,333	65,000	74,000	87,667	104,000
Green Building Professional	35,000	46,000	55,000	50,000	85,286	180,000
Water Quality / Environmental Engineer (in Resource Development)	29,000	55,606	n.a.	35,000	88,000	150,000
Water Resources Engineer	42,500	55,551	80,000	48,000	69,273	96,000
Utility Engineer	42,500	57,583	100,000	55,000	86,813	127,000
Municipal Water Systems Operators	40,000	56,327	70,000	50,000	78,895	105,000
Water Well Driller & Pump Installer	54,944	62,486	70,000	64,640	108,660	145,000
All Core WQ Occupations	10,000	57,030	150,000	20,000	88,785	400,000

Source: ECO Canada, *Survey of Water Quality Employers*, n=122, 2013.



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