2005 National Occupational Guidelines for Canadian Water and Wastewater Operators

FINAL REPORT

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ECO Canada is a not-for-profit Canadian corporation that was created in 1993 to assist the environmental sector in developing and implementing human resources development policies.

The National Occupational Guidelines for Canadian Water and Wastewater Operators will become a tool for use in building a skilled and competent workforce to staff Canadian water and wastewater facilities.

ECO Canada continues its mission to "ensure an adequate supply of people with the demonstrated skills and knowledge required to meet the environmental human resources needs of the public and private sectors."

ECO CANADA

Environmental Careers Organization
L'Organisation pour les carrieres en environment

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National Occupational Guidelines for Canadian Water and Wastewater Operators

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NOTE The Final Report and Appendices 1 and 2 are available in print and by PDF download from ECO Canada.

Appendices 3 through 9 are only available by PDF download from ECO Canada's website.

Go to www.eco.ca and click "products" to locate the final report and appendices.

EXECUTIVE SUMMARY

Concerns regarding the quality of water throughout Canada have grown significantly over the past few years. These concerns have resulted from a series of unfortunate events, such as those that occurred in Walkerton, Ontario; North Battleford, Saskatchewan; and more recently in Kashechewan, Ontario.

In response to those concerns, the Canadian government has created a number of strategies and initiatives to protect Canada's water supply. These strategies and initiatives were developed in collaboration with the Federal-Provincial-Territorial Committee on Drinking Water and the Canadian Council of Ministers of the Environment (CCME). In addition, the Environmental Careers Organization Canada (ECO Canada), formerly the Canadian Council for Human Resources in the Environment Industry (CCHREI), has been working with CCME, the Canadian Water and Wastewater Association (CWWA), and the provincial and territorial regulatory bodies to safeguard our water supply by developing National Occupational Guidelines (NOG) for the water and wastewater sector.

Developing and documenting the guidelines was a 36-month nationwide process involving hundreds of water and wastewater practitioners, all coordinated under the guidance of a National Steering Committee (NSC). The project was divided into two phases. The first phase involved a review of operator profiles from across the country and the validation and documentation of the knowledge and skills required for employment in the water and wastewater sector. The second phase dealt with the completion of an occupational analysis and the preparation of the National Occupational Guidelines for Canadian Water and Wastewater Operators.

PHASE I—DOCUMENTATION OF COMPETENCIES

The project's first phase began in January 2003. It included the formation of the NSC, and the identification and validation of the skills and competencies required by employees working in the water and wastewater sector in Canada.

The membership of the NSC included 17 regular members and three ex-officio members, each representing the various stakeholders in the project. The groups represented included operators, regulators, employers, and educators (see Acknowledgements section for a list of NSC members). Following the NSC's first meeting in March 2003, ECO Canada drafted from information gathered from committee members a five-stage methodology for completion of the project's first phase.

The results of the first phase were the documentation of a series of competency statements that clearly stated the knowledge and skills required of water and wastewater operators. It also included the identification of four functional areas: water treatment, water distribution, wastewater treatment, and wastewater collection.

The final report for this phase is called "NOG Phase I—Competency Reference Guide". The report is available at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate the report).

PHASE II—OCCUPATIONAL ANALYSIS

The goal of this phase was to identify the competencies required at the various operating levels for each of the four functional areas, as presented in the following matrix[1] :

Small Systems (Water Treatment And Distribution)	
Water Treatment, Class 1	Water Distribution, Class 1
Water Treatment, Class 2	Water Distribution, Class 2
Water Treatment, Class 3	Water Distribution, Class 3
Water Treatment, Class 4	Water Distribution, Class 4
Small Systems (Wastewater Treatment And Collection	
Wastewater Treatment, Class 1	Wastewater Collection, Class 1
Wastewater Treatment, Class 2	Wastewater Collection, Class 2
Wastewater Treatment, Class 3	Wastewater Collection, Class 3
Wastewater Treatment, Class 4	Wastewater Collection, Class 4

NOTE: For purposes of this study, facilities and systems classified as "small systems" are defined as Class 1 facilities serving populations of 500 people or less.

For this phase of the project, ECO Canada continued to partner with regulatory bodies and associations from each province and territory. A new NSC was created to guide this portion of the project with representatives from all provinces and territories. The committee met in Toronto on September 27, 2004 to show their support and to confirm the methodology that would be used to complete the second phase of the project.

1 This matrix is designed on the ABC system of classification.

The occupational analysis was compiled from data collected through 690 surveys completed by Canadian water and wastewater operators and supervisors. Additional feedback was also gathered from seven validation sessions held in various cities across Canada. These sessions were attended by operators and representatives of training organizations, municipalities, associations, and certification bodies.

ECO Canada used the results of the survey and validation sessions to separate the NOG clusters (a group of related competencies) into four different categories for each functional area. The four cluster categories of the occupational analysis are:

- **General Industry Clusters**—these clusters are common to many industries and are not specific to the water and wastewater sector.

- **General Water and Wastewater Clusters**—these clusters are common to at least two of the four functional areas and are generally not performed outside the water and wastewater sector.

- **Supervisory Clusters**—these clusters relate to the supervision of individuals and workers.

- **Facility-Specific Technical Clusters**—these clusters are specific to one or more functional areas and are of a specialized technical nature. There are two categories of Facility-Specific Technical Clusters:
    a) per facility type for all classes
    b) per facility type per class

The clusters were then organized into a hierarchy according to importance and were classified as most important, important, or least important.

The final result was the compilation of an occupational analysis grouped by cluster, with each cluster comprised of one or more competency statements. For details on the competency statements for each cluster, refer to the "NOG Phase I—Competency Reference Guide". This guide is available at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

KEY FINDINGS OF THE PROJECT

Key findings of the project include:

- Identification of a range of competencies that are appropriate for many different classes and types of facilities. In addition, a set of 'core' competencies were defined that have a broad application across the entire industry, and in some cases, are generic to other industries as well.
- The establishment of a high level of national confidence for the clusters.
- The adaptation of results to multiple alternative uses, depending upon the needs and requirements of end users.

ECO Canada is confident the NOG will assist operators by providing them with clearly defined standards, making it easier for them to complete their responsibilities. Other benefits of the NOG include:

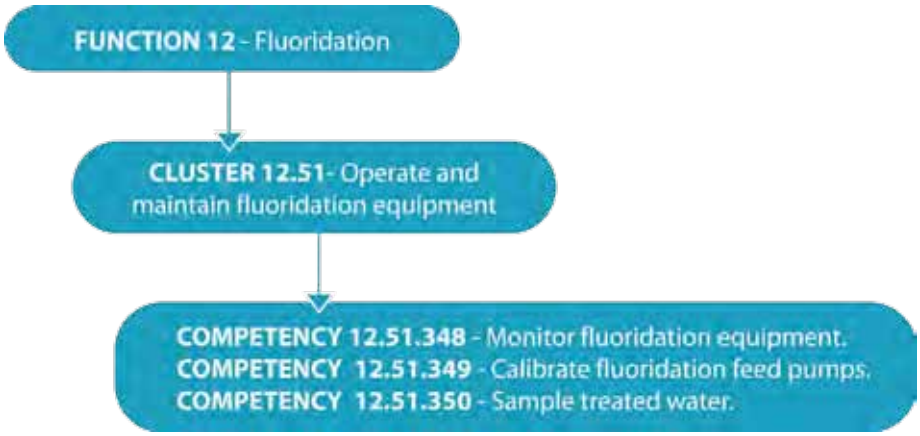
- Cross-country recognition of credentials, which makes operators' skills and experience more transportable between cities and provinces.
- Creation of national benchmarks. With these benchmarks, provinces will be able to coordinate the development of certification programs.
- Development and delivery of provincial training programs that are in compliance with national benchmarks.
- Documented competencies and competency levels for operators and operator supervisors, which enables educational institutions to design appropriate curriculum and training programs.
- Benchmarks that allow practitioners to compare their work against a standard and provides a guideline for how an individual can upgrade their skills.
- Establishment of human resource policies to address the guidelines and their corresponding certification process. For example, guidelines could be referenced when a consultant is engaged or a decision to hire is made.
- Initiating improvements in existing provincial certification programs to address competencies required by operators.
- Creation of a national examination database to accurately reflect the competencies required by operators in all jurisdictions. This will also facilitate operator mobility across Canada.

GLOSSARY

This glossary section has been provided to ensure readers have a clear understanding of the key words and terms used in this document. For each key word and term listed below, a definition and/or explanation of how that word or term has been used is provided.

National Occupational Guidelines

ECO Canada's National Occupational Guidelines (NOG) for Canadian Water and Wastewater Operators are statements of applied competencies that individuals need to demonstrate they are capable of practicing on the job. The NOG consists of a list of functions, clusters, and competencies. The following is an example of the organization of a guideline for water treatment:



Competency

The demonstrated ability to perform a task or series of tasks to the satisfaction of employers, health departments, or otherwise established norms. A competency is a measurable outcome of the combination of requisite skills and knowledge possessed by an individual. To illustrate that relationship: a person needs certain skills related to balance, hand-eye coordination, and physical strength to ride a bicycle. Having those skills, however, does not guarantee a person can successfully work as a bicycle courier because couriers also require knowledge of roads, safety, and bicycle mechanics. Knowledge and skills are the inputs that enable the competencies.

Some NOG documents use the term 'sub task' for this level.

Cluster

A cluster is comprised of a grouping of related competencies. Clusters are used only as a means to organize competencies into groups of cohesive collections of one or more tasks.

Some NOG documents use the term 'task' for this level.

Function

A function is comprised of a group of related clusters. Functions are used to link the clusters into an occupational role.

Some NOG documents use the term 'block' for this level.

Operator

A person responsible for controlling all or some of the processes or functions involved in the operation of a water treatment facility, wastewater treatment facility, water distribution system, and/or wastewater collection system.

Operator Supervisor

A person who supervises an operator or operators. An operator supervisor may perform the duties of an operator, as well as supervise other operators.

General Industry Clusters

Clusters common to many industries. Many of the 'safety' and 'administrative' clusters in the NOG for Canadian Water and Wastewater Operators are General Industry Clusters. In this study, most General Industry Clusters were included in the 'Common Core' section of the survey.

General Water and Wastewater Clusters

Clusters common to at least two of the four occupational groups in the NOG—meaning they are not specific to a particular occupation and are generally not performed outside of water and wastewater occupations. Most of these clusters were included in the 'Common Core' section of the survey.

Supervisory Clusters

Clusters that relate to the supervision of individuals or workers. These clusters were included in the 'Common Core' section of the survey.

Facility-Specific Technical Clusters

Clusters that are specific to one or more of the occupational groups in the NOG and are of a specialized technical nature. These clusters were included in the occupation-specific sections of the survey, which were Water Treatment (WT), Water Distribution (WD), Wastewater Treatment (WWT), and Wastewater Collection (WWC).

Common Core

The Water and Wastewater Operator Survey was divided into five sections—one section each for the four occupations and a final section covering the clusters common to all four functional areas. This final section was called 'Common Core'.

DCCF Rating

This mechanism is used to rate the importance of each cluster. DCCF stands for Danger, Criticality, Complexity, and Frequency. In this study, operators were asked to rate the danger, criticality, complexity, and frequency of each cluster on a scale of one (lowest) to four (highest). Each rating category has been defined as:

- **Danger**—if the cluster is not performed correctly, injury or death to an operator or persons working with an operator may occur.
- **Criticality**—if the cluster is not performed correctly, harm to public health or the environment may occur.
- **Complexity**—a measure of how difficult a cluster is to learn and how often it must be performed to remain proficient.
- **Frequency**—how often the cluster is performed.

Class 1 Small Facility and/or System

A facility classification developed by the Association of Boards of Certification (www.abccert.org). "Small" water systems are those that are ground water sourced and "small" wastewater systems are those that use lagoons, with both types serving 500 people or less. These criteria are generally accepted across North America as an industry standard. For more information, see the ABC website.

Due to low numbers of respondents in the 'small systems' category, and because these systems are 'Class 1' under the ABC guidelines, all findings for small facilities and Class 1 facilities were combined.

Class 1 Facility and/or System

A facility classification developed by the Association of Boards of Certification (www.abccert.org). This classification generally applies to water or wastewater systems servicing villages and very small towns, and is generally accepted across North America as an industry standard. For more information, see the ABC website.

In this study, findings for Class 1 small facilities and Class 1 facilities were combined.

Class 2 Facility and/or System

A facility classification developed by the Association of Boards of Certification (www.abccert.org). This classification generally applies to water or wastewater systems servicing larger populations, and/or using more advanced technologies than a Class 1 facility. The classification is generally accepted across North America as an industry standard. For more information, see the ABC website.

Class 3 Facility and/or System

A facility classification developed by the Association of Boards of Certification (www.abccert.org). This classification generally applies to water or wastewater systems servicing larger populations, and/or using more advanced technologies than a Class 2 facility. The classification is generally accepted across North America as an industry standard. For more information, see the ABC website.

Class 4 Facility and/or System

A facility classification developed by the Association of Boards of Certification (www.abccert.org). This classification generally applies to water or wastewater systems servicing larger populations and/or utilizing more advanced treatment technologies than a Class 3 facility. The classification is generally accepted across North America as an industry standard. For more information, see the ABC website.

BACKGROUND AND METHODOLOGY OF STUDY

ECO CANADA

ECO Canada is a not-for-profit corporation that assists the Canadian environmental sectors in implementing sound human resource development policies. Since its founding, ECO Canada has taken great strides toward developing a national human resource strategy that is focused on the needs of environmental practitioners, employers, and educators.

ECO Canada is one of approximately thirty national sector councils. It was established in 1993 with federal startup funding to bring employers, practitioners, educators, and governments together to address the human resource challenges facing the environmental sector. The key objectives of ECO Canada are to:

- Develop and update National Occupational Standards and Guidelines for skills and training.
- Promote employment opportunities through the use of a highly skilled workforce.
- Meet industry requirements for qualified new practitioners in the labour force.
- Provide labour market projections and information on trends to governments, educators, youth, and industry planners.
- Facilitate and develop social/economic alliances between business and labour.
- Improve the dialogue between industry and the academic community.
- Address labour market entry problems and school-to-work transition difficulties encountered by youth.

ECO Canada's mission is:

> "To ensure an adequate supply of people with the demonstrated skills and knowledge required to meet the environmental human resource needs of the public and private sectors."

ECO Canada is a web-based service provider. To access its products and services, visit www.eco.ca

PROJECT BACKGROUND

Concerns over the quality of water throughout Canada have grown significantly over the past few years. This is largely the result of a series of unfortunate events, such as the ones that occurred in Walkerton, Ontario; North Battleford, Saskatchewan; and more recently in

Kashechewan, Ontario. These events have made Canadians more aware and inquisitive as to the dangers and public health risks associated with water contamination.

Through collaboration with the Federal-Provincial-Territorial Committee on Drinking Water and the Canadian Council of Ministers of the Environment (CCME), the Canadian government has developed a number of strategies and initiatives to protect Canada's water supply. Together, these groups have developed a multi-barrier approach, which calls for the application of best management practices to every aspect of the water supply—from watershed protection to distribution system maintenance and construction. Among these barriers is also a call for qualified operators to properly manage and staff all water and wastewater facilities.

To establish the required safeguards for our water supply from a human resources perspective, ECO Canada has been working with CCME, the Canadian Water and Wastewater Association (CWWA), and the various provincial and territorial regulatory bodies to develop the National Occupational Guidelines (NOG) for Canadian Water and Wastewater Operators.

Under the guidance of a National Steering Committee (NSC), the development and documentation of the NOG was a 36-month nationwide process involving hundreds of water and wastewater practitioners. The project was divided into two phases. The first phase involved a review of operator profiles from across the country, and validation and documentation of the knowledge and skills required by individuals working in the water and wastewater sector. Phase II was the completion of an occupational analysis and preparation of National Occupational Guidelines for Canadian Water and Wastewater Operators. The guidelines cover the four functional areas: water treatment, water distribution, wastewater treatment, and wastewater collection.

SUMMARY OF PROJECT METHODOLOGY

Phase I—Documentation of Competencies

ECO Canada began the project's first phase in January 2003. It included the formation of the project's first NSC and the identification and validation of the skills and competencies required by employees working in the water and wastewater sector in Canada.

The NSC included 17 regular members and 3 ex-officio members representing the various stakeholder groups, which included operators, regulators, employers, and educators (see

Acknowledgements section for a list of NSC members). Following the NSC's first meeting in March 2003, ECO Canada used the input gathered from committee members to draft a five-stage methodology for completing this phase of the project.

The first stage of the methodology concentrated on documenting common language and logic to be adhered to throughout the project. During this phase, ECO Canada developed the language tools to be used in the development of the competency statements. This included a list of definitions that defined the scope of the standards, as well as a list of appropriate verbs to ensure consistency in the construction of the standards.

The second stage began by researching the documentation process. ECO Canada gathered existing water and wastewater occupational profiles from across North America and used their contents to identify common and core skills required by operators. This process resulted in over 1600 knowledge and ability statements, which were then condensed to approximately 250 statements per functional area. These were then submitted for validation.

The third stage of the project's five stages was a call for national validation. In September 2003, ECO Canada held its first series of focus groups in Toronto, Halifax, Calgary, and Vancouver. Participants were inviting to review the initial knowledge and ability statements, provide feedback, and identify gaps in the research, as well as indicate how relevant each statement was to job performance. Each of the four-hour focus groups concentrated on a specific functional area—water treatment, water distribution, wastewater treatment, or wastewater collection. The groups included operators with different levels of experience from different sized facilities and systems. Comments were gathered from the focus groups and incorporated into the research. The knowledge and ability statements were then translated into competencies using the language tools developed in the first stage. The result was a draft of the Phase 1 NOG for Canadian Water and Wastewater Operators.

Once the first draft of the Phase I NOG for Canadian Water and Wastewater Operators was complete, ECO Canada proceeded onto the fourth stage. The purpose of this stage was to obtain further and more extensive national validation of the standards. An on-line validation tool was developed by ECO Canada allowing reviewers to download draft copies of the standards and submit their comments via email. A second series of focus groups were held in Halifax, Montréal, Toronto, Vancouver, and Portage la Prairie in February 2004. In this second series, the audience was broadened to include employers and educators. Again, participants were given draft copies of the standards and asked to comment on the content. The feedback gained from the on-line validation and focus groups was incorporated into

the draft to produce a final version of the competencies. Over 100 practitioners evaluated the competencies throughout the validation process.

The final stage focused on strategies for adoption of Phase 1 NOG for Canadian Water and Wastewater Operators and included the presentation of the competencies to a National Forum. The National Forum was held in Toronto on March 26, 2004 and included 17 NSC members and 24 water and wastewater delegates from across the country. Delegates represented industry, government, and training providers. The National Forum was an opportunity to discuss current issues in human resources management within the water and wastewater sector, as well as how the NOG for Canadian Water and Wastewater Operators could be used to address those issues.

The final report for this phase is called "NOG Phase I—Competency Reference Guide". The report is available at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

Phase II—Occupational Analysis

The goal of the occupational analysis was to identify which competencies were required at the various operating levels in each of the four functional areas, as presented in the following matrix[2] :

Small Systems (Water Treatment And Distribution)	
Water Treatment, Class 1	Water Distribution, Class 1
Water Treatment, Class 2	Water Distribution, Class 2
Water Treatment, Class 3	Water Distribution, Class 3
Water Treatment, Class 4	Water Distribution, Class 4
Small Systems (Wastewater Treatment And Collection)	
Wastewater Treatment, Class 1	Wastewater Collection, Class 1
Wastewater Treatment, Class 2	Wastewater Collection, Class 2
Wastewater Treatment, Class 3	Wastewater Collection, Class 3
Wastewater Treatment, Class 4	Wastewater Collection, Class 4

NOTE: For purposes of this study, facilities and systems classified as "small systems" are defined as Class 1 facilities serving populations of 500 people or less.

2 This matrix is designed on the ABC system of classification.

For this phase of the project, ECO Canada continued to partner with a variety of regulatory bodies and associations from each province and territory. A new NSC comprised of representatives from the provinces and territories met in Toronto on September 27, 2004 to show their support and to confirm the methodology to be used to perform the occupational analysis. A four-stage methodology was adopted for completing the second phase of the project.

The first stage of the occupational analysis involved creating a survey that would include all the competency statements gathered in Phase I. This would also provide ECO Canada with the information required to create the occupational analysis. The survey was developed by the project's consultants along with input from NSC members. The next step involved testing the survey by gathering input from key stakeholders at two different focus groups. One focus group was held in Oakville, Ontario, and the other in Calgary, Alberta. Operators, educators, trainers, and employers reviewed the survey and provided feedback and suggestions on improving the survey.

The second stage involved the administration of the survey, which began in early April 2005 and concluded in mid-October of the same year. Data was compiled from 690 surveys completed by water and wastewater operators and operator supervisors in Canada. Data was also gathered from seven validation sessions held across Canada with operators and representatives of training organizations, municipalities, associations, and certification bodies.

The survey was launched on-line at ECO Canada's website, which gave participants the opportunity to complete the survey electronically. If preferred, participants could complete the survey by printing it from the website or by requesting to receive a hard copy by mail.

To ensure the occupational analysis was representative of the Canadian water and wastewater sector, survey results were validated nationally. In the third stage, a preliminary occupational analysis was created containing three different preliminary profiles—most important, important, and least important—per type of facility and class. These profiles were then presented to participants at seven validation sessions. At each session, the feedback proved to be similar between the provinces. The profiles were then reviewed against the feedback with the necessary changes made to the NOG.

The final stage of this phase involved documenting and presenting the final version of the occupational analysis. The report, including the methodology used, key findings, and proposed next steps, was presented to attendees of a National Forum held in Toronto in January 2006. Participants of this forum included members of different water and wastewater organization, including provincial certifying authorities, associations, municipalities, educators, trainers, operators, and government agencies.

The final report for the occupational analysis presents the results of the survey and validation sessions as a ranking of clusters. ECO Canada separated the NOG clusters (a group of related competencies) into four separate categories for each functional area. The four cluster categories of the occupational analysis are:

- General Industry Clusters—these clusters are common to many industries and are not specific to the water and wastewater sector.
- General Water and Wastewater Clusters—these clusters are common to at least two of the four functional areas, and are generally not performed outside the water and wastewater sector.
- Supervisory Clusters—these clusters relate to the supervision of individuals and workers.
- Facility-Specific Technical Clusters—these clusters are specific to one or more functional area and are of a specialized technical nature. There are two types of Facility-Specific Technical Clusters:
    c) per facility type for all classes
    d) per facility type per class

The clusters were organized into a hierarchy according to importance—most important, important, or least important. As mentioned earlier, the occupational analysis was compiled from data obtained from 690 surveys completed by Canadian water and wastewater operators and supervisors. The analysis also included feedback from seven validation sessions held across Canada with operators and representatives from training organizations, municipalities, associations, and certification bodies.

The occupational analysis phase determined the approximate percentage of water and wastewater operators across Canada who actually perform the competencies in each NOG cluster. It also measured the relative importance of each cluster using a ranking system. The ranking system was based on the criteria of DCCF, which stands for Danger, Criticality, Complexity, and Frequency.

For the occupational analysis, operators and supervisors from across Canada were asked to review and rate the relative importance of each cluster in the NOG. The review was conducted using a comprehensive survey. Almost 700 operators and supervisors completed the survey between April and October 2005. A breakdown of the final results by category is shown below (it should be noted that respondents could reply to more than one category if they worked in multiple facilities):

- 434 Water Treatment Operators and Supervisors
- 427 Water Distribution Operators and Supervisors
- 375 Wastewater Treatment Operators and Supervisors
- 343 Wastewater Collection Operators and Supervisors

Operators received the corresponding sections of the survey that related to the type of facilities they worked in or managed. The survey was made available for completion on-line, and was also distributed in print form by email, fax, and mail. Completed surveys were received from operators in every province and territory of Canada.

Survey participants were first asked whether they performed or supervised the cluster. For those that were involved with the cluster, they were asked to rate the relative importance of the cluster using the DCCF criteria. For each of the criterion, respondents were asked to rate the cluster on a scale of one to four, with one the lowest and four the highest rating. In addition to the rankings, respondents were also given space to provide comments on each cluster.

Survey information was collected in a large database developed and maintained by ECO Canada. The database was used to create a variety of reports linking participant demographics, facility types, and classes to cluster ratings. A detailed 'Cluster Analysis Summary' was created for each cluster, listing the percentage of operators who perform that cluster, their DCCF ratings, and other information related to operator certification, experience, and education.

Further detailed information regarding the methodology used, statistical validity, and data collection and analysis for "NOG Phase II—Occupational Analysis" can be found at www.eco.ca/pdf/ or at www.eco.ca (click "products" to locate report).

The final result of this phase is an occupational analysis grouped by clusters. Each cluster is comprised of one or more competency statements. For details on the competency statements for each cluster, refer to "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

KEY FINDINGS OF THE PROJECT

Key findings of the project include:

- Identification of a range of competencies that are appropriate for many different classes and types of facilities. In addition, a set of 'core' competencies were defined that have a broad application across the entire industry, and in some cases, are generic to other industries as well.
- The establishment of a high-level of national confidence for the clusters.
- The adaptation of results to multiple alternative uses, depending upon the needs and requirements of end users.

ECO Canada is confident the NOG will assist operators by providing them with clearly defined standards, making it easier for them to complete their responsibilities. Other benefits of the NOG include:

- Cross-country recognition of credentials, which makes operators' skills and experience more transportable between cities and provinces.
- Creation of national benchmarks. With these benchmarks, provinces will be able to coordinate the development of certification programs.
- Development and delivery of provincial training programs that are in compliance with national benchmarks.
- Documented competencies and competency levels for operators and operator supervisors, which enables educational institutions to design appropriate curriculum and training programs.
- Benchmarks that allow practitioners to compare their work against a standard and provides a guideline for how an individual can upgrade their skills.

- Establishment of human resource policies to address the guidelines and their corresponding certification process. For example, guidelines could be referenced when a consultant is engaged or a decision to hire is made.

- Initiating improvements in existing provincial certification programs to address competencies required by operators.
- Creation of a national examination database to accurately reflect the competencies required by operators in all jurisdictions. This will also facilitate operator mobility across Canada.

USING NATIONAL OCCUPATIONAL GUIDELINES

The intent of this section is to aid the reader in understanding the various methods by which the NOG can be used. That understanding is presented through the use of examples and case studies for employers, educators or trainers, practitioners, and certifying authorities. These examples are not intended to explain how to use the NOG in specific situations, but to illustrate some of its potential uses by different groups.

AS AN EMPLOYER:

The NOG allows an employer to:

- Define and describe different job positions at a facility.
- Develop interview questions.
- Identify gaps and develop training profiles for each operator.
- Develop performance evaluations.
- Mutually agree on operator responsibilities, which improves plant and operator performance.
- Make informed decisions when hiring.
- Assess risk and prepare relevant contingency plans.

Example

As an employer, the NOG can be used to understand the skills, knowledge, and competencies operators in your facility should possess. The NOG provides a national guide that can be used to define and describe the different positions existing in a facility. Depending upon the facility, clusters may be added or deleted to fit a facility's needs. The NOG is a useful tool that aids in visualizing required competencies.

Once you have identified the competencies required in your facility, they can be grouped by complexity. Grouping by complexity allows the more complex competencies to be performed by more experienced operators, and the least complex by newly hired operators. As a result, the different job positions in a facility can be defined, thereby providing a more efficient allocation of resources. This is very beneficial when recruiting for a particular position or in identifying areas where personnel need training to improve performance. Through the identification of personnel and training needs, the NOG also provides a facility with the ability to establish operating goals. These goals can be used to evaluate an employee's performance and job progress.

The NOG can also be used to identify weaknesses in a facility. Guidelines can be used to help assess the potential risks in a facility, which allows for the creation of relevant and accurate contingency plans.

AS A TRAINER:

The NOG allows a trainer to:

- Prioritize and develop training programs according to industry needs.
- Educate operators in current and future processes and technology.
- Develop standard training programs that are valid and recognized across Canada, with the potential of saving time and money.
- Maximize investment in training programs by sharing costs nationally.

Example

The NOG serves as a tool to assist trainers in identifying the most important competencies required for water and wastewater operators. This allows the training effort to focus specifically on critical competencies. The NOG is a good point of reference that trainers can use to evaluate areas where operators are experiencing difficulties or problems, thereby allowing curricula to be developed to address those issues.

Since this study is the result of information gathered throughout Canada, training centres could benefit from partnering with other cities and provinces to develop standard training programs for general topics. If a specific region or city needs to incorporate topics not included in the shared common training program, it could develop its own unique training programs. Using this type of an approach to training development would result in quicker delivery of programs with a lower overall cost.

Case Study

The following excerpt is from a letter written by Gina Adams from the Region of Halton, Ontario. It demonstrates the success the region has found by using the NOG to manage training and human resource needs for their facilities. This excerpt is reproduced verbatim.

> I have used the NOG document in a number of ways here at the Region of Halton. Some examples are writing up position descriptions and using the competencies to develop questions for various interviews. I am also in the process of developing a training profile for each of our operators based on the NOG document.

There are tremendous benefits in the NOG document. Firstly, it has saved me a number of hours of work to produce a working document that is so organized. The water and wastewater supervisors in my region are also becoming familiar with the NOG document and using it in terms of performance appraisals/improvements.

It is most beneficial to my position at this point in terms of obtaining a performance measure/competency in relation to prioritizing training initiatives for the water and wastewater operators.

I most definitely find the NOG document a very useful tool in terms of assisting me with defining/documenting complex organizational problems, specifically operators' performance-based training. The NOG document has also helped me expand my role with my operators to better understand their scope of responsibilities and in turn develop programs to improve performance (operator competencies).

Gina Adams
Tech. Training Advisor
Planning & Public Works Dept.

AS A PRACTITIONER:

The NOG allows a practitioner to:

- Understand what is required from an operator at different facilities and levels.
- Prepare for certification exams and career development.
- Explore training programs that operators feel are required.

Example

An operator or someone who is interested in the water and wastewater sector, could use the NOG to understand the types of competencies required by operators and what is expected of him or her at a specific job in a specific facility class. This allows the person to identify the topics they should be studying or practicing to prepare for a certain job or certification exam. Likewise, if someone is researching professional paths in the water and wastewater sector, the NOG will provide insights into what a career entails.

AS A CERTIFYING AUTHORITY:

The NOG allows certifying authorities to:

- Ease bureaucratic issues caused by jurisdictional differences.
- Develop a national certification program customized to address Canada's needs.
- Create a national examination base that accurately reflects the competencies required by operators in all jurisdictions. Also facilitates operator mobility across Canada.
- Supplement existing provincial and territorial certification programs to ease reciprocity. Create standard national competencies for operators.
- Assess risk and develop appropriate contingency plans.

Example

The NOG reflects the activities that water and wastewater operators and supervisors perform nationally. However, as was noted earlier, there may be instances where activities need to be addressed or customized at specific facilities or regions. Aside from these isolated cases, certifying authorities should benefit from sharing the costs of developing a national certification program using the NOG as the primary source. This certification program could be developed to meet the provinces' and territories' needs.

Recognition of a national standard would create harmony amongst jurisdictions. One immediate benefit would be the removal of barriers preventing the movement of skilled workers between provinces. If certified operators with skills and experience become transportable, a large impact on recruitment would emerge, particularly in rural and remote communities. Provinces and territories could use the NOG as a reference for certification and ease reciprocity. This would result if each certification regime has incorporated the same national guidelines to simplify the process of recognizing credentials awarded in different provinces.

Another benefit of the NOG for certifying authorities is the development of a national examination. The NOG outlines the current requirements for Canadian water and wastewater treatment operators. Most certification authorities in Canada currently use a North American association to supply certification exams, which sometimes are not equipped to address issues exclusive to Canadian facilities. The NOG would be a valuable resource for provincial boards should they choose to develop exams specific to Canadian regulations and facilities. Boards can use the NOG to tailor exams to suit their particular needs, as well as identify areas where current exams do not provide adequate coverage.

NATIONAL OCCUPATIONAL GUIDELINES FOR CANADIAN WATER AND WASTEWATER OPERATORS

This section presents the actual results for the NOG for Canadian Water and Wastewater Operators for the four functional areas. The results have been organized into 32 tables. The first eight tables present the NOG per facility type with clusters of competencies arranged in order of importance. The rank-ordered list has been divided into three profiles:

1. Most important. This represents the top 70% of the clusters.
2. Important. This represents the next 20% of clusters.
3. Least important. This represents the lowest ranked 10% of clusters.

The following summarizes the distribution of the NOG tables that are displayed in this section.

SUMMARY OF TABLES—NOG FOR CANADIAN WATER AND WASTEWATER OPERATORS

TYPE OF CLUSTER TABLE	WATER TREATMENT	WATER DISTRIBUTION	WASTEWATER TREATMENT	WASTEWATER COLLECTION	TOTAL
GENERAL INDUSTRY CLUSTERS	1	1	1	1	4
GENERAL WATER AND WASTEWATER CLUSTERS	1	1	1	1	4
SUPERVISORY CLUSTERS	1	1	1	1	4
SPECIFIC TECHNICAL CLUSTERS (FACILITY TYPE ALL CLASSES)	1	1	1	1	4
SPECIFIC TECHNICAL CLUSTERS (FACILITY TYPE PER CLASS)	4	4	4	4	16
TOTAL	**8**	**8**	**8**	**8**	**32**

It should be noted that the profiles reflect the global results of the entire industry, and it is possible that a cluster in the "least important" category for the industry may in fact be critically important at a particular facility or region.

The same ranking procedure described above was performed on the facility-based scores—Class 1 including small systems, Class 2, Class 3, and Class 4—to determine which, if any, clusters have a higher relative importance in a particular facility class. These results were then tabulated as 'Specific Technical Clusters'.

It is recommended that the reader print this page and the glossary terms as a reference before reviewing the NOG tables.

NATIONAL OCCUPATIONAL GUIDELINES
FOR OPERATORS

water treatment

GENERAL INDUSTRY CLUSTERS

General Industry Clusters—DEFINITION

> Clusters common to many industries. Many of the safety and administrative clusters in the National Occupational Guidelines for Canadian Water and Wastewater Operators are General Industry Clusters. In this study, most General Industry Clusters were included in the Common Core section of the survey.

According to the occupational analysis, there are 17 General Industry Clusters of competencies that operators should possess when working in water treatment plants in Canada. These clusters are common to many industries and generally include safety and administrative competencies.

The following table shows the General Industry Clusters of competencies that operators working in water treatment plants should possess according to the occupational analysis. These clusters are ranked in order of priority from MOST important to LEAST important.

GENERAL INDUSTRY CLUSTERS—**WATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**1.02**	Follow safety procedures.
	2	**1.01**	Understand requirements for use of safety equipment.
	3	**1.03**	Practice safe work habits.
	4	**3.25**	Troubleshoot equipment.
	5	**1.05**	Identify potential safety risks.
	6	**2.16**	Obtain information from written sources.
	7	**2.15**	Manage information.
	8	**14.59**	Operate and maintain pumping equipment.
	9	**14.71**	Operate and maintain control systems.
	10	**3.24**	Operate computer systems.
	11	**14.61**	Operate and maintain engines, generators, and back-up systems.
IMPORTANT (20%)	12	**2.12**	Maintain effective internal relations.
	13	**3.23**	Read and understand trade drawings.
	14	**2.14**	Manage inventory.
	15	**1.04**	Develop safety strategies.
LEAST IMPORTANT (10%)	16	**14.60**	Operate and maintain blowers and compressors.
	17	**14.67**	Install and maintain mechanical seals.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

In addition to General Industry Clusters, operators working in water treatment plants in Canada will also require other pertinent NOG clusters. These include General Water and Wastewater Clusters (one table), Supervisory Clusters (one table), Water Treatment Specific Technical Clusters for all classes (one table), and Water Treatment-Specific Technical Clusters for each class (four tables).

GENERAL WATER AND WASTEWATER CLUSTERS

General Water and Wastewater Clusters—DEFINITION

> Clusters common to at least two of the four occupational groups in the NOG, meaning they are not specific to a particular occupation and are generally not performed outside of water and wastewater occupations. Most of these clusters were included in the Common Core section of the survey.

According to the occupational analysis, there are 20 General Water and Wastewater Clusters of competencies that operators should possess when working in water treatment plants in Canada. These clusters are common to at least two of the four functional areas and are generally not performed outside the water and wastewater sector. Most of these clusters were included in the Common Core section of the survey.

The following table shows the General Water and Wastewater clusters of competencies that operators working in Canada should possess according to the occupational analysis. These clusters are ranked in order of priority from MOST important to LEAST important.

GENERAL WATER AND WASTEWATER CLUSTERS—**WATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**2.17**	Comply with legal requirements.
	2	**4.31**	Perform laboratory tests.
	3	**4.32**	Respond to laboratory tests.
	4	**4.29**	Follow proper laboratory procedures.
	5	**1.06**	Identify potential risks to the facility.
	6	**3.20**	Perform basic and applied math.
	7	**4.27**	Follow proper chemical procedures.
	8	**1.07**	Respond to emergencies.
	9	**3.26**	Apply knowledge of water sources, characteristics, and quality.
	10	**4.28**	Follow proper sampling procedures.
	11	**1.08**	Follow facility security requirements.
IMPORTANT (20%)	12	**3.21**	Apply principles of basic and applied biology.
	13	**2.09**	Identify personal roles.
	14	**2.11**	Maintain effective public relations.
	15	**14.69**	Operate service vehicles and trailers.
LEAST IMPORTANT (10%)	16	**4.30**	Establish proper laboratory procedures.
	17	**14.72**	Monitor and maintain process electrical controls.
	18	**14.78**	Monitor and maintain facility heating, electrical, and ventilation systems.
	19	**3.22**	Apply principles of basic and applied chemistry.
	20	**14.66**	Monitor corrosion control.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

In addition to General Water and Wastewater Clusters, operators working in water treatment plants in Canada will also require other pertinent NOG clusters. These include General Industry Clusters (one table), Supervisory Clusters (one table), Water Treatment Specific Technical Clusters for all classes (one table), and Water Treatment-Specific Technical Clusters for each class (four tables).

SUPERVISORY CLUSTERS

Supervisory Clusters—DEFINITION

Clusters that relate to the supervision of individuals or workers. These clusters were included in the Common Core section of the survey.

According to the occupational analysis, there are four Supervisory Clusters of competencies that operators should possess when working in water treatment plants in Canada. These clusters relate to the supervision of individuals and workers. The clusters were included in the Common Core section of the survey.

The following table shows the Supervisory Clusters of competencies that operators working in Canada should possess according to the occupational analysis. Due to the small number of clusters, they were not ranked.

SUPERVISORY CLUSTERS—**WATER TREATMENT**

NOG CLUSTER NUMBER	NOG CLUSTER NAME
2.10	Demonstrate workplace management.
2.13	Manage finances.
2.18	Manage maintenance.
2.19	Manage human resources.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

In addition to the Supervisory Clusters, operators working in water treatment plants in Canada will also require other pertinent NOG clusters. These include General Industry Clusters (one table), General Water and Wastewater Clusters (one table), Water Treatment Specific Technical Clusters for all classes (one table), and Water Treatment-Specific Technical Clusters for each class (four tables).

FACILITY-SPECIFIC TECHNICAL CLUSTERS

Facility-Specific Technical Clusters—DEFINITION

> Clusters specific to one or more occupational groups in the NOG and are of a specialized technical nature. These clusters were included in the occupation-specific sections of the survey: Water Treatment (WT), Water Distribution (WD), Wastewater Treatment (WWT), and Wastewater Collection (WWC).

According to the occupational analysis, there are 37 Facility-Specific Technical Clusters of competencies that operators should possess when working in water treatment plants in Canada. These clusters are specific to one or more functional areas and are of a specialized technical nature. There are two types of Facility-Specific Technical Clusters:

1. per facility type for all classes
2. per facility type per class

These clusters were included in the occupation-specific sections of the survey: Water Treatment (WT), Water Distribution (WD), Wastewater Treatment (WWT), and Wastewater Collection (WWC).

The following five tables present the Facility-Specific Technical Clusters of competencies—for all classes and per class—that operators working in Canada should possess according to the occupational analysis. The clusters are ranked in order of priority from MOST important to LEAST important.

Facility Type for All Classes

The following table shows Water Treatment-Specific Technical Clusters for all classes.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR ALL CLASSES—**WATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**10.46**	Operate and maintain chlorination systems.
	2	**14.70**	Operate and maintain chemical addition equipment.
	3	**14.74**	Monitor gauges, switches, and meters.
	4	**11.52**	Perform disinfection calculations.
	5	**14.73**	Maintain process equipment.
	6	**14.65**	Maintain storage reservoirs.
	7	**14.62**	Monitor and maintain valves.
	8	**5.34**	Operate and maintain pre-treatment facilities.
	9	**6.36**	Operate and monitor coagulation equipment.
	10	**6.37**	Operate and monitor flocculation equipment.
	11	**14.75**	Monitor system components.
	12	**14.77**	Detect leaks.
	13	**5.33**	Operate and maintain intake structures.
	14	**14.76**	Maintain and repair piping.
	15	**9.41**	Operate and maintain rapid sand filtration system.
	16	**14.68**	Operate and maintain residuals management equipment.
	17	**8.39**	Operate and maintain sedimentation equipment.
	18	**5.35**	Operate and maintain groundwater wells.
	19	**14.63**	Monitor and maintain screening equipment.
	20	**12.53**	Operate and maintain fluoridation equipment.
	21	**13.55**	Control oxidation processes.
	22	**12.54**	Comply with fluoride regulations.
	23	**11.51**	Reduce disinfection by products.
	24	**9.40**	Perform filtration calculations.
	25	**9.45**	Operate and maintain underdrain systems.
	26	**13.58**	Operate and maintain taste and odour control equipment.
IMPORTANT (20%)	27	**11.50**	Operate and maintain ultraviolet disinfection systems.
	28	**14.64**	Operate and maintain recirculation systems.
	29	**9.42**	Operate and maintain slow sand filtration systems.
	30	**9.43**	Operate and maintain other biological filtration systems.
	31	**9.44**	Operate and maintain membrane filtration systems.
	32	**7.38**	Operate and maintain water softening equipment.
	33	**11.49**	Operate and maintain ammonia feed systems.
	34	**11.47**	Operate and maintain ozone disinfection systems.
LEAST IMPORTANT (10%)	35	**11.48**	Operate and maintain chlorine dioxide disinfection systems.
	36	**13.57**	Operate and maintain ion exchange equipment.
	37	**13.56**	Operate and maintain demineralization equipment.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

In addition to Facility-Specific Technical Clusters for all levels, operators working in water treatment plants in Canada will also require other pertinent NOG clusters. These includes General Industry Clusters (one table), General Water and Wastewater Clusters (one table), Supervisory Clusters (one table), and Water Treatment-Specific Technical Clusters for each class (four tables).

Facility Type per Class

The following table shows Facility-Specific Technical Clusters for Class 1 water treatment facilities (including small systems).

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 1 FACILITIES—**WATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**10.46**	Operate and maintain chlorination systems.
	2	**14.74**	Monitor gauges, switches, and meters.
	3	**14.65**	Maintain storage reservoirs.
	4	**14.77**	Detect leaks.
	5	**11.52**	Perform disinfection calculations.
	6	**14.62**	Monitor and maintain valves.
	7	**14.76**	Maintain and repair piping.
	8	**14.70**	Operate and maintain chemical addition equipment.
	9	**14.73**	Maintain process equipment.
	10	**5.34**	Operate and maintain pre-treatment facilities.
	11	**14.75**	Monitor system components.
	12	**5.35**	Operate and maintain groundwater wells.
	13	**5.33**	Operate and maintain intake structures.
	14	**14.68**	Operate and maintain residuals management equipment.
	15	**6.36**	Operate and monitor coagulation equipment.
	16	**9.41**	Operate and maintain rapid sand filtration system.
	17	**13.55**	Control oxidation processes.
	18	**6.37**	Operate and monitor flocculation equipment.
	19	**12.54**	Comply with fluoride regulations.
	20	**9.42**	Operate and maintain slow sand filtration systems.
	21	**14.63**	Monitor and maintain screening equipment.
	22	**9.43**	Operate and maintain other biological filtration systems.
	23	**12.53**	Operate and maintain fluoridation equipment.
	24	**11.50**	Operate and maintain ultraviolet disinfection systems.
	25	**11.51**	Reduce disinfection by products.
	26	**13.58**	Operate and maintain taste and odour control equipment.
IMPORTANT (20%)	27	**9.40**	Perform filtration calculations.
	28	**9.45**	Operate and maintain underdrain systems.
	29	**8.39**	Operate and maintain sedimentation equipment.
	30	**14.64**	Operate and maintain recirculation systems.
	31	**7.38**	Operate and maintain water softening equipment.
	32	**11.48**	Operate and maintain chlorine dioxide disinfection systems.
	33	**9.44**	Operate and maintain membrane filtration systems.
	34	**11.49**	Operate and maintain ammonia feed systems.
LEAST IMPORTANT (10%)	35	**13.57**	Operate and maintain ion exchange equipment.
	36	**11.47**	Operate and maintain ozone disinfection systems.
	37	**13.56**	Operate and maintain demineralization equipment.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

In addition to Facility-Specific Technical Clusters for Class 1 facilities, operators working in water treatment plants in Canada will also require other pertinent NOG clusters. These include General Industry Clusters (one table), General Water and Wastewater Clusters (one table), Supervisory Clusters (one table), Water Treatment-Specific Technical Clusters for all classes (one table), and Water Treatment-Specific Technical Clusters for each of the other classes (three tables).

The following table shows Facility-Specific Technical Clusters for Class 2 water treatment facilities.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 2 FACILITIES—**WATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**10.46**	Operate and maintain chlorination systems.
	2	**14.74**	Monitor gauges, switches, and meters.
	3	**14.73**	Maintain process equipment.
	4	**14.65**	Maintain storage reservoirs.
	5	**11.52**	Perform disinfection calculations.
	6	**14.77**	Detect leaks.
	7	**14.70**	Operate and maintain chemical addition equipment.
	8	**14.62**	Monitor and maintain valves.
	9	**14.75**	Monitor system components.
	10	**14.76**	Maintain and repair piping.
	11	**6.36**	Operate and monitor coagulation equipment.
	12	**5.33**	Operate and maintain intake structures.
	13	**5.34**	Operate and maintain pre-treatment facilities.
	14	**6.37**	Operate and monitor flocculation equipment.
	15	**14.68**	Operate and maintain residuals management equipment.
	16	**9.41**	Operate and maintain rapid sand filtration system.
	17	**5.35**	Operate and maintain groundwater wells.
	18	**13.55**	Control oxidation processes.
	19	**14.63**	Monitor and maintain screening equipment.
	20	**9.40**	Perform filtration calculations.
	21	**8.39**	Operate and maintain sedimentation equipment.
	22	**11.51**	Reduce disinfection by products.
	23	**9.45**	Operate and maintain underdrain systems.
	24	**12.54**	Comply with fluoride regulations.
	25	**12.53**	Operate and maintain fluoridation equipment.
	26	**13.58**	Operate and maintain taste and odour control equipment.
IMPORTANT (20%)	27	**14.64**	Operate and maintain recirculation systems.
	28	**9.44**	Operate and maintain membrane filtration systems.
	29	**11.50**	Operate and maintain ultraviolet disinfection systems.
	30	**9.42**	Operate and maintain slow sand filtration systems.
	31	**9.43**	Operate and maintain other biological filtration systems.
	32	**7.38**	Operate and maintain water softening equipment.
	33	**11.47**	Operate and maintain ozone disinfection systems.
	34	**11.48**	Operate and maintain chlorine dioxide disinfection systems.
LEAST IMPORTANT (10%)	35	**13.57**	Operate and maintain ion exchange equipment.
	36	**13.56**	Operate and maintain demineralization equipment.
	37	**11.49**	Operate and maintain ammonia feed systems.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

In addition to Facility Specific Technical Clusters for Class 2 facilities, operators working in water treatment plants in Canada will also require other pertinent NOG clusters. These include General Industry Clusters (one table), General Water and Wastewater Clusters (one table), Supervisory Clusters (one table), Water Treatment-Specific Technical Clusters for all classes (one table), and Water Treatment-Specific Technical Clusters for each of the other classes (three tables).

The following table shows Facility-Specific Technical Clusters for Class 3 water treatment facilities.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 3 FACILITIES—**WATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**10.46**	Operate and maintain chlorination systems.
	2	**14.70**	Operate and maintain chemical addition equipment.
	3	**14.73**	Maintain process equipment.
	4	**11.52**	Perform disinfection calculations.
	5	**6.36**	Operate and monitor coagulation equipment.
	6	**14.74**	Monitor gauges, switches, and meters.
	7	**6.37**	Operate and monitor flocculation equipment.
	8	**14.65**	Maintain storage reservoirs.
	9	**5.34**	Operate and maintain pre-treatment facilities.
	10	**14.62**	Monitor and maintain valves.
	11	**5.33**	Operate and maintain intake structures.
	12	**14.75**	Monitor system components.
	13	**9.41**	Operate and maintain rapid sand filtration system.
	14	**8.39**	Operate and maintain sedimentation equipment.
	15	**14.76**	Maintain and repair piping.
	16	**14.68**	Operate and maintain residuals management equipment.
	17	**14.77**	Detect leaks.
	18	**14.63**	Monitor and maintain screening equipment.
	19	**12.53**	Operate and maintain fluoridation equipment.
	20	**11.51**	Reduce disinfection by products.
	21	**12.54**	Comply with fluoride regulations.
	22	**9.40**	Perform filtration calculations.
	23	**13.55**	Control oxidation processes.
	24	**9.45**	Operate and maintain underdrain systems.
	25	**5.35**	Operate and maintain groundwater wells.
	26	**13.58**	Operate and maintain taste and odour control equipment.
IMPORTANT (20%)	27	**14.64**	Operate and maintain recirculation systems.
	28	**9.43**	Operate and maintain other biological filtration systems.
	29	**11.50**	Operate and maintain ultraviolet disinfection systems.
	30	**9.42**	Operate and maintain slow sand filtration systems.
	31	**7.38**	Operate and maintain water softening equipment.
	32	**9.44**	Operate and maintain membrane filtration systems.
	33	**11.47**	Operate and maintain ozone disinfection systems.
	34	**11.48**	Operate and maintain chlorine dioxide disinfection systems.
LEAST IMPORTANT (10%)	35	**11.49**	Operate and maintain ammonia feed systems.
	36	**13.57**	Operate and maintain ion exchange equipment.
	37	**13.56**	Operate and maintain demineralization equipment.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

In addition to Facility Specific Technical Clusters for Class 3 facilities, operators working in water treatment plants in Canada will also require other pertinent NOG clusters. These include General Industry Clusters (one table), General Water and Wastewater Clusters (one table), Supervisory Clusters (one table), Water Treatment-Specific Technical Clusters for all classes (one table), and Water Treatment-Specific Technical Clusters for each of the other classes (three tables).

The following table shows Facility-Specific Technical Clusters for Class 4 water treatment facilities.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 4 FACILITIES—**WATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**10.46**	Operate and maintain chlorination systems.
	2	**14.70**	Operate and maintain chemical addition equipment.
	3	**14.73**	Maintain process equipment.
	4	**6.36**	Operate and monitor coagulation equipment.
	5	**14.65**	Maintain storage reservoirs.
	6	**6.37**	Operate and monitor flocculation equipment.
	7	**5.34**	Operate and maintain pre-treatment facilities.
	8	**5.33**	Operate and maintain intake structures.
	9	**12.53**	Operate and maintain fluoridation equipment.
	10	**11.52**	Perform disinfection calculations.
	11	**14.62**	Monitor and maintain valves.
	12	**14.74**	Monitor gauges, switches, and meters.
	13	**9.41**	Operate and maintain rapid sand filtration system.
	14	**9.45**	Operate and maintain underdrain systems.
	15	**8.39**	Operate and maintain sedimentation equipment.
	16	**14.63**	Monitor and maintain screening equipment.
	17	**14.68**	Operate and maintain residuals management equipment.
	18	**14.76**	Maintain and repair piping.
	19	**13.55**	Control oxidation processes.
	20	**14.75**	Monitor system components.
	21	**11.51**	Reduce disinfection by products.
	22	**11.49**	Operate and maintain ammonia feed systems.
	23	**14.77**	Detect leaks.
	24	**12.54**	Comply with fluoride regulations.
	25	**13.58**	Operate and maintain taste and odour control equipment.
	26	**11.47**	Operate and maintain ozone disinfection systems.
IMPORTANT (20%)	27	**9.40**	Perform filtration calculations.
	28	**5.35**	Operate and maintain groundwater wells.
	29	**11.50**	Operate and maintain ultraviolet disinfection systems.
	30	**14.64**	Operate and maintain recirculation systems.
	31	**11.48**	Operate and maintain chlorine dioxide disinfection systems.
	32	**9.42**	Operate and maintain slow sand filtration systems.
	33	**7.38**	Operate and maintain water softening equipment.
	34	**9.43**	Operate and maintain other biological filtration systems.
LEAST IMPORTANT (10%)	35	**9.44**	Operate and maintain membrane filtration systems.
	36	**13.56**	Operate and maintain demineralization equipment.
	37	**13.57**	Operate and maintain ion exchange equipment.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

In addition to Facility Specific Technical Clusters for Class 4 facilities, operators working in water treatment plants in Canada will also require other pertinent NOG clusters. These include General Industry Clusters (one table), General Water and Wastewater Clusters (one table), Supervisory Clusters (one table), Water Treatment-Specific Technical Clusters for all classes (one table), and Water Treatment-Specific Technical Clusters for each of the other classes (three tables).

NATIONAL OCCUPATIONAL GUIDELINES
FOR OPERATORS

water distribution

GENERAL INDUSTRY CLUSTERS

General Industry Clusters—DEFINITION

Clusters common to many industries. Many of the safety and administrative clusters in the National Occupational Guidelines for Canadian Water and Wastewater Operators are General Industry Clusters. In this study, most General Industry Clusters were included in the Common Core section of the survey.

Seventeen Water Distribution Clusters were identified as General Industry Clusters.

Clusters are ranked in order of priority from MOST important to LEAST important.

GENERAL INDUSTRY CLUSTERS—**WATER DISTRIBUTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**1.02**	Follow safety procedures.
	2	**1.03**	Practice safe work habits.
	3	**1.01**	Understand requirements for use of safety equipment.
	4	**1.05**	Identify potential safety risks.
	5	**2.16**	Obtain information from written sources.
	6	**2.15**	Manage information.
	7	**3.26**	Troubleshoot equipment.
	8	**9.51**	Operate and maintain pumping equipment.
	9	**3.24**	Operate computer systems.
	10	**9.57**	Operate and maintain control systems.
	11	**3.23**	Read and understand trade drawings.
	12	**9.53**	Operate and maintain engines, generators, and back-up systems.
IMPORTANT (20%)	13	**1.04**	Develop safety strategies.
	14	**2.12**	Maintain effective internal relations.
	15	**2.14**	Manage inventory.
LEAST IMPORTANT (10%)	16	**9.52**	Operate and maintain blowers and compressors.
	17	**9.55**	Install and maintain mechanical seals.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

GENERAL WATER AND WASTEWATER CLUSTERS

General Water and Wastewater Clusters—DEFINITION

> Clusters common to at least two of the four occupational groups in the NOG, meaning they are not specific to a particular occupation and are generally not performed outside of water and wastewater occupations. Most of these clusters were included in the Common Core section of the survey.

Sixteen Water Distribution Clusters were identified as General Water and Wastewater Clusters.

Clusters are ranked in order of priority from MOST important to LEAST important.

GENERAL WATER AND WASTEWATER CLUSTERS—**WATER DISTRIBUTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**2.17**	Comply with legal requirements.
	2	**4.29**	Perform field tests.
	3	**4.31**	Respond to tests.
	4	**1.06**	Identify potential risks to the system.
	5	**1.07**	Respond to emergencies.
	6	**4.27**	Follow proper chemical procedures.
	7	**4.28**	Follow proper sampling procedures.
	8	**3.20**	Perform basic and applied math.
	9	**2.09**	Identify personal roles.
	10	**9.56**	Operate service vehicles and trailers.
	11	**2.11**	Maintain effective public relations.
IMPORTANT (20%)	12	**9.58**	Monitor and maintain process electrical controls.
	13	**3.21**	Apply principles of basic and applied biology.
	14	**9.62**	Monitor and maintain facility heating, electrical, and ventilation systems.
LEAST IMPORTANT (10%)	15	**3.22**	Apply principles of basic and applied chemistry.
	16	**9.54**	Monitor corrosion control.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

SUPERVISORY CLUSTERS

Supervisory Clusters—DEFNITION

Clusters that relate to the supervision of individuals or workers. These clusters were included in the Common Core section of the survey.

Four Water Distribution Clusters were identified as Supervisory clusters.

Due to the small number of supervisory clusters, these were not ranked.

SUPERVISORY CLUSTERS—**WATER DISTRIBUTION**

NOG CLUSTER NUMBER	NOG CLUSTER NAME
2.10	Demonstrate workplace management.
2.13	Manage finances.
2.18	Manage maintenance.
2.19	Manage human resources.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

FACILITY-SPECIFIC TECHNICAL CLUSTERS

Facility-Specific Technical Clusters DEFINITION

Clusters specific to one or more occupational groups in the NOG and are of a specialized technical nature. These clusters were included in the occupation-specific sections of the survey, which include Water Treatment (WT), Water Distribution (WD), Wastewater Treatment (WWT), and Wastewater Collection (WWC).

Twenty-five Water Distribution Clusters were identified as Facility-Specific Technical Clusters.

There are two types of Facility-Specific Technical Clusters:

1. per facility type for all classes
2. per facility type per class

Clusters are ranked in order of priority from MOST important to LEAST important.

Facility Type for All Classes

The following table shows Water Distribution-Specific Technical Clusters for all classes.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR ALL CLASSES—**WATER DISTRIBUTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NAME
MOST IMPORTANT (70%)	1	**6.36**	Operate and maintain chlorine disinfection systems.
	2	**5.35**	Operate and maintain storage reservoirs.
	3	**4.30**	Follow proper equipment procedures.
	4	**1.08**	Follow system security requirements.
	5	**9.61**	Install and monitor system components.
	6	**8.48**	Monitor and maintain valves.
	7	**7.46**	Maintain and repair piping.
	8	**6.38**	Flush distribution system.
	9	**9.60**	Monitor gauges, meters, and switches.
	10	**6.43**	Prepare for fire flow demands.
	11	**7.47**	Detect leaks.
	12	**8.50**	Install and monitor water lines.
	13	**9.59**	Maintain support equipment.
	14	**7.45**	Install pipe, fittings, and joints.
	15	**7.44**	Construct pipeline
	16	**8.49**	Install and monitor water meters.
	17	**5.32**	Operate and maintain intake structures.
IMPORTANT (20%)	18	**6.39**	Operate and maintain flushing equipment.
	19	**6.41**	Arrange temporary service.
	20	**5.34**	Operate and maintain groundwater wells.
	21	**6.42**	Thaw frozen lines.
	22	**6.37**	Reduce disinfection by-products.
LEAST IMPORTANT (10%)	23	**5.33**	Operate and maintain pre-treatment facilities.
	24	**3.25**	Apply basic survey skills.
	25	**6.40**	Swab distribution system.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

Facility Type per Class

The following table shows Facility-Specific Technical Clusters for Class 1 water distribution systems.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 1 SYSTEMS—**WATER DISTRIBUTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**6.36**	Operate and maintain chlorine disinfection systems.
	2	**9.61**	Install and monitor system components.
	3	**6.38**	Flush distribution system.
	4	**1.08**	Follow system security requirements.
	5	**4.30**	Follow proper equipment procedures.
	6	**5.35**	Operate and maintain storage reservoirs.
	7	**7.46**	Maintain and repair piping.
	8	**7.47**	Detect leaks.
	9	**9.60**	Monitor gauges, meters, and switches.
	10	**6.43**	Prepare for fire flow demands.
	11	**8.48**	Monitor and maintain valves.
	12	**8.50**	Install and monitor water lines.
	13	**9.59**	Maintain support equipment.
	14	**8.49**	Install and monitor water meters.
	15	**7.44**	Construct pipeline
	16	**7.45**	Install pipe, fittings, and joints.
	17	**5.34**	Operate and maintain groundwater wells.
IMPORTANT (20%)	18	**6.39**	Operate and maintain flushing equipment.
	19	**6.41**	Arrange temporary service.
	20	**6.42**	Thaw frozen lines.
	21	**5.32**	Operate and maintain intake structures.
	22	**3.25**	Apply basic survey skills.
LEAST IMPORTANT (10%)	23	**5.33**	Operate and maintain pre-treatment facilities.
	24	**6.37**	Reduce disinfection by-products.
	25	**6.40**	Swab distribution system.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

The following table shows Facility-Specific Technical Clusters for Class 2 water distribution systems.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 2 SYSTEMS—**WATER DISTRIBUTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**6.36**	Operate and maintain chlorine disinfection systems.
	2	**5.35**	Operate and maintain storage reservoirs.
	3	**4.30**	Follow proper equipment procedures.
	4	**1.08**	Follow system security requirements.
	5	**8.48**	Monitor and maintain valves.
	6	**7.46**	Maintain and repair piping.
	7	**9.60**	Monitor gauges, meters, and switches.
	8	**6.38**	Flush distribution system.
	9	**9.59**	Maintain support equipment.
	10	**9.61**	Install and monitor system components.
	11	**6.43**	Prepare for fire flow demands.
	12	**7.47**	Detect leaks.
	13	**7.45**	Install pipe, fittings, and joints.
	14	**8.50**	Install and monitor water lines.
	15	**8.49**	Install and monitor water meters.
	16	**7.44**	Construct pipeline.
	17	**5.32**	Operate and maintain intake structures.
IMPORTANT (20%)	18	**6.39**	Operate and maintain flushing equipment.
	19	**6.41**	Arrange temporary service.
	20	**6.42**	Thaw frozen lines.
	21	**5.33**	Operate and maintain pre-treatment facilities.
	22	**5.34**	Operate and maintain groundwater wells.
LEAST IMPORTANT (10%)	23	**6.37**	Reduce disinfection by-products.
	24	**3.25**	Apply basic survey skills.
	25	**6.40**	Swab distribution system.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

The following table shows Facility-Specific Technical Clusters for Class 3 water distribution systems.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 3 SYSTEMS—**WATER DISTRIBUTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**6.36**	Operate and maintain chlorine disinfection systems.
	2	**5.35**	Operate and maintain storage reservoirs.
	3	**1.08**	Follow system security requirements.
	4	**4.30**	Follow proper equipment procedures.
	5	**8.48**	Monitor and maintain valves.
	6	**7.46**	Maintain and repair piping.
	7	**9.61**	Install and monitor system components.
	8	**6.38**	Flush distribution system.
	9	**7.45**	Install pipe, fittings, and joints.
	10	**9.60**	Monitor gauges, meters, and switches.
	11	**8.50**	Install and monitor water lines.
	12	**6.43**	Prepare for fire flow demands.
	13	**7.44**	Construct pipeline.
	14	**7.47**	Detect leaks.
	15	**9.59**	Maintain support equipment.
	16	**6.41**	Arrange temporary service.
	17	**5.32**	Operate and maintain intake structures.
IMPORTANT (20%)	18	**6.39**	Operate and maintain flushing equipment.
	19	**8.49**	Install and monitor water meters.
	20	**5.34**	Operate and maintain groundwater wells.
	21	**6.42**	Thaw frozen lines.
	22	**6.37**	Reduce disinfection by-products.
LEAST IMPORTANT (10%)	23	**5.33**	Operate and maintain pre-treatment facilities.
	24	**3.25**	Apply basic survey skills.
	25	**6.40**	Swab distribution system.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

The following table shows Facility-Specific Technical Clusters for Class 4 water distribution systems.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 4 SYSTEMS—**WATER DISTRIBUTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**6.36**	Operate and maintain chlorine disinfection systems.
	2	**5.35**	Operate and maintain storage reservoirs.
	3	**4.30**	Follow proper equipment procedures.
	4	**1.08**	Follow system security requirements.
	5	**8.48**	Monitor and maintain valves.
	6	**7.46**	Maintain and repair piping.
	7	**9.60**	Monitor gauges, meters, and switches.
	8	**6.38**	Flush distribution system.
	9	**9.59**	Maintain support equipment.
	10	**9.61**	Install and monitor system components.
	11	**6.43**	Prepare for fire flow demands.
	12	**7.47**	Detect leaks.
	13	**7.45**	Install pipe, fittings, and joints.
	14	**8.50**	Install and monitor water lines.
	15	**8.49**	Install and monitor water meters.
	16	**7.44**	Construct pipeline.
	17	**5.32**	Operate and maintain intake structures.
IMPORTANT (20%)	18	**6.39**	Operate and maintain flushing equipment.
	19	**6.41**	Arrange temporary service.
	20	**6.42**	Thaw frozen lines.
	21	**5.33**	Operate and maintain pre-treatment facilities.
	22	**5.34**	Operate and maintain groundwater wells.
LEAST IMPORTANT (10%)	23	**6.37**	Reduce disinfection by-products.
	24	**3.25**	Apply basic survey skills.
	25	**6.40**	Swab distribution system.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

NATIONAL OCCUPATIONAL GUIDELINES
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wastewater treatment

GENERAL INDUSTRY CLUSTERS

General Industry Clusters—DEFINITION

Clusters common to many industries. Many of the safety and administrative clusters in the National Occupational Guidelines for Canadian Water and Wastewater Operators are General Industry Clusters. In this study, most General Industry Clusters were included in the Common Core section of the survey.

Seventeen Wastewater Treatment Clusters were identified as General Industry Clusters.

Clusters are ranked in order of priority from MOST important to LEAST important

GENERAL INDUSTRY CLUSTERS—**WASTEWATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**1.01**	Understand requirements for use of safety equipment.
	2	**1.02**	Follow safety procedures.
	3	**1.03**	Practice safe work habits.
	4	**1.05**	Identify potential safety risks.
	5	**3.25**	Troubleshoot equipment.
	6	**15.61**	Operate and maintain pumping equipment.
	7	**2.16**	Obtain information from written sources.
	8	**2.15**	Manage information.
	9	**15.68**	Operate control systems.
	10	**15.63**	Operate and maintain engines, generators, and back up systems.
	11	**3.24**	Operate computer systems.
	12	**2.12**	Maintain effective internal relations.
IMPORTANT (20%)	13	**1.04**	Develop safety strategies.
	14	**15.62**	Operate and maintain blowers and compressors.
	15	**3.23**	Read and understand trade drawings.
LEAST IMPORTANT (10%)	16	**2.14**	Manage inventory.
	17	**15.66**	Install and maintain mechanical seals.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

GENERAL WATER AND WASTEWATER CLUSTERS

General Water and Wastewater Clusters—DEFINITION

> Clusters common to at least two of the four occupational groups in the NOG, meaning they are not specific to a particular occupation and are generally not performed outside of water and wastewater occupations. Most of these clusters were included in the Common Core section of the survey.

Nineteen Wastewater Treatment clusters were identified as General Water and Wastewater clusters.

Clusters are ranked in order of priority from MOST important to LEAST important.

GENERAL WATER AND WASTEWATER CLUSTERS—**WASTEWATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**2.17**	Comply with legal requirements.
	2	**4.27**	Follow proper chemical procedures.
	3	**4.28**	Follow proper sampling procedures.
	4	**1.07**	Respond to emergencies.
	5	**1.06**	Identify potential risks to the facility.
	6	**3.20**	Perform basic and applied math.
	7	**2.09**	Identify personal roles.
	8	**4.32**	Respond to laboratory tests.
	9	**4.31**	Perform laboratory tests.
	10	**1.08**	Follow facility security requirements.
	11	**4.29**	Follow proper laboratory procedures.
	12	**2.11**	Maintain effective public relations.
IMPORTANT (20%)	13	**15.67**	Operate service vehicles and trailers.
	14	**15.70**	Monitor and maintain process electrical controls.
	15	**3.21**	Apply principles of basic and applied biology.
	16	**3.22**	Apply principles of basic and applied chemistry.
LEAST IMPORTANT (10%)	17	**15.76**	Monitor and maintain facility heating, electrical, and ventilation systems.
	18	**4.30**	Establish proper laboratory procedures.
	19	**15.65**	Monitor corrosion control.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

SUPERVISORY CLUSTERS

Supervisory Clusters—DEFINITION

Clusters that relate to the supervision of individuals or workers. These clusters were included in the Common Core section of the survey.

Four Wastewater Treatment Clusters were identified as Supervisory Clusters.

Due to the small number of supervisory clusters, they were not ranked.

SUPERVISORY CLUSTERS—**WASTEWATER TREATMENT**

NOG CLUSTER NUMBER	NOG CLUSTER NAME
2.10	Demonstrate workplace management.
2.13	Manage finances.
2.18	Manage maintenance.
2.19	Manage human resources.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

FACILITY-SPECIFIC TECHNICAL CLUSTERS

Facility-Specific Technical Clusters DEFINITION

Clusters specific to one or more occupational groups in the NOG and are of a specialized technical nature. These clusters were included in the occupation-specific sections of the survey, which include Water Treatment (WT), Water Distribution (WD), Wastewater Treatment (WWT), and Wastewater Collection (WWC).

Thirty-six Wastewater Treatment Clusters were identified as Facility-Specific Technical Clusters.

There are two types of Facility-Specific Technical Clusters:

1. per facility type for all classes
2. per facility type per class

Clusters are ranked in order of priority from MOST important to LEAST important.

Facility Type for All Classes

The following table shows Wastewater Treatment-Specific Technical Clusters for all classes.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR ALL CLASSES—**WASTEWATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**15.69**	Operate and maintain lift stations.
	2	**14.60**	Monitor effluent discharge.
	3	**15.71**	Maintain process equipment.
	4	**15.64**	Monitor and maintain valves.
	5	**15.72**	Monitor gauges, meters, and switches.
	6	**7.40**	Monitor and control odour and gas production.
	7	**6.34**	Operate and maintain screening process.
	8	**3.26**	Apply knowledge of wastewater sources and characteristics.
	9	**5.33**	Operate and maintain lagoon systems.
	10	**15.75**	Detect leaks.
	11	**8.42**	Operate and maintain activated sludge systems.
	12	**15.74**	Maintain and repair piping.
	13	**10.49**	Operate and maintain chlorine disinfection systems.
	14	**7.41**	Operate and maintain solids and scum removal equipment.
	15	**9.48**	Operate and maintain secondary clarification equipment.
	16	**15.73**	Monitor system components.
	17	**8.46**	Operate and maintain solids removal equipment.
	18	**6.38**	Operate and maintain grit removal equipment.
	19	**7.39**	Operate and maintain primary clarification equipment.
	20	**13.56**	Operate and maintain biosolids processing equipment.
	21	**13.57**	Operate and maintain aerobic and anaerobic digestion equipment.
	22	**14.59**	Maintain liquid levels in system.
	23	**6.36**	Operate and maintain pre-treatment systems.
	24	**6.35**	Operate and maintain flow equalization equipment.
	25	**6.37**	Operate and maintain grinding and comminution equipment.
IMPORTANT (20%)	26	**11.53**	Operate and maintain coagulation and flocculation equipment.
	27	**10.51**	Operate and maintain ultraviolet disinfection systems.
	28	**12.55**	Operate and maintain phosphorus removal equipment.
	29	**13.58**	Operate and maintain biosolids disposal equipment.
	30	**12.54**	Operate and maintain nitrogen removal equipment.
	31	**11.52**	Operate and maintain tertiary treatment equipment.
	32	**8.43**	Operate and maintain rotating biological contactors (RBCs).
LEAST IMPORTANT (10%)	33	**8.47**	Operate and maintain constructed wetlands.
	34	**8.44**	Operate and maintain trickling filters.
	35	**8.45**	Operate and maintain membrane bioreactors (MBRs).
	36	**10.50**	Operate and maintain ozone disinfection systems.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG ````Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

Facility Type per Class

The following table shows Facility-Specific Technical Clusters for Class 1 wastewater treatment facilitites.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 1 FACILITIES—**WASTEWATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**15.69**	Operate and maintain lift stations.
	2	**5.33**	Operate and maintain lagoon systems.
	3	**14.60**	Monitor effluent discharge.
	4	**15.71**	Maintain process equipment.
	5	**15.75**	Detect leaks.
	6	**15.64**	Monitor and maintain valves.
	7	**15.72**	Monitor gauges, meters, and switches.
	8	**15.74**	Maintain and repair piping.
	9	**15.73**	Monitor system components.
	10	**3.26**	Apply knowledge of wastewater sources and characteristics.
	11	**7.40**	Monitor and control odour and gas production.
	12	**14.59**	Maintain liquid levels in system.
	13	**10.49**	Operate and maintain chlorine disinfection systems.
	14	**6.35**	Operate and maintain flow equalization equipment.
	15	**6.34**	Operate and maintain screening process.
	16	**6.36**	Operate and maintain pre-treatment systems.
	17	**8.42**	Operate and maintain activated sludge systems.
	18	**6.37**	Operate and maintain grinding and comminution equipment.
	19	**9.48**	Operate and maintain secondary clarification equipment.
	20	**6.38**	Operate and maintain grit removal equipment.
	21	**8.47**	Operate and maintain constructed wetlands.
	22	**7.39**	Operate and maintain primary clarification equipment.
	23	**10.51**	Operate and maintain ultraviolet disinfection systems.
	24	**8.46**	Operate and maintain solids removal equipment.
	25	**11.53**	Operate and maintain coagulation and flocculation equipment.
IMPORTANT (20%)	26	**13.57**	Operate and maintain aerobic and anaerobic digestion equipment.
	27	**13.56**	Operate and maintain biosolids processing equipment.
	28	**7.41**	Operate and maintain solids and scum removal equipment.
	29	**11.52**	Operate and maintain tertiary treatment equipment.
	30	**13.58**	Operate and maintain biosolids disposal equipment.
	31	**8.43**	Operate and maintain rotating biological contactors (RBCs).
	32	**12.54**	Operate and maintain nitrogen removal equipment.
LEAST IMPORTANT (10%)	33	**8.44**	Operate and maintain trickling filters.
	34	**8.45**	Operate and maintain membrane bioreactors (MBRs).
	35	**10.50**	Operate and maintain ozone disinfection systems.
	36	**12.55**	Operate and maintain phosphorus removal equipment.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

The following table shows Facility-Specific Technical Clusters for Class 2 wastewater treatment facilities

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 2 FACILITIES—**WASTEWATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**15.69**	Operate and maintain lift stations.
	2	**15.71**	Maintain process equipment.
	3	**14.60**	Monitor effluent discharge.
	4	**15.64**	Monitor and maintain valves.
	5	**15.72**	Monitor gauges, meters, and switches.
	6	**6.34**	Operate and maintain screening process.
	7	**5.33**	Operate and maintain lagoon systems.
	8	**8.42**	Operate and maintain activated sludge systems.
	9	**15.75**	Detect leaks.
	10	**15.74**	Maintain and repair piping.
	11	**7.40**	Monitor and control odour and gas production.
	12	**7.41**	Operate and maintain solids and scum removal equipment.
	13	**3.26**	Apply knowledge of wastewater sources and characteristics.
	14	**15.73**	Monitor system components.
	15	**9.48**	Operate and maintain secondary clarification equipment.
	16	**7.39**	Operate and maintain primary clarification equipment.
	17	**6.38**	Operate and maintain grit removal equipment.
	18	**13.57**	Operate and maintain aerobic and anaerobic digestion equipment.
	19	**10.49**	Operate and maintain chlorine disinfection systems.
	20	**6.37**	Operate and maintain grinding and comminution equipment.
	21	**13.56**	Operate and maintain biosolids processing equipment.
	22	**8.46**	Operate and maintain solids removal equipment.
	23	**14.59**	Maintain liquid levels in system.
	24	**6.35**	Operate and maintain flow equalization equipment.
	25	**6.36**	Operate and maintain pre-treatment systems.
IMPORTANT (20%)	26	**11.53**	Operate and maintain coagulation and flocculation equipment.
	27	**13.58**	Operate and maintain biosolids disposal equipment.
	28	**10.51**	Operate and maintain ultraviolet disinfection systems.
	29	**8.43**	Operate and maintain rotating biological contactors (RBCs).
	30	**11.52**	Operate and maintain tertiary treatment equipment.
	31	**12.55**	Operate and maintain phosphorus removal equipment.
	32	**12.54**	Operate and maintain nitrogen removal equipment.
LEAST IMPORTANT (10%)	33	**8.45**	Operate and maintain membrane bioreactors (MBRs).
	34	**8.47**	Operate and maintain constructed wetlands.
	35	**8.44**	Operate and maintain trickling filters.
	36	**10.50**	Operate and maintain ozone disinfection systems.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

The following table shows Facility-Specific Technical Clusters for Class 3 wastewater treatment facilities.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 3 FACILITIES—**WASTEWATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**15.69**	Operate and maintain lift stations.
	2	**14.60**	Monitor effluent discharge.
	3	**15.71**	Maintain process equipment.
	4	**6.34**	Operate and maintain screening process.
	5	**8.42**	Operate and maintain activated sludge systems.
	6	**15.72**	Monitor gauges, meters, and switches.
	7	**15.64**	Monitor and maintain valves.
	8	**8.46**	Operate and maintain solids removal equipment.
	9	**7.41**	Operate and maintain solids and scum removal equipment.
	10	**7.40**	Monitor and control odour and gas production.
	11	**6.38**	Operate and maintain grit removal equipment.
	12	**9.48**	Operate and maintain secondary clarification equipment.
	13	**3.26**	Apply knowledge of wastewater sources and characteristics.
	14	**13.57**	Operate and maintain aerobic and anaerobic digestion equipment.
	15	**10.49**	Operate and maintain chlorine disinfection systems.
	16	**7.39**	Operate and maintain primary clarification equipment.
	17	**12.55**	Operate and maintain phosphorus removal equipment.
	18	**13.56**	Operate and maintain biosolids processing equipment.
	19	**6.37**	Operate and maintain grinding and comminution equipment.
	20	**10.51**	Operate and maintain ultraviolet disinfection systems.
	21	**6.36**	Operate and maintain pre-treatment systems.
	22	**11.53**	Operate and maintain coagulation and flocculation equipment.
	23	**15.74**	Maintain and repair piping.
	24	**15.75**	Detect leaks.
	25	**6.35**	Operate and maintain flow equalization equipment.
IMPORTANT (20%)	26	**14.59**	Maintain liquid levels in system.
	27	**5.33**	Operate and maintain lagoon systems.
	28	**15.73**	Monitor system components.
	29	**13.58**	Operate and maintain biosolids disposal equipment.
	30	**11.52**	Operate and maintain tertiary treatment equipment.
	31	**12.54**	Operate and maintain nitrogen removal equipment.
	32	**8.43**	Operate and maintain rotating biological contactors (RBCs).
LEAST IMPORTANT (10%)	33	**8.45**	Operate and maintain membrane bioreactors (MBRs).
	34	**8.44**	Operate and maintain trickling filters.
	35	**10.50**	Operate and maintain ozone disinfection systems.
	36	**8.47**	Operate and maintain constructed wetlands.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

The following table shows Facility-Specific Technical Clusters for Class 4 wastewater treatment facilities.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 4 FACILITIES—**WASTEWATER TREATMENT**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**7.40**	Monitor and control odour and gas production.
	2	**15.71**	Maintain process equipment.
	3	**14.60**	Monitor effluent discharge.
	4	**8.42**	Operate and maintain activated sludge systems.
	5	**13.56**	Operate and maintain biosolids processing equipment.
	6	**15.72**	Monitor gauges, meters, and switches.
	7	**6.34**	Operate and maintain screening process.
	8	**9.48**	Operate and maintain secondary clarification equipment.
	9	**8.46**	Operate and maintain solids removal equipment.
	10	**7.39**	Operate and maintain primary clarification equipment.
	11	**13.57**	Operate and maintain aerobic and anaerobic digestion equipment.
	12	**15.64**	Monitor and maintain valves.
	13	**7.41**	Operate and maintain solids and scum removal equipment.
	14	**6.38**	Operate and maintain grit removal equipment.
	15	**10.49**	Operate and maintain chlorine disinfection systems.
	16	**15.69**	Operate and maintain lift stations.
	17	**12.55**	Operate and maintain phosphorus removal equipment.
	18	**3.26**	Apply knowledge of wastewater sources and characteristics.
	19	**6.36**	Operate and maintain pre-treatment systems.
	20	**15.75**	Detect leaks.
	21	**12.54**	Operate and maintain nitrogen removal equipment.
	22	**14.59**	Maintain liquid levels in system.
	23	**11.53**	Operate and maintain coagulation and flocculation equipment.
	24	**10.51**	Operate and maintain ultraviolet disinfection systems.
	25	**6.35**	Operate and maintain flow equalization equipment.
IMPORTANT (20%)	26	**15.74**	Maintain and repair piping.
	27	**13.58**	Operate and maintain biosolids disposal equipment.
	28	**15.73**	Monitor system components.
	29	**11.52**	Operate and maintain tertiary treatment equipment.
	30	**6.37**	Operate and maintain grinding and comminution equipment.
	31	**5.33**	Operate and maintain lagoon systems.
	32	**8.43**	Operate and maintain rotating biological contactors (RBCs).
LEAST IMPORTANT (10%)	33	**8.44**	Operate and maintain trickling filters.
	34	**8.47**	Operate and maintain constructed wetlands.
	35	**10.50**	Operate and maintain ozone disinfection systems.
	36	**8.45**	Operate and maintain membrane bioreactors (MBRs).

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

NATIONAL OCCUPATIONAL GUIDELINES
FOR OPERATORS

wastewater collection

GENERAL INDUSTRY CLUSTERS

General Industry Clusters—DEFINITION

> Clusters common to many industries. Many of the safety and administrative clusters in the National Occupational Guidelines for Canadian Water and Wastewater Operators are General Industry Clusters. In this study, most General Industry Clusters were included in the Common Core section of the survey.

Sixteen Wastewater Collection Clusters were identified as General Industry Clusters.

Clusters are ranked in order of priority from MOST important to LEAST important.

GENERAL INDUSTRY CLUSTERS—**WASTEWATER COLLECTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**1.01**	Understand requirements for use of safety equipment.
	2	**1.02**	Follow safety procedures.
	3	**1.03**	Practice safe work habits.
	4	**2.16**	Obtain information from written sources.
	5	**8.46**	Operate and maintain engines, generators, and back-up systems.
	6	**8.44**	Operate and maintain pumping equipment.
	7	**3.26**	Troubleshoot equipment.
	8	**1.05**	Identify potential safety risks.
	9	**3.24**	Operate computer systems.
	10	**2.12**	Maintain effective internal relations.
	11	**2.15**	Manage information.
IMPORTANT (20%)	12	**3.23**	Read and understand trade drawings.
	13	**1.04**	Develop safety strategies.
	14	**8.45**	Operate and maintain blowers and compressors.
LEAST IMPORTANT (10%)	15	**2.14**	Manage inventory.
	16	**8.49**	Install and maintain mechanical seals.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

GENERAL WATER AND WASTEWATER CLUSTERS

General Water and Wastewater Clusters—DEFINITION

Clusters common to at least two of the four occupational groups in the NOG, meaning they are not specific to a particular occupation and are generally not performed outside of water and wastewater occupations. Most of these clusters were included in the Common Core section of the survey.

Seventeen Wastewater Collection Clusters were identified as General Water and Wastewater Clusters.

Clusters are ranked in order of priority from MOST important to LEAST important.

GENERAL WATER AND WASTEWATER CLUSTERS—**WASTEWATER COLLECTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**2.17**	Comply with legal requirements.
	2	**1.07**	Respond to emergencies.
	3	**1.06**	Identify potential risks to the system.
	4	**4.27**	Follow proper chemical procedures.
	5	**4.28**	Follow proper sampling procedures.
	6	**2.09**	Identify personal roles.
	7	**2.11**	Maintain effective public relations.
	8	**1.08**	Follow system security requirements.
	9	**3.20**	Perform basic and applied math.
	10	**4.31**	Respond to tests.
	11	**8.50**	Operate service vehicles and trailers.
IMPORTANT (20%)	12	**3.22**	Apply principles of basic and applied chemistry.
	13	**3.21**	Apply principles of basic and applied biology.
	14	**8.52**	Monitor and maintain process electrical controls.
LEAST IMPORTANT (10%)	15	**8.55**	Install and monitor system components.
	16	**8.48**	Monitor corrosion control.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

SUPERVISORY CLUSTERS

Supervisory Clusters—DEFINITION

Clusters that relate to the supervision of individuals or workers. These clusters were included in the Common Core section of the survey.

Four Wastewater Collection Clusters were identified as Supervisory Clusters.

Due to the small number of supervisory clusters, they were not ranked.

SUPERVISORY CLUSTERS—**WASTEWATER COLLECTION**

NOG CLUSTER NUMBER	NOG CLUSTER NAME
2.10	Demonstrate workplace management.
2.13	Manage finances.
2.18	Manage maintenance.
2.19	Manage human resources.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

FACILITY-SPECIFIC TECHNICAL CLUSTERS

Facility-Specific Technical Clusters DEFINITION

Clusters specific to one or more occupational groups in the NOG and are of a specialized technical nature. These clusters were included in the occupation-specific sections of the survey, which include Water Treatment (WT), Water Distribution (WD), Wastewater Treatment (WWT), and Wastewater Collection (WWC).

Twenty Wastewater Collection Clusters were identified as Facility-Specific Technical Clusters.

There are two types of Facility-Specific Technical Clusters:

1. per facility type for all classes
2. per facility type per class

Clusters are ranked in order of priority from MOST important to LEAST important.

Facility Type for All Classes

The following table shows Wastewater Collection-Specific Technical Clusters for all classes.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR ALL CLASSES—**WASTEWATER COLLECTION**

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**5.32**	Construct pipeline.
	2	**4.30**	Follow proper equipment procedures.
	3	**6.39**	Maintain collection system.
	4	**7.43**	Operate and maintain pumping stations.
	5	**8.51**	Operate and maintain control systems.
	6	**5.34**	Maintain and repair piping.
	7	**4.29**	Perform field tests.
	8	**3.25**	Apply basic survey skills.
	9	**6.38**	Clean and repair sewers and appurtenances.
	10	**8.47**	Monitor valves.
	11	**6.36**	Monitor and control odour and gas production.
	12	**5.33**	Install pipe fittings and joints.
	13	**5.35**	Detect leaks.
	14	**8.54**	Monitor gauges, meters, and switches.
IMPORTANT (20%)	15	**6.37**	Detect infiltration and inflow.
	16	**8.53**	Maintain support equipment.
	17	**6.40**	Operate and maintain maintenance equipment.
	18	**8.56**	Monitor and maintain facility heating, electrical, and ventilation systems.
LEAST IMPORTANT (10%)	19	**6.42**	Maintain liquid levels, flows, and capacities.
	20	**6.41**	Perform tracer studies.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

Facility Type per Class

The following table shows Facility-Specific Technical Clusters for Class 1 wastewater collection systems.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 1 SYSTEMS—
WASTEWATER COLLECTION

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**3.25**	Apply basic survey skills.
	2	**5.32**	Construct pipeline.
	3	**4.30**	Follow proper equipment procedures.
	4	**4.29**	Perform field tests.
	5	**6.39**	Maintain collection system.
	6	**5.34**	Maintain and repair piping.
	7	**5.33**	Install pipe fittings and joints.
	8	**5.35**	Detect leaks.
	9	**6.41**	Perform tracer studies.
	10	**6.36**	Monitor and control odour and gas production.
	11	**8.47**	Monitor valves.
	12	**6.37**	Detect infiltration and inflow.
	13	**6.38**	Clean and repair sewers and appurtenances.
	14	**8.56**	Monitor and maintain facility heating, electrical, and ventilation systems.
IMPORTANT (20%)	15	**6.40**	Operate and maintain maintenance equipment.
	16	**8.51**	Operate and maintain control systems.
	17	**6.42**	Maintain liquid levels, flows, and capacities.
	18	**8.53**	Maintain support equipment.
LEAST IMPORTANT (10%)	19	**7.43**	Operate and maintain pumping stations.
	20	**8.54**	Monitor gauges, meters, and switches.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

The following table shows Facility-Specific Technical Clusters for Class 2 wastewater collection systems.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 2 SYSTEMS—
WASTEWATER COLLECTION

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**5.34**	Maintain and repair piping.
	2	**6.38**	Clean and repair sewers and appurtenances.
	3	**5.32**	Construct pipeline.
	4	**6.39**	Maintain collection system.
	5	**4.30**	Follow proper equipment procedures
	6	**7.43**	Operate and maintain pumping stations.
	7	**4.29**	Perform field tests.
	8	**6.41**	Perform tracer studies.
	9	**6.40**	Operate and maintain maintenance equipment.
	10	**8.53**	Maintain support equipment.
	11	**5.33**	Install pipe fittings and joints.
	12	**6.37**	Detect infiltration and inflow.
	13	**6.42**	Maintain liquid levels, flows, and capacities.
	14	**8.51**	Operate and maintain control systems.
IMPORTANT (20%)	15	**8.47**	Monitor valves.
	16	**8.54**	Monitor gauges, meters, and switches.
	17	**5.35**	Detect leaks.
	18	**3.25**	Apply basic survey skills.
LEAST IMPORTANT (10%)	19	**8.56**	Monitor and maintain facility heating, electrical, and ventilation systems.
	20	**6.36**	Monitor and control odour and gas production.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

The following table shows Facility-Specific Technical Clusters for Class 3 wastewater collection systems.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 3 SYSTEMS—
WASTEWATER COLLECTION

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**7.43**	Operate and maintain pumping stations.
	2	**8.51**	Operate and maintain control systems.
	3	**8.47**	Monitor valves.
	4	**8.54**	Monitor gauges, meters, and switches.
	5	**6.36**	Monitor and control odour and gas production.
	6	**8.53**	Maintain support equipment.
	7	**4.30**	Follow proper equipment procedures.
	8	**6.39**	Maintain collection system.
	9	**4.29**	Perform field tests.
	10	**6.38**	Clean and repair sewers and appurtenances.
	11	**8.56**	Monitor and maintain facility heating, electrical, and ventilation systems.
	12	**5.34**	Maintain and repair piping..
	13	**6.37**	Detect infiltration and inflow.
	14	**6.40**	Operate and maintain maintenance equipment.
IMPORTANT (20%)	15	**6.42**	Maintain liquid levels, flows, and capacities.
	16	**5.35**	Detect leaks.
	17	**5.33**	Install pipe fittings and joints.
	18	**5.32**	Construct pipeline.
LEAST IMPORTANT (10%)	19	**3.25**	Apply basic survey skills.
	20	**6.41**	Perform tracer studies.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

The following table shows Facility-Specific Technical Clusters for Class 4 wastewater collection systems.

FACILITY-SPECIFIC TECHNICAL CLUSTERS FOR CLASS 4 SYSTEMS—
WASTEWATER COLLECTION

	RANKING	NOG CLUSTER NUMBER	NOG CLUSTER NUMBER
MOST IMPORTANT (70%)	1	**5.32**	Construct pipeline.
	2	**5.34**	Maintain and repair piping..
	3	**6.39**	Maintain collection system.
	4	**6.38**	Clean and repair sewers and appurtenances.
	5	**6.37**	Detect infiltration and inflow.
	6	**7.43**	Operate and maintain pumping stations.
	7	**5.33**	Install pipe fittings and joints.
	8	**8.51**	Operate and maintain control systems.
	9	**6.40**	Operate and maintain maintenance equipment.
	10	**5.35**	Detect leaks.
	11	**4.30**	Follow proper equipment procedures.
	12	**6.36**	Monitor and control odour and gas production.
	13	**8.47**	Monitor valves.
	14	**8.54**	Monitor gauges, meters, and switches.
IMPORTANT (20%)	15	**4.29**	Perform field tests.
	16	**8.53**	Maintain support equipment.
	17	**6.41**	Perform tracer studies.
	18	**6.42**	Maintain liquid levels, flows, and capacities.
LEAST IMPORTANT (10%)	19	**8.56**	Monitor and maintain facility heating, electrical, and ventilation systems.
	20	**3.25**	Apply basic survey skills.

Each cluster has a number that corresponds to a group of competencies collected in Phase I. To see the complete list of clusters and competencies, see "NOG Phase I—Competency Reference Guide" at www.eco.ca/pdf/wastewater_eng.pdf or at www.eco.ca (click "products" to locate report).

ACKNOWLEDGEMENTS

ECO Canada would like to express its appreciation to all the organizations and individuals who contributed their time and effort to the development of the 2005 National Occupational Guidelines for Canadian Water and Wastewater Operators.

In particular, we would like to thank all members of the NOG National Steering Committee who guided the development of both phases and provided valuable feedback throughout the project.

The NOG project was funded by the Government of Canada's Sector Council Program, whose continuous support is greatly appreciated.

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ECO Canada greatly appreciates the support of Canada's water and wastewater associations, organizations, and municipalities who distributed surveys, made announcements to members, and volunteered meeting space for the project.

And finally, this report would not have been possible without the participation of the countless individuals who offered their time to talk with researchers, complete surveys, and participate in validation sessions. These individuals came from all water and wastewater levels and classes of facilities in Canada, as well as from academia and all levels of government. It is for these people that ECO Canada reserves its final and most heartfelt thank you.

PHASE I—NATIONAL STEERING COMMITTEE

Andy Bebbington	Town of Devon, Alberta
Bruce Boland	Waterbru Water and Wastewater Services
Marguerite Ceschi-Smith	Federation of Canadian Municipalities
Bob Cook	Canadian Technology Human Resources Board
Edgar Doull	International Union of Operating Engineers
Joe Francis	Aboriginal Water and Wastewater Association of Ontario
Brian Gildner	Ontario Ministry of the Environment
Hans Gruenwald	Réseau Environnement
Bill Hyslop	Environmental Operators Certification Program
Derrick Kamanga	Ontario First Nations Technical Services Corporation
Ed Norrena	Chair of ECO Canada Board of Directors
Kevin Ramsay	British Columbia Water and Wastewater Association
Art Skibinsky	Association of Canadian Community Colleges
Jean-Paul Trudel	Centre de Formation Professionnelle Paul-Gerin-Lajoie
Al Turner	Manitoba Water and Wastewater Association
Leslie Whitby	Indian and Northern Affairs Canada
Jim Young	Canadian Council of Ministers of the Environment

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Erin Thompson	ECO Canada
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PHASE II—NATIONAL STEERING COMMITTEE

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James Arnott	Environment Canada
Patricia Brooks	Yukon Department of Health and Social Services
Dermot Cain	International Union of Operating Engineers
Marguerite Ceschi-Smith	Federation of Canadian Municipalities
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ECO Canada would also like to acknowledge the contribution of those who attended the project's National Forums and whose comments and suggestions are of great value in directing future projects in the water and wastewater sector.

PHASE I—NATIONAL FORUM ATTENDEES

Rachid Baïou	Comité Sectoriel de Main-D'Œuvre de l'Environnement
André Chenard	New Brunswick Department of Environment and Local Government
Jerry Cheshuk	Resort Municipality of Whistler
Ron Duffell	Government of British Columbia
Denis Forest	Nouvelle Technologie (TEKNO) Inc.
James Foster	Government of the Northwest Territories
Morley M. Foy	Prince Edward Island Department of Environment and Energy
Duane Griffin	American Water Works Association, Western Canada Section
Ed Harding	Northern Alberta Institute of Technology
Catherine Jefferson	Canadian Water and Wastewater Association
Haseen Khan	Government of Newfoundland and Labrador
Paul Klaamas	Environment Canada
Pat Lang	Government of Alberta
Dan Limacher	Western Canada Water and Wastewater Association
Bill Marion	James Smith Cree Nation
André Marsan	Aquatech
Brian Pett	Ontario Water Works Association
James Thorbourne	Inuvialuit Land Claims Administration
Mike Van den Bosch	Manitoba Conservation
Gordon Van Fleet	Confederation College
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Tom Williams	Saskatchewan Water and Wastewater Association
Mike Yakabuski	GNWT Municipal and Community Affairs

PHASE II—NATIONAL FORUM ATTENDEES

Rachid Baïou	Comité Sectoriel de Main-D'Œuvre de l'Environnement
Andy Bebbington	Town of Devon, Alberta
Jerry Cheshuk	Squamish-Lillooet Regional District
Robert Crane	Water Environmental Association of Ontario
Saad Jasim	Walkerton Clean Water Centre
Paul Klaamas	Environment Canada
Bill Marion	First Nations Water and Wastewater Advisory Committee
Jennifer Rose	Ontario Water Works Association
Peter Sullivan	Halifax Regional Municipality

PHASE I AND PHASE II—FOCUS GROUPS PARTICIPANTS

Gina Adams	Region of Halton, Ontario
Zafar Ahmad	City of Calgary, Alberta
Tom Alkema	Alkema Environmental Assistance
Pete Allen	City of North Battleford, Saskatchewan
Michael A. Arenburg	Public Service Commission of Bridgewater, Nova Scotia
Jean-Pierre Azzopardi	Aquatech-Société de Gestion de l'Eau Inc.
Rachid Baïou	Comité Sectorial de Main-D'Œuvre de l'Environnement
Bill Baker	City of Estevan, Saskatchewan
Don Beatty	Town of Windsor, Nova Scotia
Andy Bebbington	Town of Devon, Alberta
Jean Luc Bélisle	Ville de Montréal Arrondissement Pointe-Claire, Québec
Patrick Bellemare	Halifax Regional Water Commission, Nova Scotia
Nick Benkovich	City of Greater Sudbury, Ontario
Alan Benninger	Nova Scotia Department of Environment and Labour
William J. Borlase	City of Winnipeg, Manitoba
Kelly Braden	City of Portage la Prairie, Manitoba
Doug Brereton	Resort Municipality of Whistler, British Columbia
Ken Brothers	Halifax Regional Water Commission, Nova Scotia

Ron Buxton	RAB Services Ltd.
Peter T. Bziuk	Corporation of the City of Windsor, Ontario
Douglas Campbell	City of Portage la Prairie, Manitoba
Jerry Cheshuk	Squamish-Lillooet Regional District, British Columbia
Ian Chin	City of Toronto, Ontario
Bill Clair	Charlottetown Water and Sewer Utility, Prince Edward Island
Kerry Clark	Epcor Water Services
Jeffrey Craddock	First Nations (Alberta) Technical Services Advisory Group
Robert Crane	Water Environment Association of Ontario
Steven Cripps	City of Barrie, Ontario
Jack Cronk	Manitoba Water Stewardship
Jack Crouteau	Village of Pennant, Saskatchewan
Frank Crudo	City of Vancouver, British Columbia
Rick Deans	Town of Cochrane, Alberta
Darcy Dragonetti	City of Vancouver, British Columbia
Jenny Dunsdon	City of Calgary, Alberta
Tony Edmonds	Ontario Clean Water Agency
John Eisnor	Nova Scotia Environment and Labour
J. Stephen English	Region of Halton, Ontario
Randy Engman	Okanogan University College
David F. Ernst	Town of Yarmouth, Nova Scotia
Gus Feitzelmayer	Saskatchewan Environment
Chuck Fiddy	City of St. Thomas, Ontario
Bob Fields	Corporation of Norfolk County, Ontario
Denis Forest	Ville de Pincourt (TEKNO), Québec
Morley M. Foy	Prince Edward Island Fisheries, Aquaculture, and Environment
Doug Fulton	City of Toronto, Ontario
Cory Graham	Manitoba Conservation
Troy Grobb	City of Selkirk, Manitoba
Duane Guzzi	City of Lethbridge, Alberta
Peter Hanlon	City of Saint John, New Brunswick
Chris Hanson	Parks Canada
Rick Hanson	City of Prince Albert, Saskatchewan
Monique Henry	CEGEP de Saint-Laurent
Dale Heshka	City of Melville, Saskatchewan

Timothy W. Hiltz	Public Service Commission of Bridgewater, Nova Scotia
Paul Isnor	Halifax Regional Water Commission, Nova Scotia
Lorne R. Johanson	British Columbia Water and Waste Association/ Royal Roads University
Duane Johnson	Province of Manitoba, Gout Services
Peter Jensen	Halifax Regional Water Commission, Nova Scotia
Glen Kalyk	Greater Vancouver Regional District, British Columbia
Derrick Kamanga	Ontario First Nations Technical Services Corporation
Mohammed Karim	Ontario First Nations Technical Services Corporation
Phil Karlsson	City of Vancouver, British Columbia
Lyle Laycock	The Corporation of Delta, British Columbia
Reggie LeBlanc	City of Dieppe, New Brunswick
Mike Longworth	Greater Vancouver Regional District, British Columbia
Eric Ma	City of Calgary, Alberta
Dan MacIntosh	Town of Port Hawkesbury, Nova Scotia
Don Mackinnon	Strathcona County, Alberta
Barry Mapes	City of Toronto, Ontario
Grayson Mauch	City of Medicine Hat, Alberta
Katherine McDonald	Georgian College
Brad McIntosh	City of Brandon, Manitoba
Lisa McNiven	City of Barrie, Ontario
Pat Miller	Sun Peaks Utilities Co., Ltd.
Anand Mohan	Philip Industrial Services
Delbert E. Morrison	Alberta Environment
John Muise	Region of Durham, Ontario
Samuel Odemuyiwa	Apotex Inc.
Darin Orb	SaskWater
Barry Parker	City of Greater Sudbury, Ontario
Greg Peters	Greater Vancouver Regional District, British Columbia
Rejean Piché	TEKNO
Mark Pinkney	Town of Midland, Ontario
Ben Pitman	Town of Amherst, Nova Scotia
Peter Pothier	Village of New Minas, Nova Scotia
Tony Puim	Ontario Clean Water Agency

Delbert Reeves	Prince Edward Island Department of Environment and Energy
Daniel Rehak	Ontario Society of Professional Engineers
Mike Richard	City of Moncton, New Brunswick
Dave Robertson	Town of Okotoks, Alberta
Cordell Samuels	City of Toronto, Ontario
Dale E. Scott	City of Selkirk, Manitoba
Cyr Serge	Ville de Victoriaville, Québec
Rick Sherrard	Municipality of the District of West Hants, Nova Scotia
Brian Shields	District of Central Saanich, British Columbia
Art Skibinsky	Association of Canadian Community Colleges
Ron Skwarchuk	City of Saskatoon, Saskatchewan
C. Gordon Smith	Town of Amherst, Nova Scotia
Danny Smith	Halifax Regional Water Commission, Nova Scotia
Ian Smith	City of Toronto, Ontario
Ken Smyrski	City of Winnipeg, Manitoba
Jean Soucy	Town of Fort Smith, Northwest Territories
Keith Sparkman	Manitoba First Nations Water and Wastewater Instruction Program
Wayne Stiver	Peterborough Utilities Services, Ontario
Cheryl Swan	Ontario Association of Certified Engineering Technicians and Technologists
Peter Sullivan	Halifax Regional Municipality, Nova Scotia
Bohdan Sywak	City of Winnipeg, Manitoba
James Taylor	Ontario First Nations Technical Services Corporation
Eric Tirschmann	Strathcona County, Alberta
Don Todorovich	Town of Roblin, Manitoba
Robert Trenholm	Marine Institute of Memorial University
Jean-Paul Trudel	Commission Scolaire des Trois-Lacs, Québec
Gordon Van Fleet	Confederation College
Herman Van Omme	Charlottetown Water and Sewer Utility, Prince Edward Island
Wayne D. Wall	City of Portage la Prairie, Manitoba
Eldon Wallis	Water Environment Association of Ontario
Tom Williams	City of Weyburn, Saskatchewan
Bill Wilson	Town of Newmarket, Ontario
Harland Wyand	Town of Bridgewater, Nova Scotia

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NOTE The Final Report and Appendices 1 and 2 are available in print and by PDF download from ECO Canada.
Appendices 3 through 9 are only available by PDF download from ECO Canada's website.
Go to www.eco.ca and click "products" to locate final report and appendices.

APPENDIX 1

SURVEY PARTICIPANTS BY FACILITY TYPE

FACILITY TYPE	FACILITY CLASS	NUMBER OF SURVEY
WATER TREATMENT	Class 1 (including small systems)	95
	Class 2	132
	Class 3	118
	Class 4	89
TOTAL WATER TREATMENT (ALL FACILITIES)		**434**
WATER DISTRIBUTION	Class 1 (including small systems)	106
	Class 2	197
	Class 3	64
	Class 4	60
TOTAL WATER DISTRIBUTION (ALL FACILITIES)		**427**
WASTEWATER TREATMENT	Class 1 (including small systems)	126
	Class 2	96
	Class 3	67
	Class 4	86
TOTAL WASTEWATER TREATMENT (ALL FACILITIES)		**375**
WASTEWATER COLLECTION	Class 1 (including small systems)	115
	Class 2	145
	Class 3	44
	Class 4	39
TOTAL WASTEWATER COLLECTION (ALL FACILITIES)		**343**

SURVEY PARTICIPANTS BY PROVINCE

PROVINCE OR TERRITORY	APPROXIMATE PERCENTAGE OF CANADA'S POPULATION	ACTUAL NUMBER OF SURVEY PARTICIPANTS
BC	10%	**74**
AB	13%	**188**
SK	6%	**53**
MB	6%	**62**
ON	39%	**181**
QC	19%	**45**
NB	2%	**27**
NS	4%	**31**
PI	0%	**12**
NF	0%	**3**
YT	0%	**1**
NT	1%	**10**
NU	0%	**1**
Non-Specified	—	**2**
TOTAL	**100%**	**690**

APPENDIX 2

2005 NATIONAL WATER AND WASTEWATER OPERATOR SURVEY PARTICIPANT FORM

NAME			
Email Address			
Facility Mailing Address			
Facility Telephone Number		Facility Fax Number	
How many years have you worked in Water or Wastewater Facilities?			
Your Level of Personal Certification (if any)			
Province or Territory of Certification (if any)			
Are you an Operator?		Do you Supervise or Manage Operators?	
If you are not an operator or supervisor, what is your job title?			

LEVEL OF EDUCATION - PLEASE MARK THE HIGHEST LEVEL OF EDUCATION YOU HAVE ACHIEVED WITH AN 'X'			
High school diploma or equivalent		Some college, CEGEP, or university courses	
Completed college diploma program, CEGEP, or trade ticket		Completed university degree program	

FACILITY CLASSES AND TYPES - PLEASE MARK THE HIGHEST CLASS OF FACILITY YOU WORK IN (FOR EACH FACILITY TYPE) WITH AN 'X'			
	Class 1 Water Treatment & Distribution (facility serving less than 500 people)		
	Class 1 Wastewater Collection & Treatment (facility serving less than 500 people)		
	Class 1 Water Treatment		Class 3 Water Treatment
	Class 1 Water Distribution		Class 3 Water Distribution
	Class 1 Wastewater Treatment		Class 3 Wastewater Treatment
	Class 1 Wastewater Collection		Class 3 Wastewater Collection
	Class 2 Water Treatment		Class 4 Water Treatment
	Class 2 Water Distribution		Class 4 Water Distribution
	Class 2 Wastewater Treatment		Class 4 Wastewater Treatment
	Class 2 Wastewater Collection		Class 4 Wastewater Collection

How would you prefer to complete the survey?		On Line (Web)		Printed Format
Language Preference		English		French

CONSENT FORM

I agree to participate in the 2005 National Water and Wastewater Operator Survey. I understand that this survey is being conducted by Griffiths Sheppard Consulting Group (the Consultants) on behalf of ECO Canada (formerly CCHREI) to provide valuable data for improvement initiatives.

I understand that my survey responses and contact information will only be used for this survey, and will not be used for any other purpose. I further understand that any identifiable information in regard to my name and/or employer WILL NOT BE listed in the survey report.

_____ _____

SURVEY PARTICIPANT **DATE**

PLEASE FAX, EMAIL, OR MAIL THIS FORM TO:

FAX TO: (403) 637-3800

EMAIL TO: kevin@griffiths-sheppard.com

MAIL TO:
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