

WRM 401: Water Auditing Course Syllabus

Water supply in Canada and many other countries worldwide is under increasing pressure due to expanding population, urbanization, economic development, intensive agriculture, climate change and other factors. Water auditing is a key tool to help manage our water resources more efficiently, reduce wastage, and provide useful information that can be utilized as a basis for effective water planning and management, with a focus on reducing water consumption.

As a basis for the study of water auditing, the course provides an overview of water consumption patterns and water-related issues and challenges in Canada and globally. The hydrological cycle and urban water cycle are also reviewed to understand the flow of water in natural environments as well as the urban context. Beyond the foundational content, the main part of the course examines the use of water auditing at different scales - from individual homes, to institutional-commercial settings and industrial facilities, and up to the municipal scale.

In the course, water auditing is viewed as the quantification of the flow of water in a particular setting, as well as the identification of water-saving opportunities and ensuing implementation. Accordingly, we look at range of approaches and actions aimed at decreasing water consumption, reducing water wastage, and using water more efficiently at different scales. At a municipal level, specifically, we explore a number of strategies that commonly follow from water audits, including water loss control programs, economic instruments and other demand management options.

Examples and case studies of water-related issues, water management approaches, and use of water auditing are drawn from Canadian as well as international contexts.

Course Organization

The course is divided into 10 modules, one module per week. We also have two reading weeks, the first at the end of Week 3 and the second at the end of Week 6. There are three essential components to each module:

1. Weekly module notes, which are an online guide to the course material to be covered that week
2. Required readings, which are referred to in the weekly module notes and provided online
3. The weekly discussion forum, to which you are expected to contribute each week. There may be additional readings required, depending on the topic of the discussion forum. Generally, the discussion forum for a given week relates to the material covered in the module from the previous week.

During some weeks, we will also have online live chats involving the instructor and all class members, during which you will be able to ask questions and discuss course material and upcoming assignments. There will likely be two live chats during the course to be scheduled according to everyone's availability.

Additionally, there are four written assignments (due at the end of Weeks 3, 5, 7, and 10). You will be uploading your completed assignments to the course website by the due dates specified.

Course Readings

There are no required hard copy textbooks; instead, we will use several electronic books. For free access to these and other electronic sources, please go to the University of Toronto's library website at <http://onesearch.library.utoronto.ca/>. If you access these sources from off-campus, you will be prompted to log in with your UTORid for user verification. Other reading material, such as academic journals, government documents, and reports from various organizations will be posted on the course website or accessible via electronic links provided. These sources will be in Word or PDF format. You can download a version of the free Adobe Reader at: <http://www.adobe.com/products/acrobat/readstep2.html>.

Course Objectives

The course provides a well-rounded understanding of water auditing in a variety of contexts and at different scales. Through course readings, discussions, and assignments, students will become familiar with the issues affecting water resources, the rationale for water auditing, the life cycle of drinking water, and auditing as a tool to evaluate water usage as well as a foundation for strategies to reduce consumption on a long-term basis. By the end of this course, the students will:

- Understand the goals of water management: economic efficiency, social equity and environmental sustainability
- Be familiar with the regulation and governance of water resources
- Know the different types of water infrastructure in municipal settings
- Be aware of the main patterns of current water usage in Canada
- Comprehend supply vs. demand management approaches to water resources
- Appreciate what a water audit is and what can be learned from them
- Understand the different types of water audits and applications in homes, buildings, industry and at a municipal level
- Be informed on the best practices and technologies to reduce water demand and maintain continuity of supply
- Comprehend water auditing as a solid basis for water planning and management
- Know examples and case studies of water auditing from North America and beyond
- Be aware of future trends that will affect water planning and management and the important role to be played by water audits

Assignments and Grading Scheme

The grade you obtain from this course will depend on your research and writing skills, critical thinking ability, and participation in the discussion forums and live chats. There are two short papers and one final long paper due in the final week. You will also be required to hand in a short preliminary paper for the final paper, providing an overview of your topic and several key references you will be using for the final paper. In addition, it is essential to participate actively in discussion forums weekly. The grading scheme is as follows:

Two short papers (end of Weeks 3 and 5; 15% for each paper) - 30%

Participation in weekly discussion forums (throughout course) - 30%

Participation in live chats (throughout course) - 5%

Preliminary paper for the final long paper (end of Week 7) - 5%

Final long paper (end of Week 10) - 30%

The short papers will be based on the readings from the course, or will draw from additional sources, and will allow the student to synthesize materials in a critical and succinct manner. These papers will be approximately 1000-1500 words in length. The purpose of these assignments is for you to utilize your writing and critical thinking skills, and to explore the content of the course in a formal manner. The final long paper will be a research paper based on the approval of your preliminary preparation for this paper. You will receive detailed instructions for both the short and long papers once the course has started.

Overall assessment

This program requires that students achieve a grade of 70% (B-) or higher in order to pass the course. A high level of quality is expected in the work produced by students. For evaluation purposes, work will be graded based on the following criteria:

For an A+ grade (90%+): Exceptional performance: creative and original thinking; excellent organization, capacity to analyze and synthesize; superior grasp of subject matter with sound critical evaluations; evidence of extensive knowledge base.

For an A- (80-84%) to A (85-89%) grade: Strong performance: solid evidence of original thinking; good organization, capacity to analyze and synthesize; good grasp of subject matter with sound critical evaluations; evidence of broad knowledge base.

For a B (73-75%) to B+ (76-79%) grade: Good performance: evidence that the subject matter has been grasped; some evidence of critical capacity and analytic ability; reasonable understanding of relevant issues; evidence of familiarity with the literature.

For a B- grade (70-72%): Intellectually adequate performance: student who is profiting from her or his educational experience; understanding of the subject matter and ability to develop solutions to simple problems in the material.

Student Obligations

a) Students are expected to participate "in class" every week with a **minimum** of twice weekly participation in the discussion forum. Participation counts for 35% of your overall mark and will be based on regular contributions to both the weekly discussion forums (30%) and live chats (5%), so do participate regularly. A rubric on the measure of quantity and quality of your participation in the discussion forum will be used for evaluation, as shown below:

Promptness and initiative	Does not respond to most postings; rarely participates freely	Responds to most postings several days after initial discussion; limited initiative	Responds to most postings within 24 hours; at times requires prompting to post	Consistently responds to postings in less than 24 hours; good self-initiative
Relevance of posts	Posted topics do not relate to discussion content; short or irrelevant remarks	Occasionally posts off topic; most posts are short and offer little insight into the topic	Frequently posts topics related to discussion content; prompts further discussion of topic	Consistently posts relevant topics; cites additional references related to topic
Ideas and opinions of posts	Does not express opinions or ideas clearly; no connection to topic	Minimal expression of opinions and ideas; often unclear connection to topic	Opinions and ideas stated clearly; occasional lack of connection to topic	Opinions and ideas stated clearly with obvious connection to topic

Contribution to group environment	Does not make effort to participate in group environment as it develops; seems indifferent	Occasional meaningful reflections on the group discussion; marginal effort to become involved in the group	Frequently attempts to direct the discussion and presents relevant viewpoints for consideration;	Consistently attempts to direct and motivate the group discussion; presents creative approaches to topic
Grammar and spelling	Poor spelling and grammar in most posts; posts appear "hasty"	Errors in spelling and grammar in several posts	Few grammatical or spelling errors in posts	Consistently grammatically correct posts with rare misspellings

For the weekly discussion forums, the basic expectation in the course is a minimum of two substantive posts per week (each post being 200+ words). Posts can include your own ideas and thoughts on the weekly topic and related course material, as well as responses to the posts of others in the class. Please be aware that, as noted in the rubric above regarding promptness and initiative, *when* you make your posts is important; posts made earlier in the week count more in the grading scheme than those made at the end of the week, for the reason that the early posts represent more of a contribution to the class discussion. Don't leave your posts to the last minute!

b) Students are expected to meet deadlines for written assignments. The assignments will have specific due dates. If you are unable to meet one of the deadlines (for a legitimate reason such as illness), please e-mail the course instructor in advance of the deadline. If you do not notify the instructor regarding your late assignment in advance, your paper will still be accepted, but a late penalty of 5% per day will apply. Assignments will not be accepted beyond one week past the due date, unless the student has obtained prior permission from the instructor.

c) Students are advised to check the Announcements page on the course website every few days for any new announcements posted and to also check their utoronto e-mail accounts regularly for course-related information and weekly updates sent by the course instructor.

Discussion Forum Etiquette

In discussion forums, remember to *think, discuss, and debate* from a multitude of perspectives. Both the instructor and the student will use language that is scholarly and professional.

Express yourself *clearly, accurately, and in an intellectual* rather than in a personal fashion. Discussion forums are designed for you to ask questions and gain further knowledge. Remember to reason intelligently with the instructor and other students. As the study of environmental management is a broad field and is continually evolving, please feel free to give your view or interpretation based on your own experiences.

Develop *awareness* of your own ethnocentrism and make conscious efforts to ameliorate it. Keep in mind that the course materials will come from a wide cross-section of fields of study and may use jargon that is not familiar to you. Seek to understand the subtleties of these new terms to gain a deeper understanding of the material being presented. Please ask about concepts or terms that you do not understand.

Remember, if you have a question, it is likely someone else has the same question. Also, be conscious of the language you use when you speak about race, ethnicity, and gender. And be careful to avoid any bigoted or exclusive language.

Students who express themselves *inappropriately* or attack others personally in the discussion forums will lose their points for participation, and possibly their privilege to continue. Most students are considerate and respectful of others, but once in a while, someone acts inappropriately which can detract from the experience of others.

Live Chats

The live chats will involve scheduled times for the class to meet on-line together periodically to get to know one another, review material related to the readings, ask questions about assignments, and discuss water-related issues in Canada and elsewhere. The format of the chats is text-based in live or real-time (not audio, so you will not need headphones).

WEEKLY MODULE SCHEDULE

MODULE 1: Introduction to Water Management and the Role of Water Auditing

This introductory module will enable students to get to know one another and the course instructor and become familiar with the online format of the course. The module content will provide an introduction to water auditing, review the hydrological cycle and the urban water cycle, and examine global patterns of water consumption. As further foundation for the study of water-related issues, this module looks at human rights to clean water and adequate sanitation, governance of water resources, and the fundamental goals of water management: economic efficiency, social equity and environmental sustainability.

MODULE 2: Water Infrastructure and Services

In Module 2, we consider our sources of water, both conventional and non-conventional, and the vulnerability of water sources to overuse and depletion. We then look at the three main types of water infrastructure in urban areas: water supply, sewage collection and treatment, and stormwater management. Innovative approaches to water services are then examined, using a case study of Australia. The module concludes with a brief review of water infrastructure and services in the developing world.

MODULE 3: Quantifying Water use

In water planning and management, it is important to understand where and how water is being used. In Module 3, different categories of water use are covered, including the distinction between consumptive and non-consumptive use, as well as issues related to data availability and data quality. The module then examines water use in Canada and dominant patterns and trends. We also take a brief look at virtual water, a concept related to the indirect use of water.

Short paper 1 due at end of Week 3

MODULE 4: Water Auditing in Homes

Having looked at the big picture of water management and water consumption over the past three weeks, we now turn to water auditing at a small scale – in homes. The module explains how household audits are conducted and how they can become a basis for action to conserve water and reduce water wastage. In addition, we look at overall trends in household water consumption in Canada and make comparisons to other countries, and consider the range of factors that influence levels of household water consumption. The module concludes with an overview of water-saving technologies for the home.

MODULE 5: Water Auditing in Institutional and Commercial Settings

In Module 5, we go over the diversity of water users in the institutional-commercial sector and the general patterns of end uses in these types of settings. The basic steps involved in conducting a water audit at an I-C facility are then reviewed, including the use of a water flow diagram and water balance sheet, and the development of an action plan. Module content also covers the general benefits of water auditing at institutional-commercial facilities and presents several examples from this sector.

Short paper 2 due at end of Week 5

MODULE 6: Water Auditing in the Industrial and Agricultural Sectors

In this module, industries are examined first, including the various ways in which water is utilized in this sector. Then we review the steps involved in industrial water audits, followed by a look at common ways to reduce water consumption and the general benefits of water auditing at industrial facilities. Case studies of industrial water use are provided and a new international water standard is briefly covered. The last part of the module looks at the agricultural sector, in particular, how water supply for irrigation can be conserved and used more efficiently.

MODULE 7: Water Auditing at the Municipal Level - I

This week is the first of three weeks devoted to municipal water auditing. Module material begins with a look at how water is used in the municipal sector. We then take an overview of the municipal water audit process and the types of benefits that can be achieved. Next, a framework of water demand management is presented, which relates to how municipal water audits can be potentially used. The last section of the module examines one common type of demand management strategy that can ensue from an audit, namely, water leakage control programs.

Preliminary paper due at end of Week 7

MODULE 8: Water Auditing at the Municipal Level - II

In Module 8, the second of three weeks on municipal water audits, we focus on economic instruments as part of the water demand management framework you were introduced to in Module 7. Module content examines one type of economic instrument, water pricing, as a strategy to promote water conservation and efficiency from global and Canadian perspectives. We review different systems of pricing, the use of metering, and the concept of conservation-oriented pricing. The module ends with a look at water-related rebates, another type of economic instrument.

MODULE 9: Water Auditing at the Municipal Level - III

In this module, the last week on municipal water auditing, we review possible reasons why not all municipal water providers have not made water auditing a part of their routine operations. We then shift focus to best practices in water resources management. In the last part of the module, we examine several case studies of urban water management from different parts of the world in light of the best practices and also draw connections to water auditing.

MODULE 10 – Course Conclusion

In our final module of the course, we revisit the potential of water auditing to lead to tangible actions to conserve water and use it more efficiently at the various scales we have considered in the course – from a single home up to a large city. Lastly, we revisit how water auditing can play a significant role in achieving the fundamental goals of water management: economic efficiency, social equity, and environmental sustainability.

Final paper due at end of Week 10