

SC 448

Groundwater Monitoring Techniques

3 Credits

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Created: 19/01/2010

Revised: 01/04/2020

Approval: 08/05/2020

The Implementation Date for this Outline is 04/01/2021

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SC 448 Version: 8



Groundwater Monitoring Techniques

Calendar Description

This course introduces students to equipment and methods commonly used when conducting groundwater monitoring projects. The student learns how to plan and implement a fieldwork program including conducting a desk study, field and lab evaluation of aquifers, borehole selection, taking and interpreting water level, chemistry and pump test data, and using safe working practices. Students are introduced to the impacts on groundwater resources due to agricultural, oil and gas production, and other industrial activities.

Rationale

This is a required course for students for both the Applied Environmental Sciences and the Environmental Conservation and Reclamation majors of the Environmental Science diploma. As exploitation of and impact on groundwater resources increase, the need for proper monitoring and data collection becomes very important. Such data is directly used in making groundwater management decisions which affect present and future resource users.

Prerequisites

SC 301

or equivalent water resources competency strongly encouraged

Co-Requisites

None

Course Learning Outcomes

Upon successful completion of this course, students will be able to

1. describe the interaction of groundwater and surface processes.
2. describe the geologic controls on groundwater movement.
3. plan for how to conduct a hydrogeologic investigation and gather data.
4. use field and lab techniques in order to describe the geologic and hydrologic characteristics of the subsurface.

5. use field techniques to determine and evaluate ground water levels and interpret these data.
6. describe and use relevant equipment to conduct various types of pumping tests.
7. use field techniques to measure for chemical constituents in groundwater and interpret chemical data.
8. describe the techniques to properly install piezometers and water wells.
9. describe good working practices used in a groundwater monitoring field setting.
10. describe environmental and use issues surrounding groundwater.
11. describe basic government regulation and compliance issues surrounding groundwater in Alberta.

Essential Employability Skills

Essential employability skills are critical for workplace success and lifelong learning. Lakeland College prepares its graduates for the workplace and lifelong learning by integrating and promoting essential employability skills development in its curricula. Each credit course offered at Lakeland College emphasizes one or more of the following five essential employability skills:

- A. **Communication Skills** that enable individuals to listen, interpret, express, and convey knowledge and ideas so that they are received and understood.
- B. **Teamwork Skills** that enable individuals to respect the thoughts and opinions of others as they work together to plan activities, meet deadlines, complete projects, and contribute to an organization's goals.
- C. **Critical Thinking Skills** that enable individuals to conceptualize and analyze issues from various perspectives while rationally evaluating the strengths and limitations of each perspective and deciding what action to take.
- D. **Adaptability Skills** that enable individuals to respond quickly, willingly, and positively to new conditions and changing times.
- E. **Positive Attitude and Behavioural Skills** that enable individuals to be confident about themselves and to deal with people, problems, and situations with honesty, integrity, and personal ethics.

Resource Materials

Required Text(s):

SC 448 Course Pack

Reference Text(s):

Fetter, C.W. 2001. Applied Hydrogeology. 4th ed. Prentice Hall Inc. 598 pgs.

Sanders, L. 1998. A manual of Field Hydrogeology. Prentice Hall Inc. 381 pgs.

Schwartz, F., and H. Zhang. 2003. Fundamentals of groundwater. John Wiley and Sons. 583 pgs.

Conduct of Course

This course consists of approximately 42 hours of lecture and 28 hours of lab.

Evaluation Procedures

The final mark consists of:

Course Activity	Portion of Final Mark
Midterm Exam	30%
Final Exam	30%
Laboratory Assignments	30%
Quizzes/Assignments	10%

To obtain credit for this course, **all lab exercises must be completed.**

Knowledge/Skills Matrix

Students apply and demonstrate their knowledge and skills to use

A. Communication Skills

A1. by listening, reading, interpreting information, and communicating effectively
Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7
A2. by using written, spoken, and/or visual formats and media to communicate and meet needs of each particular audience
Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments / Goals 3-7
A3. by using libraries, Internet, technical publications, journals and other sources to find pertinent information
Evaluation(s)/Goal(s): Lab Assignments / Goals 3-7

B. Teamwork Skills

B1. by using interpersonal skills to create an atmosphere that maximizes the strengths of group members to accomplish tasks
Evaluation(s)/Goal(s): Lab Assignments /Goals 3-7
B2. by using interpersonal skills to resolve conflict, relate to others, and assist others
Evaluation(s)/Goal(s): Lab Assignments /Goals 3-7
B3. by contributing and listening to others as group determines realistic objectives, prioritizes tasks, and identifies resources and timelines
Evaluation(s)/Goal(s): Lab Assignments /Goals 3-7
B4. by treating other members of the group open-mindedly and fairly
Evaluation(s)/Goal(s): Lab Assignments /Goals 3-7

B5. by developing tactics/strategies to accomplish tasks

Evaluation(s)/Goal(s): Lab Assignments /Goals 3-7

C. Critical Thinking Skills

C1. by seeing critical thinking as a lifelong process of self-assessment

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

C2. by examining problems closely

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

C3. by examining beliefs, assumptions, and opinions, and weigh them against the facts

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

C4. by seeking out the truth

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11 Lab Assignments /Goals 3-7

C5. by finding solutions; make decisions

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

C6. by incorporating new ideas that may not necessarily agree with previous thought on the topic

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

C7. by seeing connections between topics and use knowledge from other disciplines to enhance reading and learning experiences

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

D. Adaptability Skills

D1. by working independently or as part of team

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments Goals 3-7

D2. by carrying out multiple tasks or projects

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

D3. by being innovative and resourceful: identify and suggest alternative ways to get the job done

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

D4. by being open and respond constructively to change and uncertainty

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

E. Positive Attitude and Behavioural Skills

E1. by dealing with people, problems, and situations with honesty, integrity, and personal ethics

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

E2. by showing interest, initiative, and effort

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

E3. by affirming the need for positive solutions and encourage positive interaction and feedback

Evaluation(s)/Goal(s): Exams & Quizzes/ Goals 1-11; Lab Assignments /Goals 3-7

E4. by balancing personal and family activities with job-related activities

Evaluation(s)/Goal(s): Lab Assignments /Goals 3-7

Grade Equivalents and Course Pass Requirements

A minimum grade of D (50%) (1.00) is required to pass this course.

Letter	F	D	D+	C-	C	C+	B-	B	B+	A-	A	A+
Percent Range	0-49	50-52	53-56	57-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100
Points	0.00	1.00	1.30	1.70	2.00	2.30	2.70	3.00	3.30	3.70	4.00	4.00

Students must maintain a cumulative grade of C (GPA - Grade Point Average of 2.00) in order to qualify to graduate.

Attendance

Classroom and laboratory attendance is considered vital to the learning process and as significant to the students' evaluation as examinations and reports, therefore absenteeism is recorded.

- a. Students having a combination of excused and/or unexcused absence of 20 percent or higher for the scheduled course hours can be required to withdraw and would then automatically receive a "RW" (required withdrawal) for the course, regardless of any other evaluation results. (RW is a failing grade).
- b. An excused absence is one that is verified with your instructor. Verification should be prior to the absence or the next class day following the absence. Verification of the absence may take the form of a note from your doctor/College nurse regarding illness, or a note from another instructor regarding a field trip or other activity, or authorization by your instructor following an in-person meeting. Be sure to contact your instructor and ask what they will require from you as verification for each absence. An unexcused absence is anything NOT verified by the instructor prior to the absence or the next class day following the absence.

NOTE: Any exceptions to the above attendance policy (e.g. timetable conflicts, work-related issues) must be approved in writing by the Department Chair prior to the beginning of the course.

It is the students' responsibility to know their own absentee record.

Normal hours are 8:30 a.m. to 6:30 p.m., with potential for evening courses, exams or extended field trips. Students are expected to be available for classes during these times.

Course Units/Topics

Lectures

1. Introduction to Groundwater Monitoring

- Water Cycle
- Groundwater Resources
- Aquifer Systems
- Groundwater Monitoring

2. Principles of Groundwater Flow

- Properties of Aquifers
- Porosity and Hydraulic Conductivity
- Hydraulic Head and Gradient
- Darcy's Equation
- Groundwater Level Mapping

3. Monitoring Wells

- Groundwater Monitoring Systems
- Well Siting
- Design, Drilling and Installation
- Development and Abandonment
- Vertical Flow Measurement

4. Measuring Water Levels

- Groundwater Level Measurement Devices and Techniques
- Barometric Compensation
- Measuring Ground Levels and Locations
- Interpretation of Water Levels
- Groundwater Contour Maps and Flownets
- Determination of Flow Direction

5. Measuring Geochemical Parameters

- Well Purging
- Field Geochemical Measurements
- Groundwater Sampling Devices
- Sample Analysis

6. Field Tests

- Slug Test – Types, Planning and Field Methods
- Pumping Test – Types, Planning and Field Methods

7. Project Planning and Good Working Practices

- Stages of a Groundwater Investigation
- Field Work Program
- Field Notebook
- Good Working Practices

8. Groundwater Regulation and Issues

- Groundwater Issues and Management
- Groundwater Regulation in Alberta
- Allocations – Approvals and Licenses
- Field Work Scenarios and Required Regulations

LABORATORY SCHEDULE

Laboratory activities include combinations of field data collection and in-class analysis, and may address the following topics:

- Introduction to Groundwater Consulting, Well Construction and Well Reports
- Use of Lab Permeameters to Estimate Vertical Hydraulic Conductivity
- Use of Pressure Transducers to Measure Water Level in a Piezometer
- Monitoring Network Surveying and Groundwater Flow Maps
- Purging and Well Development
- Estimating Horizontal Hydraulic Conductivity using a Rising Head Slug Test



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