Peel Region

Peel Water Story Teacher Handbook

What we do on land is mirrored in the water

Contents

Introduction

The Peel Water Story is a series of online learning modules for educators and students in grades 5-12 to learn about local watersheds, water sources, and water quality. The modules use the ArcGIS Online Story Map application, include an introductory element of Geographic Information Systems (GIS), and can be adapted for multiple subject areas. Each module is curriculum-linked and designed to be completed in 40 minutes or less. The modules can be used to deliver an individual lesson or kick-start further exploration and learning.

The Peel Water Story contains 3 modules that were tested and improved upon through feedback from Peel Region District School Board and Dufferin-Peel Catholic District School Board teachers. The modules can be completed in any order.

Module	**After completing this module, students will be able to:**
Lay of the Land	• Define a watershed • Use an online map to identify which watershed they live in as well as nearby waterbodies • Define stormwater and runoff • Be able to explain the various parts of a stormwater system and why a stormwater system is required
Taking the Plunge	• Define point and non-point source pollution • Understand how pollutants such as salt enter and impact our watersheds • Identify the steps taken following a spill
Rain to Drain	• Define surface water and groundwater • Identify the source and route of their tap water • Identify the destination and route of their wastewater • View changes in land use over time

Why GIS?

- Provides real data for students to explore and connect with their community
- Connects students to infrastructure elements that would otherwise be hidden underground or not accessible to the public

- Helps students understand content in many disciplines including geography, history, math, environmental studies, biology, chemistry and enables teachers to find multiple entry points into their curriculum
- Helps visualize data and provide real world applications

Lay of the land

Module overview

Length of lesson: 40 minutes

Preparation: Access to computer lab or class set of laptops / tablets

Key themes: Review of water cycle, watersheds, stormwater, urbanization, and watershed health

Learning goals:

At the end of this module, students will be able to:

- Define a watershed
- Use an online map to identify which watershed they live in and what waterbodies are located within their watershed
- Define stormwater and runoff
- Explain the various components of a stormwater system and their importance

Additional opportunities for discussion:

What are the important natural and historical features in your watershed? How are you connected to the existing ecosystems?

Think about human interventions and how they can impact the watershed. Discuss which have harmed the natural ecosystems and what human interventions are trying to tackle these issues.

How do household and industry activities in your community impact the health of your watershed?

Handout answer sheets

GIS activity: Your watershed address handout answer sheet

NOTE: Answers to this handout will vary based on the school selected. This answer sheet uses Thomas Street Middle School as an example.

Familiarize yourself with the map. Identify the various FEATURES you will need on the map, including the search bar, layers icon, and zoom functions.

1. **Your watershed address**
   Use the following steps to identify the watershed you live in:
   a) Select the layers icon (beside the search bar) at the top of the map to turn on the school layer.
   b) Type your school address in the search bar. Make sure the suggested address that appears is in the correct city and country before selecting it.
   c) Zoom out until the name of your watershed appears. What watershed is your school located in?

      i.e. Thomas Street Middle School-2640 Thomas St, Mississauga, Ontario, L5M 5G8, Watershed-Credit River

2. **Nearby water**
   Use the following steps to follow the water flowing through your watershed:
   a) Select the layers icon to turn on the rivers, creeks, and streams layers.
   b) Begin at your school and zoom in or out until you identify the nearest river, creek, or stream. What is the name of the nearest river, creek, or stream?

      The closest creek is Mullet Creek.

   c) Follow this body of water. Does it connect to another river, creek, or stream?

      Yes, it connects to the Credit River.

   d) If yes, what is the name of this second river, creek, or stream?
      Lake Ontario

3. After watching the videos and using the maps, reflect on water on your school ground. Think about areas where water travels, creates puddles, is absorbed,

or goes down a drain. Describe how rainwater might move through your school ground.

Water around my school grounds would pool and flow into catch basins which lead into nearby creeks and rivers. Not much of it would be absorbed on the school grounds because there is mostly pavement and few greenspaces.

4. How do you think this movement or storage of water on your school ground can impact the larger watershed?

   Since water would runoff the school's grounds into nearby waterways and not be absorbed greenspaces, it would cause an increase in water levels in the larger watershed.

GIS activity: Go with the flow handout answer sheet

Familiarize yourself with the watershed map. Identify the various FEATURES you will need on the map, including the search bar, layers icon and zoom functions.

Follow these steps to compare storm water catch basins on school grounds.

1. Select the search icon and enter **296 Conestoga Dr, Brampton, Ontario**. This address will take you to Heart Lake Secondary School.
    a) Select the layers icon (beside the search bar) at the top of the map.
    b) Turn off the regional stormwater outflow and regional stormwater main layers.
    c) Turn off the City of Brampton catch basin layer.
    d) Zoom in until you can see the school property and surrounding streets.
    e) How many catch basins are located on the Heart Lake Secondary School property?

    Between 13-15

    f) Describe the surfaces that immediately surround the school. Are the surfaces permeable or non-permeable?

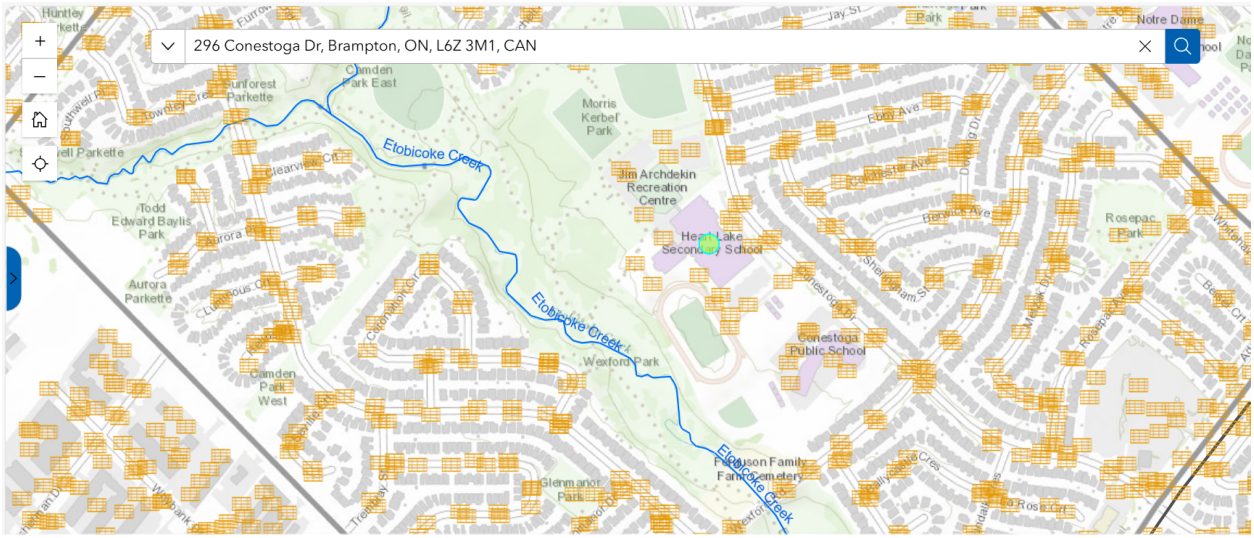
    The surfaces are non-permeable
2. Using the same steps, count the number of catch basins at **1305 Cawthra Road, Mississauga, Ontario** (Cawthra Park Secondary School – aquatics building)
    a) Select the layers icon (beside the search bar) at the top of the map.
    b) Turn off the regional stormwater outflow and regional stormwater main layers.
    c) Turn off the City of Mississauga catch basin layer.
    d) Zoom in until you can see the school property and surrounding streets.
    e) How many catch basins are located on Cawthra Park Secondary School property?

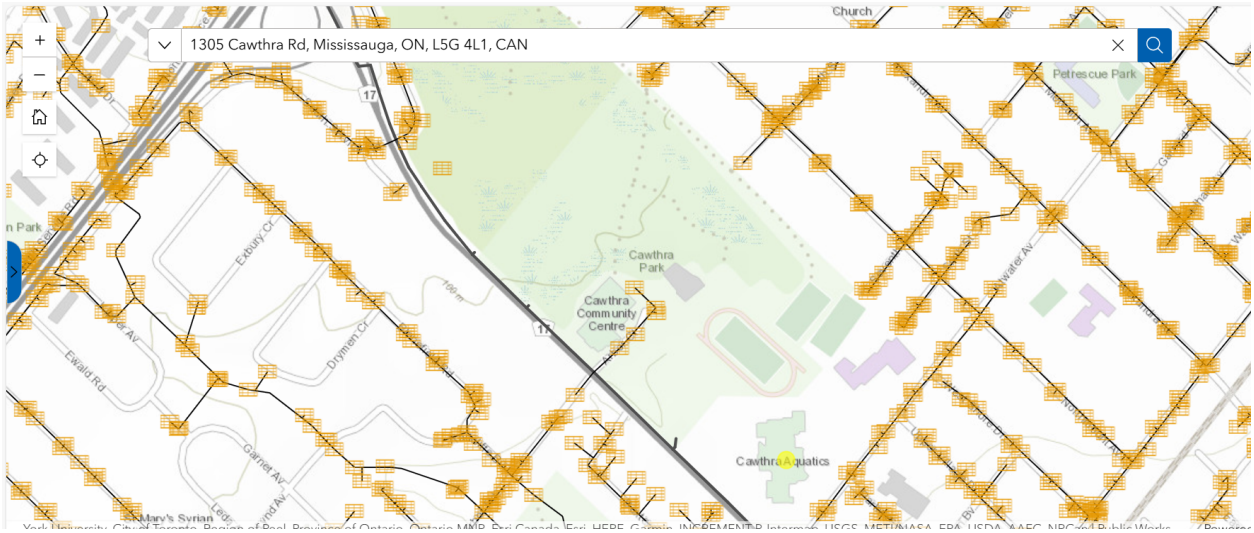
    There are 0

    f) Describe the surfaces that immediately surround the school. Are the surfaces permeable or non-permeable?

    The surface that surrounds Heart Lake Secondary School has a school nearby and includes many greenspaces including parks and Etobicoke Creek. Similarly, the surface area that surrounds Cawthra Park Secondary

School property has another school beside it and a lot of greenspaces nearby.





3. Based on your understanding of storm water and runoff, what area around each school would contribute to more runoff? What area would reduce runoff?

   Roads and developed land are non-permeable surfaces. This means that melted snow and rain would not be able to soak into these surfaces and would pool in low-lying areas. These low-lying areas have more storm drains to direct runoff away from homes, schools, and businesses.

   Both schools contribute similar runoff; however, Heart Lake Secondary School has between 13-15 storm drains while Cawthra Park Secondary School has 0. This indicates that runoff is directed toward Heart Lake Secondary School and away from Cawthra Park Secondary School and toward green spaces. Areas with

more grass, plants and greenspaces will soak up much more rainwater and snow melt.

4. If your school is in Brampton or Mississauga, search for it and look at the school grounds. How does your school compare to the other schools? (**Note: at this time, storm water data is only available for the City of Brampton and the City of Mississauga).**

   Answers will vary depending on the school chosen.

Handout activity sheets

GIS activity: Your watershed address

Name:

Familiarize yourself with the map. Identify the various FEATURES you will need on the map, including the search bar, layers icon and zoom functions.

1. **Your watershed address**
   Use the following steps to identify the watershed you live in:
   a) Select the layers icon (beside the search bar) at the top of the map to turn on the school layer.
   
   b) Type your school address in the search bar. Make sure the suggested address that appears is in the correct city and country before selecting it.
   c) Zoom out until the name of your watershed appears. What watershed is your school located in?
2. **Nearby water**
   Use the following steps to follow the water flowing through your watershed:
   a) Select the layers icon to turn on the rivers, creeks, and streams layers.
   
   b) Begin at your school and zoom in or out until you identify the nearest river, creek, or stream. What is the name of the nearest river, creek, or stream?
   c) Follow this body of water. Does it connect to another river, creek, or stream?
   d) If yes, what is the name of this second river, creek, or stream?

3. After watching the videos and using the maps, reflect on water on your school ground. Think about areas where water travels, creates puddles, is absorbed, or goes down a drain. Describe how rainwater might move through your school ground.

4. How do you think this movement or storage of water on your school ground can impact the larger watershed?

GIS activity: Go with the flow

Name:

Familiarize yourself with this map. Identify the various FEATURES you will need on the map, including the search bar, layers icon and zoom functions.

Follow these steps to compare storm water catch basins on school grounds.

Note: Storm water data is available for the City of Brampton and City of Mississauga ONLY.

1. Select the search icon and enter **296 Conestoga Dr, Brampton, Ontario**. This address will take you to Heart Lake Secondary School.
    a) Select the layers icon (beside the search bar) at the top of the map.
    b) Turn off the regional stormwater outflow and regional stormwater main layers.
    c) Turn off the City of Brampton catch basin layer.
    d) Zoom in until you can see the school property and surrounding streets.
    e) How many catch basins are located on the Heart Lake Secondary School property?
    f) Describe the surfaces that immediately surround the school. Are the surfaces permeable or non-permeable?
2. Using the same steps, count the number of catch basins at **1305 Cawthra Road, Mississauga, Ontario** (Cawthra Park Secondary School – aquatics building)
    a) Select the layers icon (beside the search bar) at the top of the map.
    b) Turn off the regional stormwater outflow and regional stormwater main layers.
    c) Turn off the City of Mississauga catch basin layer.
    d) Zoom in until you can see the school property and surrounding streets.
    e) How many catch basins are located on Cawthra Park Secondary School property?
    f) Describe the surfaces that immediately surround the school. Are the surfaces permeable or non-permeable?
3. Based on your understanding of storm water and runoff, what area around each school would contribute to more runoff? What area would reduce runoff?

4. If your school is in Brampton or Mississauga, search for it and look at the school grounds. How does your school compare to the other schools? (**Note: at this time, storm water data is only available for the City of Brampton and the City of Mississauga).**

Curriculum connections

Grade	Subject & Unit	Specific Expectations
6	Science and Technology: Understanding life systems	• Assess human impacts on biodiversity, and identify ways of preserving biodiversity
7	Science and Technology: Understanding life systems	• Assess the impacts of human activities and technologies on the environment, and evaluate ways of controlling these impacts
	Science and Technology: Understanding matter and energy	• Evaluate the social and environmental impacts of the use and disposal of pure substances and mixtures
8	Science and Technology: Understanding earth and space systems	• Assess the impact of human activities and technologies on the sustainability of water resources • Investigate factors that affect local water quality • Demonstrate an understanding of the characteristics of the Earth's water systems and the influence of water systems on a specific region
9	Science	• Assess the impact of human activities on the sustainability of terrestrial and/or aquatic ecosystems, and evaluate the effectiveness of courses of action intended to remedy or mitigate negative impacts • Investigate factors related to human activity that affect terrestrial and aquatic ecosystems, and explain how they affect the sustainability of these ecosystems
	Geography: The Physical Environment and Human Activities	• Analyse various interactions between physical processes, phenomena, and events and human activities in Canada
	Geography: The Characteristics of Canada's Natural Environment	• Describe various characteristics of the natural environment and the spatial distribution of physical features in Canada, and explain the role of physical processes, phenomena, and events in shaping them
10	Science	• Investigate various natural and human factors that influence Earth's climate and climate change
11	Geography: Patterns of Natural and Human Systems	• Describe patterns in natural features and population distribution in the selected region, and analyse the relationship between them
	Environmental Science	• Investigate air, soil, and water quality in natural and disturbed environments, using appropriate technology

Taking the plunge

Module overview

Length of lesson: 40 minutes

Preparation: Access to computer lab or set of laptops/tablets

Key themes: Categories of water pollution (point source and non-point source), salt and chloride levels in our watersheds and spill cleanup protocols

Learning goals:

At the end of this module students will be able to:

- Define point source and non-point source pollution
- Understand the negative impacts of salt our watersheds
- Use an online map to identify areas in their watersheds with high levels of chloride
- Understand how spills are treated and cleaned up in our waterways

Additional discussion opportunities:

What are some other examples of point source and non-point source pollution in our Region?

Can you think of a time where pollution (point source or non-point source) has affected your daily life?

Think about why salt might affect species of native plants and animals in our watershed, even though it is a natural substance and is found in many different waterways across the world. Discuss which types of animals or species would be more affected by high salt concentrations than others.

What are some ways we could prevent or decrease the number of point source spills occurring in our Region? What about our country?

Handout answer sheets

GIS activity: Graphing chloride in the Credit answer sheet

Familiarize yourself with the map. Identify the various FEATURES you will need on the map, including the search bar, layers icon and zoom functions.

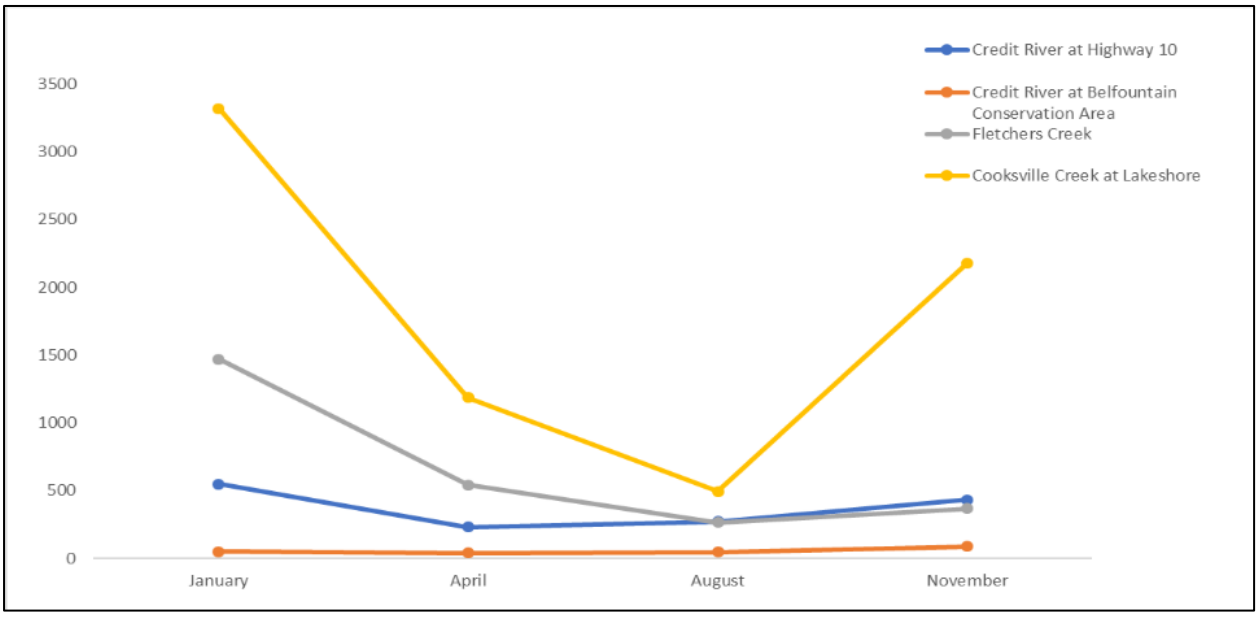
1. Use the following steps to view the chloride monthly average data:
    a) Zoom out until you can see all of Peel Region on your screen. 
    b) Select the layers icon (beside the search bar) and make sure that the Chloride Monthly Average layer is turned on.
    c) Select the purple dots that represent the locations listed on the table in your handout.
    d) Use the data to complete the table on your handout.
2. Use the following steps to identify land use type:
    a) Select the layers icon at the top of the map, to turn on the Land Use layer.
    b) Click on legend to show the land use types.
    c) Identify the land use type immediately surrounding each location (this may include more than one type of land use) and enter this information in the table on your handout.

Location	January Monthly Average Chloride (mg/L)	April Monthly Average Chloride (mg/L)	August Monthly Average Chloride (mg/L)	November Monthly Average Chloride (mg/L)	Land Use Type
Credit River at Highway 10	***550***	***231***	***272***	***431***	***Rural***
Credit River at Belfountain Conservation Area	***51***	***41***	***48***	***88***	***Conservation Area***
Fletchers Creek	***1,470***	***541***	***264***	***368***	***Estate***
Cooksville Creek at Lakeshore	***3,318***	***1,188***	***493***	***2,181***	***Employment***

3. Using the graph paper on your handout and data from your table, plot the chloride levels throughout the year for each location.

a) Use a pencil crayon and ruler to connect the dots representing chloride levels at each location.

b) Use different colours for different locations (example: use red to connect the dots you plotted for the Credit River at Highway 10 location and a green to connect the dots you plotted for the Fletchers Creek location).



4. Now use the table and graph you've created to answer the questions below about the 2019 Credit River chloride levels.

a) At which location were chloride levels the highest? In which month did this occur?

Chloride levels are the highest at Cooksville Creek at Lakeshore. This occurred in January.

b) Why do you think chloride levels were the highest in this month?

The chloride levels are the highest in this month because it is winter and more road salt is being used on icy roads and sidewalks.

c) What kind of land use is associated with the highest chloride levels?

The land use type that is associated with the highest chloride levels are employment areas.

d) What kind of land use is associated with the lowest chloride levels?

The land use type associated with the lowest chloride levels are conservation areas.

e) What patterns or changes do you notice about chloride levels in urban areas versus chloride levels in rural areas?

In more rural areas the chloride levels stay relatively constant in all four months, in urban areas the levels increase dramatically during winter months (November and January).

5. According to the Canadian Water Quality Guidelines for the Protection of Aquatic Life, the long-term exposure limit for certain freshwater species is 120 mg/L of chloride. This number is used to identify areas where chloride levels are high enough to negatively impact aquatic plants and fish.

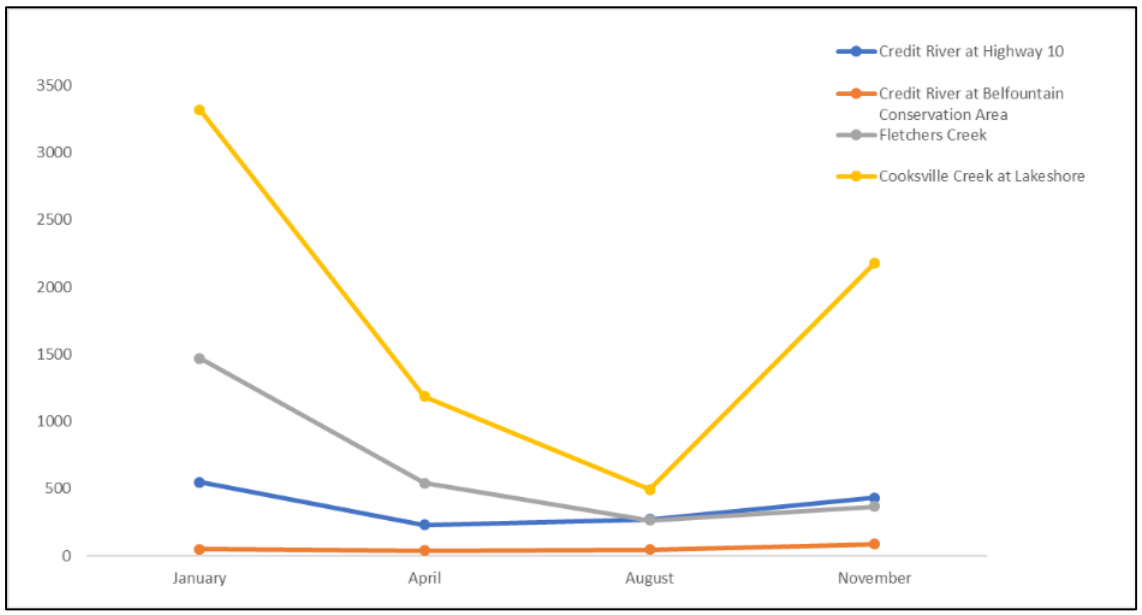
    a) Using a pencil crayon and ruler, draw a line to show 120 mg/L on your graph.

    b) Are any of the locations below the long-term exposure limit?

    The only location below the long-term exposure limit is Credit River at Belfountain Conservation Area.

    c) Do any of the locations exceed the long-term exposure limit?

    The Credit River at Highway 10, Cooksville Creek at Lakeshore and Fletchers Creek are all above the long-term exposure limit of 120 mg/L. This means that all locations (other than Credit River at Belfountain Conservation Area) have chloride levels that are far too high for certain aquatic plant and fish species and can cause negative impacts to the species found in these locations.



6. Use data from the Credit Valley Conservation Authority Real-Time Monitoring site to explore current salt levels in our watersheds.

Mississauga News: Diesel spill article answer sheet

1. Read the section called Mississauga News: Diesel Spill Article and answer the questions below.
    a. What was spilled?
    Diesel

    b. What was the source of the spill?
    A ruptured saddle tank from the tow truck caused the diesel to spill into the basin.

    c. Is this an example of point source or non-point source pollution?
    Point source pollution because the source of the spill was identified to one location.

    d. How was the spill treated and cleaned up?
    A boom was placed on the spill to contain it and prevent it from travelling downstream. The boom was left overnight to help soak up the diesel.

2. Use the internet to research Spill Coordinator careers and describe the academic and professional experience required for this job. Try searching for oil spill coordinator, environmental response coordinator, and environmental technician to expand the search.

    For this position a Bachelor of Science degree is typically required in Mechanical, Environmental or Maritime disciplines. Excellent leadership and problem-solving skills are required as they must be able to direct instructions clearly and problem solve on demand as spills can change rapidly. Other requirements include First Aid training, heavy equipment operations and experience in working with chemical compounds.

Handout activity sheets

Graphing chloride in the Credit

Name:

Familiarize yourself with the map. Identify the various FEATURES you will need on the map, including the search bar, layers icon and zoom functions.

1. Use the following steps to view the chloride monthly average data:
    a) Zoom out until you can see all of Peel Region on your screen.
    b) Select the layers icon (beside the search bar and make sure that the Chloride Monthly Average layer is turned on.
    c) Select the purple dots that represent the locations listed on the table in your handout.
    d) Use the data to complete the table on your handout.
2. Use the following steps to identify land use type:
    a) Select the layers icon at the top of the map, to turn on the Land Use layer.
    b) Click on legend to show the land use types.
    c) Identify the land use type immediately surrounding each location and enter this information in the table on your handout (Sliver Creek at Willow Park not included).

Location	January Monthly Average Chloride (mg/L)	April Monthly Average Chloride (mg/L)	August Monthly Average Chloride (mg/L)	November Monthly Average Chloride (mg/L)	Land Use Type
Credit River at Highway 10					
Credit River at Belfountain Conservation Area					
Fletchers Creek					
Cooksville Creek at Lakeshore					

3. Using the graph paper on your handout and data from your table, plot the chloride levels throughout the year for each location.

a) Use a pencil crayon and ruler to connect the dots representing chloride levels at each location.

b) Use different colours for different locations (example: use red to connect the dots you plotted for the Credit River at Highway 10 location and a green to connect the dots you plotted for the Fletchers Creek location).

4. Now use the table and graph you've created to answer the questions below about the 2019 Credit River chloride levels.

    a) At which location were chloride levels the highest? In which month did this occur?

    b) Why do you think chloride levels were the highest in this month?

    c) What kind of land use is associated with the highest chloride levels?

    d) What kind of land use is associated with the lowest chloride levels?

    e) What patterns or changes do you notice about chloride levels in urban areas versus chloride levels in rural areas?

5. According to the Canadian Water Quality Guidelines for the Protection of Aquatic Life, the long-term exposure limit for certain freshwater species is 120 mg/L of chloride. This number is used to identify areas where chloride levels are high enough to negatively impact aquatic plants and fish.

    a) Using a pencil crayon and ruler, draw a line to show 120 mg/L on your graph.

    b) Are any of the locations below the long-term exposure limit?

    c) Do any of the locations exceed the long-term exposure limit?

6. Use data from the Credit Valley Conservation Authority Real-Time Monitoring site to explore current salt levels in our watersheds. How does it compare to 2019 levels?

    a) Select Water Quality Table from right navigation (Station Data at-a-Glance).

    b) Select Chloride from navigation bar above the station column in the table.

    c) Locate station name and record the latest chloride level.

Curriculum connections

Grade	Subject & Unit	Specific Expectations
5	Science and Technology: Understanding matter and energy	• evaluate the social and environmental impacts of processes used to make everyday products
6	Science and Technology: Understanding life systems	• assess human impacts on biodiversity, and identify ways of preserving biodiversity
7	Science and Technology: Understanding life systems	• assess the impacts of human activities and technologies on the environment, and evaluate ways of controlling these impacts
	Science and Technology: Understanding matter and energy	• evaluate the social and environmental impacts of the use and disposal of pure substances and mixtures
8	Science and Technology: Understanding earth and space systems	• assess the impact of human activities and technologies on the sustainability of water resources • investigate factors that affect local water quality
9	Science	• assess the impact of human activities on the sustainability of terrestrial and/or aquatic ecosystems, and evaluate the effectiveness of courses of action intended to remedy or mitigate negative impacts • investigate factors related to human activity that affect terrestrial and aquatic ecosystems, and explain how they affect the sustainability of these ecosystems
	Geography: The Physical Environment and Human Activities	• analyse various interactions between physical processes, phenomena, and events and human activities in Canada
10	Science	• investigate various natural and human factors that influence Earth's climate and climate change
11	Biology	• analyse the effects of various human activities on the diversity of living things
	Chemistry	• analyse the properties of commonly used chemical substances and their

		effects on human health and the environment, and propose ways to lessen their impact • analyse the origins and effects of water pollution, and a variety of economic, social, and environmental issues related to drinking water
	Environmental Science	• investigate air, soil, and water quality in natural and disturbed environments, using appropriate technology • analyse the effects on human health of environmental contaminants and a significant environmental phenomenon
12	Chemistry	• demonstrate an understanding of chemical reactions that occur in the environment as a result of both natural processes and human activities

To learn more about other Peel Region education programs and resources visit: http://www.peelregion.ca/enviroed