CREDIT VALLEY CONSERVATION

Low Impact Development

Climate Change Solutions for the Credit River

Teacher Guide

Overview

What is Low Impact Development (LID)? Watch a video to learn how climate change affects cities and urban areas and how LID features can help reduce the stress on urban infrastructure. Use what you learned to design a plan for a business that wants to be prepared for climate change.

Contents

I. Learning Objectives

Students will realize that climate change is not only happening in the arctic or coastal communities but where they live as well. Many urban areas are already experiencing the impacts of climate change and extreme weather events. Students will learn that there are economic and social benefits to installing LID features, as well as minimizing climate change impacts.

Learning Objectives:
1. Potential impacts of climate change to urban infrastructure
2. How Low Impact Development can minimize climate change impacts
3. Economic and social benefits of LID features

II. Teacher Background

Climate Change and Conservation in our watershed

Instead of working inside a political boundary (within city or provincial limits), CVC works inside *watershed* boundaries. A watershed is an area of land that drains into a river - we live in the Credit River watershed. CVC is responsible for the land and water that surrounds the Credit River, including areas of Mississauga, Brampton, Georgetown, Caledon and Orangeville.

A major focus of CVC is to help the river and communities surrounding it prepare for climate change.

Vocabulary:

1. **Low Impact Development (LID):** Land planning and engineering design approach to managing stormwater runoff. LID emphasizes conservation and the use of natural features to protect water quality and reduce stress on stormwater infrastructure (storm sewers).

2. **Impermeable surface:** A surface that does not allow fluid to pass through i.e. paved asphalt, concrete roof, etc.

3. **Stormwater:** Surface water resulting from heavy rain or snowfall. Stormwater can soak into the soil, stay on the surface as puddles/floodwater, or run off and end up in nearby streams and rivers via the storm sewer system.

4. **Storm event:** Heavy rain or snow.

5. **Water Infrastructure:** Storm drains, storm sewers, drinking water and sewage pipes, roadside ditches and stormwater management ponds.

6. **Natural Water Cycle:** The movement of water between land, oceans, lakes, rivers and the atmosphere. Every time humans interrupt the natural water cycle there will be an effect.

III. Before Viewing this Video

The video is meant to be viewed after students have a basic understanding of climate change and global warming.

IV. Student Activities

Materials

- Low Impact Development video (http://www.creditvalleyca.ca/lidvideo)
- Computer and projector (if watching it in class)
- Student Guide
- CVC's Low Impact Development Case Studies (3)

Instructions for Activity # 1:

Watch the 'Low Impact Development' video and answer the viewing guide questions

Students may either watch the video at home prior to doing the in-class activity or the video can be watched together as a class. Provide the students with the link to the video

(http://www.creditvalleyca.ca/lidvideo) and the Viewing Guide Questions from Activity # 1 in the Student Guide. Students can answer the questions while watching the video.

Answer Sheet for Activity # 1: Viewing Guide Questions:

1. How does Climate Change affect our cities?

- Climate change affects the size and type of rainfall events that we receive
- It increases the risk of flooding

2. Why isn't the current stormwater infrastructure adequate?

- Current infrastructure was built based on historical climate data – it cannot handle the amount of stormwater runoff generated by climate change induced storms

3. Name three types of LID facilities:

- Rain Garden
- Bioswale
- Permeable Pavement

4. What can Low Impact Development do to help with climate-change related flooding?

- Alleviates stress on our aging water infrastructure
- Reduces the amount of runoff
- Reduces the amount of pollutants reaching our streams

Instructions for Activity # 2: (To be done in class)

Grey to Green (in class)

1. **Review** video viewing guide questions in small groups (2 to 4 students). Using shared information from the discussion, students may rewrite their answers to hand in.

2. **Have students read** the *Climate Change and Flooding in Our Cities* background information in the Student Guide (See Appendix 1). **This can be done individually, in small groups or out loud for the class.**

3. Once students are done reading the background information, they can **start the** Grey to Green activity (Appendix 2). **Follow the provided instructions** in the Student Guide to write a report to the CEO of a movie theater company about how to use LID to prepare the theatre for climate change.

4. **Remind students that they should read the LID case studies** and use what they learn to create a report addressed to the CEO of Cineplex Cinemas. The goal is to provide the CEO with options on how to minimize potential climate change impacts and to demonstrate the benefits of going 'grey to green'.

VI. Evaluation

1. Students hand in viewing guide questions and participate in discussions.
2. Students hand in their report.

Suggestions for extended learning:

1. Students can draw out a map demonstrating their plan. This map should include parking lots, buildings and any other LID features they have identified in their reports.
2. Visit an LID feature near your school.
3. Research LID projects that are being done locally or internationally.
4. Identify areas around your school/neighbourhood that could be improved using LID and discuss which LID features you would install and why.

VII. Curriculum Connections

D. Earth and Space Science: Climate Change

D1.1 - Analyse current and/or potential effects, both positive and negative, of climate change on human activity and natural systems. Some examples include the loss of habitat for Arctic mammals such as polar bears,loss of traditional lifestyles for Inuit as Arctic ice shrinks or or famine as arable land is lost to desertificationD1.2 - Assess on the basis of research, the effectiveness of current individual, regional, national or international initiatives that address the issue of climate change and propose a further course of action related to one of these initiatives i.e. community tree planting programs.

i.e. D2.1 - Use appropriate terminology related to climate change, including, but not limited to: albedo, anthropogenic, atmosphere, cycles, heat sinks and hydrosphere [C].

D2.3 - Analyse different sources of scientific data (e.g., lake cores, tree rings, fossils and preserved organisms, ice cores) for evidence of natural climate change and climate change influenced by human activity.

D2.4 - Investigate a popular hypothesis on a cause and-effect relationship having to do with climate change (e.g., the combustion of fossil fuels is responsible for rising global temperatures; the concentration of atmospheric CO2 is responsible for rising global temperatures; global temperatures have been on the increase since the industrial revolution; the severity of cyclones, hurricanes, and tornadoes increases as atmospheric temperatures increase), using simulations and/or time-trend data that model climate profiles (e.g. data from Statistics Canada and Environment Canada) [PR, AI, C].

D3.8 - Identify and describe indicators of global climate change (e.g. changes in glacial and polar ice, sea levels, wind patterns and global carbon budget assessments).

A. Scientific Investigation Skills and Career Exploration

A1.1 - Formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research.

A1.5 - Conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately and effectively to collect observations and data.

A1.7 - Select, organize and record relevant information on research topics from various sources, including electronic, print and/or human sources (e.g. websites for public health organizations, federal and provincial government publications, reference books, personal interviews), using recommended formats and an accepted form of academic documentation.

A1.8 - Analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias or uncertainty.

A1.10 - Draw conclusions based on inquiry results and research findings and justify their conclusions.

A1.11 - Communicate ideas, plans, procedures, results and conclusions orally, in writing and/or in electronic presentations, using appropriate language and a variety of formats (e.g. data tables, laboratory reports, presentations, debates, simulations and models).

A1.12 - Use appropriate numeric, symbolic and graphic modes of representation and appropriate units of measurement (e.g., SI and imperial units).

A2.1 – Identify and describe a variety of careers related to the fields of science under study (e.g. meteorologist, medical illustrator, geochemist and optical physicist) and the education and training necessary for these careers.

Appendix 1:

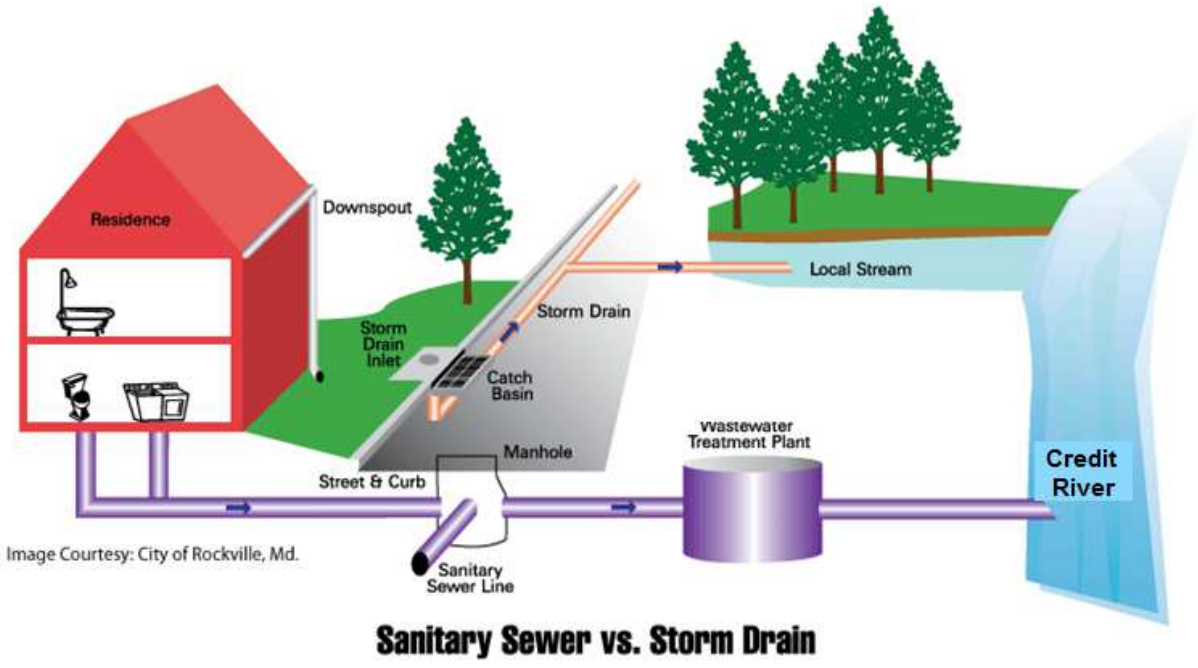
Climate Change and Flooding in Our Cities

Adapted from "Roads and Runoff: Implementing Green Streets in the Greater Golden Horseshoe" by Clara Blakelock and Clifford Maynes, 2015

Urban areas are covered in hard surfaces – buildings, parking lots, driveways, and roads. When a forest or meadow becomes a city, the impermeable surfaces interrupt the water cycle and create problems with stormwater runoff. Climate change increases runoff volumes by increasing the incidence of extreme rain and snowfall events.

Increased runoff, loss of natural areas that absorb and filter water, and combined sewer overflows result in pollution which can affect aquatic ecosystems, recreational uses, and source water for drinking. Further impacts include flooding, erosion, altered water balance in streams and rivers, and loss of groundwater recharge (which is important especially for communities relying on well water).

Road-related pollution found in stormwater includes oil, grease, metals and chemicals from vehicles, road salt, and sediment. In summer months, thermal pollution can be a major concern.



In urban areas, rain is generally removed from roads through storm drains and underground pipes, and discharged directly to rivers or lakes without being treated first.

In more recently developed areas, rain is drained to stormwater ponds, where it is held before being discharged, and some level of treatment is provided. Roadside ditches designed for conveyance perform this function in older and more rural areas.
However, these methods do not adequately treat the pollution from roads or restore the natural water balance. Many of these systems are aging and were not designed to accommodate increased volumes of runoff due to urbanization and climate change, which results in flooding that causes damage to roads themselves, homes, businesses and nearby infrastructure. Even up-to-date systems using conventional pipes and ponds cannot meet targets for quantity and quality control, and thermal pollution from stormwater ponds can shock receiving streams.

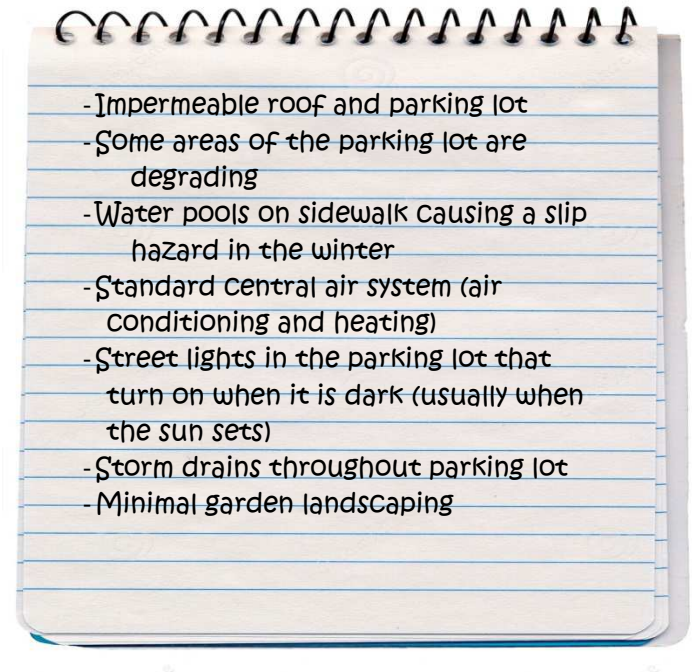
Part of the answer to the problem of urbanization and climate change is to restore and mimic the natural water cycle through a combination of natural and constructed features known as green infrastructure or low impact development (LID). Some of the measures to manage stormwater volumes can include rain gardens, permeable pavement, and urban tree planting.

Appendix 2: **Your Turn to be the Scientist – Grey to Green**

A movie theatre situated near the Credit River is concerned about climate change impacts. They are already experiencing challenges, such as ice formation in the parking lot and pedestrian paths in the winter, rising cost in energy usage, and flooding and degrading of the asphalt parking lot.

They would like to "climate change proof" their buildings and property to minimize damages that could happen during extreme weather events. Cineplex Cinemas has hired you as a consultant to advise on how to protect their assets against climate change.

You have conducted a survey of their building the property and acquired a map (red star indicates the main building and red line outlines property boundaries). You have also made some notes (below).



Using what you learned in the video and the attached case studies, create a report for the CEO of the movie theater. Your report must include:

a. *Climate change impacts that could potentially affect the theatre building and property*
b. *A plan for installing LID features, and description of how they will improve the facilities*
c. *The economic and social benefits of installing LID features*