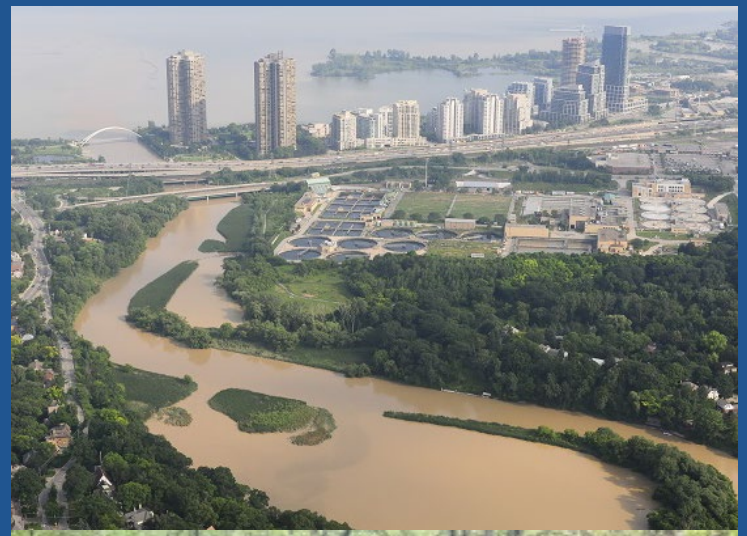

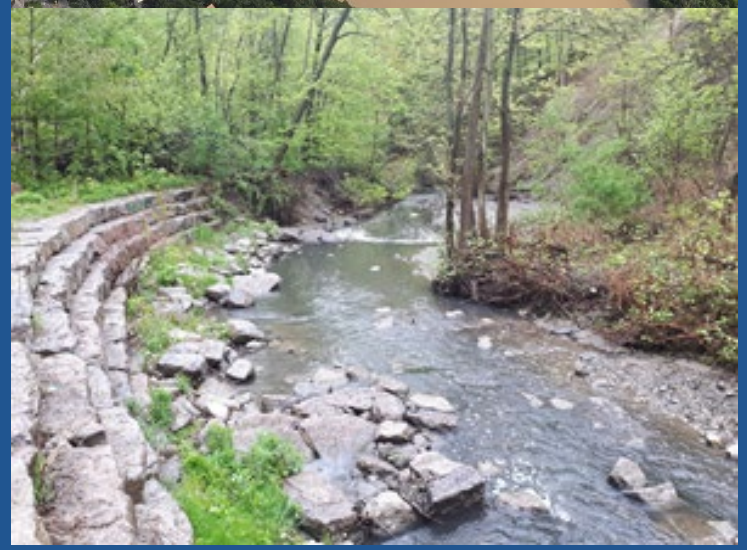

Understanding Streams

Photo Sources: Top – Humber River after large storm (Toronto and Region Conservation Authority TRCA) Bottom – Burke Brook armourstone wall (City of Toronto)

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Understanding Streams

Fluvial Geomorphology is the study of streams.

Streams are studied by:

- **Form:** width, depth, length, slope
- **Function**: movement of water and sediment
- How form and function are **interrelated** and how they **change over time**

Photo Sources: Rod Anderton (Yellow Creek)

Water and stormwater infrastructure in Toronto works with our streams, rivers, lakes and watersheds.

High flows from past storms have caused erosion damage to sewers and watermains located in and near the City's ravines and watercourses resulting in a need to protect water and sewer infrastructure from further excessive erosion.

Understanding streams helps us to develop solutions to:

- Changing conditions, such as the excessive erosion of water and sewer infrastructure
- Work with the changes in the stream
- Enhance stream functions and habitats in the long-term

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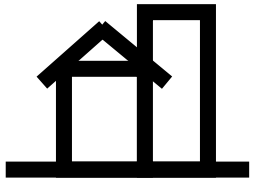
Understanding Streams

- Streams are **dynamic** and follow natural processes of erosion and laying sediment until a stable form is developed and maintained
- **Stressors** can destabilize the stream over the short or long-term causing changes in its shape, location and overall size. These stressors include:



Historical Land Use and Land Management Changes, where watershed land use and land management has been altered resulting in the obstruction of infiltration and absorption of rain and snow melt into the ground

Climate change, increases the frequency and intensity of precipitation events, including large storms, which increases the flow in streams

Historical floodplain encroachment and built controls, or adjustments, alter a stream's form in ways that counter-act natural processes, such as channelization, culverts and walls.

Photo Sources: Rod Anderton (Duncan Creek)

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Understanding Streams

How streams respond to stressors

Higher flows enter the stream

The speed and volume of water within the stream increases

The stream adjusts and accommodates the higher flows

Excessive erosion “moves” the stream closer to the City’s water and sewer infrastructure

Photo Sources: Rod Anderton (Berry Creek)

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Understanding Streams

Example of High Flows

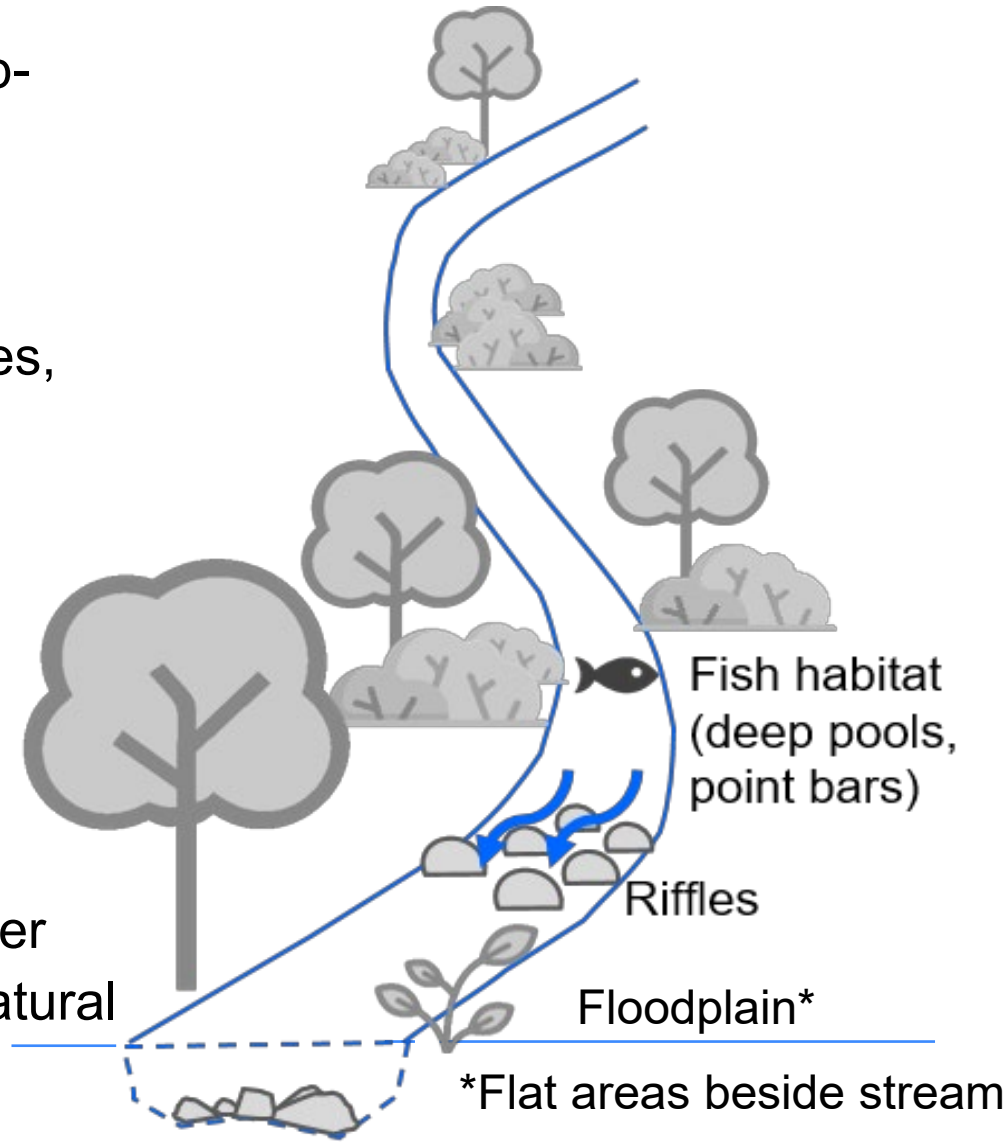
The photo on the left shows dry weather conditions in Yellow Creek near Yonge Street and St Clair Avenue. The photo below is in the same location with high flows on November 27, 2020, a few hours after a storm.

Photo source: Rod Anderton (left) John Bossons (right)

Understanding Streams

Common characteristics of natural streams include:

- Stream either meanders and curves, or is a step-pool system
- Stream has varying depths
- Diverse stream features and habitats:
  - Boulders, shallow riffles, fish spawning zones, deep pools and point bars
- Trees and vegetation provide:
  - Stream bank stability
  - Aquatic habitat
  - Cover for fish from predators
  - Shade to cool/reduce over-heating of the stream's water temperature
- This study focuses on protecting water and sewer infrastructure using solutions that incorporate natural stream characteristics as much as possible

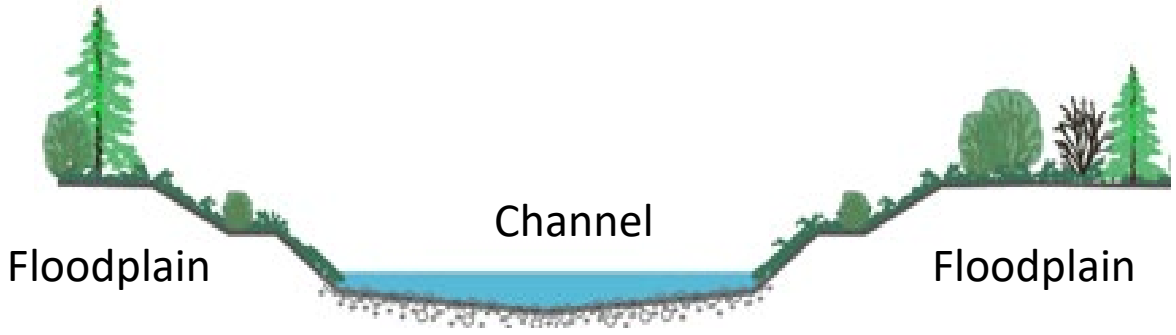


Understanding Streams

Glossary

Bank:	The sides of the stream, also part of the floodplain
Channel:	The water in the stream / creek / river / watercourse
Confluence:	Where two or more streams meet
Erosion:	The movement of soil or rock by wind, water, or other natural processes
Floodplain:	The area surrounding the stream channel which holds increased water flow when the width of the stream expands seasonally with spring snowmelt or due to storms
Geomorphology:	The study of the characteristics and history of landforms
Substrate:	The material on the stream bottom / bed

Cross-section of stream channel and floodplain



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Understanding Streams

How we develop a plan to work with a stream's geomorphology

Identify problems and causes

Identify historical context and existing stream conditions

- To determine how they influence the stream's current and future conditions
- Identify other ecological aspects such as habitats within a stream and along the banks as these are indicators of stability or instability

Collect information and evaluate existing and future conditions

Evaluate changes in the stream's form and function as a response to stressors

- Evaluate how, and at what rate, a stream's form and function changes
- Evaluate how this is impacting water and sewer infrastructure

Develop Solutions

Develop and design an improved stream form that will:

- Protect water and sewer infrastructure
- Improve stream function, such as increasing stream bank stability, reducing excessive erosion and improving aquatic habitats

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Methods of infrastructure protection

Infrastructure protection and stream restoration work can be constructed within the existing stream “footprint” over various stream segments/lengths to protect water and sewer infrastructure.

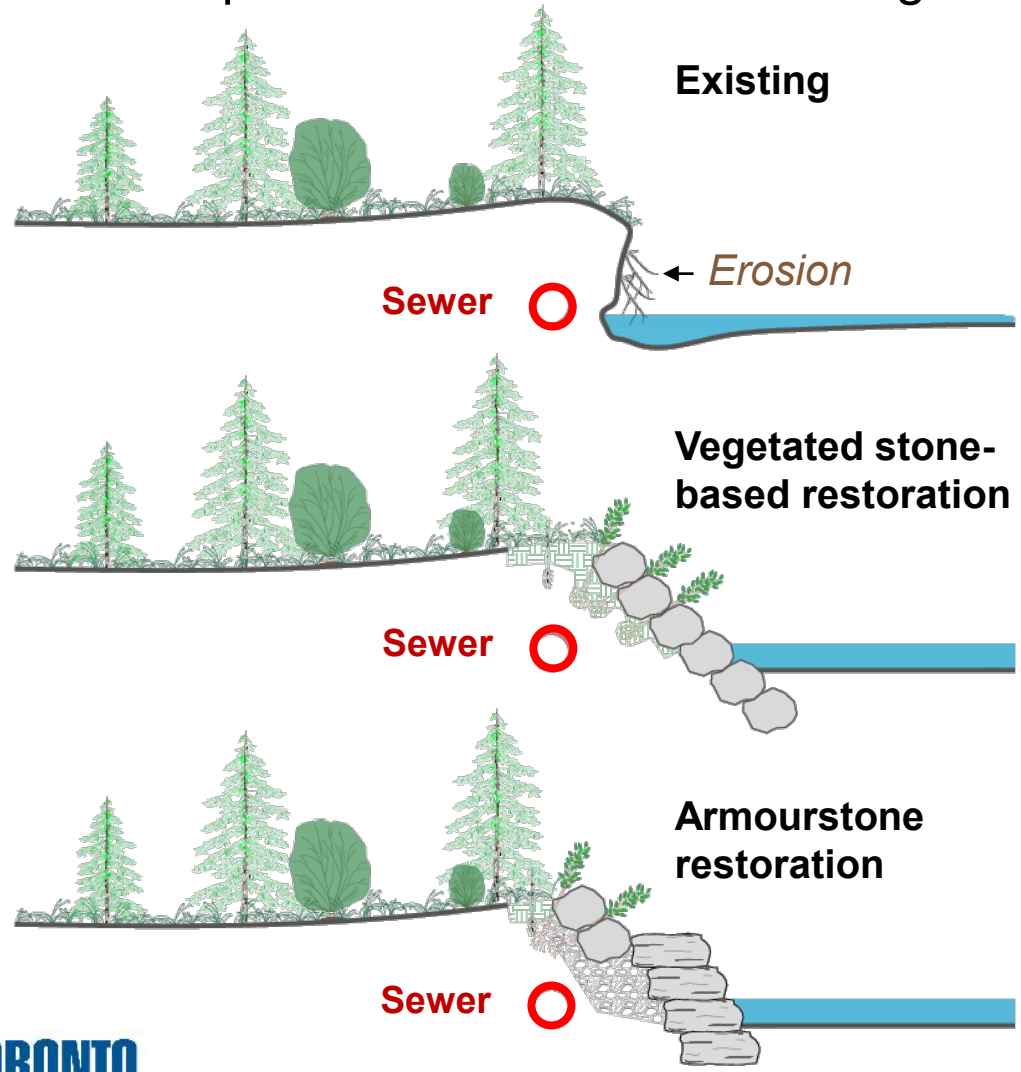

Photo of an armourstone bank and vegetated stone treatment at the water’s edge along the stream bank of Burke Brook.

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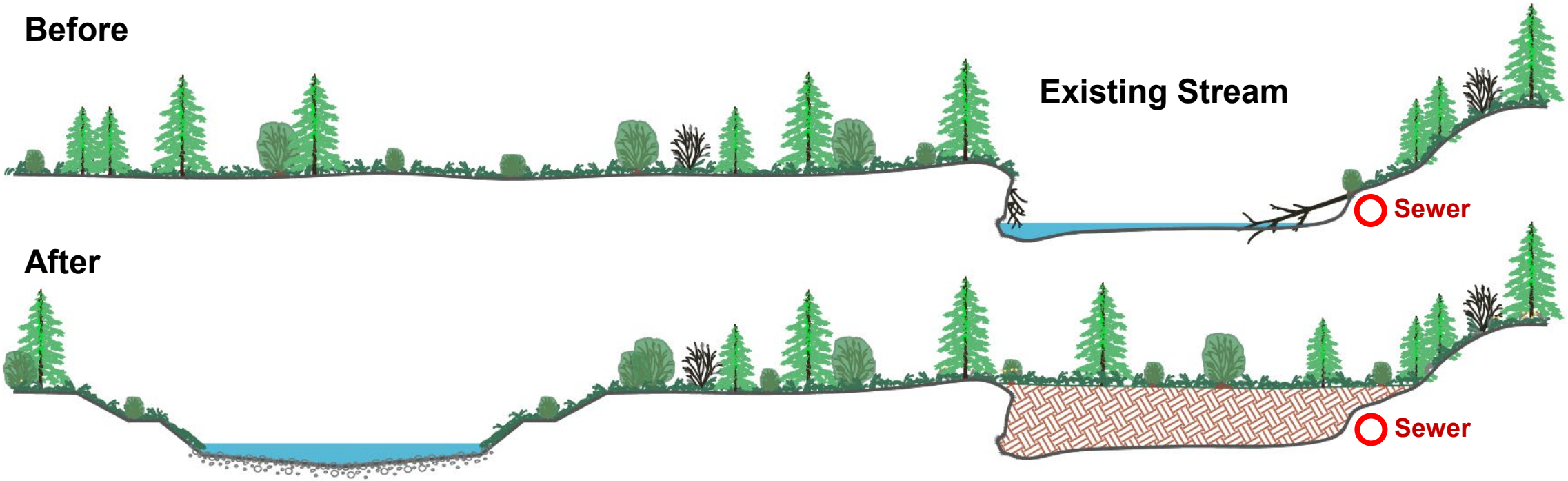
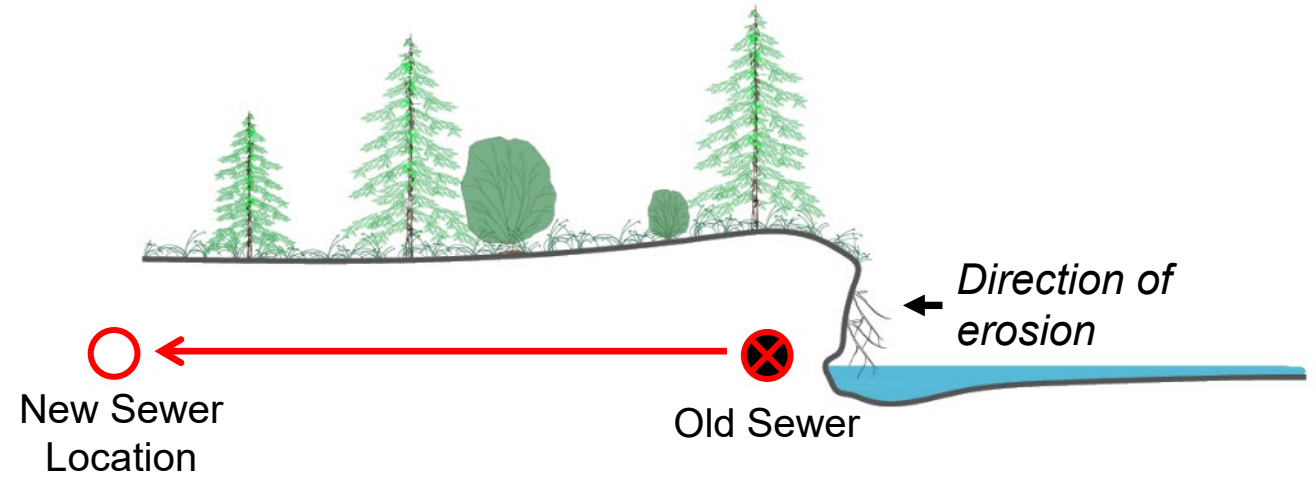
Methods of infrastructure protection

Realignment of the stream away from water and sewer infrastructure.



Methods of infrastructure protection

Move Water & Sewer Infrastructure



Where possible, new water or sewer infrastructure is constructed in a new location further from the stream in the ravine/valley. The original infrastructure is removed or abandoned in place, which is typically less disruptive and less costly than removal.

Geomorphic Systems Master Plans (GSMPs)

There are numerous ongoing GSMPs across the City in streams to identify and assess water and sewer infrastructure at risk of excessive erosion from high flows due to storms and snow melt runoff.

GSMPs are initiated with a study to observe how the City's water and sewer infrastructure can be protected within the stream along with an evaluation of recommended solutions to help reduce or prevent future impact. This ensures the City's infrastructure continues to operate and service residents and businesses. Solutions from the GSMPs for each stream will be implemented over a multi-year period.

Purpose of a GSMP study:

- To identify concerns related to excessive erosion that may damage the City's water and sewer infrastructure located in streams
- To develop solutions that protect the City's water and sewer infrastructure from excessive erosion processes within the stream
- To improve stream functions, such as increasing stream bank stability, reducing excessive erosion and improving habitats