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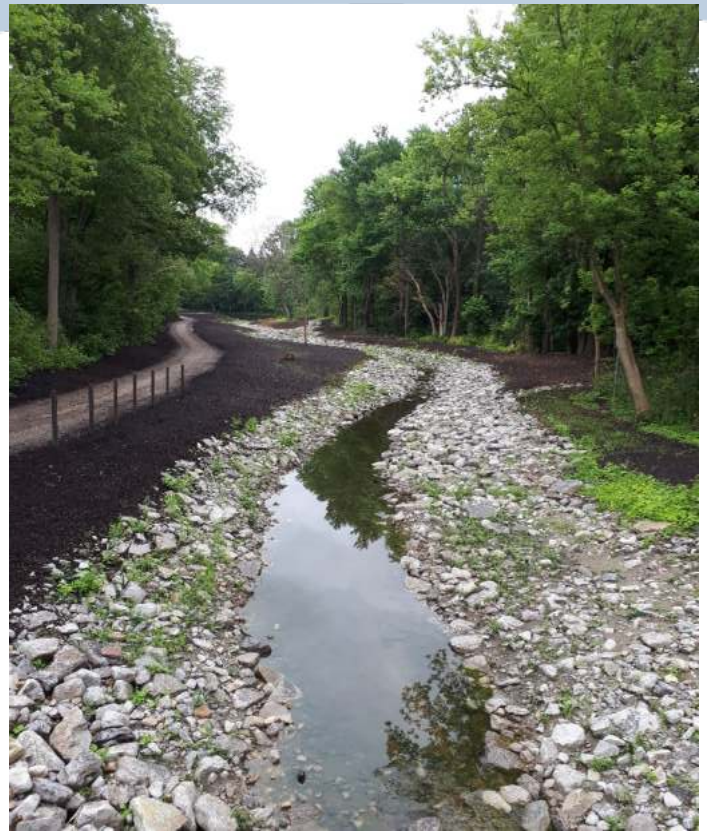
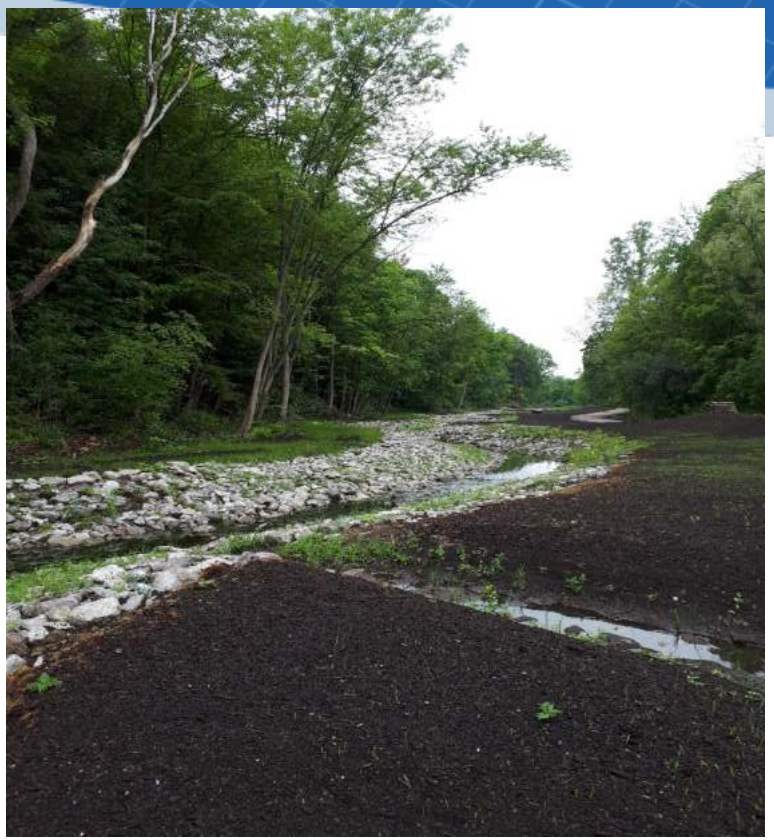
Duncan Creek Restoration
An Engineered Natural Channel Project





Niloufar Mohajerani, M.A.Sc., P.Eng

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March 2023

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Project's Description

- Duncan Creek is a tributary of German Mills within the East Don River watershed
- The length of the project is 1.1km

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Duncan Creek's Historical Transition

- Early 1800s - Converted from a forested area to agricultural land
- Mid 1970s - Redeveloped into residential subdivision
- 1970s – The creek was re-aligned, channelized, and lined with gabion baskets (rock and concrete filled wire mesh baskets)

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Duncan Creek's Historical Transition

- Large storms accelerated erosion and resulted in exposure of stormwater and sanitary sewer infrastructure

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Purpose

- Restore watercourse channel
- Restore/replace 13 outfalls
- Protect sanitary sewer along the watercourse and crossing
- Install recreational pathway

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How We Understand and Work with Watercourses

Humber River
Photo taken by TRCA

The **balance** between the movement of water and the transport of sediment is critical for the stability of the stream channel…

…such that there is **no excessive erosion** along the channel and **no excessive sediment** deposits.

How We Understand and Work with Watercourses

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

• Urbanization and "hard", impermeable surfaces decrease the infiltration and absorption of rain/snow into the ground

• Climate change increases the frequency and intensity (volume) of rainfall/storm events which increases the flows in watercourses

• Historical man-made controls or adjustments altered the watercourse's form in ways that counter-act natural processes (ie. dams, culverts, weirs)

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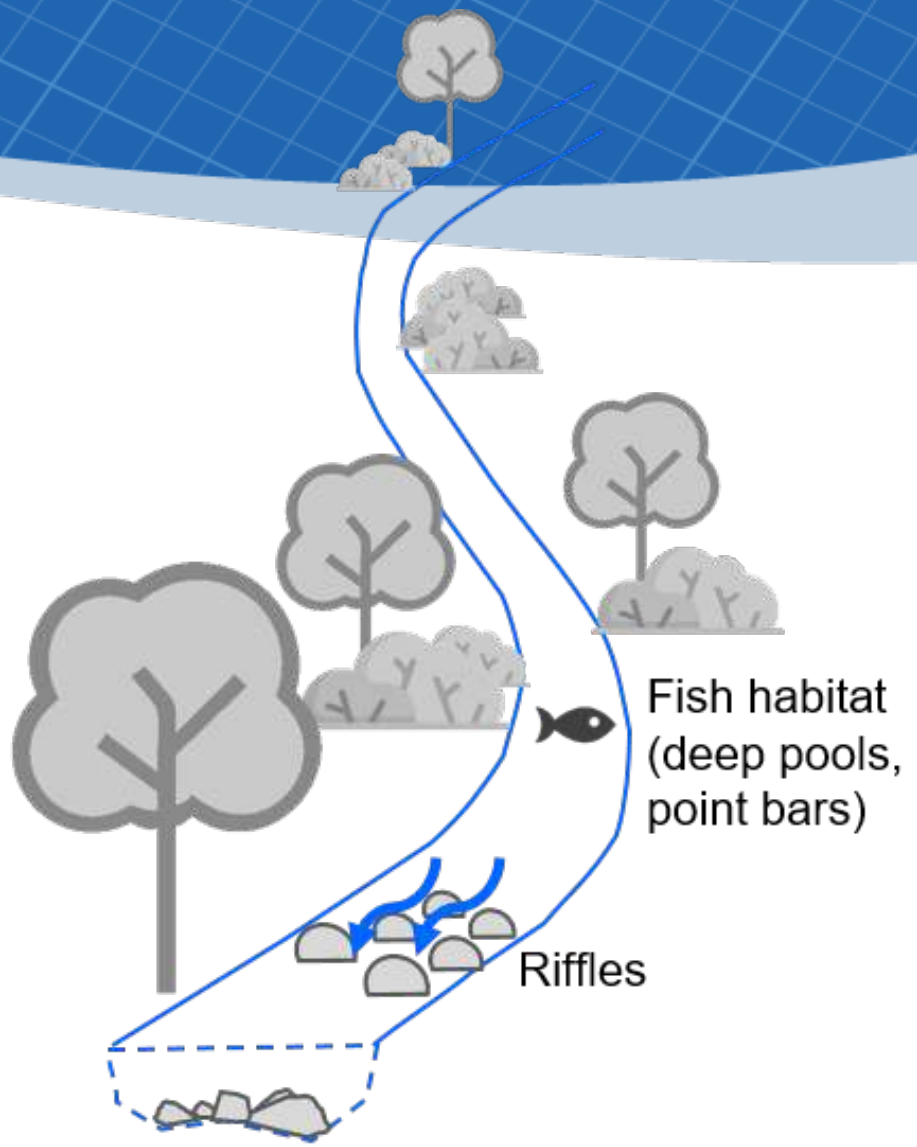
How we Understand and Work with Watercourses

Pre-Urbanization

- Watercourse meanders and curves
- Watercourse has varying depths
- Diverse watercourse features and habitats
  - Boulders, shallow riffles, fish spawning zones, deep pools, and point bars
- Trees and vegetation provide
  - Slope/bank stability
  - Aquatic habitat
  - Cover for fish from predators
  - Shade to cool/reduce over-heating water temperatures



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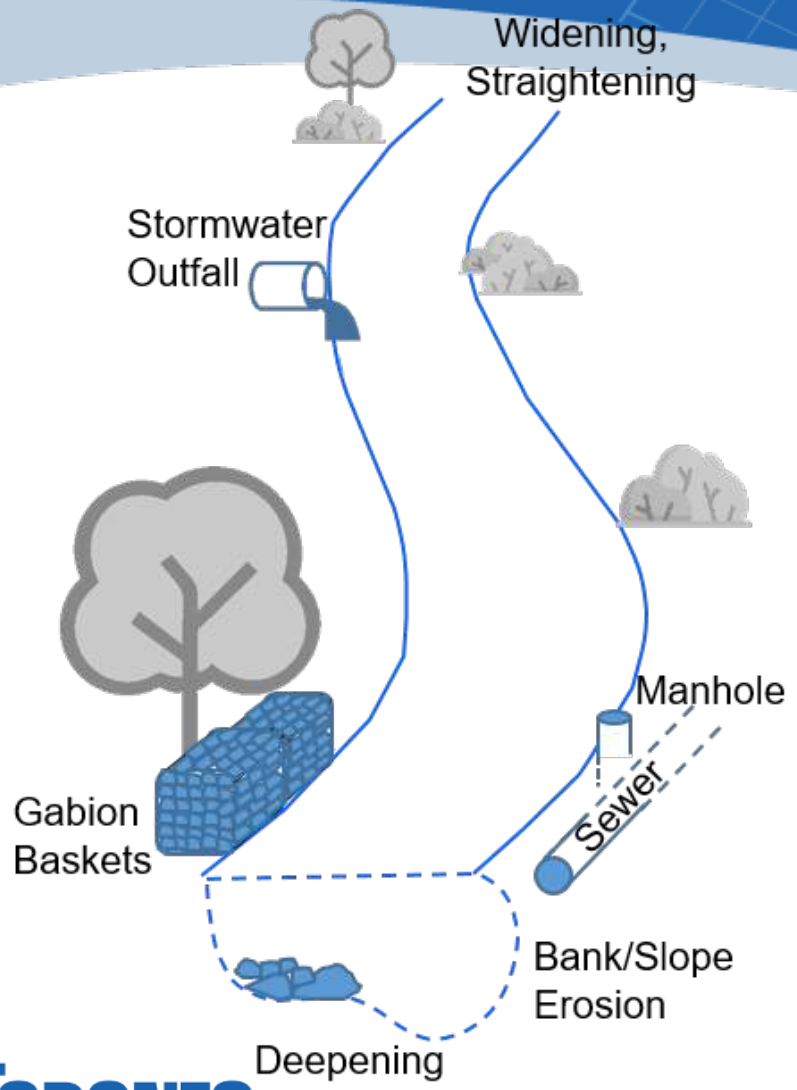
How we Understand and Work with Watercourses



Post-Urbanization

- Watercourse widens and deepens due to erosion
- Impeded or increased flows from City infrastructure -- Outfalls, bridges, culverts
- Man-made erosion controls -- Gabion baskets, watercourse straightening
- Fallen trees/less vegetation to stabilize watercourse slope/bank
- Watercourse features and habitats are degraded -- Riffles, deep pools, point bars
- Excessive flows, sediments and debris in the watercourse degrades aquatic habitats and shrinks deep pools

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Project's Process

- Master Plan (2008-2012)
- Phase 1 Design and Construction (2012-2013)
- Phase 2 & 3 Design, Permit Acquisition (2018-2020)
- Phase 2 &3 Construction (2020 – 2021)
- Post-construction Monitoring (2021 – present)

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Life Cycle Cost Analysis

Phase 2 - Life-Cycle Cost Analysis												
Alternative	**Do Nothing**				**Natural Channel Design**				**Engineered Channel Design**			
Item	Recurring Cost		30 Year Period		Recurring Cost		30 Year Period		Recurring Cost		30 Year Period	
	Value	Interval	Present Value	Future Value	Value	Interval	Present Value	Future Value	Value	Interval	Present Value	Future Value
Engineering Design Fees	$80,000	2 Years	$710,576	$2,073,360	$350,000	One-time	$350,000	$1,040,952	$350,000	One-time	$350,000	$1,040,952
Permits & Approvals	$6,000	2 Years	$53,293	$155,502	$6,000	10 Years	$9,910	$25,481	$6,000	10 Years	$9,910	$25,481
Construction Capital Cost	$0	One-time	$0	$0	$3,200,000	One-time	$3,200,000	$9,517,276	$3,800,000	One-time	$3,800,000	$11,301,765
Channel Maintenance Costs	$100,000	2 Years	$888,220	$2,591,701	$50,000	5 Years	$172,662	$478,086	$50,000	5 Years	$172,662	$478,086
Sewer Emergency Works	$400,000	2 Years	$3,552,881	$10,366,802	$200,000	10 Years	$330,324	$849,380	$200,000	10 Years	$330,324	$849,380
Trail Emergency Works	$50,000	Annual	$896,986	$2,667,769	$0	NA	$0	$0	$0	NA	$0	$0
Long-term Monitoring	$10,000	Annual	$179,397	$533,554	$10,000	Annual	$179,397	$533,554	$10,000	Annual	$179,397	$533,554
Safety & Aesthetic Value	$20,000	Annual	$358,794	$1,067,107	-$10,000	Annual	-$179,397	-$533,554	-$10,000	Annual	-$179,397	-$533,554
Ecological Benefit	$5,000	Annual	$89,699	$266,777	-$20,000	Annual	-$358,794	-$1,067,107	-$10,000	Annual	-$179,397	-$533,554
TOTAL			$6,729,845	$19,722,572			$3,704,101	$10,844,068			$4,483,498	$13,162,111

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Natural Channel Design

- Re-meandering of the channel
- Create riffle-pool consequence
- Channel bed constructed with a layer of angular stone mixture
- Install armourstone/vegetated buttress on the banks
- Storm sewer outfalls restoration

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Natural Channel Design

Before Construction

During Construction

Post Construction

TORONTO

Natural Channel Design

Before Construction

Post Construction

During Construction

TORONTO

Natural Channel Design

Before Construction

During Construction

Post Construction

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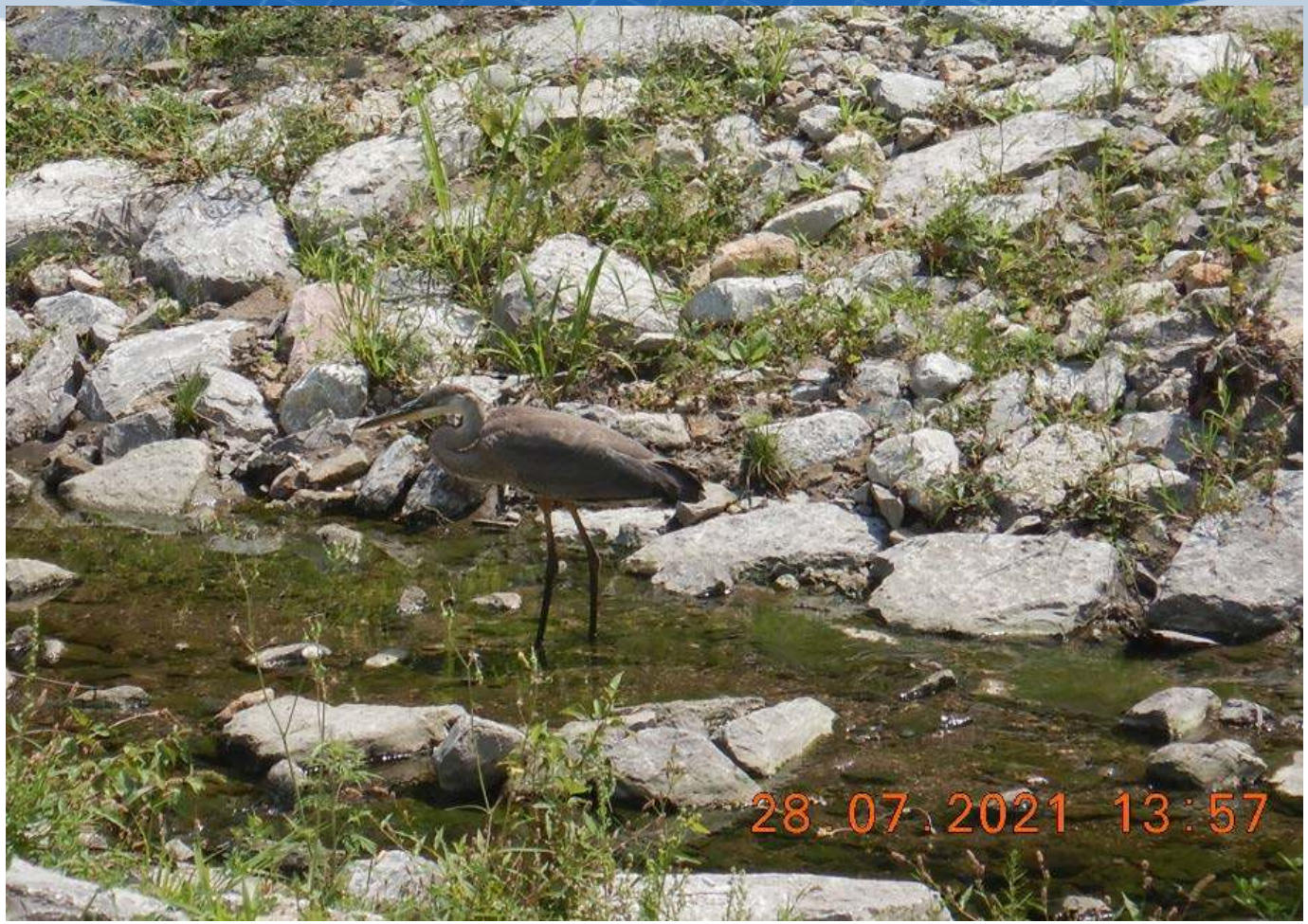
Ecological Benefit

- Improved aquatic and terrestrial habitat
- Overhanging trees and shrubs maintain cooler water
- Native vegetation provides habitat for wildlife; and
- Increase the vegetation diversity



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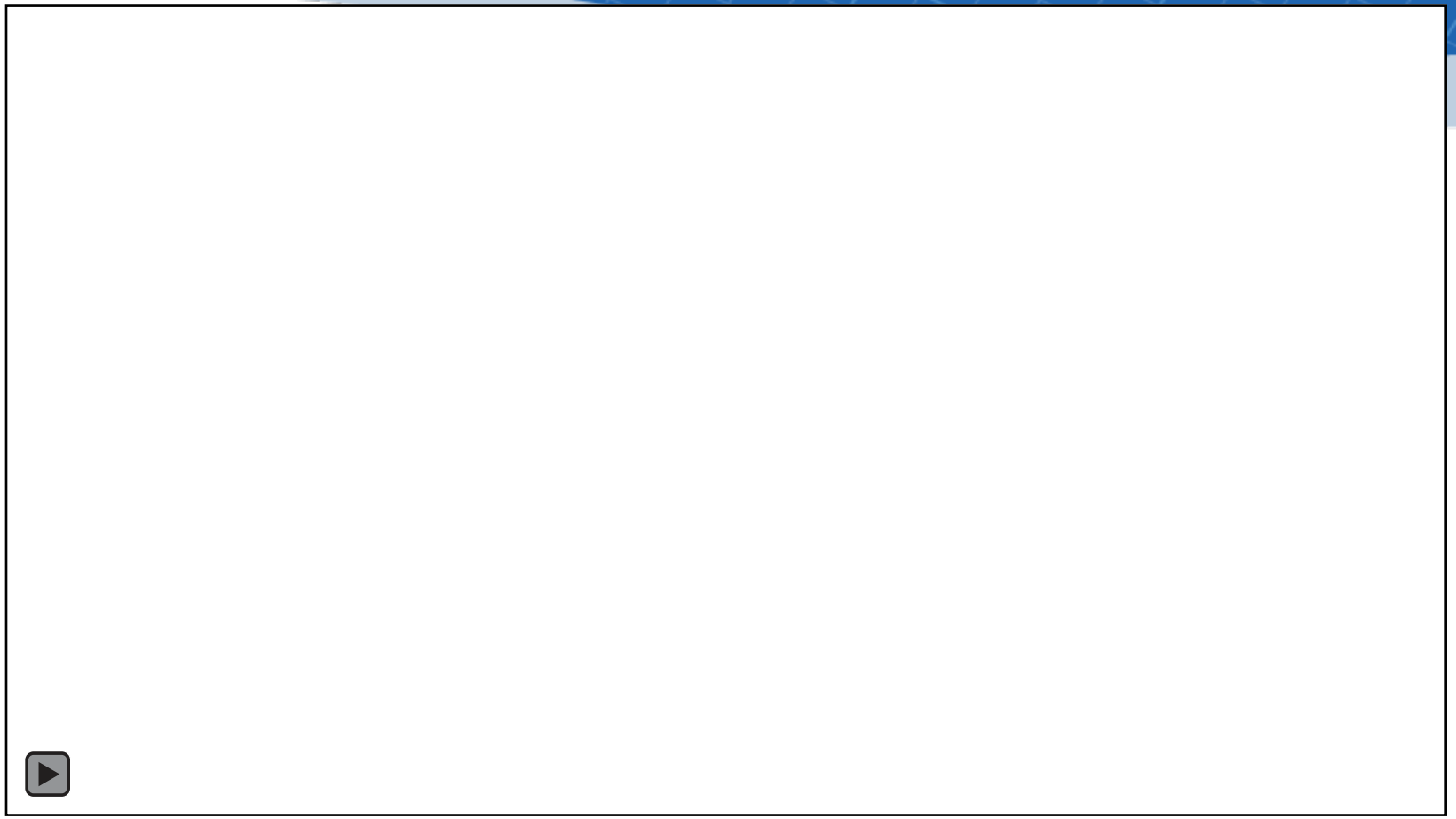
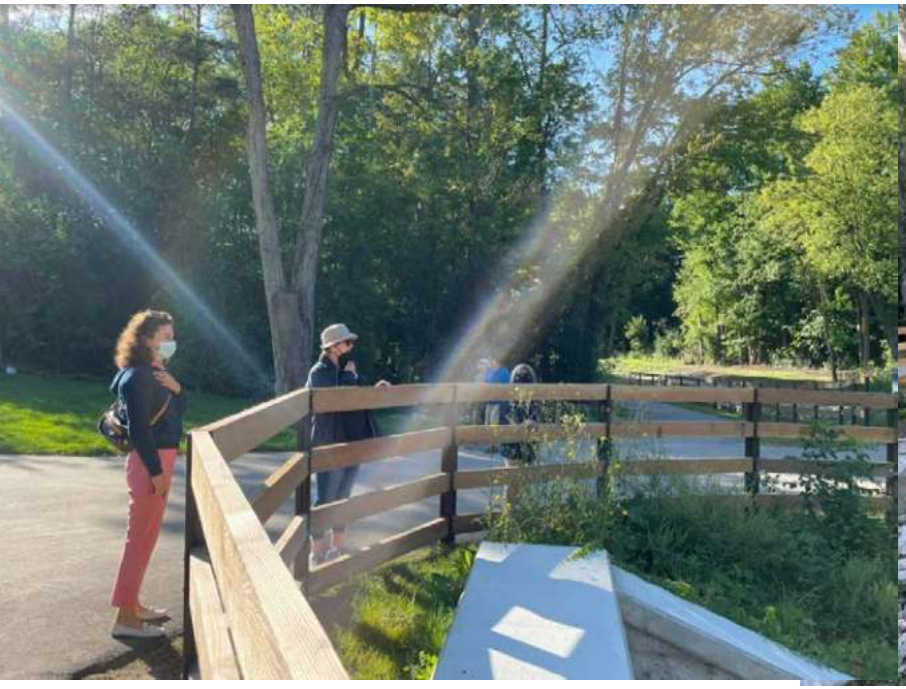
Post Construction



Post Construction



Councillor Carroll Visit

https://www.youtube.com/watch?v=n4OfDywSmcE

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Questions

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