Incorporating Environmental Flows into Land Use Planning Decisions

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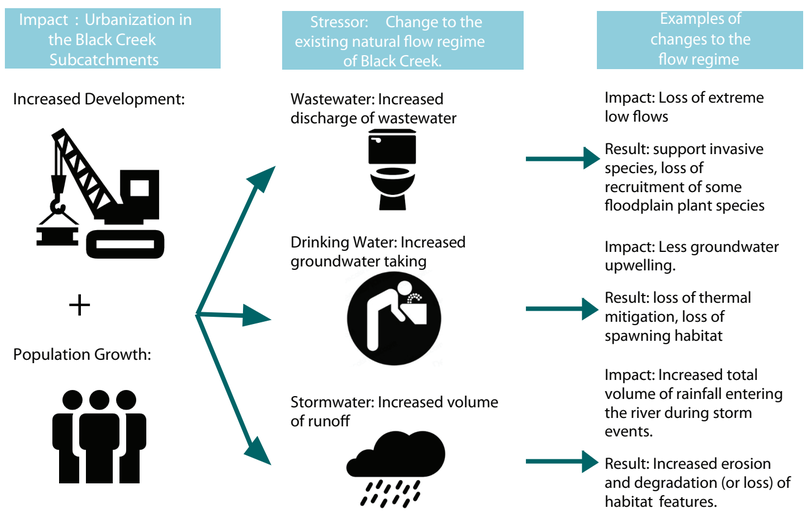
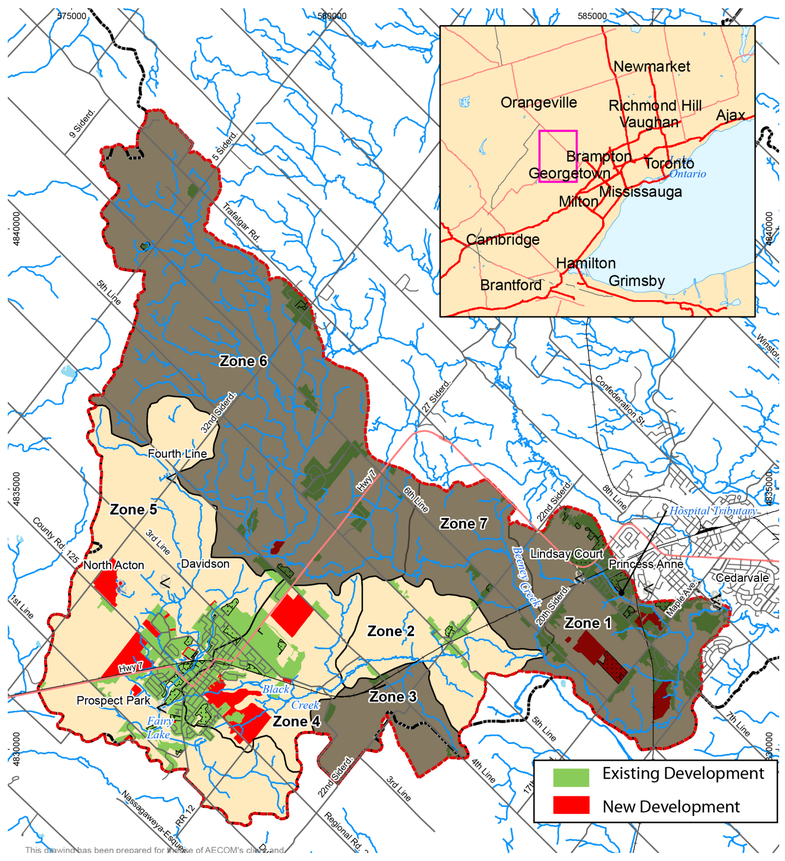
OVERVIEW
In order to make informed land use planning decisions an assessment was done to understand how flows will change as a result of increased development and resource use, and what level of best management practices is needed to maintain important characteristics of the flow regime.

Background

Black Creek is a cold water Brook Trout stream in an urbanizing subwatershed in Southern Ontario. The total catchment area is 3299 ha with mixed land uses. The receiving stream is 6.3 km long and begins at the outlet of an earthen dam. This section of stream receives direct discharge from a wastewater treatment plant.



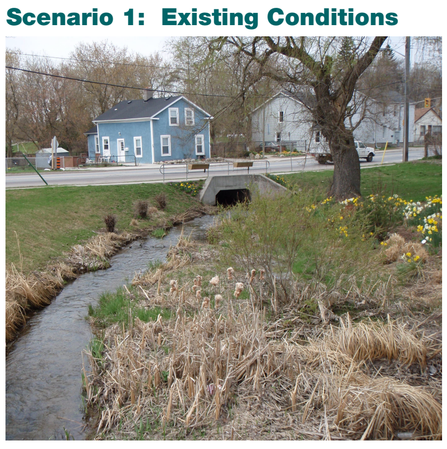


	Current land uses (2012)	Future land uses (2031)
Population	4,050	9,700
Urban	15%	22%
Rural	3%	3%
Natural area (wetland, forest)	27%	37%
Agriculture	38%	21%
Pumping rate (m^3/day)	3,362	5,326
Wastewater treatmant plant discharge (m^3/day)	4,545	7,000

Methodology

Flow data for existing conditions (2010) and 3 future scenarios (2031 with varying levels of BMP uptake) was simulated using the hydrologic model HSP-F. Simulated flow data for 50 years was developed for each scenario using climatic data for the period of 1960 to 2010 from a climate station in close proximity to the study site. Simulated flow data was analyzed using Indicators of Hydrologic Alteration and the Paired Student t-test.

Scenario 1: Existing Conditions



The model was calibrated and validated using existing conditions and measured flow data from 1 instream flow monitoring station

Scenario 2 – 2031 land use with business as usual stormwater management practices

Urban – 7% increase in urban cover
Natural Area – no change from existing
Agricultural Area – decrease by 7%
SWM - stormwater pond

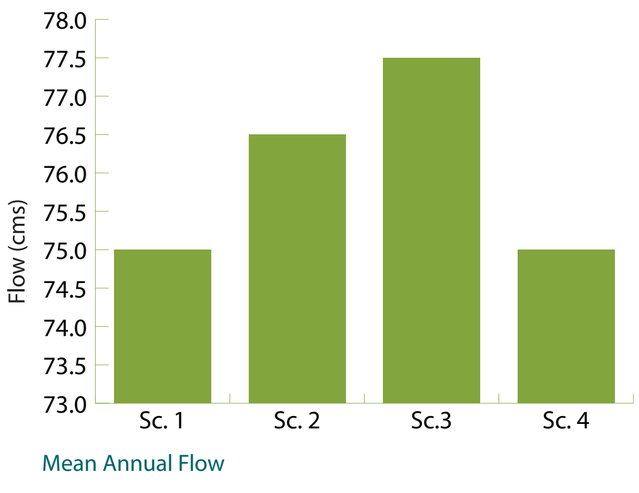
Scenario 3 – 2031 land use applying LID in new and existing developed areas.

Urban – 7% increase in urban cover
Natural Area – no change from existing
Agricultural Area – decrease by 7%
SWM - LID

Scenario 4 – 2031 land use with LID, increased forest cover and increased buffer width

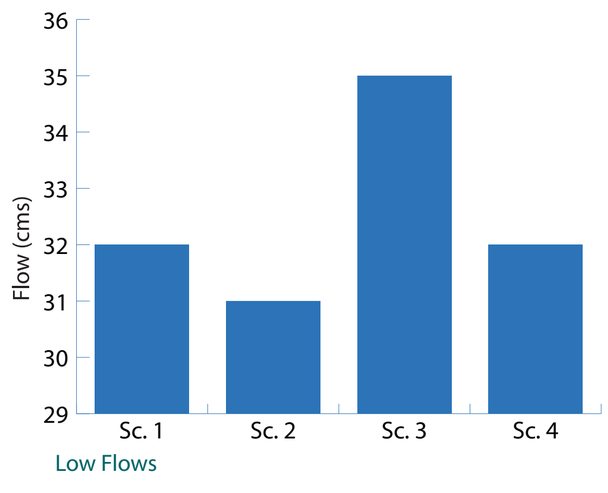
Urban – 7% increase in urban cover
Natural Area – 10% increase in forest cover
Agricultural Area – increase to 30m buffers around an additional 13% of stream
SWM - LID

Results



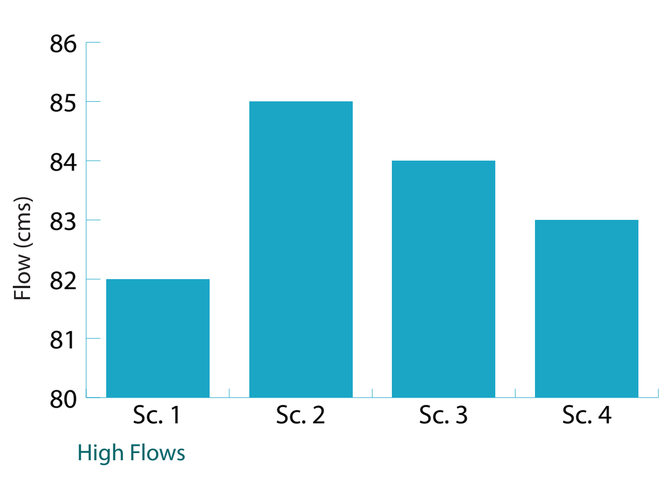
Mean Annual Flow

•Mean annual flow is best maintained with the adoption of LID, increased forest cover and increased buffer width



Low Flows

- The adoption of LID practices can maintain baseflow and the Ecological Flow Component Extreme Low Flow conditions
- The adoption of LID, increased forest cover and increased buffer width can best maintain 1-day, 3-day, 7-day, 30-day and 90-day minimum flow conditions



High Flows

- The adoption of LID, increased forest cover and increased buffer width best maintains high flows
- The adoption of LID, increased forest cover and increased buffer width best maintains the 1-day, 3-day, 7-day, 30-day and 90-day maximum flows conditions

Conclusions

- Mitigating the impacts of increased development and water resource use will reduce the change in the flow in Black Creek as determined using the Paired t-test.
- Changes to flow can be mitigated through the adoption of best management practices including LID, increased forest cover and increased buffer width. The results of the Paired t-test demonstrated that existing conditions and future conditions that included the greatest uptake of best management practices are not significantly different.
- Low Impact Development, increased forest cover and increased buffer width together are best able to maintain high and low flow conditions.
- The incremental change to the flow regime can be mitigated with best management practices.