Meander Belt Width Procedures: Developing a Regional Model for Southern Ontario

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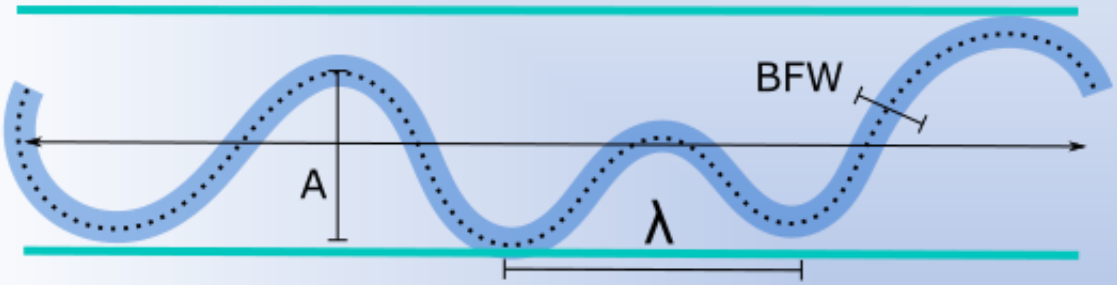
Presentation Outline

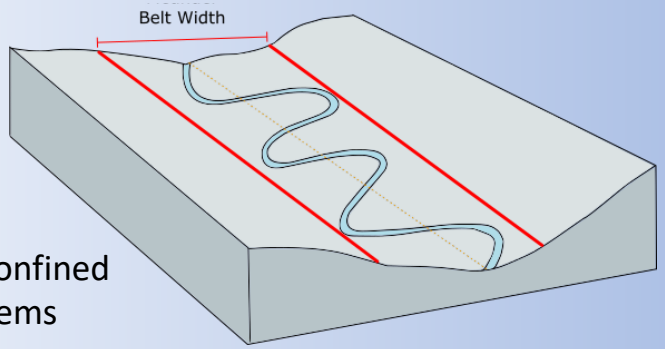
- Background
- River corridor management in Ontario
- Current procedures and challenges
- Research context
- Study area
- Methodology
- Analysis
- Future research perspectives

Meander Belt Width: Definition

- The space a watercourse occupies (or can occupy) within a floodplain.



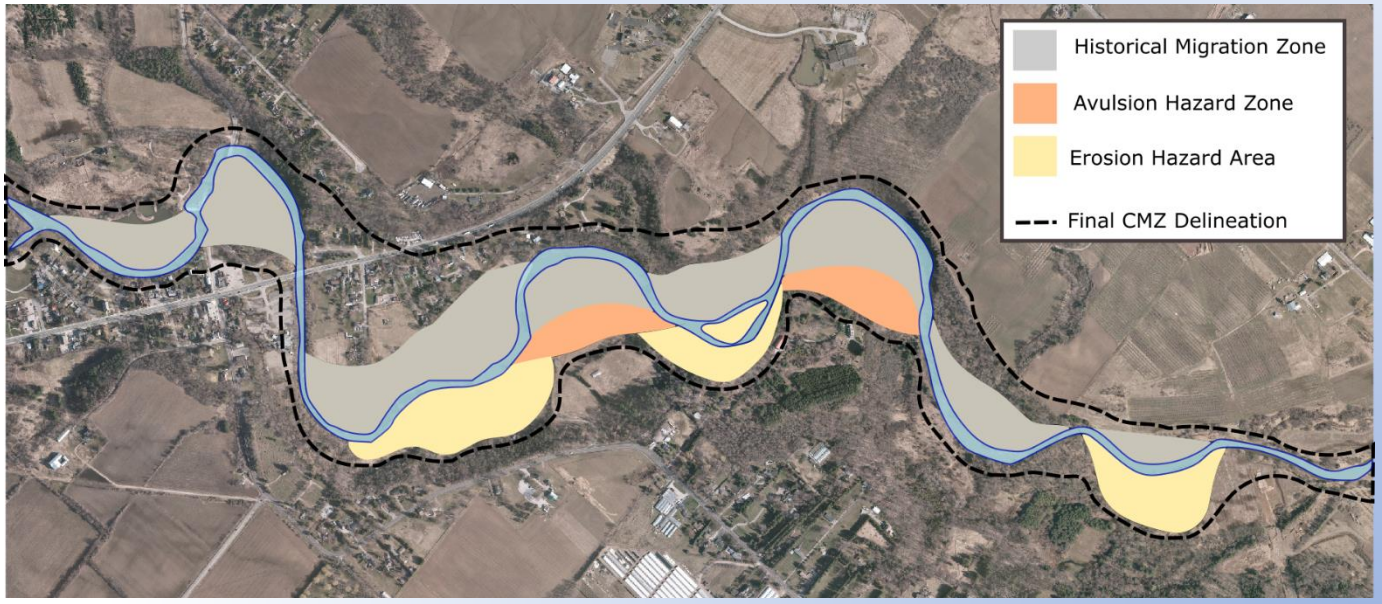
⟷	Valley Length	λ	Wavelength
·····	Channel Length	A	Amplitude
———	Meander Belt Width	BFW	Bankfull Width



Unconfined Systems

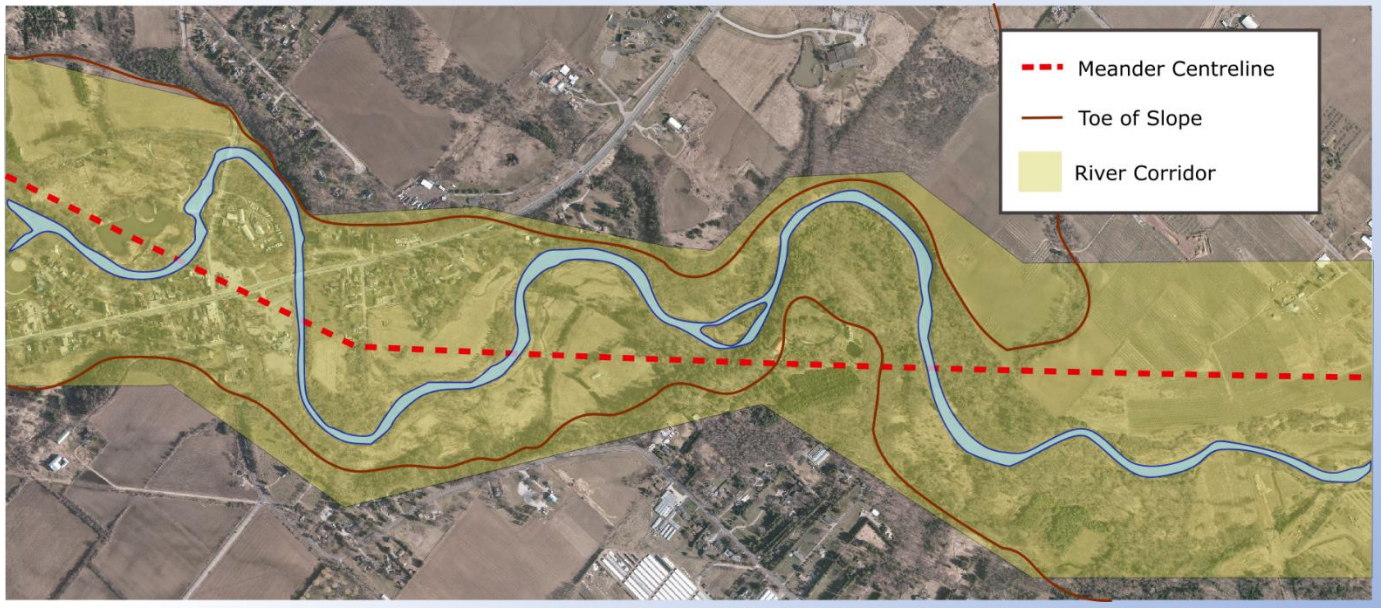
River Corridor Management

"Channel migration zone"



River Corridor Management

"River corridor"

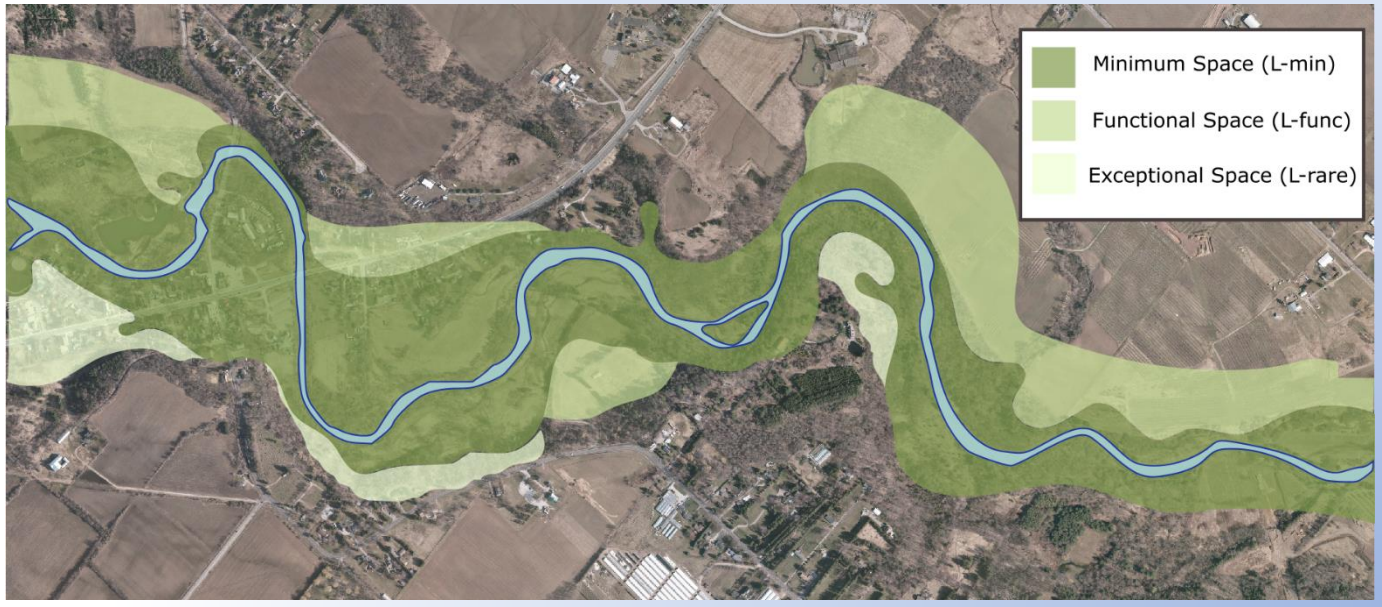


River Corridor Management

"Fluvial territory"

River Corridor Management

"Freedom space"



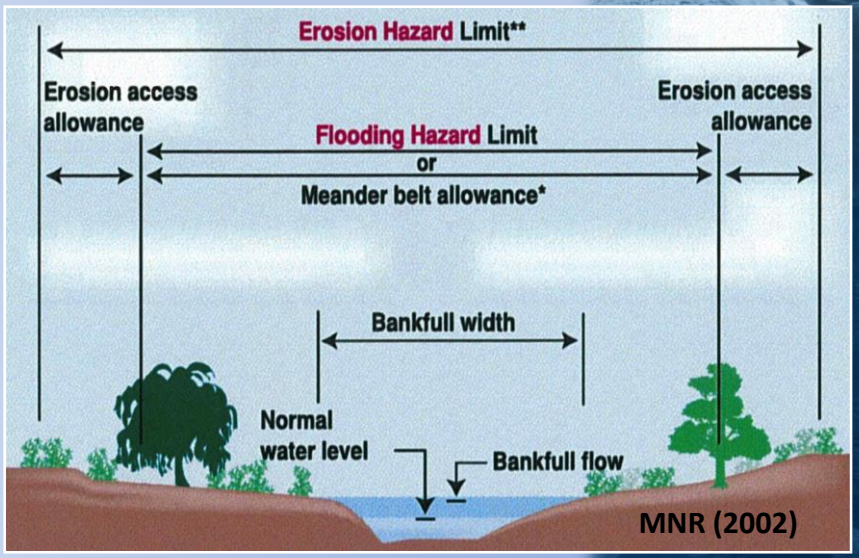
River Corridor Management

In Ontario…

- Provincial Policy Statement (2014)
- Official Plans
- Conservation Authority (e.g. Ont. Reg. 160/06)
- ORMCP
- Endangered Species Act (2007)

MNR Technical Guide River and Stream Systems (2002)

TRCA Belt Width Delineation Procedures (2004)

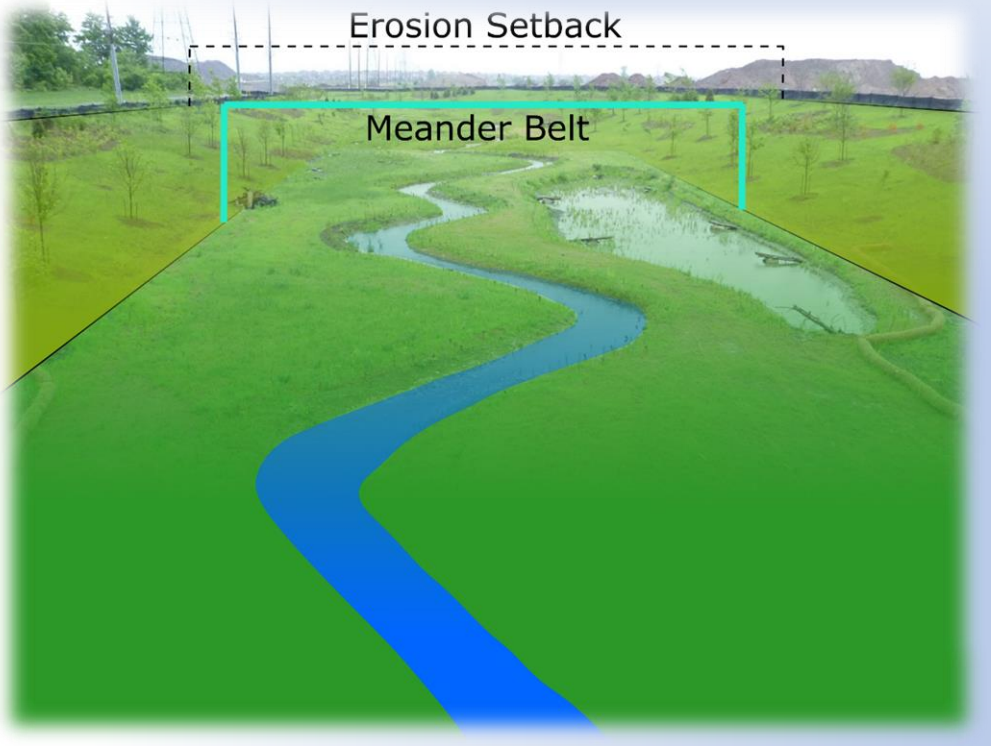


Meander Belt Width: Applications

- Development setbacks
- Watercourse crossings

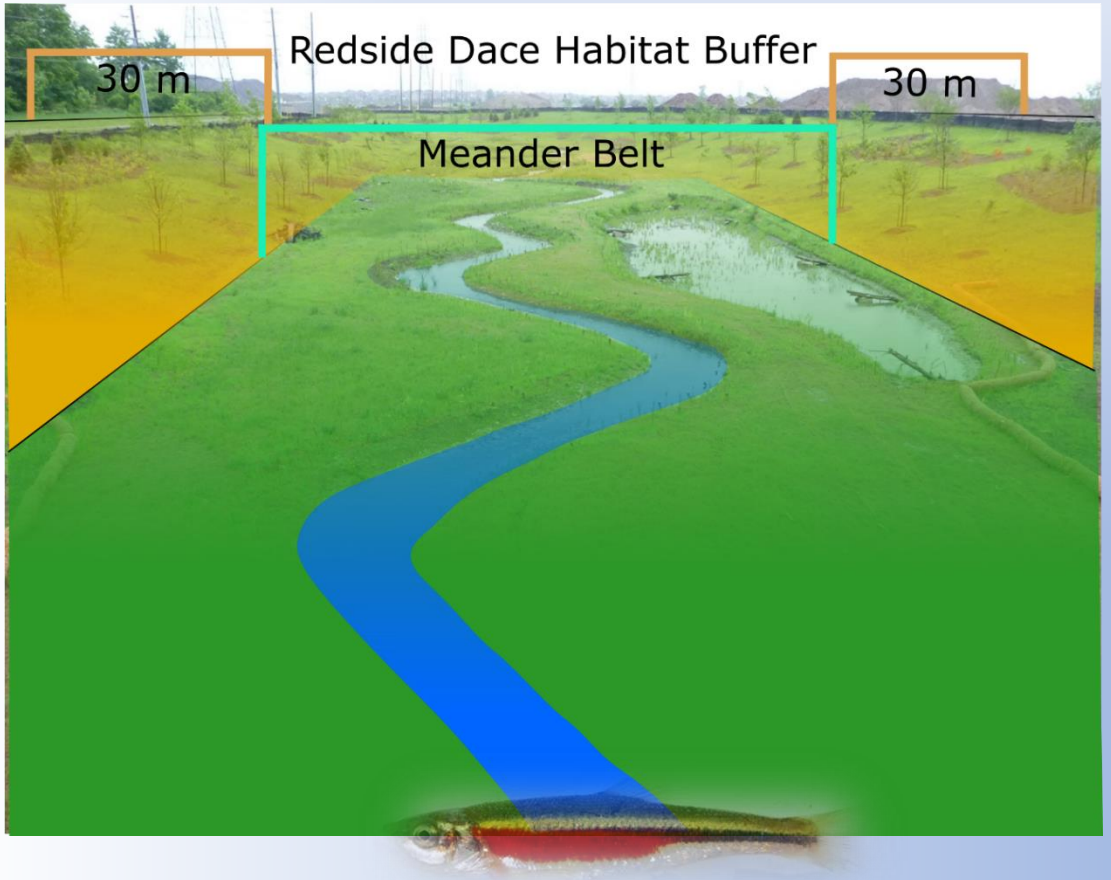
Meander Belt Width: Applications

- Natural channel systems design



Meander Belt Width: Applications

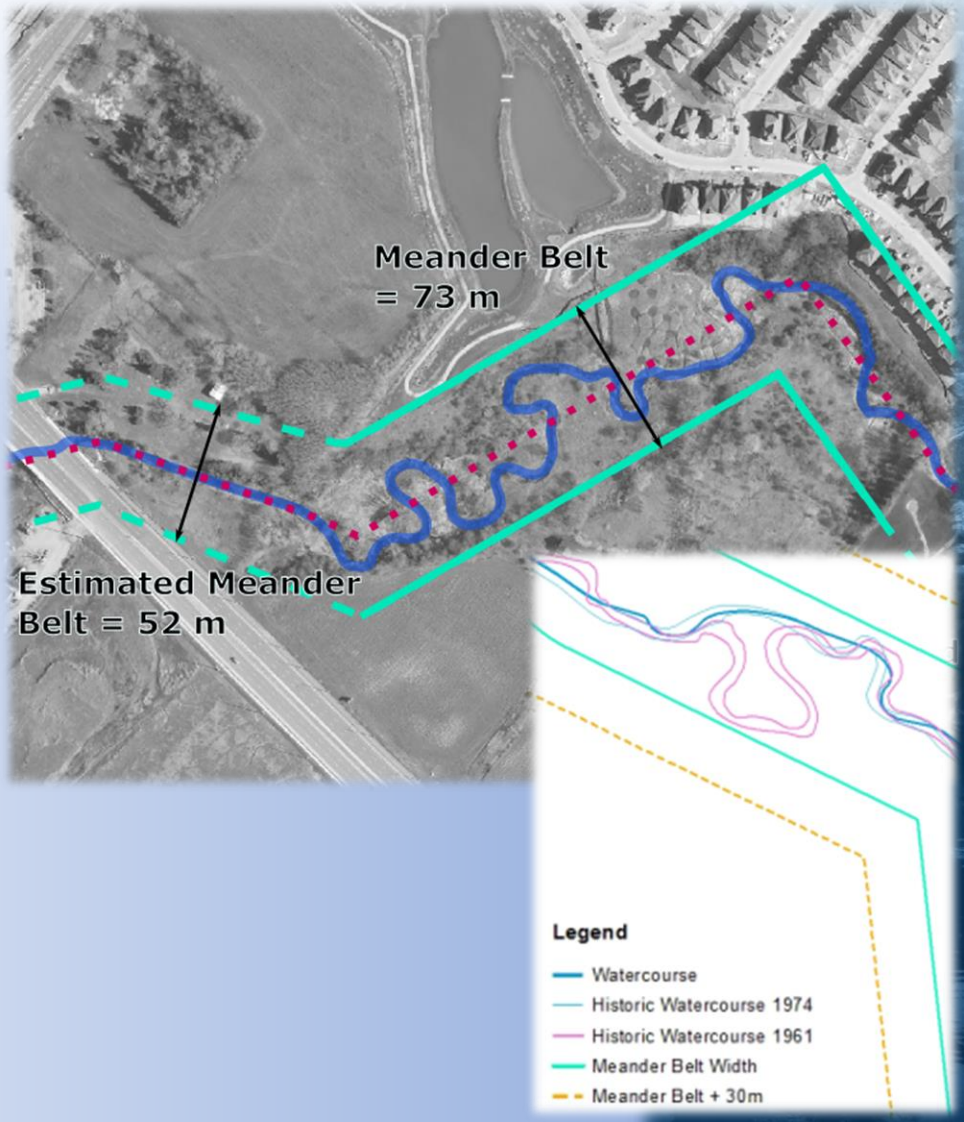
- Regulated habitat under the ESA (2007)



Redside Dace (*Clinostomus elongatus*)

Meander Belt Width: Planimetric Assessments

- Historical data: topographic maps and aerial imagery
- Analysis through geo-referenced overlays
- Simple overlays or advanced projection processes
- Supplementary field data



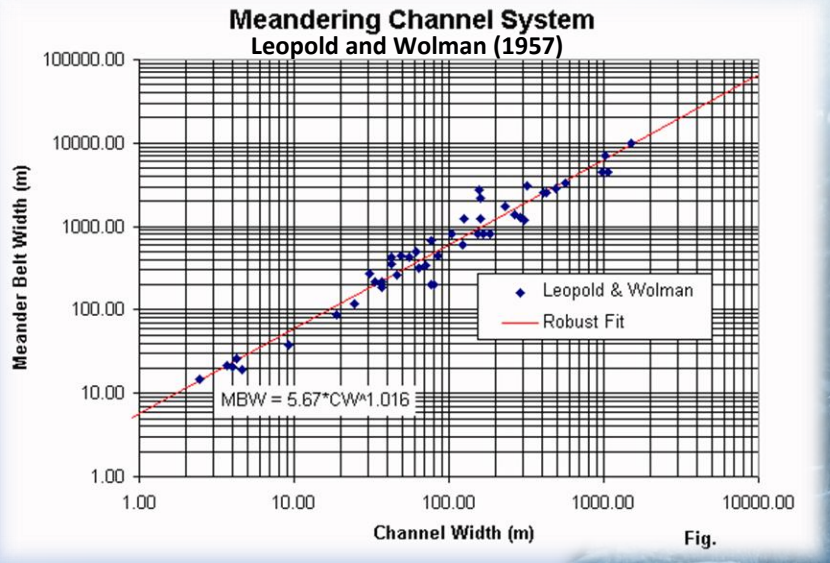
Meander Belt Width: Planimetric Assessments

Limitations

- Requires a sufficiently large watercourses
- Scale of the mapping medium not consistent
- Lower resolution of historical imagery
- Errors associated with image registration, georeferencing, and feature measurement

Meander Belt Width: Empirical Models

- Based on geomorphic and hydrologic variables
- Tool for estimation and prediction
- Used to assess altered watercourses
- Common to southern Ontario



Meander Belt Width: Empirical Models

Source	Variables	Model
Parish Geomorphic (2004)	Stream power (SP) Drainage area (DA)	M_B = -14.827 + 8.319ln (SP * DA)
Carlston (1965)	Mean annual discharge (Qa)	$M_B = 65.8\ Qa^{0.47}$
Williams (1996)	Meander wavelength (λ) Radius of curvature (Rc) Bankfull width (w) Bankfull depth (d)	$M_B = 0.61\lambda$ $M_B = 2.88\ Rc$ $M_B = 4.3\ w^{1.12}$ $M_B = 148\ d^{1.52}$
Annable (1996)	Bankfull discharge (Q_{bf})	$M_B = 56.95Q_{bf}^{0.45}$ $M_B = 16.30Q_{bf}^{0.88}$ $M_B = 131.26Q_{bf}^{0.29}$
Ward (2002)	Bankfull width (w) – in feet	$M_B = 4.0\ w^{1.12}$
Lorenz et al. (1985)	Bankfull width (w)	$M_B = 7.53\ w^{1.01}$
Bridge & Mackey (1993)	Hydraulic depth (D)	$M_B = 59.9D^{1.8}$
Collinson (1978)	Maximum depth (D_{max})	$M_B = 65.6D_{max}^{1.12}$
Jefferson (1902)	Bankfull width (w)	$M_B = 17.6\ w$

Meander Belt Width: Empirical Models

Limitations

- Poor correlations (at times) between models
- Site-specific or regional relationships
- Oversimplify and generalize the processes controlling migration

The Problem in Ontario…

- Paucity of research literature on the hydrologic and geomorphic controls of and meander morphology

- Regional characteristics of geomorphology, influenced by glacial geology and partially alluvial watercourses

What geomorphic and hydrologic variables control meander belt widths in southern Ontario watercourses?

Research Objectives

1. Document meander morphology and meander belt width in a representative sample of watercourses in southern Ontario

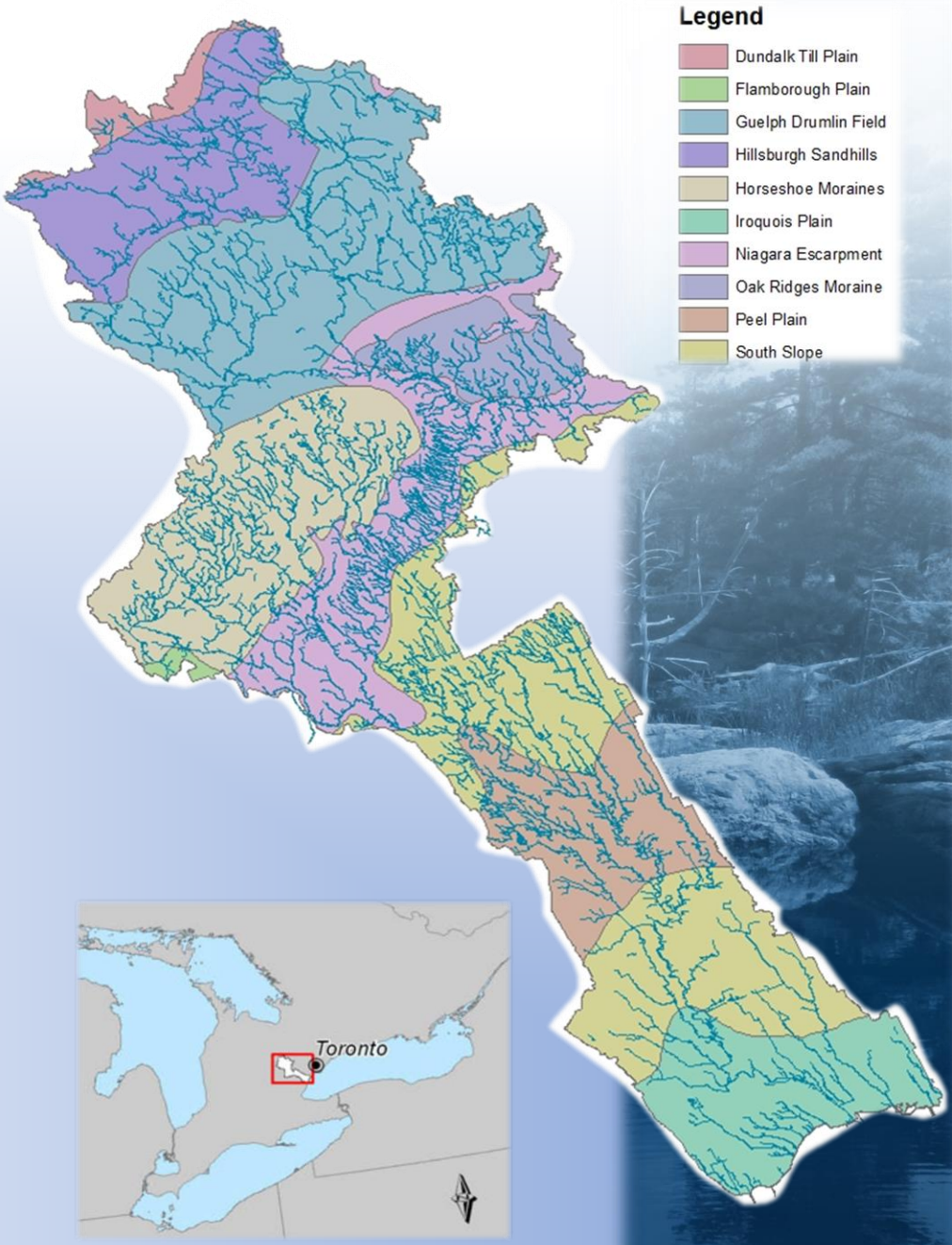
2. Correlate interactions between meander belt width and primary variables

3. Develop revised meander belt width analysis and prediction tool for southern Ontario

Study Area

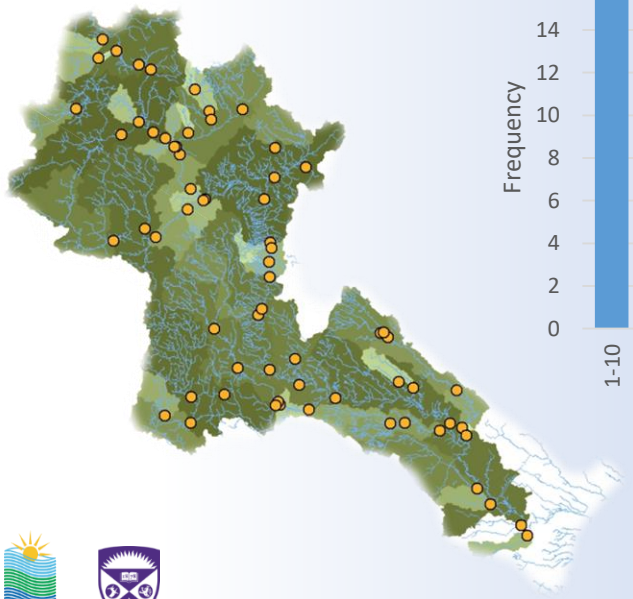
Credit River Watershed

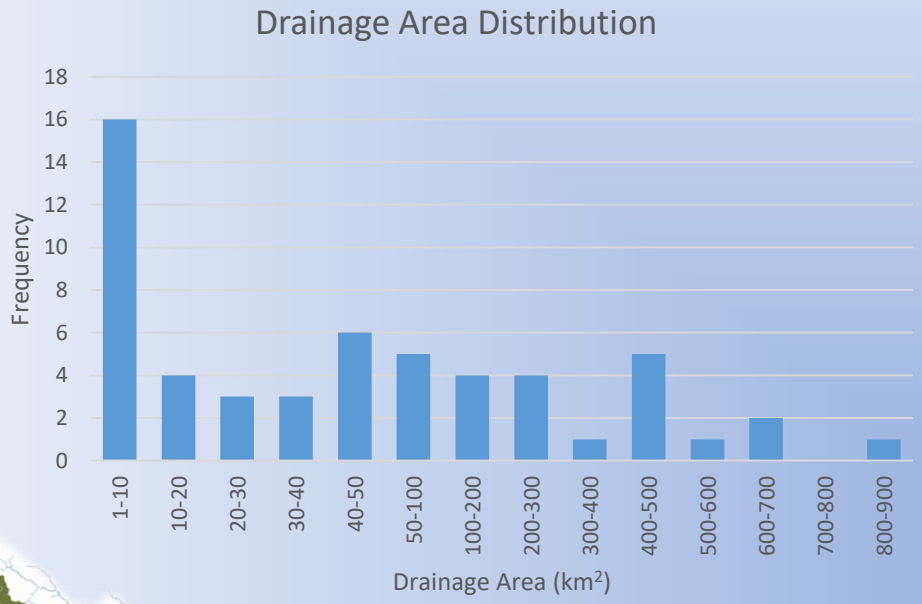
- Southern Ontario
- Physiographic diversity
- Drainage basins diversity
- Data availability
- Accessibility



Methodology: Site Selection

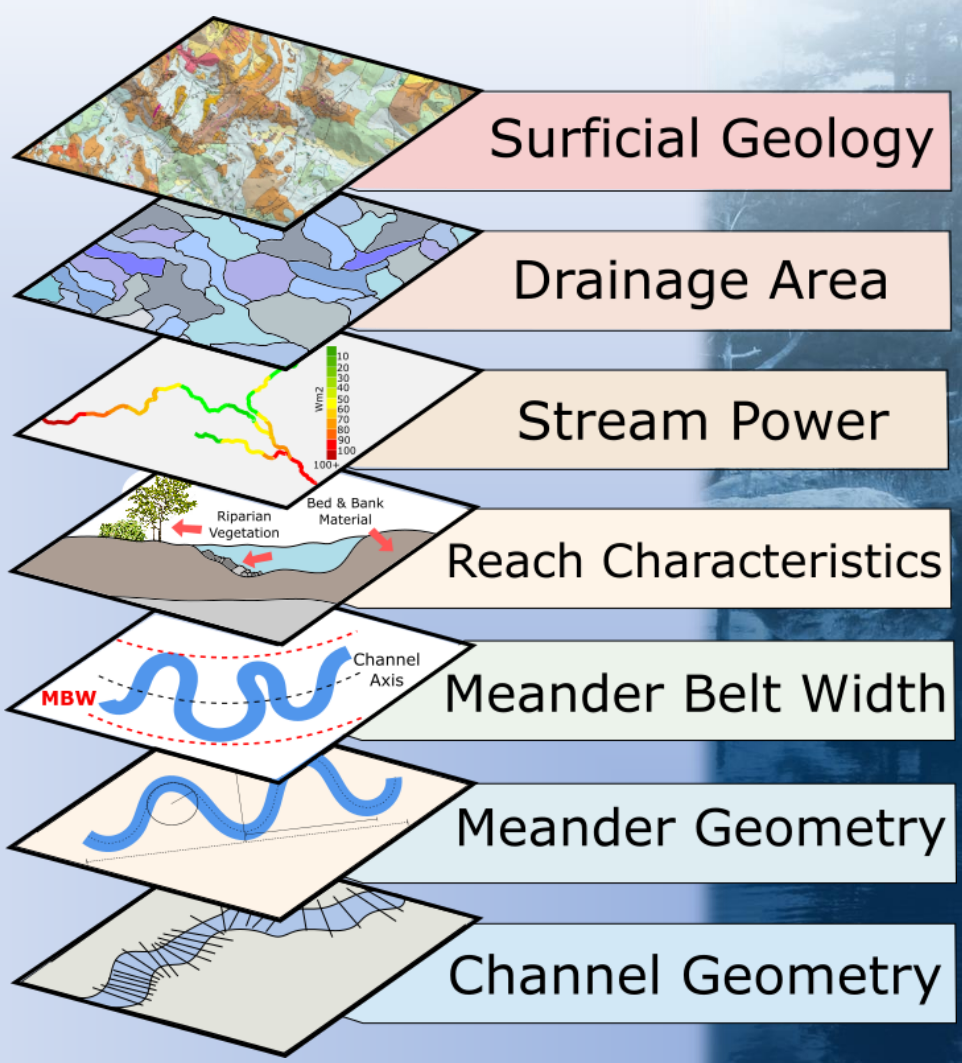
- IWMP database
- Additional selected sites
- 40-60 sites





Methodology: Data Capture

- Mapping overlays
- Desktop measurements
- Field assessments
- Key geomorphic and hydrologic parameters



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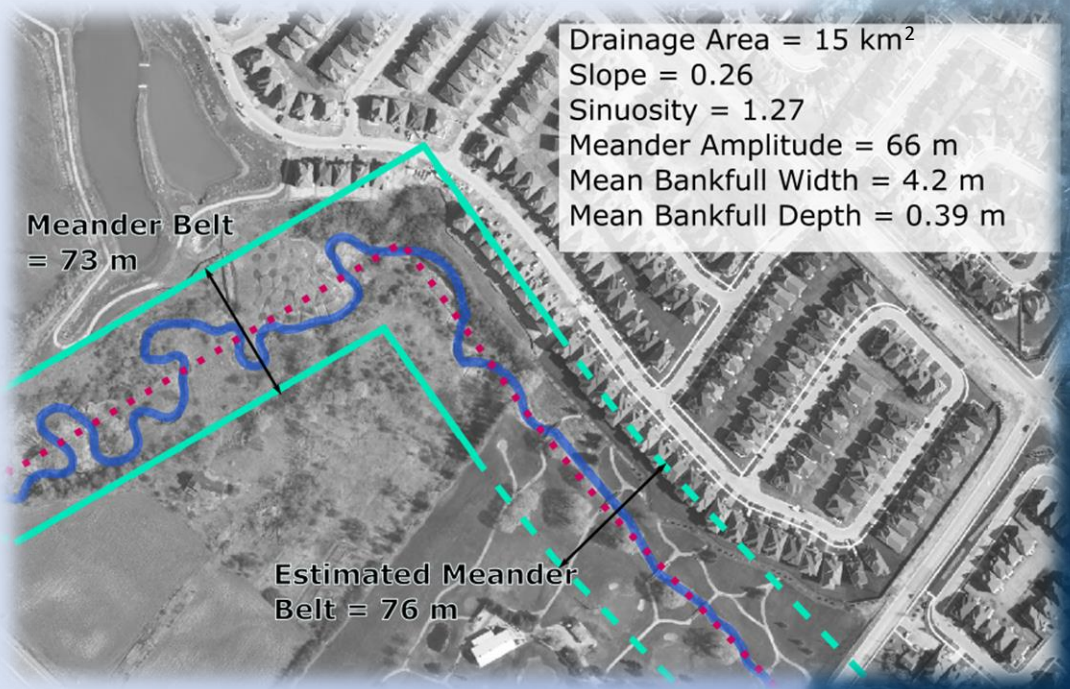
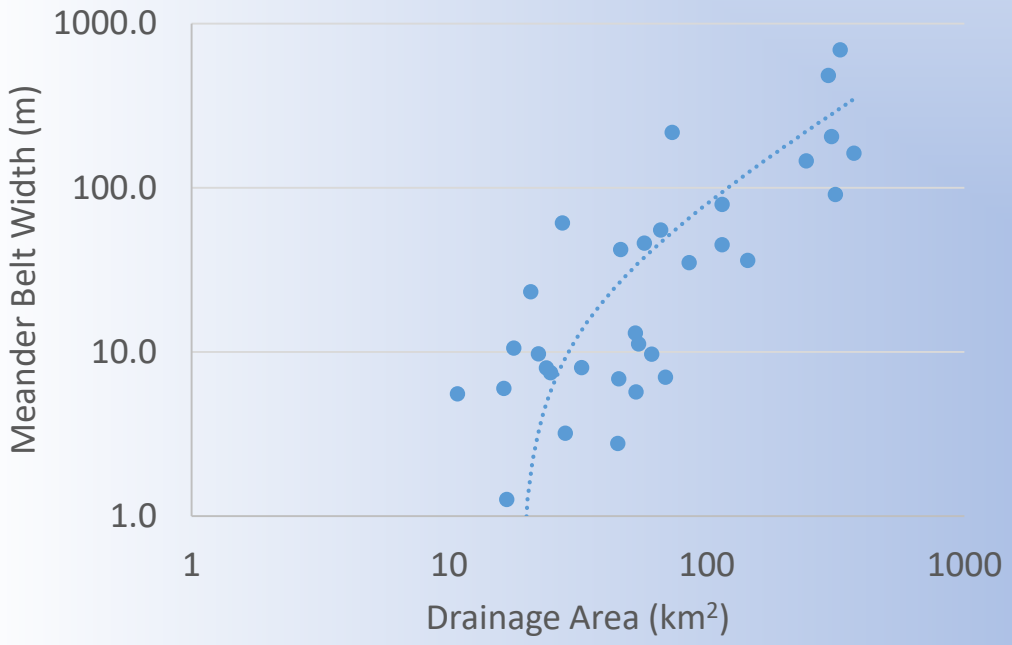


Analysis

- Multiple regression and correlation
- Dataset discretization



Example dataset

Anticipated Outcome

- Development of empirical equation(s) that may be used in addition to, or in place of, planimetirc assessments
- Derived relations will be compared to current empirical equations for meander belt delineation
- Better calibrated empirical relations for southern Ontario watercourses

Future Research Perspectives

- Contribute to geomorphic database with additional southern Ontario watercourses
- Investigate and integrate migration analysis and hazard zones
- Consider implications for confined systems

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