Assessing Floodplain Topographic Complexity in Large-Scale Corridor Restorations

Lindsay Davis, M. Sc., P. Geo., CAN-CISEC
Paul Villard, Ph. D., P. Geo., CAN-CISEC, EP, CERP
Tye Rusnak, B. Sc., CAN-CISEC
Karine Smith, M.Sc.

GEO Morphix Ltd.

GEO MORPHIX®

Introduction

- Traditionally employed relatively flat floodplain designs incorporating low-flow channels and wetland pockets
  - Most efficient way to convey flood flows

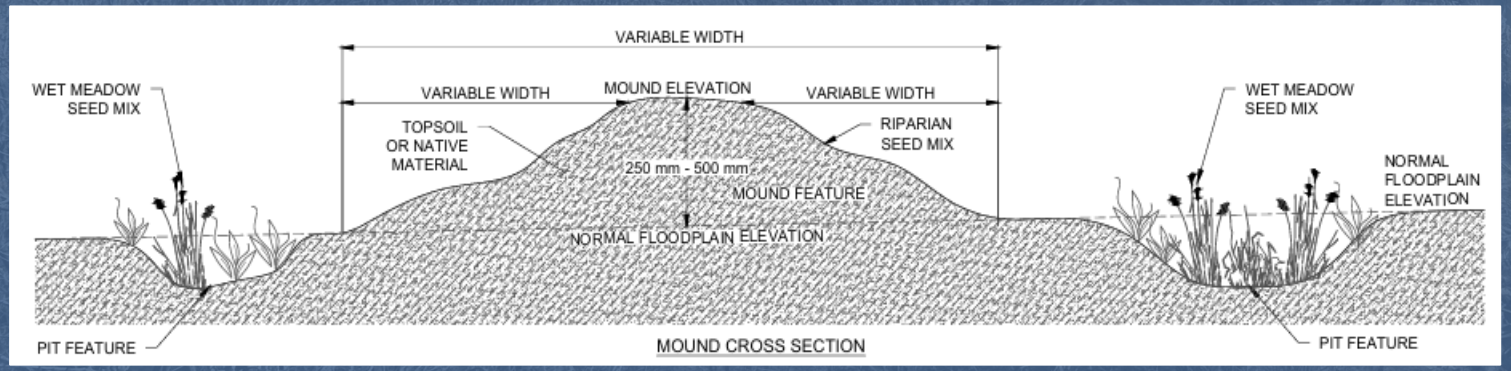
- Permit requirement to meet pre-development riparian storage volumes
  - Widening the corridor bottom doesn't always provide the increases required

Study Site


Georgian Bay
Lake Huron
Lake Simcoe
Toronto
Lake Ontario
Study Site
Lake Erie

Pit-and-Mound Design

- Enhance floodplain heterogeneity and hydrologic function
  - Vegetated mounds increase surface roughness, add variation to hydroperiod
  - Pit features retain water and promote infiltration
  - Make floodplain less efficient and increase riparian storage



MOUND CROSS SECTION

= Low Flow Thalweg

= Pit-and-Mound

GEO MORPHIX®

Volumetric Storage

Event	Max Flow (m^3/s)	Existing (m^3)	Proposed (m^3)	Difference
2-year	1.3	39620	42574	+2954
5-year	2.62	72780	72814	+34
10-year	3.69	95000	95364	+364
20-year	4.82	115850	116014	+164
50-year	6.41	144990	145704	+714
100-year	7.69	168520	169464	+944
Regional	40.8	650810	655684	+4884

Velocity

	Upstream (m/s)			On Mound (m/s)			Downstream (m/s)		
	LB	Chan	RB	LB	Chan	RB	LB	Chan	RB
50-yr	0.20	0.56	0.20	0.34	1.94	0.34	0.23	0.65	0.23
100-yr	0.23	0.62	0.23	0.40	2.17	0.40	0.26	0.71	0.26
Reg.	0.60	1.53	0.60	0.78	2.60	0.78	0.62	1.57	0.62
50-yr	0.22	0.62	0.22	0.29	1.23	0.29	0.22	0.62	0.22
100-yr	0.25	0.68	0.25	0.32	1.30	0.32	0.25	0.69	0.29
Reg	0.61	1.55	0.61	0.71	2.24	0.71	0.32	1.58	0.62

LB = left bank, Chan = in-channel, RB = right bank

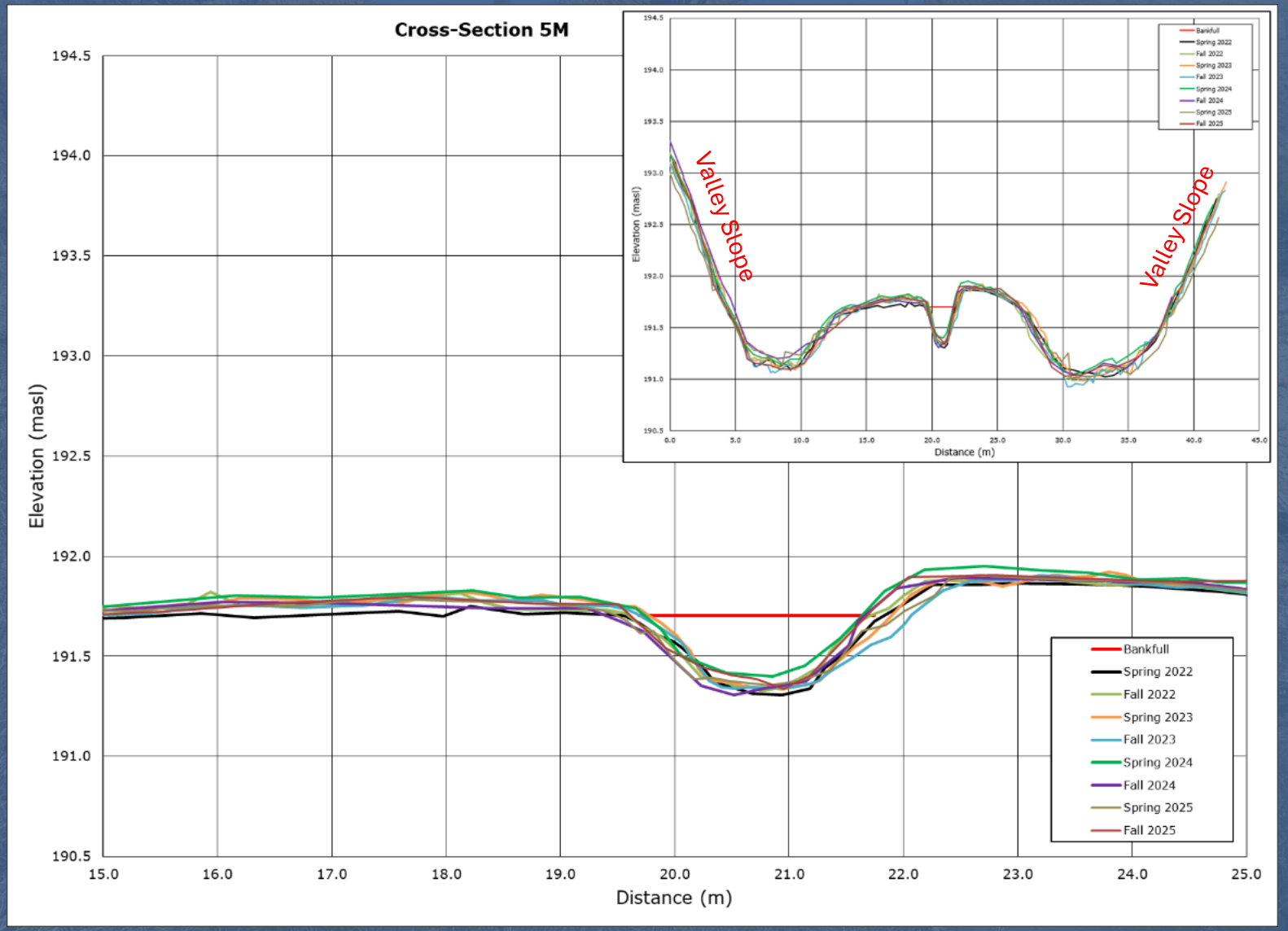
Shear Stress

	Upstream (N/m^2)			On Mound (N/m^2)			Downstream (N/m^2)		
	LB	Chan	RB	LB	Chan	RB	LB	Chan	RB
50-yr	3	4	3	6	102	6	4	5	4
100-yr	4	5	4	24	65	24	5	7	5
Reg.	12	19	12	55	74	55	22	25	22
50-yr	4	5	4	11	20	11	4	5	4
100-yr	4	6	4	13	22	13	4	6	4
Reg	21	25	21	43	54	43	22	26	22

LB = left bank, Chan = in-channel, RB = right bank

Construction

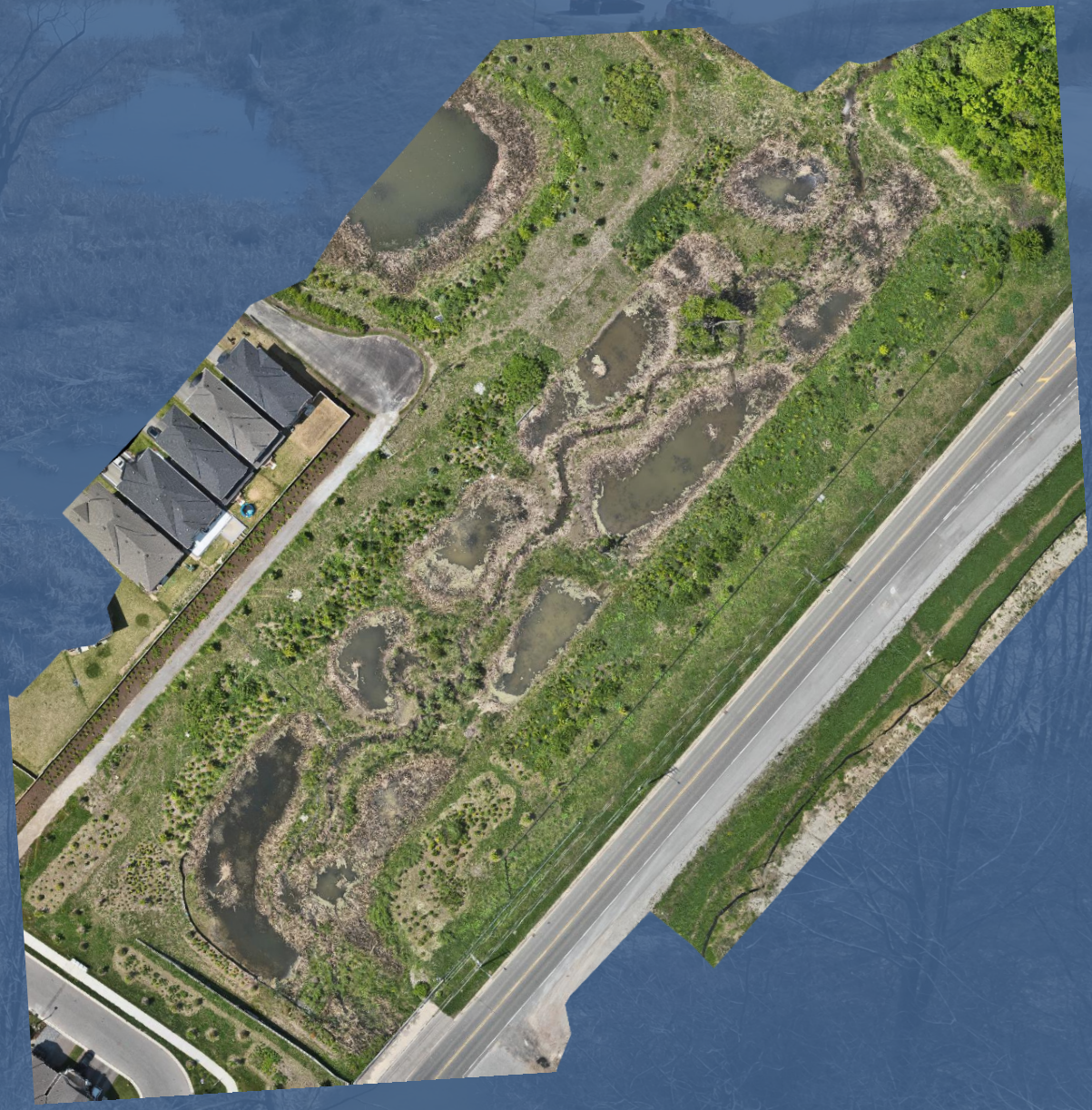
Monitoring Cross Sections



Post-Development Flow Conditions

Discussion

- Based on modelling results, there was a limited risk associated with the features
- Manage risk by reviewing modelling results to determine appropriate stabilization measures
- Features continue to be stable 4 years post-construction



June 2025


Thank You
GEO
MORPHIX®