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TECHNICAL MEMORANDUM

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To:	Barry Kolenosky, CAO	**Previous Issue Date:**	
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Client:	Municipal District of Lesser Slave River No. 124		
Project Name:	Marten Beach Flood Disaster Risk Management Strategy		
Subject:	Option 5 - Alternative Dike Alignments		

1 INTRODUCTION

The Municipal District of Lesser Slave River No. 124 (MDLSR) contracted Associated Engineering Ltd. (AE) to advise and support Council in selecting a course of action to reduce flood risk in the Hamlet of Marten Beach and Diamond Willow campground. Based on MDLSR-provided options and additional analysis and engagement by AE, AE identified five risk treatment options with the highest potential for reducing flood risk, which were subsequently further analysed through a more detailed cost-benefit analysis (CBA). Option 5 – Room for the River has the highest net present value (NPV). Following the Open House where valuable feedback was received from the property owners, AE created two additional Option 5 alternatives with slightly modified dike alignments.

This Technical Memorandum summarizes the three variations of Option 5 and provides an opinion of the probable costs of these variations. This analysis is at the feasibility/conceptual level only; preliminary and detailed design would be required to determine the final alignment of the flood protection barriers based on topology and bathymetry.

2 DESCRIPTION OF OPTION 5 ALTERNATIVES

AE incorporated feedback from the public, received during the Open House on June 24, 2022, to develop two additional dike alignments (5B and 5C). The refinement of dike alignments normally occurs during later preliminary design phases once more data and models are developed; however, AE provided this additional conceptual information to support the MDLSR decision-making process.

- **Option 5 – Alignment Along Johnson Drive (black):** This option envisions re-establishing Marten River's natural meander, widening the floodplain, earth berms on both sides of the river, and relocating properties within the existing river meander. The berm runs along Johnson Drive and Herb Crescent. This option has the widest downstream floodplain width and, subsequently, the lowest upstream flood elevations.

- **Option 5B – Alignment within Willow Cul-de-Sac (red):** In this option, the berms are identical to Option 5, with the exception of narrowing the floodplain on the downstream side at Willow Cul-de-Sac to protect two additional properties, creating slightly increased upstream flood elevations.

- **Option 5C – Alignment at the Far End of Willow Cul-de-Sac (yellow):** The entire length of the north side berm is shifted closer to the river to protect an additional six properties (along Willow Drive cul-de-sac, Marten Drive and Herb Crescent) as compared to Option 5. The furthest upstream and downstream homes would likely need a sheet pile wall due to the constrained width adjacent to the current river channel (shown as dashed yellow lines in the figure). This option more significantly restricts the downstream floodplain width and elevates the upstream water levels. Therefore, the south berm of option 5C may need to be offset further back, and a bypass channel installed through a natural high point to widen the overall floodplain to offset the higher upstream water levels and resulting costs of higher berms.

Figure 1. Alternative Option 5 Dike Alignments

3 DIKE CONCEPTUAL DESIGN AND OPINION OF PROBABLE COSTS

The same costing methodology used to assess the previous five risk treatment options was used to assess the costs for Options 5, 5B and 5C. While Options 5 and 5B are entirely earth berms, Option 5C contains short segments of sheet pile walls. While construction sheet pile walls are more expensive than earthen embankments, this cost increase is offset by a reduced property buyout cost along this alignment. Option 5C also has 155 m of overflow/drainage channel sized with a 1 m depth, 1 m bottom (invert) width, and 3H:1V slope. Riprap and geotextile placement were included. Summaries of the conceptual design details and cost estimates of options 5, 5B, and 5C are presented in Tables 1 and 2.

The difference in cost between these two variations was not determined to be significant enough to conduct further CBA analysis, as the relative cost-effectiveness of the options evaluated was not likely to change.

Table 1. Conceptual Dike Dimensions for Options 5, 5B, and 5C

Description	Option 5 Room for the River		Option 5B Narrowed by Pine Drive		Option 5C Whole Channel Narrowed	
Barrier Location	North	South	North	South	North	South
Type of Dike	Earth Berm	Earth Berm	Earth Berm	Earth Berm	74% Earth Berm/26% Sheet Pile	Earth Berm w/ 155 m of cut/channel
Berm Dimensions:						
Average Dike Height (m)	0.8	0.5	0.9	0.6	1.0	0.7
Dike Top Width (m)	-	2	2	2	2	2
Bottom Width (m)	*6.1*	*4.5*	*6.5*	*5.0*	*7.0*	*5.5*
Dike Side Slope (H:V)	2.5:1	2.5:1	2.5:1	2.5:1	2.5:1	2.5:1
Volume (m^3)	*1,834*	*598*	*2,216*	*872*	*1,973*	*751*
Dike Length:						
Sheet Pile (m)	-	-	-	-	*155*	-
Earth Berm (m)	*550*	*360*	*580*	*420*	*440*	*290*
Total per side (m)	550	360	580	420	595	290
Total Length (m)	**910**		**1,000**		**885**	

Table 2. Conceptual Cost Esimate Summary for Options 5, 5B, and 5C

Description	Option 5 Room for the River	Option 5B Narrowed by Pine Drive	Option 5C Whole Channel Narrowed
Number of Affected Properties, Residents, and Dwellings:			
Permanent Resident Properties	5	*4*	3
Secondary Resident Properties	13	*12*	9
Vacant/Campground Properties	10	*10*	10
Total Properties for Buyout	**28**	**26**	**22**
Permanent Residents	8	7	5
Secondary Residents	36	32	28
Total Residents for Buyout	**44**	**39**	**33**
Permanent Dwellings	5	4	3
Secondary Dwellings	8	8	6
Total Dwellings for Buyout	**13**	**12**	**9**
Conceptual Cost Estimate ($M (million)):			
Berms per side	*$3.7* *$2.0*	*$3.8* *$2.1*	*$4.6* *$2.1*
Berms Total	*$5.7*	*$5.9*	*$6.7*
Property Buyout Costs	*$5.8*	*$5.2*	*$3.9*
Total Cost	**$11.5**	**$11.1**	**$10.6**

Note: A dwelling is considered a permanent housing structure and does not include ancillary buildings (garages, sheds) or temporary structures (trailers). Buyout cost includes cost for property and permanent dwellings only.

4 FALL 2022 DATA COLLECTION

Further refinement of the dike design and cost estimates is dependent on surveys of river bathymetry (normal river channel) and topography within the floodplain up to and including the top of the bank (on properties). These surveys are essential to develop more accurate river models and support preliminary and detailed design. Fall is the ideal time to conduct these surveys since river levels are low and the ground is clear of snow. The cost of this recommended survey is estimated to be $45,000 and should occur before snowfall and river ice formation.

Preliminary and detailed design cost is estimated at 10% of the total conceptual dike construction cost estimate, which includes the buyout cost estimate. An additional 2% is estimated for river and topographical surveys, a geotechnical assessment, and environmental assessments, including contaminated sites and regulatory support. Potential archeological impacts such as resource finds or ongoing monitoring during construction are unknown at this time and are not included in these numbers.

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