Watercourse Crossing for Meadow Drive, Sipekne'katik NS

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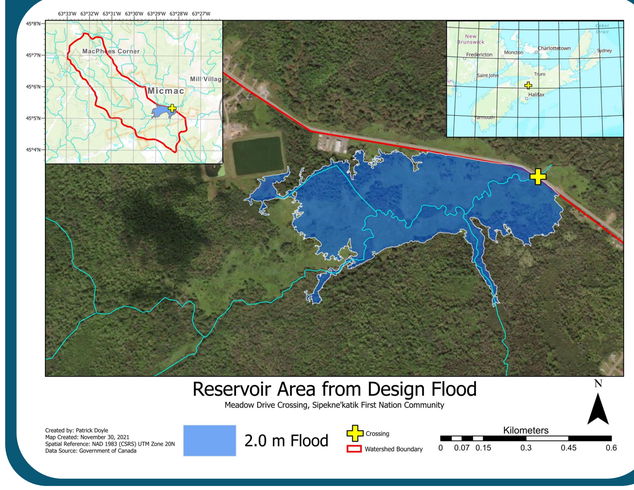
Background

Meadow Drive is the primary access route and sole paved road to the Sipekne'katik First Nations reservation in Hants County, NS. The road is prone to regular flooding due to inadequate culverts installed in the road's embankment through a stretch of wetland. The culverts are unable to manage the high flows that they are subject to, creating a reservoir which eventually overtops the road itself. This is an accessibility issue and a major safety concern.

The new watercourse crossing accommodates 50- and 100-year floods, accounting for climate change, with a hope to improve both the community and environment.

Project Location



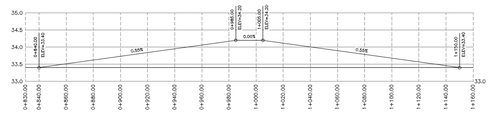
Design Process

Hydrology	Hydraulics	Structural	Geotechnical
Watershed Delineation	Hydraulic Analysis	Options Analysis	Soils Analysis
Peak Flow Analysis	Bridge Opening	Structural Analysis	Roadbed Analysis
Flood Level Analysis	Entrance Arrangement	Construction Planning	Road Alignment
Low Flow Analysis	Erosion Control	Cost Estimate	Soil-Structure Interaction

Class B Cost Estimate

ShawSpan™	$232,000
Earthwork	$26,000
Roadwork	$81,000
Contingency (15%)	$51,000
Total	**$390,000**

Geotechnical Analysis



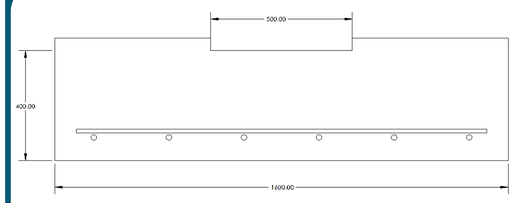
Above: Vertical realignment shown at 25:1 vertical exaggeration.

The road needs to be raised 0.6m to accommodate the new bridge's height above the streambed and ensure smooth roadway continuity. This also ensures approach grades meet minimum TAC requirements for roadway drainage.

Soil Properties

Type	Silty Sand
Cohesion	22kPa
Angle of Friction	36°
Shear Strength	200kPa
Bearing capacity	550kPa

Concrete Footing Design



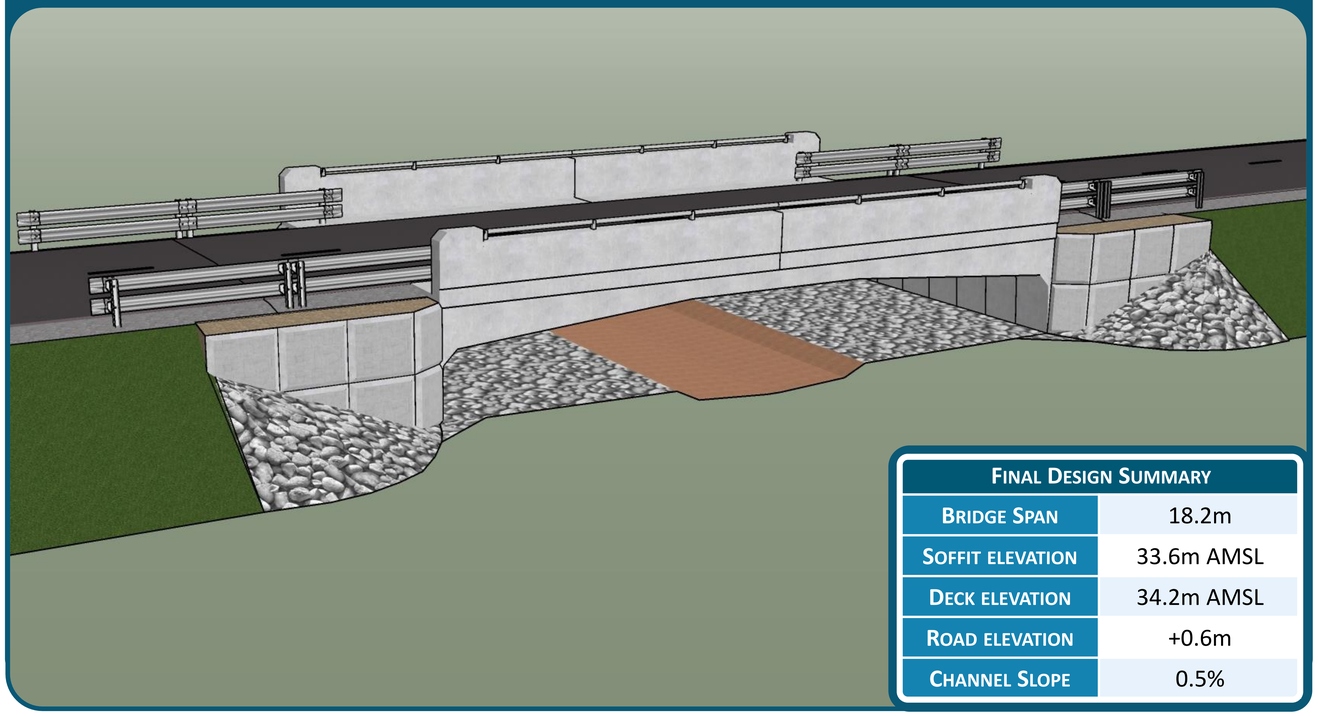
Above: The strip footings have a length of 10.9m and are designed to meet the allowable bearing capacity of 550kPa. The width of the footing meets the minimum requirement for the selected ShawSpan™ of 18.2m.

Asphalt binder board will be placed to prevent spalling during installation.

Steel Reinforcement

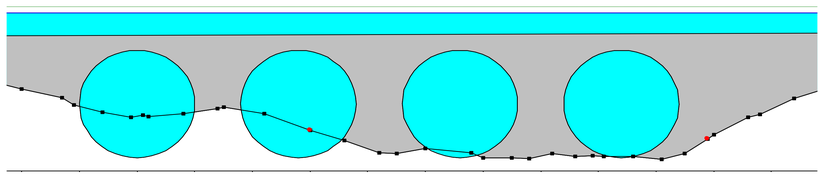
Longitudinal	6-20M @ 265mm
Transverse	4-15M @ 280mm

Final Design



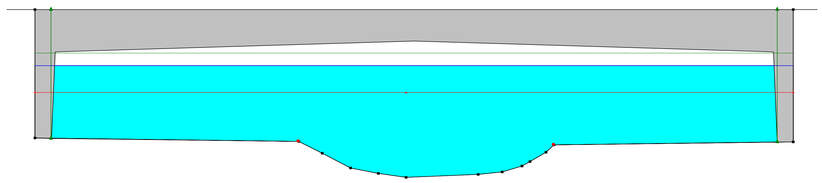
Final Design Summary	
Bridge Span	18.2m
Soffit elevation	33.6m AMSL
Deck elevation	34.2m AMSL
Road elevation	+0.6m
Channel Slope	0.5%

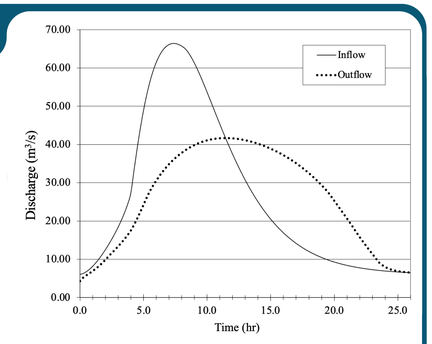
Hydraulic and Hydrologic Analyses

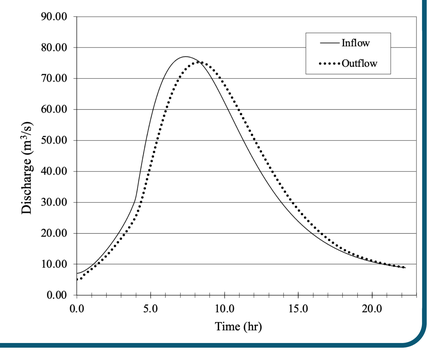


Above: Existing culvert system analysis. The outflow hydrograph is significantly attenuated meaning water will pool upstream and overtop the road.

Below: Proposed bridge analysis. Minimal outflow attenuation occurs. A 50-year event with a 16% flow increase for climate change will be fully routed 300mm below the soffit of the bridge.







Conclusion and Recommendations

Conclusion: The flooding of Meadow Drive can be prevented by replacing the existing culvert system with an 18.2m ShawSpan™ and raising the road's vertical alignment by 0.6m. The prefabricated ShawSpan™ was chosen for its clear span width and ease of installation, which minimizes roadway closure time. This bridge accommodates the 50-year flood flow rate of 77m³/s with the required soffit clearance of 300mm.

Recommendations: Performing hydraulic model calibration via field data collection, investigating further into relief culverts at the topographical low point, and conducting a site-specific geotechnical investigation will all contribute to a further effective design.

Key References

CSA Group. S6:19. 2019. Canadian Highway Bridge Design Code

Transportation Association of Canada. 2017. Geometric Design Guide for Canadian Roads

National Research Council of Canada. 2015. National Building Code of Canada

Richards W, Daigle R. 2011. Scenarios and Guidance for Adaptation to Climate Change and Sea Level Rise - NS and PEI Municipalities