ARCADIS

Michigan Department of Transportation

Infrastructure Protection and Rehabilitation Response to High Lake Levels

MDOT OR21-013

Appendix B: Proposed Coastal Design Criteria

March 2022 (Final)

Infrastructure Protection and Rehabilitation Response to High Lake Levels

MDOT OR21-031

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March 2022 (Final)

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Table 1. MDOT Current Drainage Criteria

Asset Type	Design Year Storm	Check Year Storm	Freeboard Required	Design Life	Tie-in Grading Slopes	Longitudinal Slopes	Manual Reference	Comments
Storm Sewers	10-year just full; 50-year in sags or depressed sections of roadway	Allowed to surcharge for less frequent storms	1' below gutter grade	50-years	-	-	MDOT Drainage Manual, 7.4.1	-
Pavement Spread	10-year storm for high volume roads		Keep spread within shoulder. With no shoulder, 3' maximum spread.	-	-	-	MDOT Drainage Manual, 7.4.3.4	-
Culverts	2% or 50-year storm	1% or 100-year storm	1.5' below edge of shoulder for 50-year storm and no greater than elevation where flow diverts around the culvert, i.e. overtopping elevation	Cross culverts 50-years; Drive culverts 25-years	-	Match the existing stream bottom slope	MDOT Drainage Manual 5.3, FHWA FAPG, Part 650, and Order 1977-4 "State Flood Hazard Management Plan"	Note that a culvert with a drainage area above 2 square miles, an environmental permit under part 31 of the NREPA from the MDED are required. A detailed hydraulic analyses is required and is performed by MDOT Hydraulics Unit.
Bridges (Waterway Opening)	50-year storm (no overtopping of the bridge)	100-year storm shall not cause harmful interference	Where practical, a minimum clearance of 2' between the water surface and low chord during the design flood	75 years	-	-	MDOT Drainage Manual, 6.3.2	-
Bridges (Scour)	100-year storm	500-year storm	-	75 years	-	-	MDOT Drainage Manual, 6.3.2	Geotechnical Engineer reviews foundation design using a safety factor of 1.0
Streams	Design over a range of storms - from the 10-year to the 100-year	100-year	1.5' below edge of shoulder	-	1V:3H or flatter	0.10% absolute minimum and 0.30% preferred minimum	MDOT Drainage Manual, 4.3	-
Roadway Channels	Design over a range of storms - from the 10-year to the 100-year	100-year	1.5' below edge of shoulder	-	1V:3H or flatter	0.10% absolute minimum and 0.30% preferred minimum	MDOT Drainage Manual, 4.3	-

Asset Type	Design Year Storm	Check Year Storm	Freeboard Required	Design Life	Tie-in Grading Slopes	Longitudinal Slopes	Manual Reference	Comments
Ditch Erosion Protection	-	-	-	-	-	0.10% absolute minimum and 0.30% preferred minimum	MDOT Drainage Manual, 4.4.3.2.3	Ditch erosion protection is based on slope and not on velocity or shear stress. No mention of rock channel protection or any criteria for when to use it. Special rock designs/ energy dissipaters are referred to FHWA HEC Manuals
Detention Facilities	10-year for enclosed primary device and 25-year for open channel device	100-year for auxiliary and emergency overflow device	1.5' above 100-year elevation	75 years	1V:3H or flatter	0.30% minimum bottom slope	MDOT Drainage Manual, 8.3	-

Table 2. Proposed Coastal Criteria. Note, the following is example criteria only.

Asset Type	AADT	Design Water Level	Check Design Water Level	Freeboard Required	Design Life	Design Elevation Calculation	Maximum Side Slopes	Minimum Setback from Shoreline	Specific Methodology to Use	Wave Data to Use	Comments
Coastal Roads for Inundation	Roads with ADT < 2000 vpd	25-Year	50-Year	1.5' below EOP	100-year	DWL + Wave Height +Wave Runup	2:1 Max, 3:1 preferred	75'	For wave height assume: Hb = 0.78*ds and Use Surf Similarity Eq. for Wave Runup	Weekly	-
Coastal Roads for Inundation	Roads with ADT > 2000 vpd	50-Year	100-Year	1.5' below EOP	100-year	DWL + Wave Height +Wave Runup	2:1 Max, 3:1 preferred	75'	For wave height assume: Hb = 0.78*ds and Use Surf Similarity Eq. for Wave Runup	Weekly	-
Coastal Roads for Slope Erosion	Roads with ADT < 2000 vpd	25-Year	50-Year	1.5' below EOP	100-year	DWL + Wave Height	2:1 Max, 3:1 preferred	75'	For wave height assume: Hb = 0.78*ds and Use Hudson Equation	Hourly	Used to Size Armor Stone. Assume ds = scoured depth to be conservative
Coastal Roads for Slope Erosion	Roads with ADT > 2000 vpd	50-Year	100-Year	1.5' below EOP	100-year	DWL + Wave Height	2:1 Max, 3:1 preferred	75'	For wave height assume: Hb = 0.78*ds and Use Hudson Equation	Hourly	Used to Size Armor Stone. Assume ds = scoured depth to be conservative
Coastal Bridges for Inundation	Roads with ADT < 2000 vpd	25-Year	50-Year	2' to bottom of chord	100-year	DWL + Wave Height +Wave Runup	-	75'	For wave height assume: Hb = 0.78*ds and Use Surf Similarity Eq. for Wave Runup	Weekly	-
Coastal Bridges for Inundation	Roads with ADT > 2000 vpd	50-Year	100-Year	2' to bottom of chord	100-year	DWL + Wave Height +Wave Runup	-	75'	For wave height assume: Hb = 0.78*ds and Use Surf Similarity Eq. for Wave Runup	Weekly	-
Coastal Bridges for Erosion and Scour	all	100-Year	500-Year	2' to bottom of chord	100-year	DWL + Wave Height	2:1 Max, 3:1 preferred	75'	For wave height assume: Hb = 0.78*ds	Hourly	-
Revetments (Toe of Slope)	all	25-Year	50-Year	-	50-year	DWL + Wave Height	2:1 Max, 3:1 preferred	-	For wave height assume: Hb = 0.78*ds and Use Hudson Equation	Hourly	Used to Size Armor Stone. Assume ds = scoured depth to be conservative

Asset Type	AADT	Design Water Level	Check Design Water Level	Freeboard Required	Design Life	Design Elevation Calculation	Maximum Side Slopes	Minimum Setback from Shoreline	Specific Methodology to Use	Wave Data to Use	Comments
Revetments (Overtopping & Crest Elevation)	all	50-Year	100-Year	1.5' Overtopping	100-year	DWL + Wave Height +Wave Runup	2:1 Max, 3:1 preferred	-	For wave height assume: Hb = 0.78*ds and Use Surf Similarity Eq. for Wave Runup	Hourly	-
Sea Walls (Toe of Slope)	all	25-Year	50-Year	-	50-year	DWL + Wave Height	-	-	-	Hourly	Need to do a typical retaining wall analysis for global stability, i.e. overturning and sliding with a FS = 2.0
Sea Walls (Overtopping)	all	50-Year	100-Year	1.5' Overtopping	100-year	DWL + Wave Height +Wave Runup	-	-	For wave height assume: Hb = 0.78*ds andSurf Similarity Eq. for Wave Runup	Hourly	Need to do a typical retaining wall analysis for global stability, i.e. overturning and sliding with a FS = 2.0

Notes:

adt = average daily traffic

ds = depth of water at structure toe

DWL includes normal high water level plus surge height

Hb = wave height

vpd = vehicles per day

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