

**Appendix 5-A**  
**Symbols and Acronyms**

## Chapter 9

### Symbols

<u>Symbol</u>	<u>Definitions</u>	<u>Units</u>
A	Area of cross section of flow	sf
AHW	Allowable headwater	feet
B	Barrel width	inch or feet
$C_d$	Overtopping discharge coefficient	-
$C_r$	Discharge coefficient	-
D	Culvert diameter or barrel height	inch or feet
d	Depth of flow	feet
$d_c$	Critical depth of flow	feet
$d_n$	Normal depth	feet
g	Acceleration due to gravity	feet/s <sup>2</sup>
H	Head loss in culvert	feet
$H_b$	Bend headloss	feet
$H_E$	Entrance headloss	feet
$H_f$	Friction headloss	feet
$H_L$	Total energy losses	feet
$H_o$	Outlet or exit headloss	feet
$H_v$	Velocity head	feet
$h_o$	Hydraulic grade line height above outlet invert	feet
HW	Headwater depth (subscript indicates section)	feet
$HW_{oi}$	Outlet control headwater	feet
$HW_{ov}$	Height of water over roadway	feet
$HW_r$	Upstream depth measured above roadway crest	feet
$K_E$	Entrance loss coefficient	-
$k_t$	Submergence coefficient	-
L	Length of culvert	feet
L	Length of roadway crest (Section 9.4)	feet
$L_1$	Adjusted culvert length	feet

$n$	Manning's roughness coefficient	-
$n_1$	Desired Manning n value	-
WP	Wetted perimeter	feet
Q	Rate of discharge	cfs
$Q_r$	Overtopping flow rate	cfs
R	Hydraulic radius (A/P)	feet
$S_o$	Slope of culvert	feet/feet
TW	Tailwater depth above invert of culvert	feet
V	Mean velocity of flow with barrel full	fps
$V_d$	Mean velocity in downstream channel	fps
$V_o$	Mean velocity of flow at culvert outlet	fps
$V_u$	Mean velocity in upstream channel	fps
$\gamma$	Unit weight of water	lb./cf
$\tau$	Tractive force	psf

## Acronyms

AASHTO	American Association of State Highway Transportation Officials
ASTM	American Society for Testing and Materials
BLM	Bureau of Land Management
FEMA	Federal Emergency Management Association
FHWA	Federal Highway Administration
HDS	Hydraulic Design Series
HEC	Hydraulic Engineering Circular (FHWA)
HEC	Hydraulic Engineering Center (USACE)
MDEQ	Michigan Department of Environmental Quality
MDOT	Michigan Department of Transportation
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
SCS	Soil Conservation Service, now known as NRCS
TVA	Tennessee Valley Authority
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey