

Memo

New Mexico Department of Transportation

SUBJECT: Infrastructure Design Directive
IDD-2009-03
(Drainage Design Criteria)

DATE: 25-June-2009

TO: Office of Infrastructure Divisions
District Offices
Transportation Design Community

FROM: Tamara P. Haas, Acting Chief Engineer
Office of Infrastructure Divisions

FILE REFERENCE:
PSESHARE:Design Directives

Attached is the Drainage Design Criteria (“DDC”) revised in June 2007. These criteria constitute the policies and guidelines on drainage design for all State Transportation projects.

The New Mexico Department of Transportation’s (NMDOT) Drainage Design Engineers (“DDE”) and others who work on NMDOT transportation projects should utilize this document as guidance in drainage design. These design criteria are to be used in conjunction with current NMDOT’s documents and drawings including: “Drainage Manual”, “Standard Specifications for Highway and Bridge Construction”, and the “Standard Design Drawings”.

An exception to the Drainage Criteria in design can be due to budget restrictions, right-of-way limitations, environmental and property impacts and other constraints. Design exceptions will be considered when no options are viable or available.

The drainage structures and systems need to be designed in compliance with all environmental regulations, safety issues, permit requirements, and consider future maintenance operations and the preservation of the constructed transportation infrastructures.

As a reminder, the Design Directives reside in the PSESHARE drive. General Office staff will utilize the \\asgopinon\pseshare drive to access the Directive. District staff can access the Directive utilizing the appropriate District drive as indicated below:

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In addition, the Directive will reside in the Department’s external website. The web address is:

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DRAINAGE DESIGN CRITERIA

FOR



New Mexico DEPARTMENT OF
TRANSPORTATION
MOBILITY FOR EVERYONE

PROJECTS

FOURTH REVISION

June 2007

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Acknowledgements

This document was prepared with extensive effort by all engineers of the NMDOT Drainage Design Bureau and consultation with Smith Engineering Company.

INTRODUCTION

This document establishes minimum recommended criteria for the design of drainage structures on NMDOT projects. It addresses the NMDOT's policies and guidelines on design criteria. This criteria is based on highway classification and Average Daily Traffic (ADT), protection and safety of the public, protection of property, availability of public funds, economic impacts, and location (urban or rural).

These design criteria are to be used in conjunction with current NMDOT's documents and drawings including: "Drainage Manual", "Standard Specifications for Highway and Bridge Construction", and the "Standard Design Drawings".

As stated in the Drainage Manual, budget impacts, right-of-way limitations, recommended environmental standards and property impacts and other constraints may require a design variance to recommended standards. Such variations are normally applied upon performing a Risk Analysis.

The Drainage Manual describes this procedure.

In jurisdictions that have stricter criteria than those in this manual, the local jurisdiction criteria govern the drainage design. This includes Rail Road, Cities, Counties, and other agencies.

DESIGN CRITERIA

As discussed at length in the Drainage Manual, the design of drainage systems needs to consider the following principles:

- minimizing upstream and downstream effects
- safety and welfare of the traveling public
- preserving the existing drainage path
- promoting the passage of sediment and debris
- minimizing adverse effects on adjacent properties
- minimizing the effects to the environment including impact on fish, wildlife, and wetlands
- protecting historic properties and archaeological sites
- preserving the existing floodplains
- context sensitive design

The drainage system needs to be designed in compliance with all environmental regulations, permit requirements, and consider future maintenance operations and the preservation of the constructed highway.

The level of hydrologic analysis needs to be appropriate to the importance of the drainage system. Tables 1 through 5 depict the drainage design criteria. These tables must be

used in conjunction with the NMDOT's Drainage Manual.

Detour structures shall be sized for the 24-hour, 2-year storm event. However, there may be cases where larger flood events may need to be considered, such as a very long construction period, or potential for economic or property damage, etc. In the event where a larger design storm is merited, it shall be discussed with the NMDOT drainage section engineers.

Table 1 – Criteria for Drainage Structures

	Design Flood	Check Flood*	
	Two, Four and Six Lane Roads	Two Lane Roads	Four and Six Lane Roads
Bridge Freeboard	Minimum of 2 feet	Below the low chord	Below the low chord
Bridge Scour	Determine scour depth as needed	Determine scour depth as needed	Determine scour depth as needed
Existing Culverts	Limit headwater to edge of driving lane	Limit headwater to one <u>half</u> of a driving lane	Limit headwater to one driving lane
New Culverts	Ratio of headwater depth to culvert rise shall not exceed 1.5 and limit headwater to edge of shoulder	Limit headwater to one <u>half</u> of a driving lane	Limit headwater to one driving lane
Sidewalk Culverts	Limit headwater depth to top of sidewalk	Overtopping the sidewalk is allowed	Overtopping the sidewalk is allowed
Bridge Deck Drains	Limit water spread to edge of driving lane	Limit water spread to one <u>half</u> of a driving lane	Limit water spread to one driving lane
Roadside Ditches and inlets	Limit water depth to edge of shoulder	Limit water depth to one <u>half</u> of a driving lane	Limit water depth to one driving lane
Median Ditches and inlets	Limit water depth to edge of shoulder	Limit water depth to edge of driving lane	Limit water depth to edge of driving lane
Trunk lines	Limit hydraulic grade line to 1 foot below top of grate elevation	Limit hydraulic grade line to the top of grate	Limit hydraulic grade line to the top of grate
Curb Drop Inlets	Limit water spread to half of driving lane	Limit water spread to top of curb	Limit water spread to top of curb

* The check flood is a more intense flood than the corresponding design flood and is used as a secondary criterion.

**Table 2A
Storm Frequencies for Interstate Highways and Primary Arterials**

	Bridge Structure		Bridge Scour**		Existing, New, & sidewalk Culverts		Bridge Deck Drains		Roadside Ditches & Inlets		Median Ditches & Inlets		Trunk lines		Curb Drop Inlets	
	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood
ADT* RANGE	50 y	100 y	100 y	500 y	50 y	100 y	50 y	100 y	50 y	100 y	50 y	100 y	50 y	100 y	50 y	100 y
All ADT*																

*ADT = projected average daily traffic measured in vehicles per day

** Use Overtopping flood if less than 100 years

**Table 2B
Storm Frequencies for Minor Arterials, Collectors, and Local Roads**

	Bridge Structure		Bridge Scour**		Existing, New, & sidewalk Culverts		Bridge Deck Drains		Roadside Ditches & Inlets		Median Ditches & Inlets		Trunk lines		Curb Drop Inlets	
	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood
ADT* RANGE	50 y	100 y	100 y	500 y	50 y	100 y	50y	100y	10 y	50 y	10 y	50 y	10y	50y	10 y	50 y
Rural >400 ADT and All Urban																
Rural <400 ADT	25 y	50 y	100 y	500 y	25 y	50 y	25y	50y	10 y	25 y	10 y	25 y	10 y	25 y	10 y	25 y

*ADT = projected average daily traffic measured in vehicles per day

** Use Overtopping flood if less than 100 years

Table 3A - Criteria for Retention and Detention Ponds ¹

	Design Flood	Check Flood
“Non Jurisdictional”¹	<ul style="list-style-type: none"> • 2 ft of freeboard to top of dam (rural and urban) • Water surface elev. at or below emergency spillway • <u>Detention</u> pond must drain in < 96 hours 	<ul style="list-style-type: none"> • 1 ft of freeboard to top of dam (rural and urban)
“Jurisdictional”¹	<ul style="list-style-type: none"> • Dam design, spillway and freeboard requirements must be computed per NMOSE standards for wave run-up, etc. (See Note 1) • <u>Detention</u> pond must drain in < 96 hours (See Note 1) 	<ul style="list-style-type: none"> • Dam design, spillway and freeboard requirements must be computed per NMOSE standards for wave run-up, etc. (See Note 1) • <u>Detention</u> pond must drain in < 96 hours (See Note 1)

Table 3B – Storm Frequency Criteria for Retention and Detention Ponds ¹

	“Non-Jurisdictional” Pond (dam) ¹	
	Design Flood	Check Flood
Rural Design Storm Frequency	50 y	100 y
Urban Design Storm Frequency	50 y	100 y
Rural Design Storm Duration	24 h	24 h
Urban Design Storm Duration	24 h	24 h

Notes.

1. See Glossary for definition of Non-Jurisdictional and Jurisdictional Dams as defined by the NMOSE Dam Safety Bureau.
Refer to "Rules and Regulations Governing Dam Design, Construction and Dam Safety" March 31, 2005 (or latest edition) as prepared by the NM Office of the State Engineer Dam Safety Bureau. It is recommended to consult the NMOSE Dam Safety Bureau in Santa Fe prior to design

Table 4 - Additional Design Considerations for Bridges, Channels, and Culverts

Adjacent Properties	There must be no detrimental effects - flooding, sedimentation, or erosion - on adjacent property.
Irrigation Ditches	Ensure that the proposed design does not adversely affect irrigation ditches.
Channel or Stream Deterioration and Modifications	Ensure the proposed structure does not cause significant changes to channel velocity, aggradation or degradation, scour, headcutting, and conveyance.
Debris and Sedimentation	Make allowance in the design for losses in channel conveyance due to debris and sedimentation.
Context Sensitive Issues	The design of the structure considers and respects local cultural customs and does not cause any negative effects on the local economy.
Regulatory Requirements	Ensure that the proposed structure and any channel or stream modifications meet the requirements of the US Army Corps of Engineers, the NM Environment Department, FEMA, and other agencies.

Table 5 - Other Design Considerations

Storm Drain / Inlet Item	Design Layout Criteria
Storm Drains	
Minimum Diameter Trunk line	24-inch
Minimum Diameter Connector pipes (inlets to trunk line)	24-inch
Maximum distance between manholes	
- 24-inch storm drain	300 feet
- 27-30 inch storm drain	375 feet
- 36-54 inch storm drain	450 feet
- 60 inch or greater storm drain	600 feet
Minimum cover on pipe	Based on manufacture's specifications
Minimum Storm Drain Slope	0.3 %
Minimum Velocity (trunk and connectors)	2.5 feet per second.
Manhole location	Not within an intersection
Inlets	
Minimum pipe diameter to connect inlets	24-inch

ACRONYMS

ADT – Average Daily Traffic
CFR – Code of Federal Regulations
AASHTO – American Association of State Highway and Transportation Officials
DOT – Department of Transportation
BFE – Base Flood Elevation (FEMA term for the 100-yr. water surface elevation actually shown with an elevation determined with detailed methods)
FEMA – Federal Emergency Management Agency
FHWA – Federal Highway Administration
FIRM – Flood Insurance Rate Map
FIS – Flood Insurance Study
NMDOT – New Mexico Department of Transportation
NMOSE – New Mexico Office of the State Engineer
NMED – New Mexico Environment Department
USACE – U.S. Army Corps of Engineers

GLOSSARY

Arterial, Major – due to lengthy definitions for rural and urban, refer to :
Arterial, Minor – due to lengthy definitions for rural and urban, refer to :
Collector, Major – due to lengthy definition for rural and urban, refer to :
Collector, Minor – due to lengthy definition for rural and urban, refer to :

*American Association of State Highway and Transportation Officials (AASHTO).
A Policy on Geometric Design of Highways and Streets. 2004.*

Check Flood – The check flood is a more intense flood (less frequent) than the corresponding design flood and is used as a secondary criterion for design.

Criterion - A standard on which a judgment is based. (Criteria is plural)

Context Sensitive – Consideration of the context of local surroundings, cultural customs and local community with the design sensitive to these issues.

Design Flood – The storm frequency (return period) rainfall event applied in the hydrologic analyses to obtain the design flood.

Freeboard for a Bridge - The vertical distance between the lowest hanging structural member of the bridge and the water surface immediately below it.

Freeboard for a Channel or other structure – The vertical distance between the design water surface elevation and the lowest point of the structure crest.

Freeboard for a Dam (NMOSE –Dam Safety Bureau) – The vertical distance between the spillway crest and the lowest point of the dam crest not including camber.

Guideline - A statement of policy or procedure.

Headwater – The water depth at a culvert inlet as measured from the culvert invert elevation.

Hydraulic Grade Line – The water surface elevation in an open channel or in a pressure flow pipe, the water surface elevation that would be reached if a piezometer tube was inserted into the pipe

Jurisdictional and Non-Jurisdictional Dams –

(Definitions per New Mexico Office of the State Engineer – Dam Safety Bureau. "Rules and Regulations Governing Dam Design, Construction and Dam safety" March 31, 2005.)

Non-Jurisdictional Dam – Any dam less than or equal to 10 feet in height and having storage less that or equal to 10 acre-feet of water.

Jurisdictional Dam – A dam that is more than 10 feet in height measure from the lowest point on the downstream toe to the dam crest or impounds more than 10 acre-feet of water as measured from the lowest point on the downstream to the spillway crest.

Policy - 1. A plan or course of action designed to influence and determine decisions and actions. 2. A guiding principle or procedure considered to be expedient, prudent or advantageous.

Pond, detention – A pond that detains water so that the outflow peak discharge is less than the inflow peak discharge.

Pond, retention - A pond that retains water without an outflow discharge.

Risk assessment – A relatively simple analysis approach used as means of justification for deviation from the design return period and criteria tables.

Risk analysis – A very detailed analysis approach used as a means of justification for deviation from the design return period and criteria tables.

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