

APPENDIX – A

TRANSMITTALS & CHECKLISTS



<http://www.montgomerycountymd.gov/permittingservices/>

Right of Way Permitting and Plan Review Section

GRADE ESTABLISHMENT PLAN REVIEW CHECKLIST

Project Name: _____

Engineer/Phone No. _____

DPS Project No. _____

Address _____

Preliminary Plan No: _____

Assigned/Phone No. _____

Street Names: _____

Submittal Date	Review Date	Initial
_____	_____	_____
_____	_____	_____
_____	_____	_____

Expedite Plan Review

Legend:

INC Incomplete/Incorrect
N/A Not Applicable

_____ Design Acceptable _____ Date

This checklist has been designed to provide specific instruction to engineers. All items are expected to be addressed in the first submittal. Failure to do so will result in a less than full first review. If any items marked with an asterisk (*) are not addressed, no further review of the first submittal will be made. The plan will be returned to the engineer for completion and will have to be resubmitted for a new first review.

TO THE ENGINEER:

Your submission for Grade Establishment Plan approval has been reviewed. The review was made based on the items shown on this checklist. **Please return the checklist and grade establishment plan comment sheets with your resubmittal.** If you do not address a checklist item, including comments on the grade establishment plan sheets, explain your reasoning in your transmittal letter. **Any change from the previous submission should be clearly marked on the plan or outlined separately in an explanation letter.**

SUPPORTING INFORMATION

- * _____ Transmittal specifically explaining purpose of submission.
- * _____ If requesting expedited service, attach letter explaining request and check box located above.
- * _____ Copy of approved Preliminary Plan and/ or Site Plan (if applicable).
- _____ Copy of Record Plat, if existing.
- * _____ Copy of MCDOT Preliminary Plan approval letter.
- _____ Engineers estimate (at final approval).

GRADE ESTABLISHMENT PLAN REVIEW CHECKLIST

PLAN VIEW - GENERAL

- ___ ___ ___ North Arrow.
- * ___ ___ ___ Scale: 1" = 50'.
- ___ ___ ___ Classification of Roads.
- ___ ___ ___ One street per sheet, except short cul-de-sacs (maximum of two cul-de-sacs per sheet).
- ___ ___ ___ 100' stations along centerline.
- ___ ___ ___ Intersections.
- ___ ___ ___ Critical points on centerline (ie. PC & PT of horizontal curves).

TITLE BLOCK

- * ___ ___ ___ Name, address and phone number of engineering firm.
- * ___ ___ ___ Name of street.
- * ___ ___ ___ Subdivision name.
- ___ ___ ___ Number of sheets (if more than one).
- ___ ___ ___ Date prepared.

PLANS – EXISTING FEATURES

- ___ ___ ___ Right of way width for all previously dedicated streets and roads including intersecting streets.
- ___ ___ ___ Width of intersecting streets.
- ___ ___ ___ Locations of utilities.
- ___ ___ ___ Type and width of existing paving.
- ___ ___ ___ Type and width of existing sidewalk.
- ___ ___ ___ Type and width of existing curb.
- ___ ___ ___ Type and width of existing driveway.
- ___ ___ ___ All existing utilities.

PLANS – PROPOSED FEATURES

- ___ ___ ___ Paving and right of way width.
- ___ ___ ___ Typical sections of roadway.
- ___ ___ ___ Curb and gutter.
- ___ ___ ___ Ditch location with transitions as required.
- ___ ___ ___ Top of curb stations and elevations at warped and superelevated sections.
- ___ ___ ___ Limit of warped section (station) (cul-de-sac).
- ___ ___ ___ Drainage facilities.
- ___ ___ ___ Public Improvement and Public Utility Easements.

GRADE ESTABLISHMENT PLAN REVIEW CHECKLIST

PROFILE ITEMS

- * _____ Scale: Horizontal 1" = 50' Vertical 1" = 5'.
- _____ Legend clearly labeling all symbols utilized.
- * _____ One street per sheet except for short cul-de-sacs.
- _____ Existing centerline profile.
- _____ Building Restriction Line profiles. Note: existing centerline profile and building restriction line profiles are to be at all breaks in grade with maximum 50' interval.
- _____ Elevations on property line at existing driveways.
- _____ Centerline elevations at intersections and connections with existing paving.
- _____ Elevations and MNCPPC File No. where connection or revision is made.
- _____ Centerline profile for future road extensions for a minimum of 100' beyond approval request limits.
- _____ Centerline of existing intersecting road.
- _____ Rates of grade.
- _____ PVC, PVI and PVT stations and elevations shown, also POC and offset.
- _____ Stations and elevations of high points and low points.
- _____ Profile elevations every 25 feet.
- _____ Horizontal and vertical curve design based on Montgomery County Road Code or AASHTO requirements.
- _____ If compound or unsymmetrical vertical curves are used, computations for sight distances must be submitted.
- _____ Limit of requested approval.

CERTIFICATION

_____ Plans for approval must be signed and sealed by a Professional Engineer or Registered Land Surveyor licensed in the State of Maryland.

_____ Engineer/Surveyor Certification stating as follows:

I hereby certify that

The information shown hereon has been compiled from accurate field surveys.
 There is (no) existing paving, sewer or water in this right of way.
 (A) (No) Portion of this right of way lies within, crosses or connects with an existing or proposed state road.
 This design conforms to the Montgomery County Road Code, "Requirements for Profiles," Section I, paragraph 6 (A) through (H).

Date: _____ Signature: _____

Where the Engineer's certification indicates the absence of existing paving, sewer or water, or intersecting state road the Department of Permitting Services will perform the review and grant approval on behalf of all agencies after any required revisions or corrections are made. The approved plan will be forwarded to the Maryland National Capital Park and Planning Commission who will assign a permanent file number and distribute prints to the interested agencies. Where the Engineer's or Surveyor's certification indicates there is existing sewer, water or an intersection with a state road, each of the interested agencies shall perform an independent review prior to issuance of the final approval.

MISCELLANEOUS

____ ____ ____ Sheet size to be 24" X 36".

GRADE ESTABLISHMENT PLAN REVIEW CHECKLIST

____ ____ ____ Minimum grades on open drainage roadways is 2.5% for flat bottom ditch.

____ ____ ____ Minimum grades on curb and gutter roadways is 1%.

____ ____ ____ Maximum grades are to be as specified in AASHTO and County Code.

ADDITIONAL REQUIREMENTS:

COMMENTS



Right of Way Permitting and Plan Review Section

STORM DRAIN AND/OR PAVING PLAN REVIEW CHECKLIST

Project Name: _____

Engineer/Phone No. _____

DPS Project No. _____

Address _____

Preliminary Plan No: _____

Assigned/Phone No. _____

Street Name(s): _____

Submittal Date

Review Date

Initial

Expedite Plan Review

Legend:

INC Incomplete/Incorrect
NA Not Applicable

Design Acceptable

Date

This checklist has been designed to provide specific instruction to engineers. All items are expected to be addressed in the first submittal. Failure to do so will result in a less than full first review. If any items marked with an asterisk (*) are not addressed, no further review of the first submittal will be made. The plan will be returned to the engineer for completion and will have to be resubmitted for a new first review.

TO THE ENGINEER:

Your submission for Storm Drain and/or Paving Plan approval has been reviewed. The review was made based on the items shown on this checklist. **Please return the checklist and storm drain and/or paving plan comment sheets with your resubmittal.** If you do not address a checklist item, including comments on the storm drain and/or paving plan sheets, explain your reasoning in your transmittal letter. **Any change from the previous submission should be clearly marked on the plan or outlined separately in an explanation letter.**

SUPPORTING INFORMATION

* _____ Transmittal specifically explaining purpose of submission (including limits of approval).

* _____ If requesting expedited service, attach letter explaining request and check box located above.

* _____ Copy of approved Preliminary Plan and/or site plan (if applicable).

_____ Copy of recorded Record Plat.

* _____ Copy of approved Grade Establishment Plans for streets within limits of approval.

* _____ Copy of MCDOT Preliminary Plan approval letter and MCDPS recommendations at Site Plan.

_____ Draft copy of Grant of Easement documents for any drainage easements proposed by this plan.

_____ Engineers estimate (at final approval).

_____ Sight distance analysis for all intersection type driveways.

STORM DRAIN AND/OR PAVING PLAN REVIEW CHECKLIST

PLAN VIEW - GENERAL

- ___ ___ ___ North Arrow.
- * ___ ___ ___ Scale: 1" = 50'.
- ___ ___ ___ Lot and Block numbers.
- * ___ ___ ___ Name, address and phone number of engineering firm or preparer of plan(s).
- ___ ___ ___ Name of street.
- * ___ ___ ___ Subdivision name.
- ___ ___ ___ General notes for paving and/or storm drainage.
- * ___ ___ ___ Typical paving section.

PLANS – EXISTING FEATURES

- ___ ___ ___ Curbs and gutters, paving, sidewalks, street trees and street lights.
- ___ ___ ___ Storm drainage pipes and structures.
- ___ ___ ___ Water and sanitary sewer pipes and structures.
- ___ ___ ___ Underground utilities.
- ___ ___ ___ Utility poles.
- ___ ___ ___ Streams, channels or drainage ditches.
- ___ ___ ___ Buildings or other permanent structures.

PLANS – PROPOSED WORK (Paving)

- ___ ___ ___ Proper tie in or transition to existing features.
- ___ ___ ___ Details of all special or non-standard work (Refer to Montgomery County , WSSC or MSHA standards for all standard work.
- ___ ___ ___ Proposed water and sewer.
- ___ ___ ___ All sidewalks and handicap ramps at all street intersections and intersection type driveways to be ADA compliant
- ___ ___ ___ Mid block crosswalks.
- ___ ___ ___ Where shoulder and ditch work or pavement widening along existing roads is required by the Public Improvement Agreement, show sufficient details, elevations and typical sections to accomplish this work. Any necessary utility relocation work should also be shown.

PLANS – PROPOSED WORK (Storm Drainage)

- ___ ___ ___ Pipe schedule, showing lengths, pipe sizes, materials and class or gauge.
- ___ ___ ___ Structure schedule showing structure types, elevation, dimensions with proper reference to Montgomery County, WSSC and MSHA standards.
- ___ ___ ___ For precast inlets show manufacturer name and structure type for each.
- ___ ___ ___ Structure numbers to match structure schedule, pipe profiles and drainage study.
- ___ ___ ___ Required storm drain easements whether shown on record plat or recorded by separate instrument.
- ___ ___ ___ Outfall treatment with existing topography at and 100' below outfall.

STORM DRAIN AND/OR PAVING PLAN REVIEW CHECKLIST

___ ___ ___ Details of special structures.

STORM DRAIN PROFILES

* ___ ___ ___ Horizontal scale 1" = 50'.

* ___ ___ ___ Vertical scale 1" = 5'.

* ___ ___ ___ Structure numbers (must match plan, structure schedule and drainage study).

___ ___ ___ Pipe lengths to be shown by stationing at each structure.

___ ___ ___ Pipe size, material and class or gauge for each run.

___ ___ ___ Quantity of flow, slope and velocity for each run. When pipe will not flow full due to actual slope being steeper than required, actual partial flow velocity must be shown.

___ ___ ___ Show hydraulic gradient for all pipes.

___ ___ ___ Outfall treatment – show class and length of riprap, filter cloth required and cross-section of outfall channel.

APPROVALS REQUIRED

___ ___ ___ Seal and signature of Professional Engineer or Land Surveyor responsible for plans.

___ ___ ___ Notes concerning WSSC approval if storm drainage is to be constructed prior to installation of water and sewer.

___ ___ ___ Notes concerning MSHA approval and/or permit where proposed street connects to an existing State road.

___ ___ ___ Maryland Department of Natural Resources and/or Maryland Department of the Environment approval where applicable.

___ ___ ___ Department of Permitting Services – Water Resource Section approvals where applicable.

ADDITIONAL REQUIREMENTS:

COMMENTS

APPENDIX – B

DESIGN TABLES

Curve Numbers (CN) for Montgomery County Zoning

Zoning Category	Code	TR-55 CN Value Soil Type			
		A	B	C	D
		39	61	74	80
Non-Zoning Land Uses (MDSHA Steep Slope Values, <25-yr Storm Frequency, Good or Fair Conditions)		See TR-55 Design CN Values			
Agriculture					
Meadow					
Open Space/Lawns					
Pasture/Range					
Paved/Impervious Areas					
Wooded					
Residential					
One-Family					
Residential, One-Family (1 Acre Lots)	RE-1	51	68	79	84
Residential, One-Family (2 Acre Lots)	RE-2 / RE-2C	46	65	77	82
Residential, One-Family	R-200	54	70	80	85
Residential, One-Family	R-150	54	70	80	85
Residential, One-Family	R-90	61	75	83	87
Residential, One-Family	R-60	69	80	86	89
Residential, One-Family	R-40	77	85	90	92
Residential, Fourplex	R-4PLEX	77	85	90	92
Transferable Development Rights (TDR) Zoning					
Residential, Transferable Development Rights	RE-1/ TDR	54	70	80	85
Residential, Transferable Development Rights	RE-2/ TDR	77	85	90	92
Residential, Transferable Development Rights	R-200/ TDR	69	80	86	89
Residential, Transferable Development Rights	RE-2C/ TDR	54	70	80	85
Residential, Transferable Development Rights	R-150/ TDR	74	83	88	91
Residential, Transferable Development Rights	R-90/ TDR	69	80	86	89
Residential, Transferable Development Rights	R-60/ TDR	69	80	86	89
Townhouse					
Residential, Townhouse	RT-6, 8, 10, 12.5	71	81	87	90
Residential, Townhouse	RT-15	80	87	91	93
Multi-Family					
Multiple-Family, High Density Residential	R-10, 20, 30, H	77	85	90	92
Multiple-Family, High Density Residential, Transferable Development Rights	R-10, 20, 30/TDR	80	87	91	93
Mobile Home					
Residential, One-Family	RMH-200	54	70	80	85
Planned Mobile Home Development	R-MH	80	87	91	93

**Curve Numbers (CN) for
Montgomery County Zoning**

Zoning Category	Code	TR-55 CN Value			
		Soil Type			
		A	B	C	D
Commercial					
Convenience Commercial	C-1, C-2, C-3, C-4, C-T, O-M	92	94	96	96
Low-Density, Office Commercial	C-5	83	89	92	94
Low-Density, Regional Commercial	C-6	86	91	93	94
County Inn Zone	C-INN	69	80	86	89
Commercial, Office Building	C-O	98	98	98	98
Commercial, Office Park	C-P	74	83	88	91
Hotel-Motel	H-M	71	81	87	90
Industrial					
Light and Heavy Industrial	I-1, I-2	92	94	96	96
Technology and Business Park	I-3	77	85	90	92
Low Intensity, Light Industrial	I-4	86	91	93	94
Life Sciences Center	LSC	80	87	91	93
Research and Development	R&D	83	89	92	94
Central Business District					
Central Business Districts	CBD-0.5, 1, 2, 3, R1, R2, CBD	98	98	98	98
Planned Unit Development					
Mixed Use Neighborhood Zone	MXN	69	80	86	89
Mixed Use Planned Residential	MXPD	74	83	88	91
Planned Cultural Center	PCC	80	87	91	93
Planned Development					
Low (D-2, PD-3)	(D-2, PD-3)	80	87	91	93
Medium Low	(PD-4, -5, -7, -9)	74	83	88	91
Medium High	(PD-11, -13, -15)	69	80	86	89
Medium High	(PD-18, -22, -25, -28, -35, -44)	69	80	86	89
Medium High, For workforce housing units on-site	(PD-18, -22, -25, -28, -35, -44)	77	85	90	92
Urban High	(PD-60, -68, -75, -88, -100)	80	87	91	93
Urban High, for workforce housing units on-site	(PD-60, -68, -75, -88, -100)	86	91	93	94
Planned Neighborhood Zone	P-N	Must be calculated			
Planned Retirement Community	P-R-C	60	74	82	86
Planned Retirement Community < 750 acres	P-R-C	69	80	86	89
Town Sector	T-S	Must be calculated			

**Curve Numbers (CN) for
Montgomery County Zoning**

Zoning Category	Code	TR-55 CN Value Soil Type			
		A	B	C	D
Residential Mixed Use					
Residential-Mixed Use Development, Community Center, Specialty Center and Specialty Center (Commercial Base)	RMX-1 RMX-2 RMX-2C (Residential)	89	92	94	95
	RMX-1 RMX-2 RMX-2C (Commercial)	69	80	86	89
Residential-Mixed Use Development, Regional Center	RMX-3 (Residential)	86	91	93	94
	RMX-3 (Commercial)	69	80	86	89
Residential-Mixed Use Development, Regional Center, Commercial Base	RMX-3C (Residential)	92	94	96	96
	RMX-3C (Commercial)	86	91	93	94
Overlay Zones					
Refer to the Master					
Transit					
Transit Station, Mixed	TS-M / TS-R	98	98	98	98
Agricultural					
Low Density Rural Cluster, Rural Cluster Zone, Rural Service Zone and Rural	LDRC, RC, RS, RURAL	46	65	77	82
Rural Density Transfer Zone	RDT	51	68	79	84
Rural Neighborhood Cluster	RNC	54	70	80	85
Mineral Resource Recovery	MRR	83	89	92	94

TABLE OF Kb VALUES							
<i>(for use in Section 4.3.2.3 of the Montgomery County Storm Drain Manual)</i>							
ANGLE	INLET	MANHOLE	BEND STRUCTURE	ANGLE	INLET	MANHOLE	BEND STRUCTURE
0	0.50	0.15	0.01	46	1.11	0.76	0.18
1	0.51	0.16	0.01	47	1.12	0.76	0.19
2	0.52	0.18	0.02	48	1.13	0.77	0.19
3	0.53	0.19	0.02	49	1.14	0.78	0.19
4	0.54	0.20	0.03	50	1.15	0.78	0.19
5	0.54	0.22	0.03	---	---	---	---
6	0.55	0.22	0.03	51	1.16	0.79	0.19
7	0.56	0.24	0.04	52	1.17	0.80	0.19
8	0.57	0.26	0.05	53	1.18	0.80	0.19
9	0.58	0.27	0.05	54	1.19	0.81	0.20
10	0.59	0.28	0.06	55	1.20	0.82	0.20
---	---	---	---	56	1.21	0.82	0.20
11	0.60	0.30	0.06	57	1.22	0.83	0.20
12	0.61	0.31	0.07	58	1.23	0.84	0.20
13	0.62	0.34	0.07	59	1.24	0.84	0.20
14	0.62	0.34	0.07	60	1.25	0.85	0.20
15	0.63	0.35	0.08	---	---	---	---
16	0.64	0.36	0.08	61	1.26	0.85	0.20
17	0.65	0.38	0.09	62	1.27	0.86	0.20
18	0.66	0.39	0.09	63	1.27	0.86	0.20
19	0.67	0.40	0.09	64	1.28	0.87	0.20
20	0.68	0.42	0.10	65	1.29	0.87	0.20
---	---	---	---	66	1.30	0.88	0.21
21	0.69	0.43	0.10	67	1.31	0.88	0.21
22	0.70	0.44	0.11	68	1.32	0.89	0.21
23	0.71	0.46	0.11	69	1.32	0.89	0.21
24	0.73	0.47	0.11	70	1.33	0.90	0.21
25	0.74	0.48	0.12	---	---	---	---
26	0.76	0.50	0.12	71	1.34	0.91	0.21
27	0.78	0.51	0.13	72	1.35	0.91	0.21
28	0.80	0.52	0.13	73	1.36	0.91	0.21
29	0.82	0.54	0.13	74	1.37	0.92	0.22
30	0.83	0.55	0.14	75	1.37	0.92	0.22
---	---	---	---	76	1.38	0.93	0.22
31	0.85	0.56	0.14	77	1.39	0.93	0.22
32	0.87	0.58	0.14	78	1.40	0.94	0.22
33	0.89	0.59	0.14	79	1.41	0.94	0.22
34	0.90	0.60	0.14	80	1.42	0.95	0.23
35	0.92	0.62	0.15	---	---	---	---
36	0.94	0.63	0.15	81	1.42	0.95	0.23
37	0.96	0.64	0.16	82	1.43	0.96	0.23
38	0.98	0.66	0.16	83	1.44	0.96	0.23
39	0.99	0.67	0.16	84	1.45	0.97	0.24
40	1.01	0.68	0.17	85	1.46	0.97	0.24
---	---	---	---	86	1.47	0.98	0.24
41	1.03	0.70	0.17	87	1.47	0.98	0.24
42	1.05	0.71	0.17	88	1.49	0.99	0.25
43	1.06	0.72	0.17	89	1.49	0.99	0.25
44	1.08	0.74	0.18	90	1.50	1.00	0.25
45	1.10	0.75	0.18	---	---	---	---

Conduit / Material	Manning's n-Value
<i>Overland Flow</i> (<i>uniform flow depth not in pipe</i>)	
Smooth asphalt	0.011
Smooth concrete	0.012
Brick with cement mortar	0.014
Cement rubble surface	0.024
Fallow (no residue)	0.050
Cultivated soils	
Residue cover ≤ 20%	0.060
Residue cover > 20%	0.170
Range (natural)	0.130
Grass	
Short grass prairie	0.150
Dense grasses	0.240
Bermuda grass	0.410
Woods*	
Light underbrush	0.400
Dense underbrush	0.800
<i>Closed Conduit</i>	
Insituform Lined Pipes	0.009
Concrete pipe and precast box culverts	0.013
Spiral Rib Metal Pipe (Smooth Wall - end to end)	0.013
Monolithic concrete in boxes, channels, etc.	0.015
Corrugated metal pipe - 2 2/3" x 1/2" helical corrugations:	
15" through 36" diameter	0.019
42" through 96" diameter	0.021
Corrugated metal pipe - 3" x 1" helical corrugations:	
36" through 84" diameter	0.021
96" through 144" diameter	0.024
Corrugated metal pipe-2 2/3" x 1/2" annular corrugations	0.024
Corrugated metal pipe-3" x 1" annular corrugations	0.028
Corrugated metal pipe arches	0.024
Structural plate pipe, pipe arches and arches - 6"x2" Corrugations	0.034
Ductile Iron Pipe	0.011
High Density Polyethylene Pipe	0.013
Vitrified Clay Pipe	0.015

Conduit / Material	Manning's n-Value
<i>Open Channel Lining</i>	
Concrete or bituminous concrete lined channels	0.015
Bituminous concrete paving with concrete gutter	0.015
Grass gutters and ditches	
Flow greater than 6 inches	0.040
Flow less than 6 inches	0.060
Earth gutters and ditches	0.025
Channels not maintained - uncut weeds and brush	0.080 - 0.120
Natural stream channels	0.035 - 0.150
Gabions	0.030
RIPRAP	
Class I (150 lbs. maximum stone weight)	0.038
Class II (700 lbs. maximum stone weight)	0.041
Class III (2000 lbs. maximum stone weight)	0.044
	0.030
<i>Minor Streams (Top Width at Flood stage < 100 ft)</i>	0.030
Streams on Plain	
Clean, straight, full stage, no rifts or deep pools	0.025–0.033
Same as above, but more stones and weeds	0.030–0.040
Clean, winding, some pools and shoals	0.033–0.045
Clean, winding, but some weeds and stones	0.035–0.050
Clean, winding, , lower stages, more ineffective slopes and sections	0.040–0.055
Clean, winding, , but more stones	0.045–0.060
Sluggish reaches, weedy, deep pools	0.050–0.080
Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075–0.150
Mountain Streams	
No vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages	
Bottom: gavels, cobbles and few boulders	0.030–0.050
Bottom: cobbles with large boulders	0.040–0.070
Floodplains	
Pasture, No Brush	
Short Grass	0.025–0.035
High Grass	0.030–0.050
Cultivated Areas	
No Crop	0.020–0.040
Mature Row Crops	0.025–0.045
Mature Field Crops	0.030–0.050

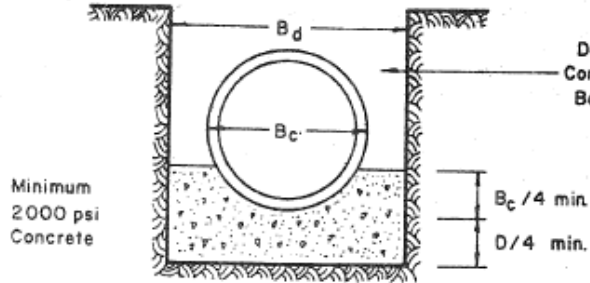
Conduit / Material	Manning's n-Value
Brush	
Scattered brush, heavy weeds	0.035–0.070
Light brush and trees in winter	0.035–0.060
Light brush and trees in summer	0.040–0.080
Medium to dense brush in winter	0.045–0.110
Medium to dense brush in summer	0.070–0.160
Trees	
Dense willows, summer, straight	0.110–0.200
Cleared land with tree stumps, no sprouts	0.030–0.050
Same as above, but with heavy growth of sprouts	0.050–0.080
Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080–0.120
Same as above, but with flood stage reaching branches	0.100–0.160
Major Streams (Top Width at Flood stage > 100 ft)	
The n value is less than that for minor streams of similar description, because banks offer less effective resistance.	
Regular section with no boulders or brush	0.025–0.060
Irregular and rough section	0.035–0.100
Alluvial Sand-bed Channels (no vegetation)	
Tranquil flow, Fr < 1	
Plane bed	0.014–0.020
Ripples	0.018–0.030
Dunes	0.020–0.040
Washed out dunes or transition	0.014–0.025
Plane bed	0.010–0.013
Rapid Flow, Fr > 1	
Standing waves	0.010–0.015
Antidunes	0.012–0.020

APPENDIX – C

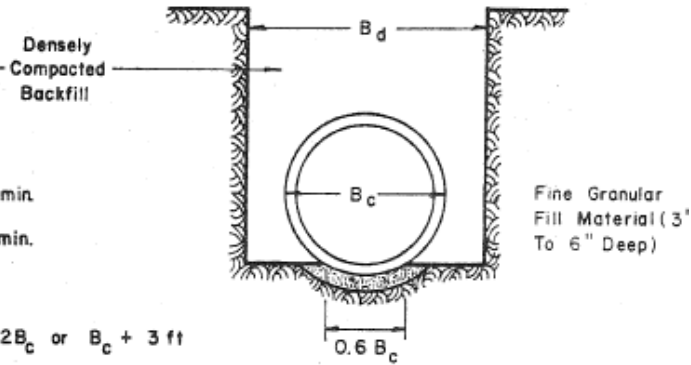
RCP LOADING & BEDDING

Trench Bedding Conditions

CLASS A
Concrete Cradle
LOAD FACTOR = 3.0

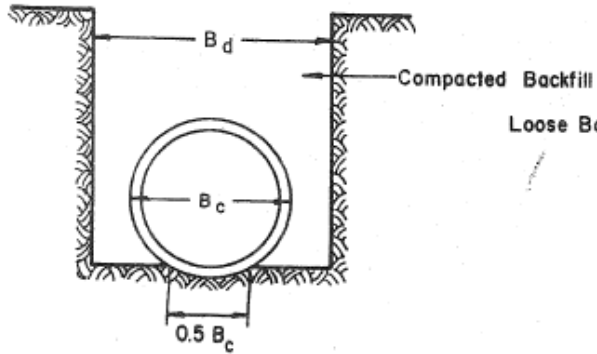


CLASS B
Shaped Subgrade
With Granular Foundation
Load Factor = 1.9

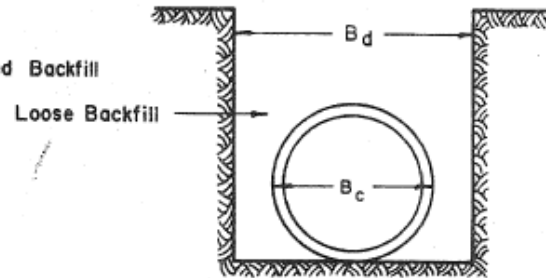


Note: $B_d = 2B_c$ or $B_c + 3 \text{ ft}$
Whichever is narrower

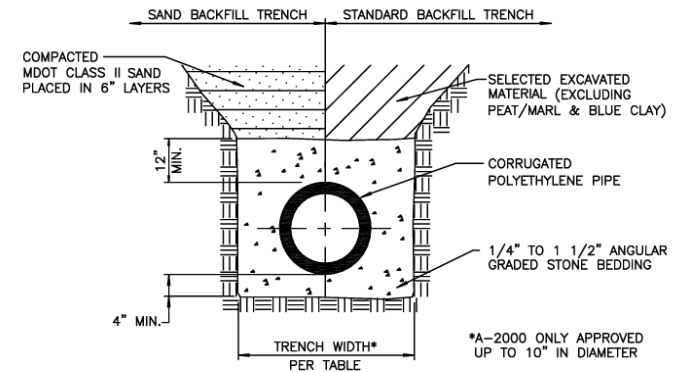
CLASS C
Shaped Subgrade
Load Factor = 1.5



CLASS D
Flat Subgrade
Load Factor = 1.1



Class E



DIA (IN)	MIN. TRENCH WIDTH (IN)
8	25
10	28
12	31
15	34
18	39
24	48

Load Resistance Factored Design (LRFD) Tables

Pipe Load Tables

All storm drain pipe must conform with the load requirements of the various pipe materials outlined in the current Maryland State Highway Administrations Highway Drainage Manual (SHA 61.1 - 407) or current LRFD requirements as perscribed by AASHTO.

Other Resources:

American Concrete Pipe Associations (ACPA)

8445 Freeport Parkway (Suite 350)

Irving, Texas 75063-2595

Phone: (972) 506 - 7216

Fax: (972) 506 - 7682

<http://www.concrete-pipe.org/>

National Corrugated Steel Pipe Association (NCSPA)

14070 Proton Road Suite 100 LB 9

Dallas, TX 75244

Phone: (972) 850 - 1907

Fax: (972) 490 - 4219

<http://www.ncspa.org/>

Plastic Pipe Institute (PPI)

105 Decker Court (Suite 825)

Irving TX, 75062

Phone: (469) 499 - 1044

Fax: (469) 499 - 1063

<http://www.ncspa.org/>

Pipe Material Requirements

All storm drain pipe /culverts must conform with the pipe material requirements as specified by the Maryland State Highway Administration unless otherwise directed in writing by MCDOT or MCDPS.

APPENDIX – D

DESIGN SPREADSHEETS

INLET NO.	INCR. AREA (ac)	TOTAL AREA (ac)	C*A	AR	ΣAR	T.C. (min)	I (in/hr)	Base Flow (cfs)	OVER FLOW (cfs)	TOTAL INFLOW (cfs)	FLOW INTER. (cfs)	FLOW BYPASS		INLET LENGTH		STREET SLOPE (%)	CROSS SLOPE (ft/ft)	CURB HEIGHT (ft)	THROAT DEPRESS. (in)	GUTTER FLOW			
												cfs	TO	COMP. (ft)	ACTUAL (ft)					DEPTH (ft)	SPREAD (ft)		
(FIRM NAME)				INLET COMPUTATIONS																COMPUTED	DATE		
				(PROJECT NAME)																CHECKED			
																				SHEET NO.	PROJECT NO.		

PIPE COMPUTATIONS

PIPE		AREA		R=C	AR	ΣAR	TC (min)	I (in/hr)	Q (cfs)	PIPE SIZE (inches)	MIN SLOPE (%)	V (fps)	PIPE LENGTH (feet)	TIME IN PIPE (min)	REMARKS
FROM	TO	INCR. AREA	TOTAL AREA												

(FIRM NAME)	PIPE COMPUTATIONS				COMPUTED	DATE
	(PROJECT NAME)				CHECKED	
					SHEET NO.	PROJECT NO.

MOMENTUM AT NO.:		MOMENTUM AT NO.:	
MOMENTUM AT NO.:		MOMENTUM AT NO.:	
MOMENTUM AT NO.:		MOMENTUM AT NO.:	
(FIRM NAME)	STRUCTURE HEADLOSS	COMPUTED:	DATE:
		CHECKED:	
	(PROJECT NAME)	SHEET NO.	PROJECT NO.

STREAM SURVEY FOR DESIGN OF BIO-SENSITIVE STREAM CROSSINGS

Project Name:		Site Inspector:	
Project Number:		Site Inspector:	
Visit Date:		MCDEP Reviewer:	
Crossing # or Station:		(if present)	
Stream Order			
STATE USE CLASS			
USE I & I-P			
USE III & III-P			
USE IV & IV-P			
Specially Designated			
STREAM QUALITY			
Biotic Community Quality (As determined by MCDEP Staff or Equivalent Monitoring Protocol)			
STREAM FLOW TYPE			
Ephemeral			
Intermittent			
Perennial (Constant Flow)			
NORMAL (BASEFLOW) CHARACTERISTICS			
< 3 Months			
> 3 Months			
WATERSHED CHARACTERISTICS			
Fully Developed			
Partially Developed (Including Agriculture)			
Undeveloped			
FUTURE OR PROPOSED DEVELOPMENT			
< 8% Impervious			
> 8% Impervious			
STREAM BED CHARACTERISTICS			
Bed Materials			
Cobble, Gravel, Sand, Silts			
Solid Rock, Hard Clay, Etc...			
Gradient			
Shallow (< 0.5%)			
Moderate ((0.5% to 2%)			
Steep (> 2%)			
Planform			
Meandering (Sinuosity <1.5%)			
Sinuosity (Sinuosity 1.2% to 1.5%)			
Straight (Sinuosity >1.2%)			
Valley Confinement			
High (Steep Valley Walls, Relatively Narrow FP)			
Moderate (Slight to moderate sloped walls; relatively wide FP)			
Low (No definable valley walls, Broad FP)			
SITE CONSIDERATIONS			
Wetland Impact (Y or N)			
Forested			
Scrub/shrub			
Emergent			
Specimen Trees Present (Y or N)			
Species	Size	Species	Size

Field Notes:

PROJECT: _____

STATION: _____
SHEET: _____ OF _____

CULVERT DESIGN FORM
DESIGN: _____ DATE: _____
REVIEW: _____ DATE: _____

HYDROLOGIC DATA

METHOD: _____

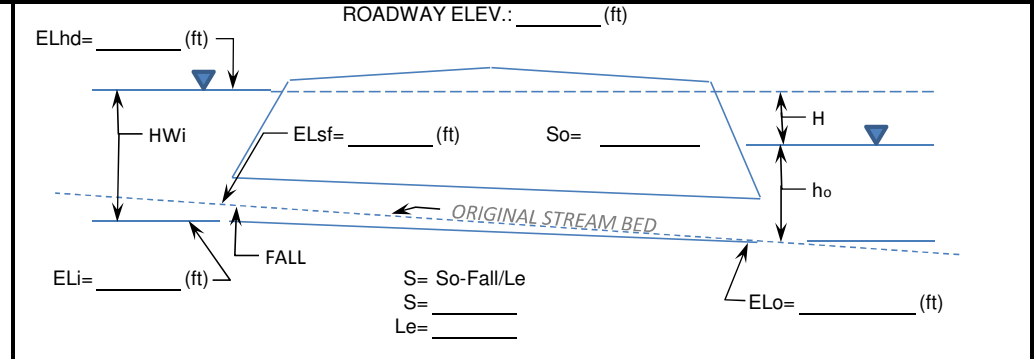
DRAINAGE AREA (AC): _____ STREAM SLOPE (FT/FT): _____

CHANNEL SHAPE: _____

ROUTING: _____ OTHER: _____

DESIGN FLOWS / TAILWATER

DESIGN STORM (YRS)	FLOW (CFS)	TW (FT)
_____	_____	_____
_____	_____	_____
_____	_____	_____



ID NO.	CULVERT DESCRIPTION:			TOTAL FLOW Q (CFS)	FLOW / BARREL Q / N (CFS) (1)	HEADWATER CALCULATIONS										CONTROL HEADWATER ELEVATION (FT)	OUTLET VELOCITY (FPS)	Comments
	Material	Entrance				INLET CONTROL				OUTLET CONTROL								
		Shape	Span			Size Rise	HW _i /D (2)	HW _i (FT)	FALL (FT) (3)	EL _{hi} (4)	TW (FT) (5)	d _c	(d _c +D)/2	h _o (FT) (6)	Ke			
1																		
2																		
3																		
4																		
5																		
6																		

TECHNICAL FOOTNOTES:

- (1) USE Q/NB FOR BOX CULVERTS
- (2) HW_i/D = HW/D OR HW_i/D FROM DESIGN CHARTS
- (3) FALL - HW_i-(ELhd-ELsf): FALL IS ZERO FOR CULVERTS AT GRADE
- (4) EL_{hi}=HW_i+EL_i (INVERT OF INLET CONTROL SECTION)
- (5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL.
- (6) h_o = TW or (D_c+D)/2 (whichever is greater)
- (7) H = [1+Ke+((Ku)(n)²(L))/R^{1.33}](V²/2g) where Ku = 19.63 (29 IN ENGLISH UNITS)
- (8) EL_{ho} = EL_o+H+h_o

SUBSCRIPT DEFINITIONS:

- W = APPROXIMATE
- F = CULVERT FACE
- hd = DESIGN HEADWATER
- hl = HEADWATER IN INLET CONTROL
- ho = HEADWATER IN OUTLET CONTROL
- i = INLET CONTROL SECTION
- O = OUTLET
- sf = STREAMBED AT CULVERT FACE
- tw = TAIL WATER

COMMENTS / DISCUSSION:



CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____ n: _____

ENTRANCE: _____