CITY OF SYLVANIA
DEPARTMENT OF PUBLIC SERVICE
DIVISION OF ENGINEERING

Effective Date
1/1/10

STORM DRAINAGE DESIGN

Drainage

The design of storm sewer systems will be based upon the "Rational Method" using the equation Q=CiA and the "Manning Formula" (A is less than 100 acres). Areas greater than 100 acres use State of Ohio Bulletin Number 43 and compare with Bulletin Number 45 Floods in Ohio or Soil Conservation Service Technical Release #55, 2nd edition.

A. The rainfall intensity, "i", will be taken from the appropriate curve for the Toledo, Ohio, area as published in Technical Paper No. 25, of the U.S. Weather Bureau, "Rainfall Intensity-Duration-Frequency Curves for Selected Station in the United States, Alaska, Hawaiian Islands and Puerto Rico" Government Printing Office, 1955.

B. A minimum of t=20 minutes may be used as the time of concentration to the first pick-up point in the system in residential areas. In areas other than residential, time of concentration shall be determined by the use of overland flow charts.

C. The runoff coefficients for rational method may be used as shown on page 6. When a soil has two hydrologic groups, the sandier soil grouping can be used for determining the proposed runoff coefficient. Example: B/D Hydrologic group proposed residential subdivision with average 1/3 acre lot size "C"=0.32. Designer may also calculate a "weighted" runoff coefficient utilizing C=0.90 for pavement, roofs and other hard surfaced areas, 0.15 for grassed areas, 0.20 for landscaped areas and 0.80 for stone areas.

D. Storm sewers shall be designed to flow "just full" for the 5 year intensity-duration-frequency curve. The minimum velocity at just full shall be 2 feet per second. Minimum pavement gutter elevations shall be at or above the hydraulic grade line for a 10 year frequency storm. Use the 10 year intensity-duration-frequency curve for determining this hydraulic grade line. Main line storm sewers should not be placed in rear or side yards.

E. Catch basin type and spacing shall be designed using the 2 year intensity-duration-frequency curve. The maximum allowable width of the sheet gutter flow from the face of the curb shall be limited to 8 feet into the driving lane. Curb inlets will usually be required at all intersections and cul-de-sacs to provide for more positive drainage. Curb inlet grates shall be bicycle safe grates.

F. An overall drainage area layout showing the limits of the contributing runoff area, broken down into areas contributing to each drainage pick-up point, shall be submitted prior to the development of final paving and drainage plans. Drainage design within the development shall be adequate to handle the entire contributing watershed area, and its existing, proposed and probable future development, and not the area under submission only. When the design makes use of an existing storm sewer or open ditch, cross section

and profiles shall be submitted which show the existing conditions at least 500 feet

downstream from the development being considered. The outletting stream for the development may need to be improved before development begins. An approved plan and City/County inspection is required when cleaning any ditch required for site plan approval. If future extensions will utilize the same drainage system, the overall drainage plan shall be submitted with the first phase plans.

G. Complete drainage calculations shall be submitted for pipe size determinations, 10 year hydraulic gradient checks and catch basin type and spacing designs. All culverts will be designed for a 10 year frequency storm with a hydraulic gradient check for a 25 year storm. If the culvert is located on a stream that is shown as having a special flood hazard area on the City's Flood Insurance Rate Map, analysis of the culvert for the 100 year frequency flood is required. No twin culverts will be allowed. See FEMA Section Y.

H. Storm sewers and culverts shall be designed to conform to the requirements of Item 603 of the current State of Ohio, Department of Transportation Construction and Material Specifications. Pipe under pavement shall be Type "A" or "B" Conduit. Pipe not under pavement shall be Type "C" Conduit. The designer may indicate a particular kind of pipe by inserting the specification item number after the designation of the type of conduit. Pipe permitted within the public right-of-way and/or easements maintained by the City are the following:

Item 603, Conduit, As Per Plan
Where Type B or C Conduit of less than or equal to 18" diameter is specified the contractor may use any of the following conduit materials:

Concrete Conduit:
ODOT 706.02 with 706.11 joints
Bedding shall be a minimum of 6" of stone below the pipe and up to the springline of the pipe. Stone shall be no finer than #9 nor courser than #6.

Polyvinyl Chloride (PVC) Conduit:
ODOT 707.45 (For 15" and under diameter)
ASTM F679 (For 18" diameter)
PVC Conduit will only be permitted at those locations where a minimum cover from the top of the pipe to the bottom of the subgrade is 12 inches, however, for no installation shall the distance from the top of the pipe to the surface of pavement, or finish grade for conduit not under the pavement, be less than 18 inches. The stone bedding shall extend to a height of 12 inches above the top of the polyvinyl chloride conduit.

Where 21" or 24" diameter is specified for either Type B conduit not under the mainline pavement (including shoulder and berm) or Type C conduit, the contractor may use any of the following conduit material:

Concrete Conduit
ODOT 706.02 with 706.11 joints

Bedding shall be a minimum of 6" of stone below the pipe and up to the springline of the pipe. Stone shall be no finer than #9 nor courser than #6.

Polyvinyl Chloride (PVC) Conduit:
ASTM F679
PVC Conduit will only be permitted at those locations where a minimum cover from the finish grade to the top of the pipe is 18 inches or greater. The stone bedding shall extend to a height of 12 inches above the top of the PVC conduit.

For 21" and 24" Type B Conduit under mainline pavement (including shoulder and berm) and for 27" Conduit and over the Contractor shall use:

Concrete Conduit:
ODOT 706.02 with 706.11 joints
Bedding shall be a minimum of 6" of stone below the pipe and up to the springline of the pipe. Stone shall be no finer than #9 nor courser than #6.

It is the designers responsibility to determine which conduit meets as per plan bidding conditions, and which conduit is closed to a specific conduit type. The plan's subsummaries and general summaries shall reflect this. Corrugated metal pipe will be permitted only when being used as a restriction in a detention facility. The design Manning roughness coefficient for corrugated pipe shall be 0.024. PVC pipe shall have a design coefficient of 0.010. All other pipe shall have a design coefficient of 0.013.

Type "A" and "B" Conduit shall have a minimum cover of 9" from the top outside crown to the bottom of the finished subgrade for concrete pipe and12" minimum cover for polyvinyl chloride. Type "C" Conduit with less than 18" of cover shall be reinforced concrete. Pipe shall be minimum 12" diameter beyond the first structure which picks up surface water.

Backfill under pavement and within five feet of the edge of pavement shall meet current ODOT specifications or 1967 ODOT Item 310.02 as modified by Lucas County (Maximum Dry Density exceeding 105 lbs/cf and 98% compaction (Standard Proctor))

I. Mainline storm sewers should not be placed in side or rear yards. Twelve inch (12") (minimum) crossovers shall have a 1% grade for better cleanout purposes.

J. Grading plans will be required showing the proposed elevations at the right of way line, building lines and back lot lines, and any other location to make clear the intent of the direction of drainage flow. In areas where the site grading plan calls for the conveyance of surface storm water along or across rear property lines, a catch basin shall be provided to limit the length draining to the basin to a maximum of the lesser of 3 lots or 300 feet in

any one direction. For the sump condition with back to back lots, a maximum of 12 lots may drain to one catch basin. A desirable grade of 1% or greater and an absolute minimum grade of 0.3% shall be provided for rear lot swales.

K. Rock channel protection will be required at all sewer and culvert outlets.

L. Storm sewer taps shall be provided for all lots unless basements and crawl spaces are prohibited by plat recitation. Taps shall be outletted to the main storm sewer system for the development and may not be outletted directly to open ditches or rear yard drainage. Storm sewer taps shall be a minimum of 6" diameter and shall be carried to the right of way line or on to the lot. If more than one lot is served by a single line, the line shall be sized assuming each lot is contributing 50 gal./min (0.11 c.f.s.). The minimum velocity for full flow shall be 2 ft./sec. Storm sewer taps shall be placed in structures whenever possible and shall be placed at least 6 inches above the main line sewer.

M. For manhole and catch basin locations, use the center of the structure.

N. Cross sections shall show all cross overs, catch basins and manholes.

O. Detention facilities will be required by the City when the storm sewer outlets into an existing storm sewer or ditch that is or will be hydraulically inadequate with the proposed storm sewer flow. The allowable flow out will be limited to the existing 5 year intensity storm for undeveloped conditions of the proposed site. (Proposed sites outletting to a state route within the City will have the allowable discharge based on a 100 feet wide strip across the frontage of the parcel.) The detention facility shall store the proposed flow from a 25 year intensity storm. Existing conditions may limit the allowable out flow of the proposed site. For example, a proposed development may drain 20 acres to a ditch or conduit that receives a total drainage area of 100 acres. The existing ditch or conduit may have the capacity to carry 20 c.f.s. and it was determined that the existing conditions for the 20 acres to be developed carried 20 c.f.s. In this situation, the proposed site would be prorated over the entire drainage area and would be allowed one fifth of the outlet capacity (4 c.f.s.), since the site has one fifth of the overall drainage area. The storage area for the detention pond should be above the 10 year storm of the outletting stream. The outlet conduit for the detention area must be set above normal water elevation of the receiving stream, ditch, or conduit.

Detention ponds will be maintained by property owners and the City will put residential subdivision detention ponds under a petition to be maintained by the City as a backup only. Detention facilities to be maintained by the City shall be designed to be dry except during a heavy precipitation event. When determining meter size for detention ponds, Q flow and not Q avg. shall be used for determining peak discharge. Detention ponds should be set up near the outlet on a separate lot and not in rear yards. See sample storm water detention calculations sheets 7, 8, and 9.

P. Maximum spacing between access structures (catch basins or manholes) shall be 350 feet for pipe sizes of 36" and under and 500 feet for sizes over 36".

Q. All catch basins and manholes shall be constructed without sumps or traps. A sump is required at the last manhole prior to the outlet. Catch basins shall have bicycle-safe grates and be stamped “DO NOT DUMP - DRAINS TO LAKE”.

R. Access to main line storm sewers shall be provided through the use of manholes located to keep the sewer a sufficient distance behind the edge of pavement or curb line. Catch basins should not be located on the main line storm sewer.

S. Rear yard catch basins shall be constructed and rear yard swales graded at the time the development's storm drainage and pavement is constructed. Swales shall be seeded, mulched and fertilized. Silt fences shall be placed around all rear yard catch basins.

T. Developments which are involved with an open ditch may be required to enclose the ditch if the enclosure would involve a 48 inch conduit or smaller size. Larger open ditches may require that side slopes of ditch banks be stabilized with dumped rock or by some other means. Ditch easements will be required for ditches from top of bank plus 20 ft. on one continuous side. No dual culvert systems will be allowed. Enclosure must be single structure.

U. Storm sewer easements shall be a minimum of 20 feet for all storm sewer and a minimum 15 feet for drainage involving swales.

V. Requirements for NPDES permits shall be followed when permit is required.

W. FEMA regulations shall be strictly followed for all developments. Impacts on floodway and floodway fringe shall be addressed. Filling or working in the floodplain requires a permit from the City of Sylvania. Flood boundaries shall be shown on plans along with 100 year storm elevations. All necessary CLOMRs, LOMRs, or LOMAs shall be secured from FEMA before construction of buildings can commence. FEMA-studied streams and ditches require that new structures do not raise 100 year storm elevation unless public notification is performed and all parties affected by change are contacted and are agreeable to the raise in the 100 year storm elevation.

RUNOFF COEFFICIENTS FOR RATIONAL METHOD

LAND USE DESCRIPTION		HYDROLOGIC SOIL GROUP			
		A	B	C	D
Cultivated Land: without conservation treatment		.32	.50	.66	.74
: with conservation treatment		.17	.30	.43	.50
Pasture or Range Land: poor condition		.26	.45	.61	.69
: good condition		.05	.16	.36	.47
Meadow: good condition		.05	.13	.30	.43
Wood or Forest Land: thin stand, poor cover, no mulch		.05	.23	.41	.54
: good cover .		.05	.10	.29	.41
Open Spaces, lawns, parks, golf courses, cemeteries, etc.					
good condition: grass cover on 75% or more of the area		.05	.16	.36	.47
fair condition: grass cover on 50% to 75% of the area		.05	.28	.45	.57
Commercial and Business Areas (85% impervious)		.69	.77	.83	.86
Industrial Districts (72% impervious)		.50	.66	.74	.80
Residential:					
Average Lot Size	Average % Impervious				
1/8 acre or less	65	.41	.59	.72	.77
1/4 acre	38	.16	.37	.54	.64
1/3 acre	30	.12	.32	.50	.61
½ acre	25	.09	.29	.47	.59
1 acre	20	.06	.26	.45	.57
2 acres		.05	.23	.41	.50
Paved parking lots, roofs, driveways, etc.		.96	.96	.96	.96

The coefficients are applicable for storm of five to ten year return frequencies.

For recurrence intervals longer than ten years, the indicated runoff coefficients should be increased, assuming that nearly all of the rainfall will become runoff and should be accommodated by and increased runoff coefficient.

Source: Medina County Stormwater Management & Sediment Control Rules and Regulations, Dec. 1998, Page 53

Chkd. By.....Date..... ..Calculation.....Job No.....

....

1. Gross Area = _____ S.F.

2. Pavement Area = S.F.

3. Building Area = _____ S.F.

4. Total Impervious _____ S.F. = _____ S.F. x 0.90 =

5. Net Pervious Area = S.F. x 0.15 = _____

6. Wt. C. = $C_W = \frac{C A_I}{A_T}$ = _____ $C \times A_I$ +

7. Allowable Q into exist system (see Design Considerations "Sect. IV-N") (April, 1977)

$Q_{allow} = CiA = 0.15 \times 3.2 \times AT/43560 = 0.15 \times 3.2 \times \overline{43560}$ =

(Note: i_5 = 3.2"/hr. (5 year 20 min.)

8. Detention Volume Required

tc (min)	i_{25} in/hr.	$C_W A$ (A=Acres)	Qin Q25	Qout = Qallow	Qin-Qout	(Qin-Qout) x t_cx60 ft^3	Design Detention Volume
20	4.40						
30	3.60						
40	3.00						
50	2.60						
60	2.30						
70	2.10						
80	1.90						
90	1.70						
100	1.60						
110	1.50						
120	1.40						
130	1.30						
140	1.20						
150	1.15						
160	1.10						
170	1.05						
180	1.00						

If peak storage volume is not reached within the 3 hr. time period in the above table, continue this procedure until peak storage volume is reached. Rainfall Intensity Chart, dated 4/17/61, is available from this office upon request.

9. Determination of Design Detention Volume

Area	End Area of Section	Length	Volume (ft^3)

10. Detention Design Meter Line Check (Culvert Analysis)

$$H = \frac{V^2}{2g}\left(1 + K_e + \frac{29n^2L}{R\ 4/3}\right)$$

$$2gH = V^2\left(1 + K_e + \frac{29n^2L}{R4/3}\right)$$

$$V^2 = \frac{2\ gH}{\left(1 + K_e + \frac{29n^2L}{R\ 4/3}\right)}$$

DATA:

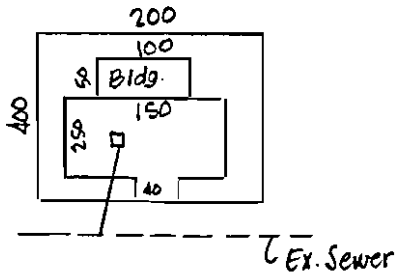
1. Length of meter line = ft.
2. Slope of meter line = %
3. Size of meter line = in.
4. Pipe type & "N"
   (CMP-n =0.024 =
   all others n= .013)
5. Entrance Coeff (K_e) = 0.5
6. Assumed Max. Head = ft.
7. Hydr. Radius (R) = ft.

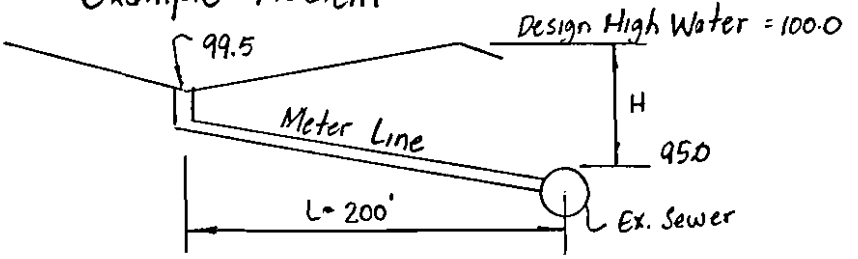
(R 4/3)=

Assumed Head(H)	H x 2g	$1+K_e+\frac{29n^2L}{R\ 4/3}$	V^2	V	Area of Pipe (A)	Flow Q.	Q av. = ΣQ./numbe
0.5'							
1.0'							
1.5'							
2.0'							
2.5'							
3.0'							

MKY:sj
12/21/78

Storm Water Detention - Example Problem





Calculate Weighted "C"

Gross Area =	80,000 sf		
Paved Area =	38,300 sf		
Bldg Area =	5000 sf	× 0.90 =	38,970
Lawn Area =	36,700 sf	× 0.15 =	5505
			44,475

$C_w = \frac{44,475}{80,000}$

$C_w = 0.56$

Determine Allowable Q

$Q_{allow} = ciA = 0.15 \times 3.2 \times \frac{80,000}{43,560} = 0.88$ cfs

Determine Detention Volume

t_c	i	$C_w A$	Q_{in}	Q_{all}	$Q_{in} - Q_{all}$	$(Q_{in} - Q_{all}) \times t_c \times 60$	
20	4.4	1.03	4.53	0.88	3.65	4380 cf.	
30	3.6	≀	3.71	≀	2.83	5094	
40	3.0	≀	3.09	≀	2.21	5304	
50	2.6	≀	2.68	≀	1.80	5400	← Design
60	2.3	≀	2.37	≀	1.49	5364	
70	2.1	∨	2.16	∨	1.28	5376	

Volume of Parking Lot

$V = 1/3 \times L \times W \times \text{depth}$

$= 1/3 \times 150 \times 250 \times 0.5 =$ 6250 cf > 5400 cf ∴ OK

Size of Meter Line

$$V^2 = \frac{2gH}{\left(1 + K_e + \frac{29n^2L}{R^{4/3}}\right)}$$

6" Diameter Concrete

$A = 0.196$ $R^{4/3} = 0.0625$

$n = 0.013$ $L = 200'$

$R = 0.125$ $K_e = 0.5$

H	2gH	$1 + K_e + \frac{29n^2L}{R^{4/3}}$	V^2	V	A	Q
1.0	64.4	17.18	3.75	1.94	0.196	0.38
2.0	128.8	≀	7.50	2.74	≀	0.54
3.0	193.2	≀	11.25	3.35	≀	0.66
4.0	257.6	≀	15.0	3.87	≀	0.76
5.0	322.0	∨	18.75	4.33	∨	0.85

0.85 < 0.88 allowable ∴ OK

Winter Snow and Ice Removal

With winter weather already here, many of us will be hauling out the boots, gloves, and snow shovels to remove snow and ice from our driveways. But not all approaches to snow removal are stormwater-friendly. Snow- and ice-melting products, known as deicers, can have negative environmental impacts, such as fish and vegetation kills, if melted snow and ice carrying the chemicals end up in streams. Overuse of certain products, such as salts, can damage driveways and vehicles and can also be a hazard for pets.

What you can do to help protect stormwater in winter:

- Shovel or plow your driveway and sidewalks before spreading de-icer.De-icer will not work on deep piles of snow anyway, and shoveling does not require chemicals that could harm streams.
- Limit the use of de-icers, especially those with the most environmental impacts.
- Don't shovel snowmelt melted by de-icers into the storm drains. Let it sink into the yard.
- Only use as much de-icer as you need. Large snow piles and thick ice will not melt faster with more de-icer. You can always reapply if you used too little.
- Do not use fertilizer for snow and ice removal. Fertilizers are very poor at snow removal and increase nitrogen in streams when the snow melts.
- Only use sand for traction. Kitty litter and ash become clumpy and are difficult to clean up after use.
- Pets can be harmed by some de-icers. Wipe your pet's paws if they walk on any salts or chemicals. This helps prevent ingestion and damage to their paws.

Not all de-icing products are equal in terms of cost, environmental impact, or effectiveness.

De-icer	Lowest Temperature	Cost*	Environmental Impact
Calcium Chloride	-25 degrees F	3 times more than rock salt	Less salt required No cyanide Contains chlorine
Magnesium Chloride	5 degrees F	Comparable to other salts	Least toxic deicing salt May cause tracking or discoloration
Sodium Chloride ("rock salt")	15 degrees F	Around 5 dollars per 50 lb bag	May contain cyanide Contains chlorine
Urea (fertilizer)	20 to 25 degrees F	5 times more than rock salt	Contains excess nutrients Less Corrosive
Calcium Magnesium Acetate (CMA)	22 to 25 degrees F	20 times more than rock salt	Less toxic
Sand	Does not melt snow/ice	Around 3 dollars per 50lb bag	Accumulates in streets and streams Needs to be swept

*Source: *Snow, Road, Salt and the Chesapeake Bay* by Tom Shuler, Center for Watershed Protection

Information provided by the Stormwater Coalition,

a committee of the Toledo Metropolitan Area Council of Governments (TMACOG).