

**CHILLICOTHE  
WATER MANAGEMENT AND SEDIMENT CONTROL  
REGULATIONS**

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## **ARTICLE I GENERAL PROVISIONS**

### **Section 1.1 - Title**

These regulations shall be cited as the Chillicothe Water Management and Sediment Control Regulations.

### **Section 1.2 - Statutory Authorization**

These regulations are adopted in accordance with and pursuant to the legal grant of authority of Article XVIII, Section 3 of the Ohio Constitution (Ohio Revised Code 307.79) {Ohio Revised Code 519} to adopt rules to abate soil erosion and water pollution by soil sediment.

Therefore, the City of Chillicothe, State of Ohio does ordain the following.

### **Section 1.3 - Purpose**

These regulations establish technically feasible and economically reasonable standards to achieve a level of water management and sediment control to minimize damage to property, degradation of water resources and to promote and maintain the health, safety and general well-being of all life and inhabitants of the City of Chillicothe. Further, these regulations:

- (1) Promote development while keeping downstream flooding, erosion and sedimentation at existing levels.
- (2) Reduce damage to receiving streams and drainage systems which may be caused by increases in the quantity and/or rate of water discharged, and impairment of their capacity which may be caused by sedimentation.
- (3) Establish a basis for the design of all storm drainage systems to preserve the rights and options of both the dominant and servient property owners and help assure the long term adequacy of storm drainage systems.
- (4) Reduce the peak flow of runoff from property through the use of stormwater detention and retention methods.

### **Section 1.4 - Scope**

These regulations shall apply to earth-disturbing activities that alter, disturb, and/or increase existing storm water runoff performed within the corporation limits of the City of Chillicothe unless expressly excluded as follows:

- (1) Farming or silvicultural operations or areas regulated by Ohio Agricultural Sediment Pollution Abatement Rules 1501:15-3 of the Administrative Code.
- (2) Surface mining operations regulated by Section 1514. Revised Code;
- (3) Public projects undertaken by a government agency shall not be required to have a WMSC permit or plan provided that the government agency has a sediment control policy approved by the Ohio EPA or the Chief of the Division of Soil and Water Conservation of the Department of Natural Resources. All other provisions of these regulations shall apply.

### **Section 1.5 - Disclaimer of Liability**

Neither submission of a plan under the provision herein nor compliance with the provisions of these regulations shall relieve any person from responsibility for damage to any person or property otherwise imposed by law.

**Section 1.6 - Severability**

If any cause, section, or provision of these regulations is declared invalid or unconstitutional by a court of competent jurisdiction, validity of the remainder shall not be affected thereby.

**Section 1.7 - Effective Date**

These regulations shall become effective on and after January 1, 1998. Any and all construction plans submitted to the City of Chillicothe on or after this date shall be subject to these regulations.

## **ARTICLE II CONSTRUCTION SITE EROSION AND SEDIMENT CONTROL**

### **Section 2.1 - Requirements**

- (1) No person shall cause or allow earth-disturbing activities, land clearing, grading, excavating or filling except in compliance with the performance criteria set out in Section 2.2 of these regulations.
- (2) Erosion and sediment control practices used to satisfy the performance criteria shall meet the standards and specifications in the current edition of Water Management and Sediment Control for Urbanizing Areas (Soil Conservation Service, Ohio).
- (3) The performance criteria are general guidelines and shall not limit the right of the City of Chillicothe to impose additional, more stringent requirements, nor shall the criteria limit the right of the City of Chillicothe to waive individual requirements

### **Section 2.2 - Performance Criteria**

- (1) Timing of Sediment Trapping Practices - Sediment control practices shall be functional throughout earth disturbing activity. Settling facilities, sediment barriers, and other practices intended to trap sediment shall be implemented as the first step of grading and within seven (7) days from the start of grubbing. They shall continue to function until the up-slope development area is restablized.
- (2) Stabilization of Denuded Areas - Denuded areas shall have soil stabilization applied within seven (7) days if they are to remain dormant (undisturbed) for more than forty-five (45) days. Permanent or temporary soil stabilization shall be applied to denuded areas within seven (7) days after final grade is reached on any portion of the site, and shall also be applied within seven (7) days to denuded areas which may not be at final grade, but will remain dormant for longer than forty-five (45) days.
- (3) Settling Facilities - Concentrated stormwater runoff from denuded areas flowing at rates which exceed the design capacity of sediment barriers shall pass through a sediment-settling facility. The facility's storage capacity shall be sixty-seven (67) cubic yards per acre of drainage area.
- (4) Sediment Barriers - Sheet flow runoff from denuded areas shall be intercepted by sediment barriers. Sediment barriers, such as sediment fences or diversions directing runoff to settling facilities, shall protect adjacent properties and water resources from sediment transported by sheet flow.
- (5) Storm Sewer Inlet Protection - All storm sewer inlets which accept water runoff from the development area shall be protected so that sediment-laden water will not enter the storm sewer system without first being treated to remove sediment, unless the storm sewer system drains to a settling facility.
- (6) Working in or Crossing Streams
  - (a) Streams, including beds and banks, shall be restablized immediately after in-channel work is completed, interrupted, or stopped. To the extent practicable, construction vehicles shall be kept out of streams. Where in-channel work is necessary, precautions shall be taken to stabilize the work area during construction to minimize erosion.
  - (b) If a live (wet) stream must be crossed by construction vehicles regularly during construction, a temporary stream crossing shall be provided.

(7) Construction Access Routes. - Measures shall be taken to prevent soil transport onto surfaces where runoff is not checked by sediment controls, or onto public roads.

(8) Sloughing and Dumping

(a) No soil, rock, debris, or any other material shall be dumped or placed into a water resource or into such proximity that it may readily slough, slip, or erode into a water resource unless such dumping or placing is authorized by the City of Chillicothe, and, when applicable, the U.S. Army Corps of Engineers or Ohio Department of Natural Resources, for such purposes as, but not limited to, construction of bridges, culverts, and erosion control structures.

(b) Unstable soils prone to slipping or landslides shall not be graded, excavated, filled or have loads imposed upon them unless the work is done in accordance with a qualified professional engineer's recommendations to correct, eliminate, or adequately address such problems.

(9) Cut and Fill Slopes. - Cut and fill slopes shall be designed and constructed in a manner which will minimize erosion. Consideration shall be given to the length and steepness of the slope, soil type, up-slope drainage area, groundwater conditions, and slope stabilization.

(10) Stabilization of Outfalls and Channels - Outfalls and constructed or modified channels shall be designed and constructed to withstand the expected velocity of flow from a post-development, ten (10) year frequency storm without eroding.

(11) Establishment of Permanent Vegetation - Permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized. Permanent vegetation shall not be considered established until ground cover is achieved which, in the opinion of the City Engineer provides adequate cover and is mature enough to control soil erosion satisfactorily and to survive adverse weather conditions.

(12) Disposition of Temporary Practices - All temporary erosion and sediment control practices shall be removed or permanently stabilized within thirty (30) days after final site stabilization is achieved or after the temporary practices are no longer needed, unless otherwise authorized by the City Engineer.

(13) Maintenance - All temporary and permanent erosion and sediment control practices shall be designed and constructed to minimize maintenance requirements. They shall be maintained and repaired as needed to assure continued performance of their intended function. The person or entity responsible for the continued maintenance of permanent erosion controls shall be identified to the satisfaction of the City Engineer.

## **ARTICLE III STORMWATER MANAGEMENT**

To protect property from flood damage and channel erosion, and to protect water resources from degradation resulting from accelerated stormwater flows, all development areas shall be designed and constructed in compliance with these regulations.

### **Section 3.1 - Requirements**

- (1) Stormwater management systems shall be designed for the ultimate use of the land. Development areas developed for subdivision shall provide a stormwater management system for the ultimate development of all the subdivided lots.
- (2) Stormwater management facilities and facilities shall be designed so that they will continue to function with minimal maintenance.
- (3) Stormwater management facilities and facilities shall be designed for multi-use wherever practical.
- (4) Stormwater management facilities and facilities shall be designed with specific regard to safety.
- (5) The design criteria shall be applied to each watershed within the development area. If the City of Chillicothe allows post-development drainage to cross pre-development drainage divides all pre- and post-development runoff rates and volumes shall be calculated using their respective drainage divides.
- (6) Stormwater management systems shall be designed so that a routing path is provided for runoff in the event the drainage facilities' design capacity is exceeded. The intent is to provide a routing path for runoff so that structures are not flooded by runoff which may exceed the design capacity of the drainage facilities. The routing path shall be continuous from one development to the next.

### **Section 3.2 - Stormwater Management Design Criteria**

- (1) Stormwater Runoff - The Rational Method to determine the peak rate of runoff for all design storms shall be used for drainage areas of 200 acres or less. For drainage areas over 200 acres and for determining major storms, the method explained in "Urban Hydrology for Small Watersheds", Technical Release No. 55, shall be used to provide peak rates of runoff. T.R. 55 can be obtained from the Soil Conservation Service Engineering Division, U.S. Department of Agriculture.
  - (a) Peak Rate of Runoff - The basic formula for the Rational Method is  $Q = CiA$  in which:
    - Q = Peak rate of runoff in cubic feet per second.
    - C = Runoff coefficient, ratio of the maximum rate of runoff to the average rate of rainfall.
    - A = The drainage area in acres.
    - I = Rainfall intensity in inches per hour for a selected storm frequency and the time of concentration.
  - (b) Runoff Coefficient - Runoff coefficients, shown in **Table I**, are present average values for use with the Rational Method. The table relates the coefficient to land use and average slope of the watershed.
  - (c) Rainfall Intensity - Rainfall Frequency Curves, shown on **Chart I** with the relation of rainfall intensity vs. time charted, based on records of Columbus Station U.S. Weather Bureau, 1897 to 1950, will be used for all design storms.
  - (d) Design Storm - The peak discharge to be computed for storm drainage facilities used for collecting and transporting storm runoff, is defined in the Design Criteria for each appropriate facility.

(e) Time (in minutes) - The time (in minutes) to be used in calculations involving the Rainfall Frequency Curves, Chart I, shall be the time of concentration at each specific point of calculation or design. Time of concentration is defined as the time it takes one drop of water to flow through the drainage system from the furthest point out to the point of calculation or design. Minimum time of concentration shall be 10 minutes.

(2) Methods for controlling increases in stormwater runoff peaks and volumes may include but are not limited to:

- a) Retarding flow velocities by increasing friction; for example, grassed ditches rather than pipe where practical, discharging roof water to vegetated areas, or grass and rock-lined drainage channels.
- b) Grading and use of grade control structure to provide a level of control in flow paths and stream gradients.
- c) Induced infiltration of increased stormwater runoff into the soil where practical; for example, constructing special infiltration areas where soils are suitable, retaining topsoil for all areas to be vegetated, or providing good infiltration areas with proper emergency overflow facilities.
- d) Provisions for detention and retention; for example, permanent ponds and lakes with stormwater basins provided with proper drainage, multiple-use areas for stormwater detention and recreation, wildlife, or transportation, or subsurface storage areas.

(3) Runoff Rate - The runoff rate from the development area shall not be greater after development than it was before development. The applicant shall provide calculations, performed by a Professional Engineer registered in the State of Ohio, showing no increase in the runoff rates from the two-, five-, ten-, twenty-five-, fifty-, and one hundred-year storms.

(4) Runoff Volume - Increases in the runoff volume shall be offset by further restricting runoff rates. Based on the increase in runoff volume, the applicant shall determine the critical storm for the development area. The runoff rate from the critical storm shall be restricted to the one (1) year pre-development storm runoff rate. The critical storm shall be calculated as follows:

- (a) Determine the runoff volume produced by a one (1) year storm both before and after development.
- (b) Determine the percent increase in the runoff volume.
- (c) Using this percentage, select the critical storm from the following table:

If the percent of increase in runoff volume is		The critical storm runoff rate will be limited to:
equal to or greater than	and less than	
-	10	1 year
10	20	2 year
20	50	5 year
50	100	10 year
100	250	25 year
250	500	50 year
500	-	100 year

(5) Roadway Culverts - A culvert is a pipe with open ends, designed to carry water from one side of the road to the other. The size and shape of the culvert should be such that it will carry a predetermined design peak discharge without the depth of water at the entrance or the velocity at outlet exceeding allowable limits.

The culvert design procedure recommended for use is Hydraulic Engineering Circular No. 5. This circular can be obtained from the Superintendent of Documents, U.S. Government Printing Office.

Single span culverts, including concrete box or slab top, should always be considered in lieu of multiple cell pipe culverts when they are the only structures that will meet the physical requirements introduced by rigid headwater controls.

The plan for each culvert shall have the drainage area in acres and the estimated runoff or design discharge in cubic feet per second shown.

The culvert inlet flowline elevation should be set such that it will be deep enough to provide an adequate outlet for future storm sewer improvements upstream.

(a) Design Storm Frequency

- 1) 10 year storm minimum.
- 2) 25 year storm for arterial streets.

(b) Design Flow

- 1) Areas under 200 acres use Rational Method  $Q = CiA$ .
- 2) Areas over 200 acres use Technical Release 55.

(c) Runoff Coefficient

- 1) Based on Table 1.

(d) Maximum Allowable Headwater

- 1) 18" below top of curb.
- 2) 12" below edge of pavement.
- 3) 1.2 times the culvert diameter.
- 4) Property Damage - 100 year frequency head water shall not exceed any existing or proposed building first floor elevation.
- 5) Diameter or rise plus 4' or 2D, whichever is lower, in deep ravines.

(e) Manning's "n" Value

- 1) Box Culverts - 0.011
- 2) Slab Top Culvert - 0.03 to 0.05
- 3) Concrete Pipe - 0.013
- 4) Corrugated Metal - 0.019 to 0.032
- 5) All other types of pipe - According to manufacturers' specifications.

(f) Entrance Loss Coefficient

- 1) Box Culvert and Slab Top Culvert - 0.2 to 0.5
- 2) Concrete pipe - 0.2
- 3) Corrugated Metal - 0.9

(g) Minimum Cover

- 1) Desirable - 30 inches to pavement subgrade.

(h) Maximum Cover

- 1) The structural design criteria for culverts will be the same as that required by the Ohio Department of Transportation.

(i) Maximum Allowable Outlet Velocity

- 1) Bare Earth Channel - 6 F.P.S.
- 2) Rock Protection - 18 F.P.S.
- 3) Stilling Basin - Over 18 F.P.S.
- 4) The ability of the downstream channel to handle the flow satisfactorily.

(j) End Protection

- 1) 12" thru 36" culverts - Full height headwall.
- 2) 42" thru 84" culverts - Full height headwall with flared wings.
- 3) Other special type headwalls must be approved before use.



(6) Storm Sewers - The important criteria to consider in designing storm sewer systems are:

- All storm sewer systems are to be designed using Manning's Equation:

$$Q = (1.49/n)R^{2/3} S^{1/2} A$$

- The sewer must be deep enough to receive the flow from all its sources within the watershed.
- The size of the sewer must be adequate for flowing full, based on the design storm.
- The gradient of the sewer must be sufficient to avoid deposition of solids.
- The pipe material for City maintained sewers shall be concrete, corrugated metal (CMP), or smooth-walled, corrugated plastic (PVC). Other approved material may be used for special design.
- The main pipe, if over 24", in a sewer system will be required to be separated from all inlets unless a special design is submitted for approval.
- The flow line of pipes should be set such that the crown of pipes, at junctions, are at the same elevation; if the outlet elevation permits, the crown of the outlet pipe may be lower.
- The flow line of elevations of sewers should be set to avoid using concrete encasement.
- Within the limits of existing or proposed right-of-way, where minimum cover during construction or proposed cover over the outside top of the pipe is 30 inches or less for pipe size 6 to 27 inches in diameter inclusive, concrete encasement will be required. Trench backfill shall be as per the requirements of the Chillicothe Engineering Department.

(a) Design Storm Frequency

- 1) 72" and under - flowing full for 2 year storm.
- 2) Over 72" diameter - flowing full for 10 year storm.

(b) Hydraulic Gradient

- 1) Based on 5 year storm, shall not exceed window or grate elevation for an inlet or catch basin.
- 2) Grade line based on tailwater or 0.8 D at outlet or other critical points within the system.

(c) Design Flow

- 1) Areas under 200 acres use Rational Method:  $Q = CiA$ .
- 2) Areas over 200 acres use Technical Release 55.

(d) Minimum Time of Concentration

- 1) Curb inlet - 10 minutes
- 2) Catch basin - 10 minutes

(e) Runoff Coefficient

- 1) Based on Table 1, with 0.4 as a minimum.

(f) Manning's "n" Value

- 1) All storm sewers shall be based on an "n" of 0.013.

(g) Minimum Cover to Subgrade

- 1) Desirable 30 inches to ground surface or pavement subgrade.

(h) Maximum Cover

- 1) The supporting strength of the conduit, as installed, divided by a suitable factor of safety, must equal or exceed the loads imposed upon it by weight of earth plus any superimposed loads.
- 2) The design procedure recommended for use in structural design of storm sewers is Design Manual Concrete Pipe, available from American Concrete Pipe Association, wide trench installation.

(i) Velocity in Sewer for Design Flow

- 1) Minimum - 3 fps
- 2) Maximum - 15 fps
- 3) No minimum for outlets from ponding areas.

(j) Maximum Length Between Access Structures

- 1) Pipes under 60" - 300 feet
- 2) Pipes 60" and over 500 feet

(7) Open Watercourse - Complete computations shall be submitted for open watercourses and channels. The computations shall show good flow characteristics at times of low flow as well as at peak flow. Channels shall be improved as necessary to carry the design flow without erosion.

Access to storm drainage ditches and channels shall be by means of maintenance easements. Such maintenance easements shall be not less than the width of the ditch at the top of the banks plus ten (10) feet each side, measured horizontally, from the top of the banks. A specifically located and described, 20 feet minimum width access easement shall be required from the maintenance easement to the nearest public right-of-way. Maintenance and access easements are to be kept free of obstructions.

(a) Design Storm Frequency

- 1) Flowing full for 10 year storm

(b) Design Flow

- 1) Areas under 200 acres use Rational Method:  $Q = CiA$ .
- 2) Areas over 200 acres use Technical Release No. 55.

(c) Runoff Coefficient

- 1) Based on Table 1.

(d) Allowable Velocities New Ditches

- 1) 3.0 fps with seeding
- 2) 5.0 fps with sod or jute mat lining.
- 3) Over 5 fps with special lining.

(e) Allowable Velocities Existing Channels

- 1) Ability of the channel to handle the flow satisfactorily.

(f) Manning's 'n' Value

- 1) Sod or Jute Mat Lining - 0.05
- 2) Paved Lining - 0.015
- 3) Rock Protection - 0.08
- 4) Existing Lining - 0.025 to 0.20

(g) Minimum Grade

- 1) The desirable minimum grade is 0.50%. All improved channels and other open watercourses which have a grade of less than 0.50% shall be paved. Paving shall be 4" minimum thickness concrete paving, reinforced with steel mesh to accommodate temperature stresses. Paving shall be air-entrained class C concrete, with synthetic or linseed oil waterproofing treatment. Paved ditches shall be 14' minimum total paved width, with 8 foot bottom width, and a 2 foot width to 1 foot rise sloped side sections. Side slope paving shall be to the depth of a 2 year storm flow, with a minimum depth of 1 foot.

(h) Side Slopes

- 1) Soil - 4:1
- 2) Concrete Paved - 2:1
- 3) Rock - 2:1

(8) Curb Inlet Spacing - The satisfactory removal of surface water from a curbed pavement is as important as any other phase of stormwater control. Spread of water on the pavement for the design storm is considered as the best control for pavement drainage.

The design procedure recommended for use is Hydraulic Engineering Circular No. 12, available from the Superintendent of Documents, U.S. Government Printing Office.

On combined runs of over 600 feet contributing to a pavement sag curve, an additional inlet may be required near the low point, 0.2± feet above the inlet at the sag.

General policy for spacing will be 400' maximum for mountable curb and 500' maximum for full height curb.

- (a) Design storm frequency using Rational Method shall be a 2 year storm.
- (b) Minimum time of concentration shall be 10 minutes.
- (c) Pavement roughness coefficient shall be 0.015.
- (d) Maximum spread of flow:
  - 1) 26' streets or less, the flow may spread to a width of 8'.
  - 2) 27' to 36' streets, the flow may spread to a width of 9'.
  - 3) 37' to 52' streets, the flow may spread to a width of 10'.
- (e) All inlets shall be curb and gutter type as required by the Chillicothe Engineering Department.

(9) Site Development Criteria - The parking areas and impervious areas for all proposed site developments shall be designed to provide drainage of surface water to natural watercourses or storm sewers and to prevent draining of such water onto adjacent properties or across public walkways. The parking lots shall be drained by means of catch basins and storm sewers to an adequate outlet.

The parking lot shall be graded such that the surface water will drain to the catch basin or basins in a low area to prevent detention of the runoff.

All roof top areas and/or building storm water drainage systems shall drain to the parking lot system for controlling stormwater rate of runoff prior to its release to downstream properties.

The catch basins must pick up the water on the paved surface. Sheet flow will not be permitted.

The outlet pipe shall be designed as follows:

- 1) Pipe flowing full for a 2 year storm.
- 2) Rational Method  $Q = CiA$ .
- 3) Minimum time of concentration = 10 minutes.

The detention or ponding area shall be designed as explained in the section under detention retention.

(10) Detention or Retention- In developed and developing urban and suburban areas, several means for controlling stormwater runoff can be used. This usually involves storing runoff on or below the ground surface. The following types of storage facilities may be considered for detention: rooftops, parking lots, underground tanks and surface basins or ponds.

(a) Parking Lot Storage - Parking lot storage is surface storage where shallow ponding is designed to flood specific graded areas of the parking lot. Controlled release features are incorporated into the surface drainage system of the parking lot. Parking lot storage is a convenient multi-use structural control method where impervious parking lots are planned. Design features include small ponding areas with controlled release by pipe-size and slope, and increased curb heights. This method can easily be incorporated into a site development at approximately the same cost as that of a conventional parking lot. Ponding areas in parking or traffic areas shall be designed for a maximum potential depth of twelve (12) inches. Flood routing or overflow must occur after the maximum depth is reached. The major disadvantage is the inconvenience to users during the ponding function. This inconvenience can be minimized with proper design consideration. Clogging of the flow control device and icy conditions during cold weather are maintenance problems. Parking lot design and construction grades are critical factors. This method is intended to control the runoff directly from the parking area, and is usually not appropriate for storing large runoff volumes.

(b) Tank Storage - Tank storage is an underground tank or chamber, either prefabricated or constructed in place, which has a special controlled release feature. This method is most applicable where land area is very valuable, such as in industrial and commercial areas. Construction cost and operation costs, which may include pumps, make this method relatively expensive. Storage trenches, a variation on basic tank storage, are rock-filled underground storage tanks. The storage is provided within the void spaces between the rock material.

(c) Surface Basins or Ponds

1) Wet Ponds or Retention Basins - Wet ponds are permanent ponds where additional storage capacity is provided above the normal water level and special features for controlled release are included. Historically, wet ponds have proven extremely effective in abating increased runoff and channel erosion from urbanized areas. They are a major Soil Conservation land treatment practice. Some problems often encountered with wet ponds are site reservation (land requirements), permanent easements, complexity of design and construction, safety hazards and maintenance problems. Because of large land requirements, and the necessity of maintaining a permanent pool of water, wet ponds have a broader application for instream control where large watershed areas are involved compared to their use as on-site facilities for small urban areas. However, the recreational and aesthetic benefits of permanent wet ponds may justify certain on-site applications. A five (5) foot chain link fence will be required where a wet pond or retention basin is to be constructed adjacent to an existing single family development for that part along the existing single family section. Due to siltation, maintenance, and safety problems created by such basins, no wet basins shall be permitted for the purposes of retention of storm water, in a single family development. Wet basins will be considered in the development of multi-family, industrial and commercial developments. Side slopes for a retention facility shall be 4:1 maximum below permanent storage and 6:1 maximum above permanent storage. Rock Channel Protection, Type D, must be placed at the normal water elevation, around the entire perimeter of the basin, five feet wide, centered on the normal water elevation.

2) Dry Basins or Detention Basin - Dry basins are surface storage areas created by constructing a typical excavated or embankment basin. There is no normal pool level and a specific controlled release feature is included to control the rate of discharge. Dry basins are the most widely used method of stormwater management. The soil permeability and water storage potential are not as important with dry basins as with wet basins. Therefore, dry basins have the greatest potential for broad applications. They can be utilized in small developments because they can be designed and constructed as small structures. Dry basins are often less costly than wet ponds because they do

not require extensive design and construction considerations. They can be designed for multi-use purposes such as recreation and parks. Detention basin invert ditches shall be provided, from the inlet to the outlet of all structures, and shall be paved. Such ditches shall be paved with 6" minimum thickness concrete paving reinforced with steel mesh to accommodate temperature stresses, of air-entrained Class C concrete, and with synthetic or linseed oil waterproofing treatment. Paved ditches shall be 14' minimum total paved width, with 8 foot bottom width, and 3 foot width by 1 foot rise sloped side sections. Minimum depth of paved invert ditch shall be 1 foot. Detention basin bottoms shall be sloped to drain, and such slopes shall be sufficient to mitigate against "flat spots" developing due to construction errors and soil conditions; or, such bottoms shall be paved. The absolute minimum transverse slope for the bottoms of such facilities shall be 0.50% and 2.0% is the recommended transverse slope. All transverse bottom slopes flatter than 2.0% to and including 0.5%, shall be 6" minimum thickness concrete, reinforced with steel mesh to accommodate temperature stresses, of air-entrained Class C concrete, and with synthetic or linseed oil waterproofing treatment.

(d) Design Criteria

1) Design Frequency

- a.) 10 year storm for individual site development with shallow ponding for drainage areas of 10 acres or less.
- b.) 100 year storm for drainage areas exceeding 10 acres.

2) Design Flow

- a.) Area under 200 acres use Rational Method:  $Q = CiA$ .
- b.) Areas over 200 acres use Technical Release No. 55.

3) Runoff Coefficient

- a.) Based on Table 1.

(e) Release Rates - The release rate for all developments shall not exceed the pre-development storm water runoff rate from the site based upon a storm of two (2) year frequency, with a runoff coefficient of 0.4 or the ability of the downstream sewers or stream channel to handle the flow satisfactorily, which ever is less. When designing the outlet device, the head on the system must be calculated to be at the designed high ponding or retention elevation. The minimum size of the outlet device must be an 8" pipe or 6" orifice.

(f) Debris-control structures may be required in some detention situations and should be considered as an essential part of design. The procedure recommended for use is Hydraulic Engineering Circular No. 9, available from the Superintendent of Documents, U.S. Government Printing Office.

(g) As-built surveys may be required and shall be provided by the Developer, Contractor, or other entity constructing the stormwater drainage facilities, in order to demonstrate conclusively that the facilities are constructed to the elevations, slopes, grades, and sizes shown on the reviewed plans on file with the City. Such surveys shall be conducted by a registered Professional Surveyor, shall employ standard survey techniques, and shall produce original field notes which shall be furnished to the City for review and record purposes. Reduction of notes, and any plotting necessary to make the notes interpretable, shall be by the surveyor performing the as-built survey. As-built surveys shall be in addition to, and separate from, other construction surveys which may be conducted by the City or its agents. All discrepancies revealed in the as-constructed facilities by the as-built survey shall be rectified by the Developer, Contractor, or other entity constructing the storm water drainage facilities, and the as-built survey re-performed, in order to demonstrate conformance.

(h) Access and Maintenance Easements - Specific dedicated easement rights shall be required, in order to provide for the necessary maintenance of all stormwater facilities. A maintenance easement of 20 foot minimum width, in addition to the size of the stormwater facility when flooded, is required. A specifically located, 20 foot minimum width access easement shall also be required, from the easement at, alongside, or around the stormwater facility, to the nearest public right-of-way. Maintenance responsibilities will be determined and so stated in the easement. The 20 foot maintenance easement outside the flooded facility must be on a slope of 10:1 maximum.

### **Section 3.3 Stormwater Facility Maintenance**

(1) The Chillicothe Utilities Director shall be responsible for permanent maintenance of stormwater management facilities and other facilities designed to manage stormwater runoff when the land served involves two or more property owners. The Utilities Director may allow an individual or group of property owners to maintain the facilities, with responsibility for overseeing remaining with the Utilities Director.

(2) Maintaining the hydraulic integrity of stormwater management facilities shall be the responsibility of the Utilities Director. This is limited to work ensuring the design standards and provisions of these regulations continue to be satisfied. Maintenance required for aesthetics, recreation or nuisance control shall be the responsibility of the owners of land served by the facility.

(3) An inspection and maintenance agreement and easement binding on all subsequent owners of land served by the stormwater facilities shall be provided to the City of Chillicothe. Such agreement shall provide for access to the facilities at reasonable times for regular inspection by the Utilities Director to ensure that the facility is maintained to meet design standards and the provisions of these regulations.

Such agreements or restrictions shall be recorded on the deed or final plat for the property or subdivision, and reference thereon be made to the entity or individuals to be responsible for maintenance. The location, dimensions and bearing of stormwater facilities and easements shall be recorded on the deed, or when in an approved subdivision, on the final plat, and reference thereon be made to the entity or individual(s) responsible for maintenance.

The owner and/or developer shall maintain all stormwater management facilities for a period of one year following final inspection and acceptance. All stormwater management facilities shall be maintained to meet the design standards and the provisions of these regulations. Failure to maintain the improvement during the one year maintenance period may result in action against the owner and/or developer.

(4) The costs for any special maintenance deemed necessary by the Utilities Director to be performed by the City of Chillicothe on drainage structures or systems, shall be proportionately assessed to each property owner being served or contributing stormwater to said drainage structure or system. The assessment shall be based upon the proportionate amount of additional runoff created by the development of each property being served. The assessment shall be added to the bi-monthly utility bill as a "Stormwater Management Fee" with the enforcement and responsibility for payment being governed by the Codified Ordinances of Chillicothe. "Special maintenance" is defined as any such maintenance, work, or repairs that are anticipated to be necessary more often than one time in a five (5) year period. Said special maintenance may be necessary for, but is not limited to, the following:

- (a) Mowing of detention and retention areas;
- (b) Removal of siltation and debris from detention and retention areas and open channels and swales;
- (c) Removal of siltation and cleaning wet or dry wells;
- (d) Removal of siltation and debris and flushing of storm sewers and catch basins as a result of construction and erosion activity.

## **ARTICLE IV ADMINISTRATION**

### **Section 4.1 - Plan Review and Permit Approval**

(1) A Water Management and Sediment Control (WMSC) Permit shall be required for any earth-disturbing activities that will alter, disturb, and/or increase existing storm water runoff.

To obtain a WMSC Permit when the disturbed area is more than 5,000 square feet, the applicant shall develop and submit to the City Engineer for review and approval a WMSC plan prepared by a registered engineer and complete the "WMSC Permit Application" (Form WMSC-1).

When the disturbed area is 5,000 square feet or less, the "WMSC Agreement in Lieu of a WMSC Plan" (Form WMSC-2) shall be required to obtain a WMSC permit.

(2) All permit applications (Forms WMSC-1 and WMSC-2), except those submitted by a public entity or agency, shall be accompanied by a filing and inspection fee of \$100.00 per acre of disturbed area. The minimum fee shall be \$100 for any application.

All revenues generated from this fee shall be used solely for stormwater management purposes.

(3) Application for a WMSC Permit shall be submitted to the City Engineer. The City Engineer shall review the application and forward copies of the application to the Utilities Director. If the City Engineer and the Utilities Director find the application in conformance with the provisions of these regulations, a permit will be issued with such reasonable conditions as deemed necessary to secure the objectives of these regulations.

(4) An application for a WMSC Permit shall be approved or denied within thirty (30) days from the time of application for WMSC Permit was submitted. If a revision to the WMSC application is required, the thirty (30) day review period commences upon receipt of the revisions.

(5) Every permit holder shall notify the City Engineer two (2) days in advance of commencement of work authorized by such Permit.

(6) All permitted earth disturbing activities shall be subject to site inspection by the Utilities Director to determine compliance with these regulations.

### **Section 4.2 - WMSC Plan Content**

In compliance with Article II and III, a WMSC plan shall be prepared by a professional engineer registered in the State of Ohio and shall identify potential erosion, sediment pollution, and stormwater problems from the development area and describe measures to be taken to control those problems. The WMSC plan must be submitted to and approved by the City Engineer prior to any earth-disturbing activity on the development area. The WMSC plan shall contain the following information:

(1) Narrative - The narrative shall be included on the site plan in the form of notes, or in letter form attached to the plans and shall include the following:

(a) The schedule of major construction operations as related to implementing erosion and sediment control practices and stormwater management facilities;

(b) Maintenance requirements for temporary erosion and sediment control practice:

(1) Sediment levels necessitating clean out;

(2) Person to perform maintenance;

(c) The name, address and telephone number of the WMSC plan designer and the owner or persons responsible for the development area.



(2) Site Plan

- (a) Vicinity map at a scale of not less than two thousand (2,000) feet to the inch locating the site in relation to the surrounding area.
- (b) Limits of earth-disturbing activity.
- (c) Existing and proposed topography shown in 2' contour intervals.
- (d) Existing and proposed drainage patterns including watershed lines, directions of flow and watershed acreage. Drainage patterns during major phases of construction shall also be included as appropriate.
- (e) The types of soils within or affected by the development area and the location of all highly erodible or unstable soils.
- (f) Erosion and sediment control practices:
  - (1) Their location;
  - (2) Settling ponds drawn to scale with basic dimensions;
  - (3) Detail drawings of structural control practices;
- (g) Proposed utilities which may effect erosion and sediment control practices.
- (h) Temporary erosion control measures, their locations, and details of such.

(3) Stormwater Management Provisions

- (a) General description of the stormwater management strategy proposed to meet the requirements of Article III of these regulations.
- (b) The location and design calculations for all permanent stormwater control structures, and all stormwater conveyance systems.
- (c) The person or entity responsible for maintenance of the stormwater control structures.
- (d) Maintenance requirements and schedules as defined by Article III of these regulations.
- (e) Permanent access and access easements required to perform inspection and maintenance of stormwater control structures and stormwater conveyance systems.

**Section 4.3 - Guarantees for Completion of Work**

All persons proposing earth-disturbing activities involving one (1) acre or more shall provide a performance bond in the form of a letter of credit, cash on deposit, traditional bond, or other pledging of securities, as deemed adequate by the City Engineer. The performance bond shall be retained by the City Auditor until measures identified in the WMSC plan and these regulations have been completed to the satisfaction of the City Engineer. The performance bond shall be 100% of the design engineer's estimate for establishing vegetative stabilization on the site and constructing the stormwater management facilities.

**Section 4.4 - Inspection and Enforcement Actions**

(1) The City Engineer or his representatives may inspect any permitted development area to determine compliance with the approved plan and these regulations. When it is determined that there is a violation or the development area is not in compliance, the following procedure shall be followed:

- (a) The inspector representing the City Engineer shall notify the site superintendent of the violation and the work required to be in compliance with the approved plan and these regulations. Notification may be verbal or written.
- (b) One week following the inspection during which the violation was noted or after a time period mutually agreed to by the inspector and the site superintendent, the inspector shall reinspect the site.
- (c) If the violation still exists the City Engineer may issue, by certified mail, an order to comply. The order shall describe the problem and the work needed, and specify a date whereby the work must be completed.
- (d) On the date specified in the order to comply the site shall be reinspected.
- (e) If the violation still exists the issue may be reported to the Law Director for consideration. If the Law Director determines that a violation exists one or all of the following options may be pursued:

- (1) The WMSC Permit may be revoked. No earth-disturbing activity shall proceed without a WMSC Permit.
- (2) An injunction or other appropriate relief may be sought through the court of competent jurisdiction.
- (3) The performance bond may be used by The City of Chillicothe to abate the erosion, sedimentation or water management problem caused by the subject site.
- (2) The inability to perform any of the inspection and enforcement procedures as defined in this Section shall not preclude the use of any other procedure nor shall the procedure be binding in cases of severe hazard or threat to the public welfare as determined by the Law Director.

#### **Section 4.5 - Penalties for Violation**

- (1) Revocation of Permits - No WMSC Permit shall be revoked or suspended until a hearing is held by the Law Director. Written notice of such a hearing shall be served on the permit holder either personally or by registered mail.
- (2) Legal Offense - Violation of the provisions of these regulations or failure to comply with any of its requirements shall constitute for a first offense a minor misdemeanor violation, and a fourth degree misdemeanor for a second or subsequent offense which occurs within one (1) year. For a first offense the court of competent jurisdiction may levy a fine of up to one hundred (\$100.00) dollars per day for each day the violation exists. For a second or subsequent offense which occurs within one year the court of competent jurisdiction may levy a fine of up to two hundred fifty (\$250.00) dollars per day and/or a thirty (30) day sentence of incarceration for each day the violation exists.

#### **Section 4.6 - Variances**

The Chillicothe Planning Commission, with input and guidance from the Utility Director and City Engineer, may grant a variance to these regulations where the applicant or permit holder can show that compliance with all of these regulations is not appropriate. A variance may be granted if the probability of off site damage is slight because of exceptional topographic or other physical conditions of the development area, an example of such being the availability to outlet drainage to a major drainage channel, creek or river. Requests for variances shall be submitted to the City Engineer in accordance with Chillicothe Planning Commission requirements and procedures and shall include justification for the granting the variance.

#### **Section 4.7 - Appeals**

Any person aggrieved by any order, requirement, determination, or any other action for inaction by the City of Chillicothe or its representatives in relation to this regulation may appeal to the Court of Common Pleas. Such an appeal shall be made **in conformity with Chapters 2505 and 2506 of the Revised Code.** **Written notice of appeal shall be served to the Law Director.**

## **ARTICLE V DEFINITIONS**

For the purpose of these regulations, words used in the present tense include the future tense; and the singular includes the plural, unless the context clearly indicated the contrary. The term "shall" is always mandatory and not discretionary; the word "may" is permissive. The word or term not interpreted or defined by this article shall be used with a meaning of common or standard utilization, so as to give these regulations their most reasonable application.

- (1) **"Accelerated water erosion"** means the wearing away of the land surface by water, occurring at a much more rapid rate than geologic or normal erosion, primarily as a result of the influence of the activities of humans.
- (2) **"Channel"** means a natural stream that conveys water; a ditch or channel excavated for the flow of water.
- (3) **"Concentrated stormwater runoff"** means surface runoff which converges and flows primarily through water conveyance features such as swales, gullies, waterways, channels or storm sewers and which exceeds the maximum specified flow rates of filters or perimeter controls intended to control sheet flow.
- (4) **"Conservation"** means the wise use and management of natural resources.
- (5) **"Cut and fill slopes"** means a portion of land surface or area from which soil material is excavated and/or filled forming a slope or embankment.
- (6) **"Denuded area"** means a portion of land surface on which the vegetation or other soil stabilization features have been removed, destroyed or covered and which may result in or contribute to erosion and sedimentation.
- (7) **"Detention facility"** means a facility, by means of a single control point, which provides temporary storage of stormwater runoff in ponds, parking lots, depressed areas, rooftops, buried underground vaults or tanks, etc., for future release, and is used to delay and attenuate flow.
- (8) **"Development area"** means any tract, lot or parcel of land or combination of tracts, lots or parcels of land which are in one ownership, or are contiguous and in diverse ownership where earth-disturbing activity is to be performed.
- (9) **"Ditch"** means an excavation either dug or natural for the purpose of drainage or irrigation with intermittent flow.
- (10) **"Dumping"** means grading, pushing, piling, throwing, unloading, or placing of soil.
- (11) **"Earth-disturbing activity"** means any grading excavating, filling, or other alteration of the earth's surface where natural or man-made ground cover is destroyed and which may result in or contribute to erosion and sediment pollution.
- (12) **"Earth material"** means soil, sediment, rock, sand, gravel, and organic material or residue associated with or attached to the soil.
- (13) **"Erosion"** means the process by which the land surface is worn away by the action of water, wind, ice, or gravity.
- (14) **"Erosion and sediment control practices"** means conservation measures used to control sediment pollution and includes structural practices, vegetative practices and management techniques.

- (15) "**Frequency year storm**" means a rainfall event of a magnitude with a specified average recurrence interval and is calculated with soil conservation service type II twenty-four-hour curves or depth-duration frequency curves.
- (16) "**Grading**" means earth-disturbing activity such as excavation, stripping, cutting, filling, stockpiling, or any combination thereof.
- (17) "**Grubbing**" means removing, clearing, or scalping material such as roots, stumps or sod.
- (18) "**Highly erodible soil**" means a portion of land surface which is very susceptible to erosive forces and is characterized by steep slopes or long slopes.
- (19) "**Landslide**" means the rapid mass movement of soil and rock material downhill under the influence of gravity in which the movement of the soil mass occurs along an interior surface of sliding.
- (20) "**Outfall**" means an area where water flows from a structure such as a conduits\, storm sewer, improved channel or drain, and the area immediately beyond the structure which is impacted by the velocity of flow in the structure.
- (21) "**Person**" means any individual, corporation, partnership, joint venture, agency, unincorporated association, municipal corporation, township, county, state agency, the federal government, or any combination thereof.
- (22) "**Public stormwater open channel**" means all open channels which: 1) convey, in part or in whole, stormwater; 2) have a permanent drainage/stormwater easemenet owned by the City of Chillicothe or are located within City of Chillicothe owned property; and 3) drain an area which includes City of Chillicothe owned property or public right-of-way. A public stormwater open channel does not include roadside ditches which convey only immediate right-of-way (roadside) drainage.
- (23) "**Retention facility**" means a facility which provides storage of stormwater runoff and is designed to eliminate subsequent surface discharges.
- (24) "**Sediment**" means solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site by origin by wind, water, gravity, or ice, and has come to rest on the earth's surface.
- (25) "**Sediment basin**" means a settling pond meeting or exceeding the design specifications of a temporary sediment basin as defined in water management and sediment control for urbanizing areas (Soil Conservation Service, Ohio)
- (26) "**Sediment control**" means the limiting of sediment transport by controlling erosion, filtering sediment from water, or detaining sediment-laden water allowing sediment to settle out.
- (27) "**Sediment pollution**" means failure to use management or conservation practices to control wind or water erosion of the soil and to minimize the degradation of water resources by soil sediment in conjunction with land grading, excavating, filling, or other soil disturbing activities on land used or being developed for non-farm commercial, industrial, residential, or other non-farm purposes.
- (28) "**Sensitive area**" means an area or water resource as delineated by the approving authority prior to plan approval that requires special management because of its susceptibility to sediment pollution or because of its importance to the well-being of the surrounding communities, region, or the state and includes:
- (a) ponds, wetlands or small lakes with less than five acres of surface area;
  - (b) small streams with gradients less than ten feet per mile with average annual flows of less than 3.5 feet per second containing sand or gravel bottoms.

- (29) "**Settling pond**" means a runoff detention structure such as a sediment basin or sediment trap, which detain sediment-laden runoff allowing sediment to settle out.
- (30) "**Sheet flow**" means overland water runoff in a thin uniform layer.
- (31) "**Slip**" means landslide as defined in paragraph (B) of this rule.
- (32) "**Sloughing**" means a slip or downward movement of an extended layer of soil resulting from the undermining action of water or the earth-disturbing activity of man.
- (33) "**Soil**" means unconsolidated erodible earth material consisting of minerals and/or organics.
- (34) "**Soil stabilization**" means vegetative or structural soil cover controlling erosion, and includes permanent and temporary seed, mulch, sod, pavement, etc.
- (35) "**Stormwater**" means stormwater runoff, snow melt runoff, and surface runoff and drainage.
- (36) "**Stormwater control facility**" means practices used to control accelerated stormwater, runoff from development areas.
- (37) "**Stormwater conveyance system**" means all storm sewers, channels, streams, ponds, lakes, etc., used for conveying concentrated stormwater runoff or storing stormwater runoff.
- (38) "**Stream**" means a body of water running or flowing on the earth's surface or channel in which such flow occurs. Flow may be seasonally intermittent.
- (39) "**Unstable soil**" means a portion of land surface or area which is prone to slipping, sloughing or landslides.
- (40) "**Water resources**" means all streams, lakes, ponds, wetlands, watercourses, drainage systems, and all other bodies or accumulations of surface water, natural or artificial, which are situated wholly or partly within, or border upon, this state, or are within its jurisdiction, except those private waters which do not combine or effect a junction with natural surface waters.

**FORM WMSC-1 - WMSC PERMIT APPLICATION**

**CITY OF CHILLICOTHE  
WATER MANAGEMENT & SEDIMENT CONTROL  
PERMIT APPLICATION**

Project Name: \_\_\_\_\_

Project Location: \_\_\_\_\_

Applicant: \_\_\_\_\_

(Name)

(Phone)

\_\_\_\_\_  
(Address)

Landowner: \_\_\_\_\_

(Name)

(Phone)

\_\_\_\_\_  
(Address)

Plan prepared by: \_\_\_\_\_

(Name)

(Phone)

\_\_\_\_\_  
(Address)

A brief description of the nature and purpose of the earth-disturbing activity:

\_\_\_\_\_  
\_\_\_\_\_

A brief description of the developments area's existing and proposed stormwater conveyance system, including any allied ponds or stormwater control structures beyond the development area:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

The name of sensitive areas as identified by \_\_\_\_\_ which receive runoff from the development area:

\_\_\_\_\_  
\_\_\_\_\_

Requests for variances and justification (attach additional sheets if needed):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

I, \_\_\_\_\_, hereby certify that I understand the provisions of the Chillicothe  
(signature of applicant)

WMSC Regulations and that I accept responsibility for carrying out the WMSC Plan for the above referenced project as approved by the City Engineer.

I further grant the right-of-entry onto the project site to the designated personnel of the Chillicothe Engineering department and the Chillicothe Utility Department for the purpose of inspecting for compliance with the Chillicothe WMSC Regulations.

Received by \_\_\_\_\_ Date \_\_\_\_\_

Approved by \_\_\_\_\_ Date \_\_\_\_\_

**FORM WMSC-2 - WMSC AGREEMENT IN LIEU OF A WMSC PLAN**

**WMSC AGREEMENT**

WMSC Permit No. \_\_\_\_\_ Building Permit No. \_\_\_\_\_

Subdivision \_\_\_\_\_ Lot No. \_\_\_\_\_

I agree to develop and construct on this lot in a manner which will minimize erosion and sedimentation. At a minimum, all denuded areas on the lot described above shall be stabilized if they are at final grade or will not be regraded or disturbed further for a period of forty five (45) days or more. Soils stabilization shall be applied within seven (7) days from being last disturbed. Sediment barriers, settling ponds or other control practices shall also be used as determined by the City Engineer.

Further measures:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_.

Signature of Landowner: \_\_\_\_\_ Date \_\_\_\_\_  
(or person responsible for development area)

Address \_\_\_\_\_

Phone \_\_\_\_\_

Approved By: \_\_\_\_\_ Date \_\_\_\_\_

CITY OF CHILLICOTHE  
RIGHT OF ENTRY

\_\_\_\_\_, hereinafter termed "Owner", and the CITY OF CHILLICOTHE, hereinafter termed "City", in consideration of the mutual promises of the Owner and City hereinafter contained, agree upon the following terms for the entry of the City and its representatives as set forth herein upon the real estate hereinafter described as follows:

Situate in the City of Chillicothe, Scioto Township, Ross County, Ohio and being more fully described as : \_\_\_\_\_

\_\_\_\_\_ as described in Volume \_\_\_\_\_ Page \_\_\_\_\_, Ross County Deed Records.

1. Owner hereby grants to City, its employees, agents, consulting engineers, contractors, and other representatives the right to enter upon the above described real estate on and after the \_\_\_\_\_ day of \_\_\_\_\_, 199\_\_, for the purposes of inspection and surveying of retention/detention facilities, review of facility layout, and impervious areas.

2. The City shall, as soon as practicable after completion of the work as above described, cause all affected property of the Owner to be restored to its original condition as nearly as reasonably possible.

3. Owner hereby covenants with City that he/she is the true and lawful owner of the above described real estate and has lawfully seized of the same in fee simple and has the right and full power to grant this right of entry, which right of entry shall cease to be effective on completion of the above described work.

4. Owner will not charge City rent or other compensation during the period of time City occupies the said real estate for the purposes aforesaid under the provisions of this right of entry.

IN WITNESS WHEREOF, the parties have caused their respective names to be signed on this \_\_\_\_\_ day of \_\_\_\_\_, 199\_\_.

Witnesses:

"Owner"

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_  
City of Chillicothe



**TABLE I**  
**RUNOFF COEFFICIENTS**

Average values of developed runoff for various types of developments:

	(General Slope)	
	(Less Than) 2%	(More Than) 7%
Unimproved Areas	0.20	0.30
Railroad Yard Areas	0.20	0.40
Park and Cemeteries	0.10	0.25
Playgrounds	0.20	0.35
<u>RESIDENTIAL</u>		
Suburban	0.35	0.40
Single Family	0.40	0.40
Multi Units	0.50	0.70
Apartments	0.60	0.80
<u>COMMERCIAL</u>	0.80	0.95
<u>INDUSTRIAL</u>		
Light	0.50	0.80
Heavy	0.60	0.90

# RAINFALL FREQUENCY CURVES

RELATION OF RAINFALL  
INTENSITY VS. TIME

BASED ON RECORDS OF COLUMBUS  
STATION - U.S. WEATHER BUREAU

## EXPLANATION

CURVE SUBSCRIPT AS FOR  $I_{10}$  INDICATES THAT CURVE REPRESENTS INTENSITIES EQUALLED OR EXCEEDED ONCE IN 10 YEARS  
THE FIFTY YEAR FREQUENCY CURVE IS A MODIFICATION OF THE FIFTY THREE YEAR FREQUENCY CURVE, THE ONE HUNDRED YEAR FREQUENCY CURVE IS INTERPOLATED

