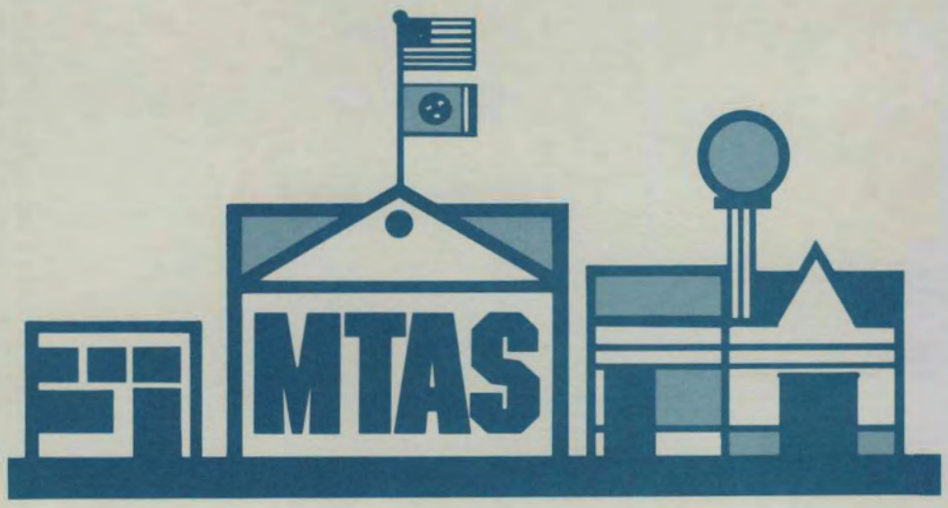
PUBLIC WORKS

DRAINAGE MANAGEMENT

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Compiled by
MUNICIPAL TECHNICAL ADVISORY SERVICE
of The University of Tennessee
in cooperation with The Tennessee Municipal League

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DRAINAGE MANAGEMENT

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in cooperation with the

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THE RIVERS RUN INTO THE SEA BUT THE SEA IS NEVER FULL, AND THE WATER RETURNS AGAIN TO THE RIVERS AND FLOWS AGAIN TO THE SEA.

ECCLESIASTES 1:7

BY THE RULE OF THE CIVIL LAW THE PROPRIETOR OF THE LOWER LAND MAY NOT OBSTRUCT, BY ANY MEANS, THE NATURAL FLOW OF SURFACE WATER, AND TURN IT BACK, TO THE INJURY OF THE HIGHER LANDS OF HIS NEIGHBOR, THE LATTER OWNER HAVING BY THE LAW OF NATURE, AN EASEMENT OR SERVITUDE OF DRAINAGE OVER THE LANDS OF THE FORMER FOR THE FLOW OF SURFACE WATERS.

Garland v. Aurin, 103 Tenn. 555.

THE UNIVERSITY OF TENNESSEE
MUNICIPAL TECHNICAL ADVISORY SERVICE

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Dear City Official:

Storm drainage management has emerged as one of the high visibility areas of overall public works management. Development pressures, potential legal impacts, and federal regulations have all contributed to the increased priority being placed on storm drainage management.

In an effort to respond to the need for more management capability in this vital area, the Municipal Technical Advisory Service contracted with Alley, Young, and Baumgartner, Inc. of Brentwood, Tennessee, to develop this publication. A companion training program was developed through funding assistance from the University's Center for Government Training.

Additional funding and/or development assistance for the production of this publication was provided by the Tennessee Chapter of the American Public Works Association and the cities of Athens, Columbia, Covington, Germantown, Gallatin, Goodlettsville, and Maryville. Without the support of TCAPWA and the cities, we could not have accomplished this task. We acknowledge the contribution of TCAPWA and these cities and wish to thank their officers and officials for their assistance.

As always, MTAS, the municipal government technical assistance agency of The University of Tennessee, welcomes input and suggestions regarding this document. If we can be of any assistance, please contact us at your convenience.

Sincerely,

C.L. Overman
Executive Director

CLO/csw

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SECTION 100
INTRODUCTION

101. NEED

Since stormwater occurs only periodically instead of daily like sewage and other public works responsibilities, it has been normally considered only after major storms. The funds that have been allocated toward stormwater control have normally been expended only after major storms with their subsequent complaints. Even though stormwater has been the cause of the loss of thousands of lives and billions of dollars of damage, there has been relatively little planning or management at a local level to prevent future problems.

As cities grow and runoff increases, a disproportionate number of complaints arise from stormwater problems. These time consuming complaints and the liabilities resulting from them have caused a need for municipalities to solve existing stormwater problems and develop future problems.

102. HISTORICAL BACKGROUND

The Municipal Technical Advisory Service (MTAS), seeing stormwater management as a general concern of municipalities across Tennessee, has sponsored the production of this Drainage Management Policy Document as a service to these municipalities. A series of public meetings has been held to solicit input on stormwater management. All of this input has been addressed in this Document.

103. PURPOSE

The purpose of this Document is to make recommendations that can be used by municipalities to implement short term solutions to existing drainage problems and long term solutions to prevent future drainage problems.

104. SCOPE

MTAS has developed and adopted Local Government Public Works Standards and Specifications to standardize drainage structure design. These Standards recommend methods for sizing drainage structures and waterways. The Standards will be used in this Document as the basis for all calculations.

This Document is intended to be a working guide to be used by a municipality in developing programs, procedures and regulations to aid in solving and preventing drainage problems. An attempt has been made to consider as many potential problems as possible but there is no guarantee that the Document will be all inclusive in suggesting solutions or that the adoption of its recommendations will prevent all conceivable future drainage problems.

This Document has important legal and engineering consequences and should be used only in conjunction with the advice and counsel of an attorney and an engineer, both duly licensed under the laws of the State of Tennessee.

SECTION 200
TECHNICAL BACKGROUND

201. SCOPE

The scope of this section of the document is to describe engineering studies and maps which should be used to determine the extent and type of drainage problems existing in a municipality. The purpose of the study is to recommend solutions to the problems if stormwater flow does not increase in the future. Further recommendations are made in later sections of this Document which have the goal of assuring that there will be no increase in stormwater flow in the future.

202. INVENTORY OF DRAINAGE STRUCTURES AND WATERWAYS

202.1 General

The first step in determining the extent of existing problems is the development of an inventory of existing drainage structures and waterways. This inventory is necessary to calculate the capacity of these facilities. The inventory should include all structures which transmit or detain stormwater within the jurisdiction of the municipality but may eliminate smaller drainage structures, such as those less than 18 inches in diameter, if they are not downstream from larger structures or known to cause problems. This will minimize the extensive field work required to survey many driveway culverts which are small but still oversized or do not carry the quantity of water which might cause damage.

202.2 Culverts

The inventory must include the following characteristics of culverts in order to calculate capacities:

Size: the inside diameter or height and width

Shape: normally circular, oval, square or rectangular

Material: the material affects the friction loss

Condition: the condition affects the friction loss

Slope: the slope affects the capacity if the structure is outlet controlled

Length: the length controls the total friction and the slope

Inlet Type: The inlet type affects the capacity if the structure is inlet controlled. This includes whether the pipe is projecting or mitered, whether a bell or spigot end exists, and what type of head wall exists.

Inlet Conditions: The potential inlet headwater affects the capacity if the structure is inlet controlled. The potential headwater will be determined by the level at which the water will overflow the drainage structure or spread out over a large floodway so as not to increase slightly.

Outlet Conditions: The potential tailwater may affect the capacity of the culvert if the structure is outlet controlled. The tailwater for a given flow is determined by the capacity of the downstream waterway and the depth of water at that capacity.

202.3 Bridges

The inventory of bridges in the system should include all characteristics listed above for culverts with the addition of the number of bays and type of columns, walls, etc. in the floodway. notes should be made if debris regularly catches at the bridge entrance. The Rational Method and Mannings Formula which are recommended in the Local Government Public Works Standards and Specifications are not usually adequate for computing capacities of bridges. If there are drainage problems caused by bridges, it is recommended that another method such as the HEC II computer analysis be used. If no problems exist at bridge locations, these structures need not be included in the inventory.

202.4 Waterways

The capacity of ditches, streams and rivers is determined by their cross section, slope, roughness coefficient and configuration. Waterways can change in capacity radically with time due to vegetation and erosion during storms due to debris. For this reason, it is recommended that water way inventory be limited to the conditions immediately upstream and downstream from drainage structures which will affect the capacity as explained above. In order to minimze field expense, it is recommended that further information be obtained only for waterways known to cause drainage problems.

To determine the headwater and tailwater conditions, the waterway should be measured for depth, width and side slope as a minimum.

203 DRAINAGE MAP

203.1 General

In order to maintain a permanent record of drainage structure and waterway location, it is recommended that a map be drawn and periodically updated for additions and changes. The map should be of a scale that is large enough to be readable and small enough to be easily handled. It should shown all roads, drainageways, lakes, drainage structures, and landmarks. The Tennessee State Board of Equalization publishes 1" = 400' maps for rural areas and 1" = 100' maps for urban areas for much of the state. Reproducibles of these maps can be used for a base to add the culverts. Certain areas may need to be blown up for clarity.

203.2 Size

The drainage map should indicate the size of each structure for easy reference.

203.3 Numbering System

It is suggested that each culvert on the map be described with its size and an ID number. The ID number could consist of a drainage area number before a decimal and a culvert number after the decimal. This nomenclature would allow the computerization of the culvert capacity calculations if the culverts are numbered in each drainage area from upstream to downstream. In this way, the flows can be accumulated as explained in Section 204. The ID numbers should be cross-referenced to an alphabetized list for easy access.

204. TABLE OF DRAINAGE STRUCTURE CAPACITIES

204.1 General

A table of drainage structure capacities should be developed to list all structures in descending order in drainage basins. The table should include structure characteristics, capacity and the stormwater projected to occur at the structure.

In order to allow periodic updating of the system, the table should be designed so that new culverts can be inserted into or added to the list. The necessary computations and flexibility make computerization of the table mandatory.

204.2 Existing Capacity

The information described above in Section 202 will allow the calculation of the existing culvert capacity. The capacities for both inlet and outlet control should be computed and the higher value used. As explained above, Mannings Formula is recommended for use in the Public Works Standards.

204.3 Existing Flow for Various Storm Frequencies

As explained in Section 202, the Rational Method of computing existing flow is recommended. The limitations of this method must be understood, especially when applied to larger drainage areas. Comparisons between the Rational Method and other methods of estimating flow have shown that the Ra tional Method normally predicts higher flows and is, therefore, conservative when used to size culverts. Because of the potential judgment errors in volved in selecting C factors, or comparable factors in other methods such as Curve Numbers, the more conservative approach is recommended.

The storm frequency is the interval of storm return predicted from historic records. The greater the frequency the greater the flow and the larger the required drainage structure. Many municipalities will use a 10 year design storm frequency but check the culvert for a 100 year frequency to determine if the extra cost is justified. In many cases, the extra cost of accommodating a 100 year storm would be greater than the damage caused by the storm when the probability of occurrence is considered. The runoff or C factors used should be carefully weighted to eliminate the subjectivity in volved in selecting average values.

In order to accumulate flows automatically when using the Rational Method, each drainage structure should be computed independently with its own rainfall intensity. If the flows are accumulated directly, they will be conservatively high since higher rainfall intensities will be assumed for the upstream flow than actually occur. Some designers will still accumulate flows in smaller systems in order to be conservative and to simplify calculations. A justification for this practice is that it eliminates the problems of downstream flows being smaller than upstream flows which occurs many times when accumulating the Rational Method calculations properly due to the lack of a routing procedure.

204.4 Flow for Future Developed Conditions

As recommended above, one purpose of a drainage management plan is to prohibit future increases in runoff. This is not always possible without prohibitive expense; therefore, the future effect of additional runoff should be considered by checking higher C values in areas of potential development. The future developed conditions should be estimated for saturation development based on present or proposed zoning.

204.5 Drainage Structures Needed for Various Flow Conditions

Mannings Formula can be used to determine the proper culvert size to contain the projected flow for various storm frequencies and developed conditions. These sizes can be calculated for replacement structures or for structures added parallel to the existing structure. A computerized table can quickly examine these alternatives.

204.6 Flexibility to Add New Structures

The table should be designed as explained above so that it can be up dated periodically with the addition of new culverts. Any proposed new drainage structures should be sized by the program.

204.7 Flexibility to Determine Downstream Effect Caused by Changing Development

The runoff from proposed developments can be checked with the program by changing the C factor. This will automatically indicate the effect of the increased flow on all drainage structures downstream from the proposed development.

205. PUBLIC PARTICIPATION

205.1 General

During the preparation of the Inventory of Drainage Structures and waterways as described in Section 201, it is recommended that the municipality publicize and hold a public hearing to receive comments on the drainage system.

205.2 Publicity

It is important that a request for comments and a public hearing be adequately publicized. It is suggested that newspapers, radio and television be used for this publicity. The population should be informed that both written and oral comments will be received and that the comments should include a description of the problem, damage caused by the problem and if possible, suggested solutions to the problem.

205.3 Meetings

Public meeting can be an invaluable source of information for the Stormwater Management Plan or can be a source of confusion and conflict, depending on their administration. The meeting should be chaired by a city official who will explain the rules of the hearing. The comments should be preceeded by an explanation of the Study, progress and its time of anticipated completion. It is suggested that the floor not be opened for questions at this time. If possible, the meeting should take place before or during the Inventory of Drainage Structures and Waterways.

The goal of public meetings is to solicit information about drainage problems and to give each citizen an opportunity to vocalize complaints. This opportunity should minimize the possibility of overlooking problems.

205.4 Oral and Written Comments

Strict rules must be set, explained and enforced by city officials to set the order of comments and restrict the length of comments. Each commentor should state their name, address and assigned comment number and locate their home on a map posted in the hearing room with a pin and comment number. The meeting should be recorded and commentors should be encouraged to follow up the oral comment with a written comment and map.

It is recommended that written comments be allowed up to two weeks after the meeting.

All effort should be made to assure that all citizens have an opportunity to express themselves, regardless of their communicative skills. This may involve city representatives communicating for some citizens.

206. EXISTING DRAINAGE PROBLEMS

206.1 General

With adequate notice and meetings, the municipality should accumulate a list of drainage problem points which should be addressed. In addition to the public meetings, sources will include records of previous problems or complaints, comments to the field crew during the inventory phase and com ments from pubic works officials.

206.2 Location

It is recommended that an alphabetized list of all legitimate complaints be published as part of the Stormwater Management Plan.

206.3 Description

Each compliant should be described by name, address, nearest drainage structure by ID number, and nature of the problem.

206.4 Solution

It is recommended that an engineer visit each problem site and publish a solution to the problem in the Stormwater Management Plan. This record will allow the complaintant to see that his problem has been addressed and provide an incentive to the municipality to solve the problem.

207. CAPITAL IMPROVEMENTS

207.1 General

In order to solve existing stormwater problems, it is recommended that a short term prioritization of the problems described in Section 206 be developed. Depending on budget considerations, the capital improvements to eliminate these problems should be completed in about five years.

207.2 Prioritization

A municipality should establish and publish a priority order to solve drainage problems. This order should be announced in the publicity for the public meeting so that complaintants can address their problem with respect to priority levels. The problem ranked top priority would be solved in the first years will lower priority items solved during the later years.

It is suggested that a priority order similar to the following be established:

1. Problems historically resulting in loss of life or jobs.
2. Problems historically resulting in monetary damage to public or private property.
3. Problems potentially resulting in loss of life, jobs or monetary damage.
4. Problems which have caused street closures.
5. Problems which have caused property flooding.
6. Nuisance flooding.

In certain cases, prioritization must be shifted or reversed in order to solve downstream problems caused by upstream corrections or to more efficiently complete all work in a localized area before moving on. In addition, during the solving of one problem, another may surface. For these reasons it is recommended that the priority list have a certain amount of flexibility.

207.3 Location

It is recommended that the priority list include a description of the problem location by address and nearest drainage structure by ID number.

207.4 Description

A brief description of the recommended improvement should be given including size of structure or length of ditch.

207.5 Cost Estimate

Each prioritized item should include a cost estimate for the survey or design of the project and the construction.

207.6 Annual Budgets

The total list of priorities should be divided into years based on a budgeted annual amount.

207.7 Implementation

Upon approval by the municipality of the improvement program and perhaps a period of public comment, the program should be adopted and funded. It is suggested that no item be completed outside of its adopted priority without specific approval by the governing body unless minor priority adjustments are required under the conditions described in paragraph 207.2. The adoption of the selected program could vary from a verbatim adoption of all of the recommended regulations and priorities, to an adoption of the principals to be implemented by the municipality staff.

All of the effort put into developing a Stormwater Management Plan is wasted unless the municipality is willing to implement the complete program. Once all the existing problems are solved, stormwater problems should be

minimized if maintenance is performed and future drainage is regulated. Stormwater management is also aided by regulations which allow a drainage approval process for subdivisions as described in Section 400.

If the capital improvements are extensive, a part or full time crew and equipment may need to be delegated to this work. Most improvements will involve culvert replacement, ditch reshaping and stream maintenance.

207.8 Funding

Funding for stormwater improvements and maintenance has normally been provided out of annual public works operating budgets or bond issues. Several municipalities around the country have used additional methods such as property frontage or acreage assessments, drainage fees for new development, and permit fees for new construction. Other innovative ideas for funding drainage improvements are runoff changes per cubic feet per second and changes per acre which vary based on zoning or development type. Drainge funding should be carried in a separate set of books in order to preserve it for its intended use.

SECTION 300
POTENTIAL LEGAL PROBLEMS AND POSSIBLE SOLUTIONS

301. SCOPE

Common, Statutory and Case Law all address the liability of a municipality concerning stormwater. This section includes questions which have arisen concerning this liability. The answers are supplied by Mr. Eugene Puett, consultant to the Municipal Technical Advisory Service in municipal law. Following this series of questions and answers is a discussion of potential legal problems and solutions.

302. THE LAW

302.1 If the city adopts a stormwater management plan or ordinance, does this increase or reduce their liability?

To determine whether a drain or sewer is necessary, and its location and general plan, is the exercise of a legislative function; and a city is not responsible in a private action for its failure to exercise its discretion in establishing one. Chattanooga v. Reid, 103 Tenn. 616, 53, S.W. 937; Dixon v. City of Nashville; 29 Tenn. App. 282, 203 S.W. 2d 178 (1946). But it will be liable if, after they are established, the city authorizes or with knowledge permits them to be so negligently constructed or operated by it agents as to become a nuisance detrimental to health or property. Knoxville v. Glasing, 111 Tenn. 134, 76 S.W. 814; Dixon v. City of Nashville; 59 A.L.R.2d 288. The fact that the drainage plans were adopted by the city engineer cannot relieve the city of liability for creating and maintaining a nuisance. Dixon v. City of Nashville.

It should be kept in mind, however, that it is only broad planning decisions, such as whether to build a sewer system, the extent of the system and the amount of be spent therein, for which the municipality is immune. Once the municipality determines to construct the sewer, it enters upon an undertaking which, in all its details, requires the use of care, for the work is then ministerial. McQuillin on Municipal Corporations, 3rd Ed. Rev. 53.121.

Immunity from suite of governmental entities is removed for injury proximately caused by a negligent act or omission of any employee within the scope of his employment except if the injury arises out of the exercise or the failure to exercise or perform a discretionary function, whether or not the discretion is abused. T.C.A. 29-20-205(1).

The "discretionary function" exception is similar to provisions in Federal Tort Claims Act. The discretionary function exemption in that Act has been construed to apply only in cases where government officials were acting at the policy making level or where exercising powers of a policy nature, and not in cases where government officials were operating under mandatory statutes or regulations which they had a legal duty to observe and implement. Donohue v. United States (1977, D.C. Mich.) 437 F. Supp. 836. Existence of discretionary function for governmental liability under the Federal Tort Claims Act ultimately rests on characterization of challenged behavior as "policy" or "operations"; relevant considerations include whether the nature of judgment exercised called for policy considerations and where act complained of is the result of judgment or decision that government official be free to make without fear of vexatious or fictitious suits and alleged personal liability. Ench v. United States (1980, CA7 Wis.) 630 F2d 525.

Although rainfall is extraordinary, if it is such as has occasionally occurred in the past and should reasonably be expected to occur in the future, a municipality will be liable for overflow caused by inadequacy in the planning of sewers of a size sufficient to prevent damage to private property. 57 Am. Jur. 2d, Municipal Etc. Tort Liability, 187.

302.2 What is the definition of natural waterways?

A great variety of terms such as "depression," "drainway," "channel," "watercourse," "waterway," "swale," "draw," "gulch," "ravine," "ditch," etc. have been employed in describing natural ways or means for the drainage of surface water, or the course of such drainage, and there is considerable variance in the rules which obtain in different jurisdictions as to the kind and physical characteristics of such ways, means or courses.

The view taken by some authorities is that if the conformation of the land is such as to give to the surface water flowing from one tract to the other a fixed and determinate course, so as to discharge it uniformly on the servant tract as a fixed and determinate point, the course thus uniformly followed by the water in its flow is a watercourse within the meaning of the rules applicable to the drainage of surface water. According to some decisions it does not seem important that the force of the water flowing from one tract to the other has been sufficient to create a channel or a canal having definite and well marked sides or banks. Others, however, hold that there must be a distinct channel, the bed of a stream, with well-defined banks, cut through the turf and into the soil by the flowing water, presenting on a casual glance the evidences of the frequent running of water, and not a mere depression. 78 Am. Jur. Waters, 135. Several jurisdictions have broad

definitions of water courses which include almost any definable channel. Water and Water Rights, the Allen Smith Company, Publishers, Indianapolis, Ind., (1972).

302.3 What is the definition of a drainage ditch?

The word "ditch" has no technical or exact meaning, but is mostly used to designate a trench on the surface of the ground. It has been defined or employed as meaning a hollow or open space in the ground, natural or artificial, open or covered; also a right-of-way for the passage of water. 277 C.J.S., p. 828.

302.4 Does a city have the legal responsibility for storm water which runs from one piece of private property to another?

The construction of sewers and drains involves the exercise of discretionary powers and a municipality is not bound to construct. 56 Am. Jur. 2d, Municipal Corporation, 571; Horton v. Nashville, 72 Tenn. 39 (1879); Miller v. Brentwood, Tenn. App., 548 SW2d 878 (1977). The mere fact that a nuisance exists and has occasioned an injury to a third person, does not render a city liable therefore, provided the nuisance was not created or maintained the city itself. Chattanooga v. Reid, 103 Tenn. 616, 53 S.W. 937 (1899), Miller v. Brentwood.

The plaintiffs in Miller v. Brentwood were homeowners in a subdivision. A drainage ditch passed through their properties which were in a lower portion of the subdivision. They sued the city alleging that by granting building permits for construction which reduced the absorption of rainfall into the earth, the city had authorized and permitted an increase in the runoff and rainfall which overtaxed the drainage ditch thereby causing flooding of their properties.

The lower court found that the city caused the increased flooding and created an actionable nuisance and (1) enjoined the city from authorizing or issuing any further building permits for projects which would direct in creased storm water into the easements flowing past or though plaintiff's lots and (2) ordered the city to prepare and file with the court a uniform plan to render the city's water drainage adequate so as to abate the nuisance.

The Court of Appeals, Middle Section, reversed the lower court and dismissed the suite. Miller v. Brentwood, 548 S.W.2d 818 (1977). Cert. denied by S. Ct. Tenn. March 18, 1977. The court held that there was no liability of the city for damages or injunctive process.

No right of action is recognized against a municipality for issuing a permit for construction in accordance with existing laws and regulations. Correspondingly, there is no authority for the courts to enjoin the issuance of a permit, otherwise lawful, for the reason that its use might result in a private injury.

There were other reasons why the court thought enjoining the city from issuing building permits inappropriate. The watershed which drained into the drainage ditch was not entirely within the city limits. Other construc tion outside the city contributed to the runoff, and it would be inap propriate to restrain the city from allowing construction within the city and leave the remainder of the watershed free to develop.

Also, to enjoin the city from issuing permit for construction would have the effect of transferring the plaintiff's subservient status. Under the civil law rule of surface water the upper land has an easement for drainage in its natural flow over lower lands.

The court also held that there is no authority for compelling a city to construct an artificial drainage sewer.

In the Brentwood case, there was not interference with drainage, except that construction may have increased runoff.

302.5 Does a city have legal responsibility for storm water which runs from public property across private property?

The rule that one person cannot change the course of drainage and cast upon the land of another water which naturally would not have flowed there applies equally to municipal corporations, so that a municipal corporation incurs the same liability as an individual when it damages the land of another person by casting thereon water which would not have flowed there naturally, either by changing the course of drainage, by causing surface water to accumulate and flow onto the land of another person in greater quantities than would have flowed there, or by collecting surface water into artificial channels in such quantities that it overflows onto adjoining property. 57 Am. Jur. 2d Municipal Etc. Tort Liability 237; Dixon v. City of Nashville, 29 Tenn. App. 282, 203, S.W. 2d 178 (1946); Butts v. City of South Fulton Ct. App. Tenn., 565 S.W. 2D 879 (1978); City of Sweetwater v. Pate., Ch. App. Tenn., 59 S.W. 480 (1900); Kind v. Johnson City, 63 Tenn. App. 666, 478 S.W. 2d 63 (1970)

302.6 What are the legal problems involved in a large development rerouting ditches into other drainage area?

The right to accumulate and discharge surface water into a natural watercourse is subject to the limitation that an owner of property may not drain into a stream surface waters which otherwise would not flow in that direction. 78 Am. Jur. Waters, 133.

A landowner cannot divert into a watercourse diffused surface waters from an area that would not naturally have drained into the watercourse. Water and Water Rights, The Allen Smith Company, Publishers, Indianapolis, Ind. (1972).

302.7 What are the problems involved in combining several natural waterways into one or, conversely, splitting one natural waterway into several?

A natural drainway must be kept open to carry water into streams, and as against the rights of the upper proprietor, the lower proprietor cannot obstruct surface water when it has found its way and is running in a natural drainage channel or depression. It is the duty of a lower landowner who builds a structure across a natural drainway to provide for the natural passage through such obstruction of all the water which may be reasonably anticipated to drain therein, and this is a continuing duty. 78 Am Jur. 2d Waters, 134.

A landowner has an easement of flow for drainage of surface waters in its natural flow over the lower land of a neighboring owner and if the latter places an obstruction of any character upon his land that arrests this drainage and thereby causes injury to the form, an action lies for damages. Tally v. Baker, 3 Tenn. Appl. 321 (1926).

The right to accumulate and discharge surface water into a natural watercourse is subject to the general limitation that it be done in the reasonable use of land, and according to the generally accepted view, it would seem that where, by means of ditches or drains, so much water is thrown into a stream as to fill it beyond its natural capacity, and to cause

it to flood and overflow the lands of a lower proprietor, the upper proprietor, for so doing, is liable for the resulting damage. 78 Am Jur. 2d Waters, 133.

Problems in combining: natural watercourses must be kept open to accept water from upper land. Combined watercourse may fill watercourse on lower land beyond its natural capacity causing it to flood and overflow lower lands.

Problems with splitting: discharging water in concentrated form and unnatural quantities at points on the lower land where there is no natural watercourses.

The owner of higher lands is liable when he collects the water and pours it in a concentrated for or unnatural quantities upon the lower lands. Louisville N.R. Co. v. Hays, 79 Tenn. 382 (1883); Dixon v. City of Nashville, 29 Tenn. App. 282, 203 S.W.2d 178 (1946).

If the waterway is a natural stream, there is a problem of riparian rights. Riparian owners have the right to have the stream flow in its natural course and volume or to have the body of water remain in its natural conditions. 78 Am Jur. 2d Waters 765.

The owner of land, across or over which a stream flows, has a right to have it flow over his land in its natural channels, without unreasonable detention, undiminished in quantity, and unimpaired in quality, except so far as it is inseparable from a reasonable use of the water of the stream for the ordinary and useful purposes of life by those above him on the stream. Cox v. Howell, 108 Tenn. 130, 65 S.W. 868 (1901).

The sink hole case, Slatten v. Mitchell, involved the right of the owner of higher land to build a wall along the line between his property and a public highway to keep surface water off his land and force it to flow on

down the highway ditch upon the land below. It was found that the owners of still higher lands had constructed lateral ditches to drain surface water into the ditch along the highway thus preventing the natural diffusion and absorption of water into the soil above defendant's lands. It was held that the defendent's lands were burdened only with surface water which reached it under natural conditions and that the defendent had a right to build a wall along the highway with an opening of such size as would permit only the normal mount of surface water to enter upon his lands. The effect of that holding is that the construction of lateral ditches which altered the course of natural drainage, preventing or slowing absorption of water into the soil and hastening and concentrating its flow, placed an undue burden on defendant's land which he was warranted in removing by construction of the wall.

In the Slatten v. Mitchell case surface water which would have been absorbed to some degree or diffused, or some of which may not have reached the land and sink hole, was diverted by the lateral ditches into the road side ditch and was concentrated in unnatural quantities on the land of the farmer.

302.8 How can the city enforce maintenance of drainage culverts on private property?

For an injury growing out of an obstruction of a natural drainage, a mandatory injunction is proper because successive suits for damages would not furnish an adequate remedy. Wilson v. Louisville & N.R. Co., 12 Tenn. App. 327. If city property is flooded as result of obstruction of natural drainage course, injunction.

A landowner has an easement for drainage for surface water in its natural flow over the land of a lower owner. Carland v. Aurin, 103 Tenn. 555, 53 S.W. 940 (1899).

302.9 Who is liable if an owner puts leaves in a ditch for the city to pick up and the leaves stop up a culvert and a child is drowned?

Immunity from suit of governmental entities is removed for any injury caused by a defective, unsafe, or dangerous condition of any street, alley, sidewalk or highway, owned and controlled by such governmental entitity. T.C.A. 29-20-203(a). Does not apply unless constructive and/or actual notice to governmental entity of such condition be alleged and proved. T.C.A. 29-20-203(b).

Immunity from suit of a governmental entity is removed for any injury caused by the dangerous or defective condition of any public building, structure, dam, reservoir or other public improvement owned and controlled by such governmental entity. T.C.A. 29-20-204. Does not apply unless con structive and/or actual notice to governmental entity of such condition be alleged and proved. T.C.A. 29-20-204(b).

Immunity from suit of all governmental entities is removed for injury proximately caused by a negligent act or omission of any employee within the scope of his employment (exceptions, but failure to keep drain free from obstruction not one.) T.C.A. 29-20-205.

The duty of maintaining sewers and drains in good repair includes the obligation to keep them free from obstructions, and a municipality failing to do so is liable to any person injured by such negligence. 59 A.L.R.2d 281, 5. It is the duty of a municipality to remove an obstruction in a drain or sewer within a reasonable time after actual or constructive notice thereofe, and its failure to do so renders it liable to one injured thereby. 59 A.L.R.2d 281, 6.

A municipality has been held liable for obstructions in its drains or sewers by third persons, of which it had notice. 59 A.L.R.2d 281 17.

302.10 Would a retention basin filled with water during a storm be classified as an attractive nuisance with an inherent liability?

The elements of attractive nuisance:

(a) the place where the condition exists is one upon which the possessor knows or has reason to know that children are likely to pass, and

(b) the condition is one which the possessor knows or has reason to know and which he realizes or should realize will involve an unreasonable risk of death or serious bodily harm to such children, and

(c) The children because of their youth do not discover the condition or realize the risk involved in intermeddling with or coming within the area made dangerous by it, and

(d) the utility to the possessor of maintaining the condition and the burden of eliminating the danger are slight as compared with the risks to children involved, and

(e) the possessor fails to exercise reasonable care to eliminate the danger or otherwise to protect the children. Metropolitan Govt. of Nashvillee v. Counts, 541 S.W. 2d 133 (Tenn., 1976).

Whether a retention basin filled with water during a stream would be an attractive nuisance would depend on a showing of those elements.

The Tennessee cases have consistently applied the rule that absent evidence of an unusual or hidden danger - a danger other than that incident to all bodies of water - a landowner will not be held liable for the death of a trespassing child by drowning in a pond or other body of water maintained on his premises. Metropolitan Govt. of Nashville v. Counts.

It is well established that the attractive nuisance doctrine does not apply to situations in which the condition causing the harm is one involving a common and obvious danger. Pardue v. City of Sweetwater, 54 Tenn. App. 286, 390 S.W. 2d 673 (1965); Ray v. Hutchison, 17 Tenn. App. 477, 68 S.W. 2d 948 (1933).

In the Metro case the court compared the utility of maintaining the condition, and the burden of eliminating any danger, with the risk of harm to trespassing children. In that case the condition was a pond serving the useful function of watering livestock. The court took the view that the risk of drowning in the pond was slight, there being no unusual or hidden danger present, that it would be an unreasonable burden to require the main tenance of a full-time guard or the erection of a fence which would effec tively prevent the trespass of children.

302.11 Does the city have any recourse against a railroad because of the cost involved in cleaning trash and debris which collects on supports for bridges under railroads, and does the city have a legal recourse against the railroad in the case of inadequately sized culverts under railroads which cause ponding conditions?

The power of municipal corporations with respect to nuisances generally extends to nuisances arising from the use, action or presence of water. It has been held that a municipality, acting by virtue of its public power, when necessary to protect the public health, may, at the expense of the owner of the land, fill or require to be filled, depressions in which surface water stagnates. It has been held, however, that if a pond of water accumulates on land, from natural causes, in such quantities that in the process of evaporation, noxious and deleterious gases are emitted, injurious to the public health and to the health of persons residing in the vicinity, the owner cannot

be held answerable for creating or maintaining a nuisance, nor be compelled to abate the pond as such, when he has not, by his own act or negligence, contributed to bring about the condition complained of. 78 Am Jur. 2d, Waters, 374.

The public authorities may summarily enter upon real estate and remedy conditions which endanger the public health, and may require the owner of the property to pay the expenses thus incurred. 58 Am. Jur. 2d, Nuisances, 207.

If because of inadequately sized culverts municipal property is flooded the railroad would be liable.

It is the duty of a railroad in providing a culvert to carry off surface water to provide a passage large enough to carry off the greatest amount that may be expected in extraordinary rainfall. Tennessee Cent. Ry. v. Askew, 11 Tenn. App. 406 (1930).

Although land may be subject to the servitude of receiving the waters that flow naturally on, to, or through it from an adjoining estate above, it has been held that the owner of the latter estate has no right to enter at will upon the land for the purpose of cleaning out or removing obstructions in order to enjoy the servitude, but it is only entitled to ask the owner to remove the obstructions, and upon his failure to do so, may compel such action by legal process. 78 Am. Jur. 2d, Waters, 140.

302.12 If a culvert across private property which carries water from other properties has been undersized by the property owner, who should pay for the upsizing?

It is the duty of railroad companies to provide culverts or other means for the safe passage of accumulated water, and they are liable in

damages for injuries to adjacent lands by overflow or back-water, caused by their failure or neglect to perform this duty. They must provide against the recurrence of unusual and extraordinary accumulations which have once happened, and are conclusively presumed to know the habits of streams ad jacent to the tracts. Carriger v. Railroad Company, 75 Tenn. 378 (1881); Tennessee Central R. Co. Askew, 11 Tenn. App. 406C (1930); Davis v. Louisville & N.R. Co., 147 Tenn., 1, 244 S.W. 483 (1922). Although the plantiff may own the ultimate fee, the railroad has a duty to keep the ditches open to take care of natural drainage, and the fact that the plaintiff did not go on the right-of-way and himself open the ditch or did not dig one on his land in lieu of the one on the right-of-way, is not a bar of his right to recover damages from overflow sustained by him because of the railroad's failure to keep the drainage ditch open. C.N.O. & T.P. Ry. Co. v. Moon, 2 Tenn. App. 477 (1926). The duty of maintaining a railroad in such manner as not to obstruct natural drainage is a continuing duty. Wilson v. Louisville & N.R. Co., 12 Tenn. App. 329 (1930).

It is the duty of a railroad in providing a culvert to carry off surface water and provide a passage large enough to carry off the greatest amount that may be expected in extraordinary rainfall. Tennessee Cent. Ry. v. Askew.

The same rule applies to other property owners and municipalities. Although rainfall is extraordinary, if it is such as has occasionally occurred in the past and should reasonably be expected to occur in the future, a municipality will be liable for overflow caused by inadequacy in the plan ning of sewers of a size sufficient to prevent damage to private property. 57 Am. Jur. 2d, Municipal Etc. Tort Liability, 187.

302.13 Should a city request easements for all ditches and culverts on private property and condemn if the easements are not given?

Providing drains is discretionary and a municipality is not bound to provide drains. (See 302.4)

302.14 If the city replaces a culvert at its expense on private property, does the culvert become city property, therefore causing maintenance liability and obligation?

A municipality has occasionally been held liable for damages due to the obstruction of a drain or sewer, even when such drain or sewer has been constructed upon private property. 59 A.L.R.2d 314.

Ordinarily the city is only liable for the clogging or obstruction of the drains and sewers maintained by it or over which it has control, with the result that it is not liable for the clogging of a drain or sewer maintained and controlled by a private property owner. 59 A.L.R. 2d 314.

It would appear that before the city could be liable it would have to be shown that the city adopted the drain for drainage purposes and assumed control over it.

302.15 Is the city legally liable for permitting a shopping center or other development to install certain drainage facilities if it is proven that these facilities are inadequate and cause downstream damage?

The Governmental Tort Liability Act provides that "Except as may be otherwise provided in [The Act] all governmental entities shall be immune from suit for any injury which may result from the activities of said governmental

entities wherein said governmental entities are engaged in the exercise and discharge of any of their functions, governmental or proprietary." T.C.A. 29-20-201. Immunity from suit is removed for injury approximately caused by a negligent act or omission of any employee within the scope of his employment except if the injury arises out of the issuance, denial, suspension or revocation of, or by the failure or refusal to issue, deny, suspend or revoke, any permit license, certificate, approval, order or similar authorization. T.C.A. 29-20-205(3).

Immunity from suit not removed where planning commission approved sub division plat waiving its rock grading and compacting regulations. Foley v. Hamilton, (Tenn. 1983) 569 S.W.2d 356.

302.16 What is the precedent of the law concerning drainage going into sink holes and stopping up sink holes?

In Slatten v. Mitchell, water flowing down a roadside ditch overflowed and ran into sink holes on a farmer's land. It was contended that the sinks were natural means of disposing of the water, but it was not so held by the court. Apparently the sink holes were where the land had sunk, and when filled, the farmer's land was flooded. Apparently, they were no underground streams which could be considered an underground watercourse.

In a railroad case, Carriger v. Railroad Company, 75 Tenn. 388 (1881), the railroad built an embankment which caused surface water to overflow land. Before the embankment was built, water went into sink holes which were adequate to take care of the surface water. After the embankment was built, the water flowed onto the land because there was no culvert. The sink holes were filled and the land was flooded.

302.17 Does a city have the right to set and require floor elevations for building in flood prone areas but not in flood ways or flood way zoning?

To be valid, a building regulation must be reasonable and not arbitrary, and it must have a tendency to promote the public health, safety, morals, or general welfare. 13 Am. Jur. 2d, Buildings, 2.

302.18 Should the city in its roadway requirements provide for the passage of cars during a rainfall in an unflooded portion of the street?

The duty of the public authority to exercise ordinary care to keep its highways and streets reasonably safe for travelers does not require the public authority to guard the traveling public from such normal hazards as ordinary puddles of water in the way, but where the accumulation of water is so wide or deep as to constitute a real danger not reasonably to be anticipated by users of the way, the public authority has the duty to eliminate the hazard or to warn the public of its presence or barricade the way. 39 Am. Jur. Highways, Streets and Bridges, 461. 61A.L.R.2d 427. Owens v. Seattle, 49 Wash. 2d187, 299 P2d 560; Smith v. Commonwealth, Department of Highways (Ky.) 468 SW2d 790; Ehlinger v. State (Iowa) 237 N.W.2d 734; Hass v. Firestone Tire & Rubber Co. (1976 Okla) 563 P2d 620; Pickarski v. Clark Overlook Estates, Inc. (1980 Pa Super) 421 Azd 1198; State v. William (1981 Ind. App.) 423 NE2d668; Bush v. State, (198 La. App.) 395 Ao.2d 916; Brown v. Brown (1981) 86 NJ, 565, 430A2d 493.

302.19 Outline the control of the city outside of the city limits; for instance, the five mile planning commission control.

In the event the state planning office establishes a planning region composed of a single municipality together with territory adjoining but outside of such municipality, no part of which is more than 5 miles beyond the limits of such municipality, it may designate the planning commission of the municipality as the regional planning commission, and when so designated the municipal planning commission when acting as a regional commission for such region, shall have all the powers and be governed by the provisions in Chapter 3, Title 13, T.C.A. or other statutory provisions relating to regional planning commissions. T.C.A. 13-3-102. The regional planning commission shall adopt regulations governing the subdivision of land within its jurisdiction. Such regulations may provide for the production of adequate drainage facilities. T.C.A. 13-3-403.

303. POTENTIAL PROBLEMS

303.1 Municipal Experiences

The following is a list of actual experiences of municipalities in Tennessee which should be used as typical examples to anticipate and avoid with regulations and standard practices.

301.1.1 The most common problem is undersized or plugged culverts. A municipality should set a minimum size for culverts. The Public Works Standards recommends 18 inches in diameter except under driveways where 15 inches should be a minimum. The lack of adequate headwalls on a culvert allows dirt to wash into the culvert and does not protect the ends of a culvert from being bent or broken. It is recommended that all culverts include headwalls on each end.

303.1.2 The second most common problem is ditches and streams stopped up with debris and undergrowth.

303.1.3 A restriction in a major drainage area in the form of a box culvert installed by a private owner under a building which caused upstream flooding on other properties.

303.1.4 A practice by a municipality of allowing homeowners to put leaves in roadside ditches in front of their home to be picked up by mulching crews. Culverts became clogged when rainfall occurred before the leaves were picked up.

303.1.5 Apartment construction runoff overloading the downstream drainage system. Runoff from the apartment complex also discharged directly onto a city street in large quantities.

303.1.6 Adequately sized box culverts which restrict flow during storms due to debris collecting on the walls between bays.

303.1.7 Roadside ditches that fill with sediment causing upstream flooding or overtop causing flooding of a lower adjacent property.

303.1.8 Private homeowners installing an undersized culvert across private property which causes upstream flooding.

303.1.9 Large ditches eroding and damaging adjacent yards or houses.

303.1.10 Fences or sewer services installed across ditches or streams which restrict flow causing flooding.

303.1.11 Curbed streets without subsurface storm drains which will not adequately carry stormflow.

303.1.12 Ditches with inadequate grades cause ponding and swampy areas.

303.1.13 Sink holes have been filled which eliminates former drainage passages causing flooding.

303.1.14 Parking in urban areas in front of houses will cause a ditch to be filled in and cause flooding.

303.1.15 Culverts have been installed too high to drain an area.

303.1.16 A house flooded during storms and the owner sued the city for damages. The flooding was caused by inadequate ditches.

303.1.17 Culverts have been installed of sufficient size but not deep enough so that in order to make use of the upper portion of the culvert, upstream property would flood.

303.2 Potential Administrative Problems

Stormwater complaints monopolize the time of city officials especially after a rainfall. Historically most municipalities have followed a policy of solving drainage problems only when complaints arise. If the recommendations contained in this document are used as a basis to implement a comprehensive stormwater management plan, these complaints should be minimized and improvements can be budgeted annually. Even with the plan, problems will continue unless the existing problems are eliminated, the drainage sys tem is maintained periodically, and additions to the system are sized and recorded properly.

303.3 Potential Legal Problems

Lawsuits filed against municipalities are common in drainage situations. Even though, as explained in Section 302, the municipality is not usually held liable in court, the time and expense of defending the suits is considerable. Readers are referred to paragraph 302.1 as to potential liability from adopting a stormwater management plan. In a properly conceived and executed stormwater

management plan, when past complaints are addressed and solved on a schedule, and no additional flow is allowed, legal problems and liability should be minimized.

SECTION 400
REGULATIONS

401. SCOPE

The most effective method of limiting future runoff to present levels is stormwater regulation. This section will recommend regulations designed to preserve present storm conditions once existing problems are corrected.

402. DRAINAGE EASEMENTS

402.1 General

It is recommended that all drainageways which carry water from one piece of property to downstream property have drainage easements the width of the improved channel plus 10 feet on both sides. No drainage easement, regardless of the conduit, shall be less than 20 feet in width.

402.2 Acquisition

Even though a municipality is not bound to provide storm sewerage (see Section 302), the provision and maintenance of storm sewers is a public service that will minimize time consuming complaints.

Tennessee law provides a quick procedure for condemning property for easements for the public good. Appraisals are required and payment is based on these appraisals. This provision is explained under TCA 29-17-803.

403.3 Maintenance

The property owner has the responsibility of maintaining the drainage system through his property as explained in Section 302. It is suggested that specific regulations be passed to prohibit dumping trash or leaves in ditches or streams. The owner could also be required to maintain the proper cross section of the ditch or creek by removing sedimentation.

403.4 Improvements

It is recommended that regulations be passed which prohibit construction of buildings on drainage easements or obstructions across the easement and allow access to the easement for inspection.

403. PERMITS

403.1 General

A municipality has the right to permit and charge for services rendered in sizing, designing, constructing and maintaining stormwater facilities. This section outlines possible services and fees.

403.2 Driveway Connections

It is recommended that regulations require an application submittal before connecting driveways to public roads. The application should state the location of the driveway, the width of the driveway, the depth of the ditch under the driveway, and the slope of the ditch across the driveway. This information can be entered into a computer program to quickly size the culvert.

403.3 Building Permits

It is recommended that regulations be passed to restrict drainage flow rates from all industrial, commercial and multi-family developments to no more than occurred before the development was constructed.

It is further recommended that all building permits in these zoning districts be proceeded by a proposed drainage plan to be submitted for approval to the City. This plan should be stamped by an engineer licensed to do engineering in Tennessee and qualified for drainage design. The plan should show detention basins or other structures designed to accomplish the purpose expressed above and include calculations. The plan should also show the total

area of the development, the weighted runoff factor, the location of the site with respect to surrounding streets and all existing drainage structures on the site or on streets adjacent to the site. This information is needed for the computer program to determine whether drainage structures downstream will be affected.

403.4 Fees

Fees for services involved in sizing drainage structures or reviewing designs submitted by developers should be charged to the owner. The fees should be sufficient to cover the cost of administration, design or review, and field inspection. This cost could vary from as low as $25.00 for a driveway culvert to several hundred dollars for a subdivision or shopping center. It must be emphasized that field inspection, although usually omitted, is of utmost importance since it is the only method of assuring that the approved drainage facilities are installed.

A municipality may elect to design all drainage systems itself even for large developments in order to control sizing and construction more completely and to coordinate the design with the entire drainage system. In this case, the fee should be larger, perhaps based on a percentage of the construction cost.

Since the City will have a perpetual obligation for maintaining drainage structures and ditches, it is reasonable to charge an initial fee or an annual fee to cover this cost. The initial fee would have to be the present worth value of the annual maintenance cost. The annual fee could be charged for all developments fronting public streets on a front foot basis.

404. ZONING

404.1 General

It is recommended that exiting zoning ordinances be carefully reviewed to determine whether they protect floodway areas from development that would deter the flow during storms.

404.2 Floodway

It is recommended that all area within the 100 year flood boundary as determined by the National Flood Insurance Program or other reliable sources be classified as Floodway zoning. This zoning should be shown on a map. The zone should prohibit all construction, storage, parking, and any other activity that would affect stormwater flow in the floodways.

It is recommended that the zoning ordinance prohibit filling in the area unless calculations by a registered engineer show that flood levels will not be increased.

404.3 Flood Prone Areas

A flood zoning area for localized areas not included in studies should be set aside based on historical information. If construction or activities in such an area raises localized flood levels to the point that damage occurs, these areas should be included in floodway zoning.

405. SUBDIVISION REGULATIONS

405.1 General

It is recommended that existing subdivision regulations be reviewed to determine whether stormwater is controlled to permit proper review and fees and to limit increased future flow.

405.2 Easement Requirements

The Regulations should require drainage easements along all ditches or streams to be shown on subdivision plats.

405.3 Drainage Requirements

It is recommended that regulations be passed to limit future stormwater to current levels. This can be accomplished with detention basins or other methods. As a minimum this regulation should apply to commercial, industrial and multi-family zoning and could apply to all zoning.

Additionally, the Regulations should require that all ditches, culverts, and bridges be submitted to the City for approval before building permits are issued.

405.4 Drainage Structure Design

It is recommended that Subdivision Regulations adopt the Local Government Public Works Standards and Specifications as referenced in Section 104 for all drainage structure and waterway design.

405.5 Drainage Plan Review

A policy should be adopted and implemented that clearly regulates the procedure for submitting plans for review of drainage. The public works department, a committee of qualified individuals or the City's consulting engineer should be delegated to review and approve plans. The review should include the sizing, material and configuration of structures, ditches and detention basins, and the effect of these facilities on downstream structures. The computer program described above will aid in this review.

405.6 Fees

Fees can be charged for subdivision plat review to cover the cost involved. The fees should be based on acreage.

406. PLANNING AREA REGULATIONS

As explained in Section 302, the state planning office has established planning regions for many cities in Tennessee which includes the municipality and territory adjoining and within five miles of the city limits. In such cases, the City acts as a regional planning commission and can adopt regulations governing the subdivision of land in this area. It is recommended that municipalities use this authority to regulate drainage that will affect the area inside the city limits.

SECTION 500
MAINTENANCE

501. SCOPE

The suggestions contained in this Document for the correction and improvement of a drainage system will work only when the system is maintained. This section suggests maintenance procedures that can be used to assure the continued service of these facilities.

502. ROUTINE

It is recommended that all ditches, streams and drainage structures be cleaned and re-shaped on a periodic basis. Both large and small structures and waterways will normally become clogged with debris, sediment, and vegetation at least each five years to the point that flooding can occur. The frequency and severity of this clogging depends on the slope, the degree of meandering and the side slope condition of waterways and depends on upstream conditions and entrance conditions in drainage structures.

A crew should set aside sufficient time annually to inspect all structures and waterways and to clean and remove vegetation where necessary.

503. POST STORM

It is recommended that all culverts and bridges with center piers or walls be inspected routinely after each storm and cleaned if necessary. Certain box culverts may need to be added to this list if they routinely accumulate debris. Accumulated debris is a major cause of flooding and should be quickly removed, especially since many storm events follow closely on one another.

504. FUNDING AND STAFFING

In order to budget the recommended maintenance, a municipality should outline the time for routine and post storm inspection and maintenance. A one or two man crew can handle inspection in all but the largest ystems. Routine small ditch cleaning can be accomplished with a grader and larger ditches can be maintained with a back hoe. Vegetation and sedimentation removed may require loaders, backhoes, bulldozers, excavators and/or dump trucks. Hand work may also require power saws and burning. This work can be accomplished in the summer when water flow is low with temporary help. Some cities will staff a full time two man crew year around for inspection and routine maintenance, supplemented by public works crews for emergencies and a full summer crew for stream clearing.

It is recommended that the annual budget include funding for the equipment and labor described above.

SECTION 600
STORMWATER ORDINANCE

601. SCOPE

The most concise and comprehensive means of regulating stormwater is a drainage ordinance. This section will describe possible ordinances, their adoption and implementation.

A model ordinance is contained in Section 700, the Appendix. Several of the paragraphs of this ordinance are presented in optional form with various choices. Other paragraphs contain blanks which must be filled in. Municipalities are encouraged to use these paragraphs as a guide to develop an ordinance suited to their particular situation.

602. AUTHORIZATION

The Legislature of the State of Tennessee has in section 6-21-201, Tennessee Code Annotated, delegated the authority to local governmental units to adopt regulations designed to promote the public health, safety and general welfare to its citizenry.

603. DESCRIPTION

An ordinance must be adopted in the form accepted by the local government. The ordinance should give as a minimum the title, the authority, the purpose, definitions, standards, requirements, enforcement and penalties. These general categories are presented below in detail and in several cases, optional form.

604. ADOPTION

Municipalities are urged to adopt a form of the ordinance presented herein that will serve to lessen or avoid hazards to persons and property caused by increased stormwater runoff or by obstructions to drainage.

605. IMPLEMENTATION

The adopted ordinance must be implemented by enforcing applications, permits, and maintenance and purchasing equipment and hiring personnel for administering the program.

606. FEES

It is recommended that the ordinance set fees sufficient for the additional cost of administering permit, review and inspection procedures. The additional costs of implementing a storm management plan such as capital and maintenance costs should be addressed individually by the municipality.

607. ENFORCEMENT

The ordinance should specify that violations of the provisions of the ordinance is constituted as a misdemeanor subject to fines.

SECTION 700
APPENDIX

Ordinance No.____

701. TITLE

This Ordinance shall be known as The _____ Stormwater Management Ordinance.

702. AUTHORITY

These regulations are adopted pursuant to the power and authority vested through Section 6-2-201 of the Tennessee Code Annotated.

703. PURPOSE

The purpose of this Ordinance is to lessen or avoid hazards to persons and property caused by increased stormwater runoff or by obstructions to drainage.

704. DEFINITIONS

704.1 Rules Applying To Text; Definitions

Unless specifically defined, words or phrases shall be interpreted so as to give them the meaning they have in common usage and to give this chapter its most reasonable application. For the purpose of this Section, certain rules of construction apply herein as follows:

704.1.1 Words used in the present tense include future tense; and the singular includes the plural, unless the context clearly indicates the contrary.

704.1.2 The term "shall" is always mandatory and not discretionary; the words "may" and "will" are permissive.

704.1.3 The term "drainage management plan" refers to either the preliminary drainage management plan or the final drainage management plan described in this chapter.

704.2 Adverse Impact

Any modifications, alterations, or effects on a feature or characteristic of community waters including their quality, quantity, hydrodynamics, surface area, species composition, living resources, aesthetics or usefulness for human or natural uses which are or may potentially be harmful or injurious to human health, welfare, safety or property, to biological productivity, diversity, or stability, or which unreasonably interfere with the enjoyment of life or property, including outdoor recreation. The term includes secondary and cumulative, as well as direct impacts.

704.3 APPLICANT

The record owner, or his authorized representative, of a tract of land that is the site of development, or development activity within the scope of this Ordinance.

704.4 Base Flood Elevation

The elevation at any location delineating high waters having a one-percent probability of being equaled or exceeded in any given year (also known as the 100-year flood).

704.5 Building

Any structure built for the support, shelter or enclosure of persons, animals, chattels, or movable property of any kind.

704.6 Capacity of a Storm Drainage Facility

The maximum ability of a storm Drainage facility to convey, detain or retain stormwater flows without causing substantial damage to public or private property, and in the case of a pipe, without surcharging.

704.7 Channel

A natural or artificial open watercourse with definite bed and banks which periodically or continuously contains moving water or which forms a connecting link between two bodies of water.

704.8 Compensatory Storage

An artificially excavated volume of storage within a floodplain used to balance the loss of natural flood storage capacity when artificial fill or structures are placed within the floodplain.

704.9 Conduit

Any channel, pipe, sewer or culvert used for the conveyance or movement of water, whether open or closed.

704.10 Control Device

An element of a discharge structure which allows the gradual release of water under controlled conditions.

704.11 Control Elevation

Design elevation of a discharge structure at which, or below which, water is contained behind the structure.

704.12 Detention

The delay of storm runoff prior to discharge into receiving waters.

704.13 Detention Basin

A facility constructed or modified to restrict the flow of stormwater to a prescribed maximum rate, and to concurrently detain the excess waters that accumulate behind the outlet. A wet bottom detention basin is a structure designed to retain a permanent pool of water after having provided its planned detention of runoff during a storm event. A dry bottom detention basin is designed to be completely dewatered after having provided its planned detention of runoff during a storm event.

704.14 Detention Storage

The temporary detaining or storage of stormwater in storage basins, or rooftops, in streets, parking lots, school yards, parks, open space, or other areas under predetermined and controlled conditions, with the rate of drainage therefrom regulated by appropriately installed devices.

704.15 Detention Volume

The volume of water equal to the difference between the control elevation of a discharge structure and the maximum level of which water can be accumulated prior to discharge times the average area of open surface storage (between the control elevation and maximum level) behind the discharge structure).

704.16 Developer

Any individual, firm, corporation, association, partnership, or other entity involved in commencing proceedings under this chapter to effect the development of land for himself or another.

704.17 Development or Development Activity

The carrying out of any building or mining operation or the making of any material change in the use or appearance of any structure or land and the dividing of land into two (2) or more parcels. A change in the intensity of use of land, such as increase in the number of dwelling units in a structure or on land or a material increase in the number of businesses, manufacturing establishments, offices, or dwelling units in a structure or on land.

704.18 Discharge

The rate of outflow of water from detention storage.

704.19 Discharge Structure

Structural device, usually of concrete, metal, timber, etc., through which water is discharged from a project to the receiving water.

704.20 Drainage Area

The area from which water is carried off by a drainage system; a watershed or catchment area.

704.21 Drainage Facility

An element in a drainage system which includes, but is not limited to any of the following: conduits and appurtenant features, canals, channels, ditches, streams, culverts, streets and pumping stations.

704.22 Drainage System

The surface or subsurface system which conveys water from or over the land including all watercourses, water bodies and wetland (also referred to as the Stormwater Management System).

704.23 Easement

Authorization by a property owner for use by another party or parties of all or any portion of his/her land for a specific purpose.

704.24 Elevation

Height in feet above mean sea level according to National Geodetic Vertical Datum (NGVP) as corrected in 1929.

704.25 Emergency Spillway

Saddle or low point facility located around the rim of a dammed impoundment such as a detention or retention basin for providing an efficient and safe means of conveying the maximum design flood. Discharge through the impoundment, without overtopping the dam. Minimum size depends upon degree of downstream development, size of dam, and any applicable state regulations.

704.26 Excess Stormwater Runoff

The volume and rate of flow of stormwater discharged from a drainage area which is or will be in excess of that volume and rate which is specified in this Ordinance.

704.27 Floodplain

The special flood hazard lands adjoining a watercourse, the surface elevation of which is equal to or lower than the Base Flood Elevation (the 100 year flood), which are subject to periodic inundation during floods.

704.28 Floodway

The channel of a watercourse and those portions of the adjoining floodplain which are reasonably required to carry and discharge the design flood.

704.29 Flood Fringe

The higher portion of the floodplain, immediately adjacent to and on either side of the floodway, occupied by quiescent or slow moving waters during floods.

Flood Fringe (optional definition)

Lands lying outside the designated floodway, but within the area subject to inundation by the five hundred (500) year flood.

704.30 High Water Elevation

The elevation of floodwaters of a flood of specified frequency or occurrence at any given point.

704.31 Impervious Surface

A surface which has been compacted or covered with a layer of materials so that it is highly resistant to infiltration of water; the term includes most conventionally surfaced streets, roofs, sidewalks, parking lots and similar structures.

704.32 Local Development Official

The person employed by the governing body given the responsibilities for enforcing this Ordinance (the official so designated could be the Zoning Administrator, the Subdivision Inspector, the Building Official, the Local Government Engineer or other person employed by the Governing Body).

704.33 Local Government Engineer

A Professional Engineer (P.E.) registered in the State of Tennessee retained by the Governing Body (as staff, consultant or through cooperative agreement with another public agency) to review and comment upon stormwater management plans on behalf of the Governing Body.

704.34 Off-Site Detention Basin

A feature or structure for temporarily storing excess stormwater originating at two or more sites having devices for controlling the rate of release of the stored water, and located downstream of all sites where the runoff originates.

704.35 On-Site Detention Basin

A feature or structure for temporarily storing excess stormwaters, having devices for controlling the rate of release of the stored waters, and located within the sites where the runoff originates.

704.36 One Hundred-Year Storms

Rainstorms of varying durations and intensities having a one percent probability of recurring in any one year.

704.37 One Hundred-Year Storm Runoff

The stormwater runoff from a rain event of specific intensity and duration having a one percent probability of occurring in any one year.

704.38 Overflow Elevation

Design elevation of a discharge structure at which point, or above which point, water leaks out, or bleeds out, through a control device down to the control elevation.

704.39 Peak Flow

The maximum rate of flow of water at a given point in a channel or conduit resulting from a predetermined storm or flood.

704.40 Post-development Conditions

Those conditions which are expected to exist, or do exist, after

alteration, resulting from human activity, of the natural topography, vegetation and rate, volume or direction of surface or groundwater flow.

704.41 Pre-development Conditions

Those conditions which existed at the time this Ordinance become effective in terms of topography, vegetation and rate, volume or direction of surface or groundwater flow, as indicated by the best available historical data.

704.42 Primary drainage (Water Management) Systems

Includes major waterways and appurtenant structures or systems whose total tributary area from origin to outfall exceeds or equals 50 acres.

704.43 Professional Engineer

An engineer duly registered or otherwise authorized by the State of Tennessee to practice engineering.

704.44 Rational method

An empirical formula for calculating peak rates of runoff resulting from rainfall. Expressed mathematically, the formula is:

$$Q=CIA$$

Where Q = peak flow in cubic feet per second (cfs)

C = runoff coefficient, or fraction of runoff to rainfall, dependent on type of surface cover and topography

I = rainfall intensity, in inches per hour, for a specific storm and duration

A = watershed area, in acres

704.45 Receiving Bodies of Water

Any water body into which surface waters flow.

704.46 Site Plan

The plan, usually in map form, prepared pursuant to the governing body's zoning or other land development ordinances as a requirement of the development of property.

704.47 Stormwater Runoff

The waters derived from rain falling or snow melting within a tributary drainage basin, flowing over the surface of the ground or collected in a stormwater drainage system, storm sewer, or water course.

704.48 Subdivision

The division of a parcel of land, whether improved or unimproved, into two or more continuous lots or parcels of land designated by reference to the number or symbol of lot or parcel contained in the plat of such subdivision, for the purpose, whether immediate or future, of transfer of ownership or, if the establishment of a new street is involved, any division of such parcel. The term includes a resubdivision and, when appropriate to the context, relates to the process of subdividing and to the land subdivided.

704.49 Ten-Year Storm

Using local rainfall curves the 10-year storm event was selected as the design storm. This event has a 10 percent probability of being equaled or exceeded in any given year.

704.50 Time of Concentration

The elapsed time for stormwater to flow from the most distant point in a drainage basin to the outlet or point in question.

704.51 Watercourse

Any stream, creek, brook, branch, natural or artificial depression, slough, gulch, reservoir, lake, pond or natural or man-made drainageway in or into which stormwater runoff and flood waters flow either regularly or intermittently.

705. APPLICABILITY, EXEMPTIONS, MODIFICATIONS AND APPEALS

705.1 Applicability

A Stormwater Management Plan prepared in accordance with this Ordinance, must be approved by the Governing Body, unless exempted by Subsection B below, or waived pursuant to Subsection C below, before:

705.1.1. Recording a Subdivision Plan, subdividing land or commencing development for subdivision; or

705.1.2. Commencing residential, institutional, commercial, industrial, utility development or other development activity as defined by this Ordinance (including roads, utility rights-of-way and any other dedicated lands); or

705.1.3. Altering, rerouting, deepening, widening, obstructing or changing the characteristics of an existing drainage system or taking such actions that would crease off-site adverse impacts; or

705.1.4. Excavating, filing, grading, draining or paving lots, parcels or areas.

705.1.5. Applicability (optional): Any person, firm, corporation or business proposing the following activities within the municipality shall apply to the Local Development Official for approval of a Stormwater Management Plan and issuance of a drainage permit as specified in this chapter:

705.1.5.1. Altering, rerouting, deepening, widening, obstructing, or changing in any way an existing drainage system outside the floodway; or

705.1.5.2. Commencing development for:

Subdivisions

Shopping Centers

Commercial or industrial facilities; or

705.1.5.3. Commencing any other development which may:

Significantly increase or decrease the rate or quantity of surface water runoff

Degrade the quality of water

Adversely affect any wetland or

Adversely affect any sinkhole, watercourse or waterbody

705.2 Exemptions

Development within a subdivision shall not require approval of a Stormwater Management Plan if each of the following conditions have been met:

705.2.1 Drainage provisions for the project were previously approved and remain valid as part of a final plat;

705.2.2 The development is conducted in substantial accordance with the Stormwater Management provisions contained in the development plan submitted with the final plat as approved.

705.2 Exemptions (Optional)

Stormwater Management Plans and drainage permits are not required for development occurring on individual single-family and two-family lots and

parcels located in subdivisions, providing the following conditions have been met:

705.2.1 A Stormwater Management Plan for an area in which the subject lot or parcel is located, was previously approved and continues to be implemented;

705.2.2 The residential development has been and is being conducted in accordance with the previously approved Stormwater Management Plan;

705.2.3 Written notice of intent to commence development is delivered to the Local Development Official within 30 days before commencing development. The notice shall be submitted on forms supplied by the town engineer and must include:

The name, address, and telephone number of the owner and developer; and

The location of the development; and

A description and a sketch of the proposed development; and

Any other information requested by the Local Development Official.

705.2 Exemptions (Optional)

Isolated single-family lots of any size and two-family residential lots (parcels) greater than one (1) acre shall not require approval of a Stormwater Management Plan, nor a drainage permit, unless the Local Development Official determines there to be a need for such Plan. Written notice of intent to commence development shall be delivered to the Local Development Official.

705.3 Modification and Waiver of Requirements

The Governing Body or the Local Development Official, upon written supportive recommendation of the Local Government Engineer, may modify or waive the requirements of this Ordinance in response to a written request from an Applicant citing the modification or waiver requested, using the following criteria. All decisions, approvals and denials regarding modifications and waivers shall be prepared and reported to the Governing Body at the next regular meeting of the Governing Body in writing, by the Local Development Official with specific reference to the requirement (s) modified or waived. Decision of the Local Development Official may be ap pealed consistent with the requirements of this Ordinance. Modification or waivers to the requirements of this Ordinance may be granted if:

There are special circumstances applicable to the subject property or its intended use that do not apply to other properties or uses in its same class of activity; and

The applicant demonstrates that the modificationss or waiver will not create adverse impacts.

705.4 Appeals

Decisions of the Local Development Official may be appealed, in writing, by the Applicant or a party potentially suffering adverse impacts within ten (10) working days of the date on which the Local Development Of ficial submitted his written report to the Governing Body. Appeals shall be heard by the Governing Body at their next regular meeting.

706 APPLICATION PROCEDURES, REQUIRED SUBMITTALS AND FEES

706.1 Pre-Application Conference

706.1.1 Purpose: The purpose of the Pre-Application Conference is to discuss concepts, acceptable sources of information, applicable requirements and information known about the subject property prior to submittal of the Stormwater Management Permit Application in order to identify issues that should be addressed by the Applicant.

706.1.2 Required Information: At the time when a Pre-Application Conference is requested by the Applicant, the Pre-Application Conference Form (Attachment 1) shall be submitted by the Applicant to the Local Development Official and shall be accompanied with the following information:

706.1.2.1 A location map of the property at a scale of 1" = 2000' or similar scale that shows regional features (such as USGS 7.5' Quadrangle Maps).

706.1.2.2 A statement and sketch of the property at a reasonable scale expressing the intent and scope of the proposed project and the extent of disturbance to the natural and existing drainage system on and around the site.

706.1.3 Review Process: The Pre-Application Conference Form and the accompanying information shall be reviewed by the Local Development Official, the Local Government Engineer and other persons with special technical expertise as deemed appropriate by the Local Development Official. The review shall be completed within ten (10) working days after submission of the Pre-Application Conference Form. The Pre-Application Conference shall be held between the Applicant, Local Development Official, Local Government Engineer, and other persons as deemed appropriate by the Local Development Official within five (5) working days after completion of the review.

706.1.4 Fees: No fee shall be charged for the Pre-Application Review and Conference.

706.2 Stormwater Management Plan Approval Application

706.2.1 Purpose: The purpose of the Stormwater Management Plan review process is to provide an organized framework for evaluating and acting upon proposals for development as they relate to stormwater management issues.

706.2.2 Required Information: It is the responsibility of an Applicant to include sufficient information in the Stormwater Management Plan to enable evaluation of the environmental qualities of the affected area, the potential and predicted impacts of the proposed activity on affected waters, and the effectiveness and acceptability of the measures proposed by the Applicant for preventing or reducing adverse impacts.

The applicant shall furnish the Local Development Official with seven (7) copies of the Stormwater Management Plan Approval Application Form (Attachment 1) and Stormwater Management Plan, sealed by a Professional Engineer registered in the State of Tennessee, as described below.

706.2.2.1 Stormwater Management Plan Approval Application Form (Attachment 1)

706.2.2.1.1 The name, address, and telephone number of the Applicant, and the Owner if different from the Applicant.

706.2.2.1.2 Name and address of the Professional Engineer.

706.2.2.1.3 The legal description of the property.

706.2.2.2 Pre-development Site Information (Map scales are minimums)

706.2.2.2.1 Detailed location sketch showing the parcel, major adjacent roads, water bodies and existing drainage patterns through and around the site at a scale of 1" = 2000'.

706.2.2.2.2 Topographic map of the site at a scale of 1" = 100' with 5 foot contour intervals.

706.2.2.2.3 Location and identification of vegetative cover, soils characteristics and suitability, at a scale of 1" = 100'.

706.2.2.2.4 Percolation tests and soils borings, if percolation or exfiltration systems are proposed, representative of design condition.

706.2.2.2.5 Location of streams and other flood water runoff channels, their normal channels, and the extent of the floodplains at the established high water elevations, and the limits of the floodway at a scale of 1" = 100'.

706.2.2.2.6 Location of lakes, ponds, swamps and detention basins indicating their normal shorelines, floodplains and lines of inflow and outflow, at a scale of 1" = 100'.

706.2.2.2.7 Location of farm drains, inlets and outfalls, storm, sanitary and combined sewers and outfalls, septic tank systems and outlets, if any, and seeps, springs and flowing and other wells mapped at a scale of 1" = 100'.

706.2.2.2.8 Location and description of nearby existing off-site water management facilities mapped at a scale of 1" = 100' such as wells, lakes, drainage ways, etc., which might be affected by the proposed construction or development.

706.2.2.3 Stormwater Management Plan: A stormwater management plan is designed to safely manage the stormwater runoff following the rainstorms which exceed the maximum allowable release rate and the capacity of the stormwater drainage system and/or the storm sewer system by detention of the excess stormwater runoff. The plan shall provide or be accompanied by maps at a minimum scale of 1" = 100' and other descriptive material, including basis of computations, showing the following:

706.2.2.3.1 Location of drainage basins showing direction of flow, taking into account off-site runoff being routed through or around the project.

706.2.2.3.2 Location of all existing drainage facilities (including, but not limited to, water bodies, wetlands, waterways, floodplains, detention ponds, detention basins, swales, ditches, storm sewers, storm drains, culverts and bridges) which are to be maintained, altered, or enlarged as part of the stormwater management system. Provide information as to their size, slopes, depths, outfalls, receiving waters, elevations, cross sections, profiles, construction materials and other design details as applicable.

706.2.2.3.3 Location of all new drainage facilities to be constructed. Provide their design details as applicable.

706.2.2.3.4 Location and extent of existing and proposed impervious surfaces (roads, parking lots, buildings, etc.) and their elevations. Provide grading and paving plans and specifications.

706.2.2.3.5 Location and extent of rights-of-way and easements for the stormwater management system, including all areas to be dedicated for water management purposes.

706.2.2.3.6 Identification and description of "Best Management Practices" to be used in the project.

706.2.2.3.7 Provide stormwater management system design calculations as follows:

706.2.2.3.7.1 Design storms used

706.2.2.3.7.2 Calculated hydrographs of inflow and outflow of design storms runoff for the project site under natural and undeveloped conditions.

706.2.2.3.7.3 Hydrographs of the design storms runoff for the project site under developed conditions.

706.2.2.3.7.4 For all detention basins, a plot or tabulation of storage volumes with corresponding water surface elevations and of the basin outflow rates for those water surface elevations.

706.2.2.3.7.5 Acreages and percentage of property proposed as:

706.2.2.3.7.5.1 impervious surfaces

706.2.2.3.7.5.2 pervious surfaces (green areas)

706.2.2.3.7.5.3 lakes, canals, retention areas, etc.

706.2.2.3.7.5.4 total acreage of project

706.2.2.3.7.5.5 other

706.2.2.3.7.6 Runoff routing calculation showing discharge, elevations, and volumes retained and/or detained during applicable storm event.

706.2.2.3.7.7 Calculations required for determination of minimum building floor and road elevations.

706.2.2.4 Legal and Institutional Information including:

706.2.2.4.1 Identify entity responsible for operation and maintenance of the system.

706.2.2.4.2 If the operation and maintenance entity is to be a public body such as a county, city or drainage district, a preliminary letter from

public body indicating willingness to accept the system should be submitted with the Stormwater Management Plan. A final letter of acceptance by the Governing Body is required upon completion of construction.

706.2.2.4.3 If the entity is a homeowners association, then documents verifying the existence of such an organization and its ability to accept operation and maintenance responsibility must be submitted with the Stormwater Management Plan. A final letter of acceptance by the Homeowners Association must be submitted prior to commencement of construction.

706.2 Review Process: The Local Development Official will ascertain the completeness of the Stormwater Management Plan Approval Application within five (5) working days of submission or resubmission. The Local Development Official will return incomplete applications to the Applicant for completion and resubmission. After determining that the application is complete, the Local Development Official will distribute copies of the application for review and comment to the Local Government Engineer, and other persons with special technical expertise as deemed appropriate by the Local Development Official. Within thirty (30) calendar days after submission of the completed Stormwater Management Plan Approval Application by the Applicant, the Local Development Official shall approve, approve with specified conditions or deny the application and shall notify the Applicant accordingly. If a decision on the application is not rendered by the local Development Official within thirty (30) calendar days after submission of a complete application, the Application will automatically be approved without conditions. If the Stormwater Management Plan Approval Application is denied or approved with conditions, the Local Development Official shall state the reasons for denial or the specified

conditions. If the Applicant feels aggrieved due to the denial or conditions, he may appeal the decision to the Governing Body consistent with the requirements of this Ordinance.

706.2.4 Fees: A standard fee shall be collected at the time of the Stormwater Management Plan Approval Application is submitted by the Applicant to the Local Development Official and will reflect the cost of the administration and management of the review process. The Governing Body will establish, by resolution, a fee schedule which may be amended from time to time by the Governing Body.

Where work for which an approved application is required by this Ordinance is commenced prior to obtaining said approval, the Governing Body may establish fees higher than the standard fee to reflect the additional administrative, inspection and enforcement efforts required to deal with the violation. The payment of such higher fee shall not relieve any persons from fully complying with the requirements of this Ordinance in the execution of the work nor from any other penalties prescribed herein.

707. DESIGN REQUIREMENTS FOR STORMWATER MANAGEMENT PLANS

701.1 General

701.1.1 A stormwater management system shall be provided for protecting lots, roads, streets and building in the project area from the potential adverse impacts of stormwater runoff. Streets, blocks, depths of lots, parks and other public grounds, and ultimate land usage shall be determined, located and laid out in such a manner as to reduce the velocity of overland flow and allow the maximum opportunity for infiltration of stormwaters into the ground, and to preserve and utilize natural streams, channels and detention basins, and

wherever possible, to include streams and floodplains within parks or other public grounds.

701.1.2 The maximum allowable release rate of stormwater after development shall not exceed the before development rate based on a 10 year frequency storm. The total tributary area must be used in calculating the allowable release rate. The required storage volume will be based on the project area only, with extraneous flows from upland areas being bypassed or discharged via overflow spillway or other device.

707.1.3 The increased stormwater runoff resulting from the proposed development shall be detained on-site by appropriate detention basins; by storage on flat roofs, parking lots or streets; or by other acceptable techniques. Storage shall be sufficient to store excess flows from the 10 year storm. Control devices shall limit the discharge from storage to a rate no greater then that prescribed by this Ordinance. Downstream property, watercourses, channels or conduits shall not receive stormwater runoff from proposed development at a higher peak flow rate than that which existed prior to the development.

707.1.4 Generally acceptable locations of the stormwater runoff channels in the design of the project area may include the following:

707.1.4.1 In a depressed median of a double roadway, street or parkway, provided the median is wide enough to permit flat side slopes.

707.1.4.2 Centered on the rear lot lines in a block, or entirely within the rear yards of a single row of lots or parcels, provided that in either case the lots are deep enough to permit side slopes in the runoff channel and a building site of the elevation required by other sections of the Ordinance.

707.1.4.3 In a depressed greenway along roadway, street or parkway, provided the greenway is wide enough to permit side slopes as required in other sections of this Ordinance.

707.1.5 Alternative systems such as curb and gutter and storm sewers that discharge into an appropriate detention basin may be incorporated into the Stormwater Management Plan.

707.1.6 The smaller, uppermost reaches of drainage channels and swales forming the natural drainage system near a watershed divide may be relocated or eliminated and incorporated into the planned system of storm sewers and open channels designed consistent with the requirements of this Ordinance.

707.1.7 A continuous easement may be provided along rear lot lines as shown in the stormwater management plan within which utility lines and open drainage facilities may be located and maintained, but on which no accessory buildings may be constructed. The utility-drainage easement shall be at least twenty (20) feet wide, with ten feet on each lot. Within the area so designed for the passage or storage of waters, no structure may be erected, no fences, shrubbery or trees planted, or changes made to the prescribed grades and contours of the specified flood water or stormwater runoff channels.

707.1.8 All storm sewer outfalls shall be so designed, by reason of elevation of the invert, by the installation of pumps, or by other features, that when the receiving stream is in full flood, the storm sewers will continue to drain the areas they are designed to serve unless the provision is made for sewer backups into planned storage locations. When this is not practical, a flap gate or some other valving device shall be constructed to prevent backup.

707.1.9 All sanitary sewer manholes constructed in a floodplain, in a street designed for detention, or in an area designed for the storage or

passage of flood or stormwater, shall be provided with either a watertight bolted manhole cover, a watertight concealed pick-hole cover, or be constructed with a rim elevation of a minimum of 1.0 feet above the high water elevation of the 100 year flood or the high water elevation of the design storm, whichever is applicable to the specific area.

707.1.10 Projects that are to be developed in phases will normally require the submission of a master plan of the applicant's contiguous land holdings. Applications for individual project phases may be considered only when the phases are totally independent of, or make sufficient provisions for, adjacent lands.

707.2 Hydraulic Design Considerations

707.2.1 Design Storms: Stormwater systems will be designed with sufficient hydraulic capacity for the following frequencies and durations:

Facility	Frequency For Design	Frequency For Checking
Detention Basins	10 years	100 years
Primary Drainage Systems	10 years	100 years
Secondary Drainage Systems, i.e., Crossdrains and Ditches for Internal Subdivision Drainage	10 years	100 years

The local development official has the right to require the 100 year frequency design in critical areas or in cases where the 100 year design will cost little more than the 10 year design.

707.2.2 Sources of Information: Rainfall frequency-duration curves are included in the Local Government Public Works Standards and Specifications for Memphis, Nashville, Knoxville and Chattanooga. The curve for the city closest to the project shall be used.

707.3 Stormwater Management System Design Requirements

707.3.1 Runoff: The design methods described in the Local Government Public Works Standards and Specifications shall be used.

707.3.2 Detention Design Criteria: Detention in the overall system, including swales, lakes, canals, greenways, etc., shall be provided as follow:

707.3.2.1 General

707.3.2.1.1 Storage Volumes: The volume of storage provided in detention basins, together with such storage as may be authorized in other on-site facilities, will be sufficient to control the excess stormwater runoff from the 10 year storm.

707.3.2.1.2 Outlet Control Structures: Outlet control structures shall be designed to operate simply and automatically. They will limit discharges into existing or planned downstream channels or conduits so as not to exceed predetermined maximum authorized peak flow rates.

707.3.2.1.3 Emergency Spillway: Emergency overflow facilities must be provided in all instances so that stored waters will not exceed the safe capacity of the basin. At a minimum, the emergency spillway must be able to withstand the 100 year storm.

707.3.2.1.4 Designs should result in aesthetically pleasing configurations which will enhance public acceptability.

707.3.2.2 Dry/Detention Facilities

707.3.2.2.1 Perimeter maintenance and operation easements of 25 feet (minimum preferable) width at slopes no steeper than 3:1 (horizontal to vertical) shall be provided.

707.3.2.2.2 Side slopes of the facility shall not be steeper than 3:1 (horizontal to veritical).

707.3.2.2.3 Provisions must be incorporated to facilitate complete interior drainage of dry bottom basins, to include the provision of natural grades to outlet structures, longitudinal and transverse grades to perimeter drainage facilities, or the installation of subsurface drains.

707.3.2.2.4 Multipurpose features may be designed to serve secondary purposes for recreation, open space or other types of use which will not be adversely affected by occasional or intermittent flooding.

707.3.2.3 Wet Detention Facilities

707.3.2.3.1 Perimeter maintenance and operation easements of 25 feet (minimum preferable) width at slopes no steeper than 3:1 (horizontal to vertical) shall be provided.

707.3.2.3.2 Control elevations should be no higher than 2.5 feet below the minimum road centerline elevation in the area served by the control device in order to protect the road subgrade when structures are constructed near roads.

707.3.2.3.3 Side slopes shall not be steeper than 3:1 (horizontal: vertical) out to a depth of two feet (2') below the control elevation, then as steep as soils stability will allow.

707.3.2.3.4 If fish are to be used to help keep the basin clean, at least one-quarter of an area of the permanent pool must be a minimum depth of 10 feet.

707.3.2.3.5 For emergency purposes, cleaning or shoreline maintenance, facilities shall be provided or plans prepared for the use of auxiliary equipment to permit emptying and drainage.

707.3.2.4 Impervious Areas: Paved parking lots may be designed to provide temporary detention storage of stormwaters on all or a portion of their surfaces. Outlets will be designed so as to slowly empty the stored waters, and depths of storage must be limited to a maximum depth of 7 inches so as to prevent damage to parked vehicles. Ponding should be relegated to those positions of the parking lots farthest from the area served. For projects which include substantial paved areas, such as shopping centers, large highway intersections with frequent stopped traffic, and high density developments, provisions shall be made for the removal of oil, grease and sediment from stormwater discharges.

707.3.2.5 Rooftop Storage: Detention storage requirements may be met in total or in part by detention on flat roofs. Details of such designs to be included in the Stormwater Management plan application shall include the depth and volume of storage, details of outlet devices and down-drains, elevations of overflow scuppers, design loadings for the roof structure and emergency overflow provisions.

707.3.2.6 Underground Storage: All or a portion of the detention storage may also be provided for in underground facilities, as long as all applicable requirements of this Ordinance are met. Details of such designs are to include type of facility, depth and volume of storage, details of in let and outlet devices and locations, emergency overflow provisions, and measures to be used for surface and groundwater pollution control.

707.3.2.7 Design Alternatives: The above listing of design criteria is not intended to preclude the use of other known state-of-the art methods and available best management practices and should not be construed as a mechanism to discourage innovative design concepts.

707.3.3 Developments Adjoining a Flood Plain - where a development adjoins or encompasses a portion of a flood plain for a 100 year flood, the following shall apply:

707.3.3.1 The Applicant shall show the floodway on the Stormwater Management Plan.

707.3.3.2 The Applicant shall include in the Stormwater Management Plan all other plans, plats, specifications, etc., required by federal, state, county and/or municipal law or regulations detailing such provisions or restrictions as are necessary to comply with the following:

707.3.3.2.1 All applicable zoning and subdivision requirements.

707.3.3.2.2 All applicable building code requirements.

707.3.3.2.3 All requirements of the Federal Emergency Management Agency, or its successors.

707.3.3.2.4 All requirements of other federal, state or local agencies exercising jurisdiction over the area.

707.3.3.3. The Applicant shall not alter any channel in such a way that would prohibit any section of the channel from conveying, in its post-development state, the same amount of flow at the same or lower maximum water elevation, that it conveyed in its pre-development state.

707.3.3.4 The Applicant shall furnish, for the Local Development Official's review and approval based on comments from the Local Government Engineer, the following information pertaining to proposed channel modifications:

707.3.3.4.1 Typical cross-section of the existing and proposed channel and special cross-section of areas as indicated in paragraph 707.3.3.3 above.

707.3.3.4.2 Plan view of the channel showing the location of existing constrictions, obstructions and other non-typical areas.

707.3.3.4.3 Hydrographs and/or Flood Routing Calculations and Backwater Curve Profiles of the proposed waterway corresponding to a storm recurrence interval of 100 years.

707.3.3.4.4 Engineering evaluation of all potential increases in flood hazards to the adjacent upstream or downstream private or public lands and facilities located thereon. Show provisions for eliminating any and all adverse impacts on said lands and facilities at no public cost.

707.3.3.4.5 Minimum finished floor elevation which shall be set at or above the maximum water surface elevation determined from:

-Flood Insurance Rate Map" and "Flood Boundary and Floodway

-Map" published by the Federal Emergency Management Agency.

- Backwater Curve Profiles of the proposed waterway due to a 100 year storm recurrence interval.

707.3.3.4.6 Designation on the Final Plan of all areas reserved for flood routing, retention or storage, together with the required wording pertaining to restrictions, dedications and maintenance responsibilities of such areas.

707.3.3.5 If detention storage is provided within a floodplain, only the net increase in storage volume above that which naturally existed on the floodplain shall be credited to the development. No credit will be granted for volumes below the elevation of the regulatory flood at that location un less compensatory storage is also provided.

707.3.3.6 An exception of the above policy is authorized when the floodways and floodway fringes have been established for floodplains by State or Federal agencies.

707.3.4 Right-of-Way and Easements

707.3.4.1 All stormwater management facilities shall be instructed within an easement or right-of-way dedicated to the public and connected to a public road or other location from which operation and maintenance is legally available. Minimum rights-of-way and maintenance easements by instrument of plat dedication shall be provided for all waterways used to convey, retain or detain runoff. The minimum widths of rights-of-way and easements shall be as follows:

Facility	Maintenance Access Width
Open Drainage Channel or Facility	20 feet, 10 feet each side
Greenways	width of greenway
Pipes and Culverts	15 feet, centered
Detention Areas	25 feet continuous around total area

707.3.4.2 Easement will include the "top of the bank width" and the main tenance access width.

707.3.4.3 The maintenance access width begins at the point where the bank joins natural ground.

707.3.4.4 Additional maintenance access width may be required by the Local Government Engineer in special circumstances where more width on one or both sides is necessary for maintenance purposes.

707.3.4.5 Safety Features: Designs of detention facilities will incorporate safety features, particularly at outlets, on steep slopes, and at any attractive nuisances to include, as necessary, fencing, hand rails, lighting, steps, grills, signs and other protective or warning devices so as to restrict access during critical periods and to afford some measure of safety to both authorized and unauthorized persons.

707.3.4.6 Installation of Stormwater Runoff Control Measures: Positive stormwater runoff control shall be provided for during development. Stormwater Management Plans shall include a schedule for the installation, construction or modification of all drainage facilities. Erosion control measures and a schedule for their installation shall be shown on the Stormwater Management Plan. Installation of drainage facilities and erosion control measures shall proceed as scheduled in the approved Stormwater Management Plan.

708. MAINTENANCE RESPONSIBILITIES FOR STORMWATER MANAGEMENT FACILITIES

708.1 Purpose: The purpose of the Section is to establish maintenance standards to ensure that after stormwater management facilities have been properly designed and constructed, they continue to function properly. Continued proper functioning is highly dependent upon the proper maintenance of the facilities.

708.2 Design of Facilities: Maintenance costs over a period of years will generally surpass the costs of initially constructing water management facilities. The Applicant and the Local Government Engineer should utilize all appropriate methods, approaches and techniques to design and construct these facilities in such a manner that fulfills the requirements of this Ordinance, facilitates their inspection, and minimizes future maintenance costs.

708.3 Maintenance Responsibilities: The growth of obnoxious weeds, the creation of conditions which support the growth of mosquitoes and other insects, and the decrease in available storage by accumulated sediments shall be controlled. The cleanup of accumulated debris, flotsam and other materials after runoff events have subsided shall be assured.

The installed system(s) required by this Ordinance shall be maintained in one of the following ways to be determined prior to approval of the Stormwater Management Plan.

708.3.1 Facilities Maintained by Applicant or Owner: The system(s) to be maintained by the owner shall have adequate easements, dedicated to the public, to permit the Governing Body to inspect and, if necessary, to take corrective action should the owner fail to properly maintain the system(s). A schedule will be established for periodic review by the Local Development Official. If the owner fails to properly maintain the system(s) under his responsibility, the Local Development Official shall give such owner written notice of the nature of the corrective action necessary. Should the Owner fail, with thirty (30) days from the date of the notice, to take, or commence taking corrective action to the satisfaction of the Local Development Official, the Governing Body may enter upon lands, take corrective action and place a lien on the property of the owner of the costs thereof. In cases where the owner is a Homeowner Association or other collective/member organization, failure to maintain common water management facilities will be the basis for corrective action by the Governing Body to be funded by the imposition of a special taxing district, municipal service (or benefit) taxing unit or other arrangement designed to provide funds for such corrective actions.

A maintenance agreement or covenant(s) approved by the Local Development Official, assuring perpetual maintenance of drainage management facilities shall be agreed upon for any facilities remaining in private ownership.

708.3.2 Facilities Maintained by the Governing Body: All areas and/or structures to be maintained by the Governing Body must be designed and constructed consistent with the requirements of this Ordinance and dedicated to the Governing Body by plat or separate instrument and be accepted by the Governing Body.

708.4 Performance and maintenance security (optional): Security against defects in workmanship shall be required for any portion of the drainage management facilities dedicated to the public. The terms of the performance security shall apply to any repairs needed and maintenance needed during the two-year period following completion. Inspection and repair of defects shall be required as a condition of release of the posted security.

709 LEGAL RESERVATION

Areas to be utilized for the conveyance or storage of stormwater shall be legally reserved for that purpose by plat, easement, etc., so that subsequent owners or other may not remove such areas from their intended use.

710 PLAN ADHERENCE

The Applicant shall be required to adhere strictly to the Stormwater Management Plan as approved. Any changes or amendments to the Plan must be approved by the Local Development Official in accordance with the procedures set forth in this Ordinance for obtaining Stormwater Management Approval. Enforcement officials shall be, and are herein, granted inspection rights and right-of-entry privileges in order to ensure compliance with the requirements of this Ordinance.

711 ENFORCEMENT

711.1 Approved Projects: The Local Development Official or designated representative shall carry out periodical inspections of the project site to insure the Applicant's compliance with the Ordinance. If it is determined that the project is not being carried out in accordance with the Approved Stormwater Management Plan, the Local Development Official is authorized to:

711.1.1 Written Notice: Issue written notice to the Applicant or owner, specifying the nature and location of the alleged noncompliance, with a description of the remedial actions necessary to bring the project into compliance within a reasonable specified time.

711.1.2 Stop-Work Order: Issue a stop-work order directing the Applicant or owner, to cease and desist all or any portion of the work which violates the provisions of this Ordinance, if the remedial work identified in the "written notice" is not completed within the specified time.

711.1.3 Revocation of Approval: Should the Applicant or owner, not bring the project into compliance with the written notice and stop-work order, he shall then be subject to immediate revocation of his Stormwater Management Plan Approval and to the penalties described in Section 712.

711.1.4 Appeal: Any notice, order or revocation issued pursuant to sub paragraphs 711.1.1, 711.1.2 or 711.1.3 above shall become final unless the person or persons named therein requests, in writing, a hearing before the Governing Body no later than ten (10) days after the date such notice, order or revocation is served.

711.2 Unapproved Projects: Any project determined by the Local Development Official or designed representative to be subject to this Ordinance, and being carried out without approval, the Local Development Official is authorized to:

711.2.1 Written Notice: Issue written notice to the owner specifying the nature and location of the alleged noncompliance, with a description of the remedial actions necessary to bring the project into compliance within a reasonable specified time.

711.2.2 Stop-Work Order: Issue a stop-work order directing the owner to cease and desist all or any portion of the work which violates the provisions of this Ordinance, if the remedial work identified in the "written notice" is not completed within the specified time.

711.2.3 Non-Compliance With Stop-Work Order: Should the owner not bring the project into compliance with the written notice and stop-work order he shall then be subject to the penalties described in Section 712.

711.2.4 Appeal: Any notice, order or revocation issued pursuant to sub paragraphs 711.2.1, 711.2.2 or 711.2.3 above shall become final unless the person or persons named therein requests, in writing, a hearing before the Governing Body no later than ten (10) days after the date such notice, order or revocation is served.

711 Violations and penalties (optional): Any person, firm or corporation who fails to comply with or violates any provisions of this chapter shall be guilty of a misdemeanor.

712 PENALTIES FOR VIOLATION

712.1 General: Violation of the provisions of this Ordinance or failure to comply with any of its requirements, including conditions and safeguards established in connection with variances or special use permits, shall constitute a misdemeanor. Any person who violates this Ordinance or fails to comply with any of its requirements shall upon conviction thereof be fined not more than (_____) dollars or imprisoned for not more than (_____) days, or both, and in addition, shall pay all costs and expenses involved in the case. Each day such violation continues shall be considered a separate offense.

712.2 Corrective Actions: Nothing herein contained shall prevent _____(City)_____ from taking such other lawful action as is necessary to prevent or remedy any violation. All such costs connected therewith shall accrue to the person or persons responsible.

713 VESTED RIGHTS

This ordinance shall not in any way limit or modify the vested rights of any person to complete any development or improvements to lands based upon prior law, where a previous permit or authorization has been granted or applied for and where such previous permit or authorization remains in effect. The Governing Body may acknowledge vested rights in other circumstances where it is equitable and just.

714 CONFLICT WITH OTHER ORDINANCES AND CODES

In case of conflict between this Ordinance or any part thereof, and the whole or part of any other existing or future Ordinance or code of the City of _____, the most restrictive in each case shall apply.

715 OTHER PERMITS

Before starting any of the work regulated by this Ordinance, an Applicant shall comply with the requirements set forth in all other applicable ordinances with respect to the submission and approval of preliminary and final subdivision plats, site plans for construction and rezoning improvement plans, and building, grading and zoning permits, along with those set forth in this Ordinance and as may be required by the State statutes and the regulations of any department of the State of Tennessee.

716 INTERPRETATION

In the interpretation and application of this Ordinance, the provisions expressed herein shall be held to be the minimum requirements and shall be liberally construed in favor of _____(City)_____ and shall not be deemed a limitation or repeal of any other powers granted by State statutes.

717 SAVINGS CLAUSES

717.1 Separability: If any part of this Ordinance is held to be unconstitutional, it shall be construed to have been the legislative intent to pass this Ordinance without such unconstitutional part and the remainder of this Ordinance, as to the exclusion of such part, shall be deemed and held to be valid as if such part had not been included herein. If this Ordinance or any provision hereof is held to be inapplicable to any persons, group of persons, property, kind of property, circumstances or set of circumstances, such holding shall not affect the applicability hereof to any other person, property or circumstances.

717.2 Abrogation and Greater Restrictions: It is not intended by this Ordinance to repeal, abrogate or impair any existing easements, covenants or deed restrictions. However, where this Ordinance imposes greater restrictions, the provision of this Ordinance shall prevail.

718 AMENDMENT PROCESS

The contents of this Ordinance may be amended by the Governing Body from time to time in a manner like that used for original adoption.

719 LIABILITY DISCLAIMER

The performance standards and design criteria set forth herein establish minimum requirements which must be implemented with good engineering practice and workmanship. Use of the requirements contained herein shall not constitute a presentation, guarantee, or warranty of any kind by the municipality or its officers and employees of the adequacy or safety of any drainage management structure or use of land. Nor shall the approval of a Stormwater Management plan and the ince of a drainage permit imply that land uses permitted will be free from damages caused by stormwater runoff. The degree of protection required by these regulations is considered reasonable for regulatory proposes and is based on historical records, engineering and scientific methods of study. Larger storms may occur or stormwater runoff heights may be increased by man-made or natural causes. Enforcement of these provisions, therefore, shall not create liability on the part of the municipality or any officer of the municipality with respect to any legislative or administrative decision lawfully made hereunder, nor shall compliance relieve an owner, developer, and/or permittee from responsibility under any circumstances where liability would otherwise exist.

720 IMPLEMENTATION

EFFECTIVE DATE

This Ordinance shall be in full force and effect from an after its passage, approval and publication, as approved by law.

PASSED: This _____ day of _____, 19____.

_____

(Clerk)

APPROVED by me this _____ day of _____, 19____.

(Clerk)

(Mayor, ___(City)_____, County of _____, _____ (State)_____.

ATTESTED and FILED in my office this _____ day of _____, 19____, and published as provided by law this _____ day of _____, 19____ in _____.

_____

(Clerk)

ATTACHMENT I

STORMWATER MANAGEMENT PLAN APPROVAL PRE-APPLICATION

AND APPLICATION FORM

Project Name _____

Date of Submission _____

Date of Return _____

Date of Acceptance _____

APPLICANT:

Name: _____

Firm: _____

Address: _____

Phone Number: _____

PROFESSIONAL ENGINEER:

Name: _____

Firm: _____

Address: _____

Phone Number: _____

LEGAL DESCRIPTION OF PROPERTY:

(Attached)

BIBLIOGRAPHY OF HOLDINGS ON URBAN STORMWATER MANAGEMENT AND EROSION AND SEDIMENT CONTROL AT THE MTAS LIBRARY, KNOXVILLE, TENNESSEE

by Cathy Moore-Jansen, MTAS Library

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INTRODUCTION

This is a bibliographic guide to materials on urban stormwater management housed in the Municipal Technical Advisory Service Library, the University of Tennessee, Knoxville. The scope of this bibliography is urban stormwater management and related erosion and sediment control. Stormwater management can be defined as the optimum use of specific structural and nonstructural techniques and practices used to control storm runoff, reduce pollutant levels, and prevent or reduce damage to property, streams, etc. Erosion and sediment control is the optimum use of techniques and practices used to reduce soil loss from a given area and attempts to prevent or reduce both on- and off-site deposition damage. Erosion and sediment control measures are often integrated with stormwater management measures. MTAS Library materials related to the administration, planning, design, regulatory or any other aspect of urban stormwater management and erosion and sediment control are compiled in this bibliography. These materials include all related monographs and ordinances published since 1970 and currently held by the library as well as selected magazine articles published since 1980.

The selected items are arranged alphabetically by author or by title, if there is no designated author, under one of several broad subject areas within the fields of stormwater management and erosion and sediment control. Each monograph citation includes the author, title, publisher, place and date of publication, number of pages, series name (if available), and annotation. Each article citation includes the author, title, page numbers, magazine title, serial designation, date of publication, and annotation. Ordinance citations also include chapter, section, and ordinance number references. At the end of each citation is the primary MTAS subject heading assigned to the item to indicate where the item is filed in the library.

1. GENERAL MANAGEMENT

Combined sewer regulation and management : a manual of practice / by the American Public Works Association for the Federal Water Quality Administration, Department of the Interior and Twenty-five Local Governmental Jurisdictions. -- Washington, DC : The Department, July 1970. 134 p. -- (water pollution control research series)
SEWERS--STORM

Design application, operation, and maintenance of combined sewer overflow regulator facilities are detailed. (tables, figures)

Hartigan, John P.
Watershed-wide approach significantly reduces local stormwater management cost / John P. Hartigan. -- p. 34-37. In Public Works. -- Vol. 114, no. 12 (Dec. 1983)
SEWERS--STORM

An analysis of the costs associated with watershed-wide v. onsite control of urban runoff. (tables, photos)

Lager, John A.
Urban stormwater management and technology : an assessment / by John A. Lager and Williams G. Smith. -- Cincinnati : National Environmental Research Center, Dec. 1974. 471 p. -- (Environmental protection technology series)
SEWERS--STORM

A comprehensive investigation and assessment of promising, completed, and ongoing urban stormwater projects, representative of the state-of-the-art in abatement theory and technology, has been accomplished. The results provide a compendium of project information on management and technology alternatives within a framework of problem identification, evaluation procedures, and program assessment and selection. In textbook format. (tables, figures, photos)

Lindley, R. Wm.
Municipal storm water management programs / by R. Wm. Lindley. -- [S.l : s.n., 197-?]. 9 p.
SEWERS--STORM

A report on the results of a four year effort by the City of Naperville, Illinois, the Naperville School District, the Naperville Park District, and land development corporations to provide facilities for public education, recreation and storage of excess storm water runoff. Design parameters utilized in the development of these areas are presented as well as a model storm water management ordinance.

Mason, John M.
On-site stormwater detention : an overview / John M. Mason. -- p. 62-64. In Public Works. -- Vol. 113, no. 2 (Feb. 1982)
SEWERS--STORM

Discusses areas of concern and methods of controlling stormwater drainage. Includes sections on runoff storage techniques, outlet structures, and economic aspects. (photos)

Smith, Horace L.
Urbanization promotes systems approach to drainage control / Horace L. Smith. -- p. 12, 13, 22. In APWA reporter. -- Vol. 37, no. 7 (July 1970)
SEWERS--STORM

Urbanization is pointing toward the development of a systems approach to drainage control in which the use of sewers is one of many factors. Discusses the public services that have to be considered when determining the best final drainage plan, e.g. street maintenance, health hazards, etc.

Storm water management controls / Knoxville-Knox County Metropolitan Planning Commission, Weston Environmental Consultants-Designers. -- [S.l. : s.n.], Oct. 1979. ca. 60 p.
SEWERS--STORM

Addresses current stormwater management programs, the short and long term runoff impacts of residential land developments, and the need for developing alternative approaches to stormwater management in Knoxville and Knox County. (tables, figures)

Stormwater management / prepared by Southwestern Illinois Metropolitan and Regional Planning Commission with the assistance of Black & Veatch Consulting Engineers and Richard K. Thompson. -- [S.l.] : Illinois Department of Transportation, Division of Water Resources, Dec. 1982. 29 p. -- (Local assistance series ; 4a)
SEWERS--STORM

Assists reader in understanding problems created by stormwater runoff, considerations involved in responding to the problems, alternative solutions, and the role of local government decision-makers in planning and providing for stormwater management. Discusses legal considerations (Illinois law), stormwater management measures, selection of measures, operation and maintenance, and stormwater regulations.

Stormwater management : an issue that won't wash away. -- p. 22-27. In Colorado municipalities. -- Vol. 60, no. 5 (Sept./Oct. 1984)
SEWERS--STORM

A discussion of drainage issues and solutions.

Urban stormwater management / prepared by APWA Research Foundation and the Institute for Water Resources of the American Public Works Association. -- Chicago : The Association, c1981. 285 p. -- (Special report ; no. 49)
SEWERS--STORM

Describes in detail the many aspects of urban stormwater management; masterplan development; management process; runoff control problems; urban hydrology; design and operation of collection systems; design, construction, and operation of detention facilities; related law and ordinances; and financing. (tables, figures, photos)

Urban stormwater management and technology : case histories / by William G. Lynard ... [et al.]. -- Cincinnati : Municipal Environmental Research Laboratory, EPA, August 1980. 355 p. -- ("Special" reports series)
SEWERS--STORM

Presents twelve case histories representing the most promising approaches to stormwater control. The histories were developed by evaluating completed and operational facilities or ongoing demonstration projects that have significant information value for future guidance. Essential elements of the case history evaluations cover approach methodology, design considerations, costs, effectiveness, and environmental and socioeconomic impacts.

2. MANAGEMENT AS UTILITY

Engemoen, Marc
A utility approach to comprehensive stormwater management / Marc Engemoen, Roger E. Krempel. -- p. 68-7, 92. In Public works. -- Vol. 116, no. 4 (Apr. 1985)
SEWERS--STORM

Self-supporting storm drainage utility at Fort Collins, Colorado, is financed by a combination of monthly utility fees and development fees. (photos)

Introduction to stormwater utility financing. -- [S.l] : Water Resource Associates, Inc., 198-. 8 p.
SEWERS--STORM

Demonstrates that stormwater utility financing offers the prospect of stable, adequate, and publicly acceptable funding for drainage capital improvements, operations, and routine and remedial maintenance.

Stormwater management financing. -- [S.l.] : Water Resource Associates, Inc., 198-. 39 p.
SEWERS--STORM

Describes some of the alternative and innovative approaches to stormwater management financing available to local governments. Briefly summarizes a range of financing concepts and proposes a logical process for developing a drainage financing strategy that is compatible with local needs. A number of communities have successfully established "drainage utilities" which generate revenues through service charges. (tables)

Warren, Richard E.
Treating urban drainage as a utility / Richard E. Warren. -- p.85. In Public works. -- Vol. 108, No. 3 (Mar. 1977)
SEWERS--STORM

The author proposes that urban drainage control should be elevated to the status of a utility and presents guidelines for such a program.

Wilkinson, E.G.
Why drainage/flood control should be considered a utility / by E. G. Wilkinson. -- p. 27-30. In Colorado municipalities. -- Vol. 60, no. 5 (Sept./Oct. 1984)
SEWERS--STORM

One solution for dealing with storm drainage problems of urban areas is to establish a stormwater management utility. Includes discussion of utility funding and staffing.

3. PLANNING AND DESIGN

A. GENERAL PLANNING

Alley, E. Roberts
Stormwater management solves flooding problems / by E. Roberts Alley. -- p. 22-23. In Tennessee public works. -- Vol. 1, no. 5 (Jan. 1984)
SEWERS--STORM

Tullahoma, Tennessee, adopted a comprehensive stormwater management plan designed to solve existing flooding problems and prevent future reoccurrences. Includes recommended solutions to problem areas, cost estimates, and suggested priority of correction.

Debo, Thomas N.
Rapid urbanization? : don't forget storm drainage / Thomas N. Debo. -- p. 58-60. In Public works. -- Vol. 115, no. 3 (Mar. 1984)
SEWERS--STORM

Discussion of Camden County, Georgia, drainage program. Anticipating rapid population growth due to the construction of a naval base, Camden County makes plans for a drainage program. (photos)

Novi's storm water management plan. -- p. 208-209. In Michigan municipal review. -- Vol. 57, no. 8 (Sept.-Oct. 1984)
SEWERS--STORM

Describes the development of a system of regional storm water holding basins by the city administration and an active citizens' committee.

Spencer, Ellis L.
Stormwater management in Chattanooga / presented by Ellis L. Spencer, 1980 Conference, Tennessee Chapter, American Public Works Association. -- Memphis : The Chapter, 1980. 27 p.
SEWERS--STORM

Outlines the need for a comprehensive drainage plan in Chattanooga. (tables)

Stormwater management plan : Tullahoma, Tennessee. -- Brentwood, TN : Alley, Young & Baumgarter, Sept. 23, 1983. ca. 70 p.
SEWERS--STORM

Makes recommendations for a 5 year program to solve the flooding and drainage problems of the City of Tullahoma and suggests regulations designed to prevent future problems. (tables, figures)

B. HYDROLOGIC AND OTHER ANALYSES

Baker, William R.
Stormwater detention basin design for small drainage areas / William R. Baker. -- p. 75-79. In Public works. -- Vol. 108, no. 3 (Mar. 1977)
SEWERS--STORM

A modification of the rational equation is presented for determination of storage volume required in detention basins. (tables, figures, photos)

Huber, Wayne C.
Urban rainfall-runoff-quality data base / by Wayne C. Huber and James P. Heaney. -- Cincinnati : Municipal Environmental Research Laboratory, EPA, July 1977. 167 p.
SEWERS--STORM

Urban rainfall-runoff-quality data gathered by others have been assembled on a storm event basis for one or more catchments in eight cities. Descriptions of catchments, parameters, and sampling procedures provided. (tables, figures)

Hydrologic and hydraulicmodeling of the Upham Brook Watershed : final report : phase I comprehensive drainage study for Henrico County, Virginia / prepared for J. K. Timmons and Associates. -- Waltham, MA : Resource Analysis, Inc., Jan. 1978. ca. 120 p.
DRAINAGE--DATA PROCESSING

Presents the results of a hydraulic and hydrologic study of this watershed. The methods employed depended primarily on mathematical modeling performed with a digital computer. Modeling portion of Phase I of comprehensive drainage study. Illustrates feasibility of conducting a drainage study using mathematical modeling as major tool. (tables, figures)

McKinnon, Ronald J.
Simplifying stormwater detention basic discharge control / Ronald J. McKinnon. -- p. 68-69. In Public works. -- Vol. 115, no. 6 (June 1984)
SEWERS--STORM

Mathematical formulas are charted to related outflow from a detention basin with head and pipe size. (figure)

Medina, Miquel A.
Level III : receiving water quality modeling for urban stormwater management / by Miquel A. Medina. -- Cincinnati : Municipal Environmental Research laboratory, EPA, Aug. 1979. 217 p.
SEWERS--STORM

A simplified continuous receiving water quality model has been developed as a planning guide to permit preliminary screening of areawide wastewater treatment strategies. The total hours of runoff-producing rainfall throughout a year are separated into storm events by defining a minimum interevent time. For a given storm event, the runoff and pollutant loads are summed and critical dissolved oxygen concentrations are estimated as a function of several hydrodynamic and biochemical parameters. An application to the Des Moines River at Des Moines, Iowa is presented. (tables, figures)

Poertner, Herbert G.
Detention storage of urban stormwater runoff : a study of concepts, techniques and applications / by Herbert G. Poertner. -- p. 14-17, 20. In APWA reporter. -- Vol. 40, no. 5 (May 1973) (Based on a paper presented at the International Public Works Congress and Equipment Show, Sept. 1972)
SEWERS--STORM

Discusses temporary storage of runoff at or near points of precipitation and reduction of overland stormwater flow rates prior to entry into drainage collection systems as a practical and economical means of reducing pollution and flooding at reasonable costs. Project activities focus on identification of criteria and techniques which can be implemented in urban drainage systems to restructure sewer input hydrographs to reduce peak sewer flows. Discusses benefits and drawbacks, design, and legal aspects of on-site detention storage facilities. (figure, photos)

Tettemer, John M.
BENEVAL : how to get more from your storm drain dollar / John M. Tettemer and Harold A. Vance. -- p. 43-44. In Public works. -- Vol. 109, no. 1 (Jan. 1978)
SEWERS--STORM

Los Angeles County Flood Control District establishes a technique which provides cost-benefit information on proposed projects and aids in establishing priorities. BENEVAL = Benefit Evaluation of Urban Storm Drains.

Truitt, M. M.
The N-year flood : what does it mean? / M.M. Truitt. -- p. 81. In Public works. -- Vol. 110, no. 6 (June 1979
SEWERS--STORM

The adequacy of design for control structures based on floods of a definite frequency interval require an understanding of probability theory.
(table, chart)

Urban rainfall-runoff-quality data base : update with statistical analysis / by Wayne C. Huber ... [et al.]. -- Cincinnati : Municipal Environmental Research Laboratory, EPA, Aug. 1979. 282 p.
SEWERS--STORM

Urban rainfall-runoff-quality data gathered by others have been assembled on a storm event basis for 25 catchments in eleven cities and rainfall-runoff data for 22 more in other fourteen cities. Also includes a statistical analysis of data from all catchments that include quality sampling. (tables, figures)

Wall, Glenn R.
A public works objective: flood loss reduction. [S.l. : s.n], Oct. 1980 (Presented at the 28th annual meeting, Tennessee Chapter, American Public Works Association, Oct. 1980, Memphis, TN). 22 p.
SEWERS-STORM

In contrast to management or structural solutions a flood loss reduction program is directed toward broadening the available alternatives which should be used to reduce flood losses. Discusses how the flood loss reduction concept works.

C. DESIGN AND TECHNICAL CRITERIA

Aurora (CO). Utilities Department
Storm drainage design & technical criteria. Aurora, CO : The Department, revised June 1980. 32 p.
SEWERS--STORM

Presents the minimum design and technical criteria and specifications for the analysis and design of drainage systems. (tables, figures)

Austin (TX)
Drainage criteria manual. -- Austin, TX : The City, 1977. 1 v. (loose-leaf).
SEWERS--STORM

Establishes standard principles and practices for the design and construction of surface drainage systems within the City of Austin and its extraterritorial jurisdiction. (tables, figures)

Debo, Thomas N.
Storm water management handbook ; Columbus, Georgia / by Thomas N. Debo, Alan M. Lumb, Ray K. Kinsley ; prepared for Department of Community Development, Columbus, GA ; prepared by Hydrocomp, Inc. -- Atlanta : Hydrocomp, Oct. 1977. ca. 213 p.
SEWERS--STORM

Provides engineering design guidance to those involved in stormwater management. Technical references define and illustrate engineering design techniques. Planning concepts are considered. (tables, figures)

Des Moines (IA). Engineering Department
Storm drainage design standards manual. -- Des Moines : The Department, 1977. ca. 60 p.
SEWERS--STORM

Concerned with flow determination of storm runoff, facility design, and storage. (tables, figures, charts)

Design criteria for storm sewers and appurtenances / prepared by the Kansas City Metropolitan Chapter of the American Public Works Association. -- Kansas City, MO : The Chapter, revised 1973. 20 p.
SEWERS--STORM

Criteria for standard procedures in storm sewer design to help develop improved routine methods of planning, designing, and checking storm sewer plans. Covers reference information needed, design procedures, standard details, and checklist by which to review the completed plans. (charts and graphs)

Drainage system reconstruction utilizes aluminum box culvert. -- pp. 84-85. In Public works. -- Vol. 112, no. 2 (Feb. 1981)
SEWERS--STORM

Aluminum structural plate assembly is economical alternative for drainage improvement requirements in Mont Clare, Pennsylvania. Aluminum box culvert is relatively new concept in metal structures and is cheaper than concrete. (photos)

Goddard, James B.
Storm water retention/detention : a new solution / James B. Goddard. -- p. 82-85. In Public works. -- Vol. 115, no. 6 (June 1984)
SEWERS--STORM

A discussion of the design method that can be used to incorporate the subsurface drainage system into a detention/groundwater recharge system. Includes technical notes for storm water retention and disposal.

Iowa City (IA)
Revisions to design standards for public works improvements, Iowa City, Iowa, section VII - storm sewers. -- Iowa City : The City, [197-]. ca. 60 p.
SEWERS--STORM

Design standards and ordinances regulating storm water runoff. (tables, figures)

Local government public works standards & specifications : construction standards, materials specifications, design criteria and contract documents for streets, storm and sanitary sewers, and water distribution systems / John Coleman Hayes and Associates, Inc., ; Tennessee Innovation Group. -- Knoxville, TN : Municipal Technical Advisory Service, University of Tennessee : in cooperation with the Tennessee Municipal League, 1982. 1 v. (loose-leaf).

Sets forth basic requirements, rules, and regulations to be followed during the development, design, and construction of public works projects. Includes sections on drainage systems.

Practical hydraulics for the public works engineer. Reprinted from Public works magazine, Ridgewood, NJ. -- [S.l. : s.n., 197-?]. 25 p.
DRAINAGE

The design or analysis of almost any public works project requires application of hydraulic engineering principles and procedures. Drainage, flood control, and irrigation are examples. This is a review of principles and procedures.

Ruzzo, William P.
Storm drainage design and technical criteria / William P. Ruzzo and Mike Serlet. -- p. 116--119. In Public works. -- Vol. 115, no. 9 (Sept. 1984)
SEWERS--STORM

The development of an urban storm drainage criteria manual gives engineers county-wide design guidelines. Developed for Boulder County and Longmont, Colorado. (tables, figures)

4. OPERATION AND MAINTENANCE

Computerized city-wide control of urban stormwater / by Neil S. Grigg ... [et al.]. -- New York : American Society of Engineers, Feb. 1976. 81 p. -- (ASCE Urban Water Resources Research Program technical memorandum ; no. 29)
SEWERS--STORM

Provides information and guidelines for local government water resource supervisors who are contemplating the possible incorporation of automation as a means of upgrading the effectiveness of their facilities. (tables, figures)

Developing an effective storm drainage maintenance program / by Marc Engemoen ...[et al.]. -- p. 84-89. In Public works. -- Vol. 116, no. 6 (June 1983)
SEWERS--STORM

A sound preventative maintenance system coupled with design to minimize maintenance in the first place avoids problems in the stormwater utility for Fort Collins, Colorado. (photos)

Maximizing storage in combined sewer systems / by Municipality of Metropolitan Seattle for the Office of Research and Monitoring, Environmental Protection Agency. -- Washington, DC : EPA, Dec. 1971. 227 p. -- (Water pollution control research series)
SEWERS--STORM

Interim report of a project aimed at eliminating or minimizing overflows in a combined sewer system. (The overflow is a result of excessive amount of stormwater entering sewer systems of limited design capability.) The project is based on computer control of sewage collection, treatment, and disposal. (tables, figures, photos)

5. MANAGEMENT REGULATIONS

Boulder (CO)
Storm water and flood management utility. In [Boulder municipal code]? -- Chapter 5 of Title 11, sections 11-5-1 to 11-5-9, adopted by ordinance no. 4749 (198-)
MTAS ordinance no. 2774 (SEWERS AND SEWAGE DISPOSAL)

Establishes a master plan for stormwater and flood management, a stormwater and flood management utility, reasonable stormwater and flood management fees, and encourages and facilitates urban water resources management techniques.

Farragut (TN)
Drainage ordinance of the Town of Farragut, Tennessee. -- p. 371-396. In The Farragut Municipal Code. -- Chapter 8, Sections 4-801 to 4-831, ordinance no. 83-1 (1983)
MTAS ordinance no. 2683 (SEWERS AND SEWAGE DISPOSAL)

Purpose is to lessen or avoid hazards to persons and property caused by increased stormwater runoff or by obstructions to drainage. Paramount objective is to prompt stormwater management. (figures)

First Tennessee-Virginia Development District 208 Water Quality Management Program : final report : stormwater management ordinance study. -- [S.l.] : Stanley Consultants, Dec. 1981. 1 v. (various pagings).
SEWERS--STORM

Study of stormwater management ordinances of Tennessee cities including Bluff City, Bristol, Church Hill, Elizabethton, Johnson City, Jonesborough, Kingsport, Mt. Carmel, and Watauga.

Knoxville (TN)
City of Knoxville storm water detention ordinance. -- p. 348-351. In Charter and code of ordinances of the City of Knoxville, Tennessee. -- Article III, sections 10-42 to 10-48, ordinance no. 6191 (10-5-76)

Intent is to minimize increases in peak flow rates of stormwater runoff caused by urban development of watersheds and to establish procedures to fulfill that purpose.

Model stormwater management ordinance / prepared by Southwestern Illinois Metropolitan and Regional Planning Commission with the assistance of Black & Veatch Consulting Engineers and Richard K. Thompson. -- [S.l.] : Illinois Department of Transportation, Division of Water Resources, Dec. 1982. 39 p. -- (Local assistance series ; 4B)
SEWER--STORM

Provides detailed information on regulating new subdivisions and other developments to ensure that they will properly manage their stormwater runoff. This model ordinance should be adopted, supplemented, and amended as necessary to reflect the findings and policy of the individual unit of government. (tables, figures)

Monterey (TN)
Drainage. -- p. 26-28. In Subdivision regulations of Monterey Municipal Planning Commission. -- Article III, section E (1973)
MTAS ordinance no. 2457 (SUBDIVISIONS)

Includes sections on street draining, spring and surface water, storm drainage, accommodation upstream development, responsibility downstream, and land subject to flooding.

Naperville (IL)
An ordinance amending chapter 12, plumbing, sewers and water by the addition of article IX, storm runoff control. -- Ordinance no. 72-74. (Approved 12-11-72)
SEWERS--STORM

Intent is to eliminate the storage or transportation of excess stormwater in or through habitable structures. The use of "natural" paths or stormwater runoff to form the "by-pass" channel and the restriction of this channel to form storage areas is encouraged.

Naperville (IL)
An ordinance amending section 12.903 of article IX, storm runoff control, of chapter 12, plumbing, sewers and water, of the municipal code of the City of Naperville of 1960, as amended. -- Ordinance no. 75-76. (Approved 8-19-75). 2 p.
SEWERS--STORM

Expands section on adherence to approved plans, enforcement, right of appeal, and penalties.

Nashville (TN)
Storm water management. -- p. 1222.4-1222.17. In The Code of the Metropolitan Government of Nashville and Davidson County, Tennessee. -- Article III, sections 40-1-226 to 40-1-234, bill no. 78-840 (10-3-78)

Establishes metropolitan stormwater management committee, floodplain requirements, and requires the review of building permit applications and development plans.

Suggested on-site stormwater detention ordinance : a guide for local officials. -- Chicago : Northeastern Illinois Planning Commission, March 1980; second printing, July 1982. ca. 65 p.
SEWERS--STORM

A model ordinance to assist local units of government in developing their own regulations. Developed primarily for Northeastern Illinois governments. (tables, figures)

6. EROSION AND SEDIMENT CONTROL

A. GENERAL CONTROL

Community action guidebook for soil erosion and sediment control / by Mel D. Powell ... [et al.]. -- Washington, DC : National Association of Counties Research Foundation, Mar. 1970. 64 p.
SOIL EROSION

Discusses various aspects of soil and sediment control -- organizing a program, legal authority, financing, implementation and control, and public acceptance and support. (tables, figures, photos)

Residential erosion and sediment control : objectives, principles and design considerations. -- Washington, DC : Urban Land Institute : National Association of Home Builders ; New York : American Society of Civil Engineers, c1978. 63 p.
SOIL EROSION

Concerned with the setting of objectives, principles, and design considerations to be applied to the development of erosion and sediment control systems to serve residential communities. The authors hope to stimulate communities to rethink current erosion and sediment control practices and to adopt those which are responsive to local conditions and supportive of basic objectives and principles presented herein. (figures, photos)

B. PLANNING AND DESIGN

Erosion & sediment control handbook. -- Knoxville, TN : Knox County Soil Conservation District, Jun 1981. 145 p.
SOIL EROSION

Effective erosion control and sediment reduction depends upon careful planning and the selection of practices that are adequately designed, accurately installed and properly maintained. Contains tried and proven ways to control erosion and reduce sediment. Intends to help city and county officials develop and administer erosion and sediment control program in developing areas. Contains standards, specifications, and guidelines. (tables, figures)

Iowa City (IA)
Revisions to design standards for public works improvements, Iowa City, Iowa, section X - erosion and sedimentation control. -- [Iowa City : The City, 197-]. 21 p.
SOIL EROSION

The guidelines contained in this manual are specifications for erosion and sedimentation control. Describes methods and procedures for gaining satisfactory results. (tables, figures, photos)

Virginia erosion and sediment control handbook. -- 2nd ed. -- Richmond, VA : Virginia Soil and Water Conservation Commission, 1980. 1 v. (loose-leaf).
SOIL EROSION

Establishes new state minimum criteria, standards, and guidelines for the control of soil erosion and sedimentation on "land disturbing activities" in Virginia, and to provide guidelines for the implementation of those standards in accordance with State Law. (tables, figures)

C. CONTROL TECHNIQUES

Buxton, Herb
Evaluation of selective erosion control techniques : Piedmont Region of S. E. United States / by Herb Buxton and Frank T. Caruccio. -- Cincinnati : Municipal Environmental Research Laboratory, EPA, Dec. 1979. 117 p.
SOIL EROSION

Commercially available soil stabilizers, including chemical tackifiers, hydromulches and blanket (netting) products and combinations, thereof, were tested in the Piedmont of South Carolina. The test site was designed to provide a quantitative assessment of treatment effectiveness. A cost analysis showed that some of the more successful treatments are too expensive to be applied routinely over large areas. (tables, figures, photos)

Erosion control with wood chips on newly graded areas : interim report. -- Arlington, VA : Federal Highway Administration, Research and Development Demonstration Projects Division, July 1970. 27 p. -- (Demonstration project ; no. 6)
SOIL EROSION

The objective of this project is to demonstrate the practicality of salvage and conversion of woody vegetation into wood chips for erosion control on newly graded areas. (tables, photos)

Jontos, Robert J.
Using vegetation for nonstructural sediment control / Robert J. Jontos and Christopher P. Allan. -- p. 88-89. In Public works. -- Vol. 115, no. 3 (Mar. 1984)
DRAINAGE

Plants can provide satisfactory sediment control and use of natural systems is cost-effective. Discusses example of planting cattails in a drainage swale to help remove sediment from highway runoff. (table, figure, photos)

Martin, James S.
Erosion control and revegetation mats : a cost-effective approach / James S. Martin. -- p. 70, 71, 106, 108. In Public works. -- Vol. 116. no. 3 (Mar. 1985)
SOIL EROSION

Case histories illustrate the types of projects where the use of erosion control and revegetation mats is appropriate.

D. INVENTORIES

Critical erosion areas in Knoxville and Knox County : Knoxville-Knox County 208 Areawide Water Quality Management Plan. -- Knoxville, TN : Knoxville-Knox County Metropolitan Planning Commission, Mar. 1981. 66 p.
SOIL EROSION

Designed to provide an inventory of the critical erosion areas, a measure of their size, and an estimation of the amount of soil lost in each watershed. The information in this report will help to focus the work scope of soil erosion problems and facilitate the mitigation of erosion problems and upgrading water quality. (tables, figures)

E. REGULATIONS

Brentwood (TN)
Policy governing erosion control and storm water management. -- p. 827-828. In The Brentwood Municipal Code. -- Chapter 16A, sections 11-16A01 and 11-16A02, ordinance no. 82-16.
MTAS Ordinance No. 2687 (SUBDIVISIONS)

Purpose is to prevent erosion during and subsequent to development, to substantially reduce the speed that storm water runs off new development, and to establish reasonable criteria for development to minimize potential flooding damage.

Elizabethton (TN)
Erosion and sedimentation control ordinance of the City of Elizabethton, Tennessee. -- p. 969-976. In The Elizabethton Municipal Code. -- Chapter 10, sections 11-1001 to 11-1007, ordinance no. 18-3.
MTAS ordinance No. 2686 (SUBDIVISIONS)

If land is to be developed by grading, filling, removal or destruction of topsoil, trees, etc., developer must prepare a site plan for erosion and sedimentation control. Ordinance includes site plan and workable agreement standards.

Erosion and runoff ordinances. -- p., 104-112. From unidentified source. Includes 1) Ordinance of DeKalb County, Georgia: 2) Ordinance of Marion County, Florida; 3) Subdivision regulations of the City of Tallahassee and Leon County, Florida (Drainage Section); and 4) Storm runoff control ordinance of Naperville, Illinois.
SOIL EROSION

Farragut (TN)
Farragut erosion control ordinance. -- p. 353-365. In The Farragut Municipal Code. -- Chapter 7, sections 4-701 to 4-727, ordinance no. 82-84 (1982)
MTAS ordinance no. 2578 (ENVIRONMENT)

Intent is to substantially reduce existing and future erosion and sedimentation damage in the town. Includes developmental and permit requirements.

Memphis (TN)
Soil erosion. -- p. 55. In Subdivision regulations of Memphis and Shelby County. -- Section 506 (1984)
MTAS ordinance no. 2696 (SUBDIVISIONS)

Provides for submission of a plan and schedule for soil erosion and sedimentation control by subdivider.

Model grading and sediment control ordinance: with a procedure to eliminate soil loss resulting from water erosion on development areas and conservation practice standards & specifications for urban areas / prepared by Mid-America Association of Conservation Districts in cooperation with Mid-American Regional Council, Soil Conservation Service. -- Independence, MO : Mid-American Association of Conservation District, Mar. 1977? 49 p.
SOIL EROSION

Includes model ordinance as well as standards and specifications which establish uniform criteria for the design, installation and maintenance of erosion and sediment control practices in urban areas. (tables, figures)

Pittsburg (CA)
Grading, erosion, and sediment control. -- p. 265-20 to 265-39. In Municipal code of Pittsburg, California. -- Chapter 15.88, ordinance no. 856 (1984)
MTAS ordinance No. 2684 (SUBDIVISIONS)

Adopted to provide stringent control of all aspects of grading operations within the city limits.

Warwick (RI)
Soil erosion ordinance. -- p. 837-847. In Municipal code of Warwick, Rhode Island. -- Chapter 18 1/2, sections 18 1/2-1 to 18 1/2-11, ordinance no. 0-77-27 (10-11-77)
MTAS ordinance no. 2351 (SUBDIVISIONS)

Provides for the submission of a plan for erosion and sedimentation control by developers.

7. BIBLIOGRAPHY

Vance, Mary
Storm sewers : monographs / by Mary Vance. -- Monticello, IL : Vance Bibliographies, June 1984. 10 p. -- (Public administration series : bibliography ; P-1466
SEWERS--STORM--BIBLIOGRAPHIES

Bibliography of monographs on topics related to storm sewers. Includes references to bibliography, law and legislation, research, standards, and data processing.