

## Chapter 525

### STORM WATER MANAGEMENT PLAN

#### ARTICLE I

#### General Provisions

**Section 525.010. Generally.** [R.O. 2012 §525.010; Ord. No. A-5926 §1, 6-9-1994; Ord. No. A-7097, 10-26-2001; Ord. No. 7304, 4-14-2003; Ord. No. 7422, 6-1-2004; Ord. No. 7988 §§1 — 2, 8-20-2010]

A. Current and enforceable municipal ordinances, regulations, and statutory requirements notwithstanding:

1. The applicant for a building permit shall submit with the application, plans, drawings, and any other such information required by this Chapter for the management and control of surface water runoff from the tract or tracts for which the permit is requested, and to provide that temporary flooding does not occur to other properties during construction.
2. Any person or party submitting a final subdivision plat for consideration and approval under the subdivision and zoning ordinance in effect at the time of submittal shall submit plans, drawings, and any other such information required by this Chapter for the management and control of surface water runoff from the tract or tracts to be subdivided, and to provide that temporary flooding does not occur to other properties during construction.
3. Any person or parties prior to grading, excavating, ditching, or otherwise implementing activities that would alter the topography of an area or contiguous areas greater than ten thousand (10,000) square feet, or alter, channelize, rechannel, or modify a natural or man-made watercourse shall first submit to the City Engineer of the City of Monett, plans, drawings, calculations, and other information required by this Chapter for the management and control of surface water runoff from the area to be altered, or surface water conveyed by any natural or manmade watercourse, and to provide that temporary flooding does not occur to other properties during construction.
4. Any person or party submitting plans for new development or construction of any commercial or industrial property that exceeds a detention volume of five hundred (500) cubic feet shall submit plans, calculations and any other information required by this Chapter for the management and control of surface water runoff from the property. Such person or party shall also provide and maintain temporary straw bales and silt fences as necessary to

control flooding, erosion and/or silt deposition from off the property. If, at any time, the cumulative total of detention volume for a development or commercial or industrial construction project exceeds five hundred (500) cubic feet, the responsible person or party shall comply with the provisions of this Section.

5. The requirement for storm water detention may be waived for property which lies inside the FEMA 100-year floodplain.

**Section 525.020. Surface Water Runoff Management and Control.** [R.O. 2012 §525.020; Ord. No. A-5926 §II, 6-9-1994]

- A. The applicant or the person or party submitting a final subdivision plat shall retain the services of a professional engineer, registered in the State of Missouri, to provide under his/her professional seal and signature the surface water runoff management and control plans, drawings, calculations, and information required under Article III of this Chapter.
- B. All facilities constructed or required to be constructed for approval of a final subdivision plat for the management and control of surface water runoff, shall, during and upon completion of construction, be inspected by a professional engineer licensed in the State of Missouri. Upon completion of construction of the surface water runoff management and control facilities, the City Engineer of the City of Monett shall receive from the professional engineer certification that the said facilities have been completed and constructed in accordance with the intent of the plans, drawings, and calculations upon which permits or approval were issued.
- C. Upon written request by the building permittee or person or parties submitting a subdivision plat, the City, upon receipt of fees established by the Superintendent of Utilities, shall retain the services of a professional engineer licensed in the State of Missouri to perform the inspection and provide certification requirements of Subsection (B).
- D. In the event certification of completion and compliance with plans, drawings and calculations are not received by the City Engineer of the City of Monett, or should the City Engineer determine the improvements facilities as described in the approved plans are not being constructed to meet minimum standards set forth in Article III of this Chapter, then the City Engineer shall so notify the permittee and may issue an order revoking the building permit, or recommend to the Governing Body to discontinue provision of municipal utilities until the deficiencies are corrected.

**Section 525.030. Obstruction of Watercourses Prohibited.** [R.O. 2012 §525.030; Ord. No. A-5926 §III, 6-9-1994]

- A. It shall be unlawful for any person to block, obstruct, destroy, cover, fill, or alter in any way a watercourse or any part thereof so as to cause damage to the property of other persons from surface water.

- B. A watercourse is land which has a conformation so as to give to surface water flowing from one tract of land to another tract of land, a fixed and determinate course so as to uniformly discharge it upon the servient tract at a fixed and definite point. It shall include, but shall not be limited to, ravines, swales, sinkholes, or depressions of greater or less depth extending from one tract and so situated as to gather up the surface water flowing upon the dominant tract and to conduct along a definite course to a definite point of discharge upon the servient tract. It shall not be deemed to be important that the force of water flowing from one tract of land to another has not been sufficient to wear out a channel or canal having definite or well-marked sides or banks. If the surface water, in fact, uniformly or habitually flows over a given course having reasonable limits as to the width of the line of its flow, it shall be considered to have a definite course.
- C. A violation of Subsection (A) hereof shall be deemed to be a public nuisance. Whenever the City Engineer of the City of Monett has determined that a person has blocked, obstructed, destroyed, covered, filled, or altered in any way a watercourse so as to cause surface water damage to the property of others, the City Engineer is authorized to proceed in accordance with Monett City Code so as to abate the public nuisance.
- D. In reviewing applications for building permits, the City shall further determine if the work interferes with the use and operation of existing watercourses. If the City has reason to believe that the work may interfere with the use and operation of existing watercourses, then the City shall notify the applicant and request information or revisions to the plans and drawings stipulated in Section 525.010. When determined by the City Engineer to be necessary, the applicant shall comply with the provision set forth in Section 525.020 of this Chapter.

**Section 525.040. Wastewater Discharge.** [R.O. 2012 §525.040; Ord. No. A-5926 §IV, 6-9-1994]

- A. Storm water and all other unpolluted waters shall be discharged to storm sewers or waters of the State.
- B. It shall be unlawful to discharge into any storm sewers and/or waters of the State within the City or in any area where there is an availability of sanitary sewers any waste water or pollutant, except where suitable treatment has been provided and approved by the City and the State of Missouri under the National Pollution Discharge Elimination System (NPDES).
- C. Violations of this Section shall be subject to the enforcement procedures contained in Wastewater Regulations of the Monett City Code.

**Section 525.050. Maintenance of Surface Water Runoff Control Facilities.** [R.O. 2012 §525.050; Ord. No. A-5926 §V, 6-9-1994]

- A. When any Surface Water Runoff Control Facility (hereafter called Facility) is located on the same lot or tract it is intended to serve, the facilities shall be maintained at all times by the owner of the lot or tract. Unless otherwise approved

by the City, such facility shall not be constructed on separate lots and no building permit shall be issued for any such facility if it is located on a lot or tract of land other than the lot or tract of land it is intended to serve.

- B. When the Facility is designed to serve more than one lot or tract, the City may permit the construction of such facilities on a lot other than the lot or tract the facility is intended to serve, if it is determined that there are sufficient easements and covenants filed of record with the County Recorder of Deeds imposing the duty and responsibility to maintain the facilities, together with the liability for the costs of such maintenance upon the owners of each of the lots served by the Facility and further covenanting that the assessed costs of any repairs and maintenance work done by the City shall be a lien enforceable against each of the lots so served. The City shall require as a precondition to the issuance of a building permit that the owner of the property file such covenants and easements with the County Recorder of Deeds allocating such obligations and liabilities for the cost of the maintenance of the Facility, which covenants and easements shall secure the right of the City to execute remedies and the power to assess the costs thereof against each lot served by the Facility.
- C. In the event the owners of the lots or tracts served by the Facility fail to maintain the Facility, then the City, upon ten (10) days written notice, may revoke the occupancy permit issued for such premises and in addition thereto, or in the alternative, may order utilities disconnected. Any aggrieved owner shall have the right to an administrative hearing prior to revocation of the occupancy permit or disconnection of utilities, to determine whether the Storm Water Detention Facility has been maintained so as to meet the standards set forth, provided the owner has filed a written demand for hearing with the City within ten (10) days after notice was given. The hearing shall be conducted before a hearing officer designated by the City within twenty (20) days of receipt of the owner's demand for hearing, and at the conclusion of the hearing, the hearing officer shall prepare a written decision setting forth his/her findings of fact and conclusions. The decision of the hearing officer shall be final for purposes of Chapter 536, RSMo., as revised or amended.
- D. *Failure To Maintain Declared A Nuisance — Assessment Of Costs As A Lien.* If the owners of the lots or tracts served by the Facility fail to adequately maintain the Facility, the same is hereby declared to be a nuisance and the City may require abatement of the nuisance under the procedures set forth in the Monett City Code. In addition to the procedures set forth above, or in the alternative, upon determining that a nuisance exists, City Officials may refuse to issue or renew City licenses for any business on any lot or tract served by the Facility.

**Section 525.060. Development in Areas of Karst Geological Characteristics and Sinkholes.**  
[R.O. 2012 §525.060; Ord. No. A-5926 §VI, 6-9-1994]

- A. No person shall engage in the altering of topography, grading, excavating, or the development of land in a sinkhole area without first securing a permit from the City. To obtain a permit, the owner of the property or person having an interest therein shall submit an application for a permit to the Director of Public Works with

a plan set out in Section 525.030, which shall contain the following additional information:

1. The plan shall show the location of the sinkhole, the immediate sinkhole drainage area, a sinkhole cluster area, or portions of such items, along with ground contours, a storm water analysis of the sinkhole, and significant physical features on the property.
  2. Upon review of the information presented by the applicant, the site, and such other information as may be available, the City may issue a permit for work to be performed in the sinkhole area. All work shall be performed in accordance with the permit. The City may designate certain areas where grading or construction equipment is not permitted or is otherwise limited.
- B. In addition to establishing a plan for grading and use of construction equipment, the City may, based upon the topography, geology, soils, and history of the sinkhole (such as past filling) and the storm water analysis and plan of the developer's engineer establish sinkhole-related non-buildable areas. No buildings, parking areas, grading, or other structures shall be permitted within the sinkhole-related non-buildable area unless otherwise authorized by the City.
- B. This non-buildable area shall follow the limits of the sinkhole in most cases. However, the non-buildable area may be expanded or contracted by action of the City where warranted, due to the nature of the specific sinkhole, the underlying geology, soils, drainage, and any related information, such as depth to bedrock. In sinkhole cluster areas, the City may require the owner or developer to provide recommendations from a consulting engineer and a consulting hydro-geologist, based upon substantial and state-of-the-art field studies and evaluation of the specific sinkhole system. Such studies shall be submitted to the City's Authorized Representative for review.
- C. Development may occur in the immediate sinkhole drainage area if the developer provides alternative surface drainage away from the sinkhole, while keeping the water in the same surface drainage basin; and provided further that the water shall not go into another stream of known flooding problems. The immediate sinkhole drainage area (or portion thereof) which cannot be provided with an alternative drainage system can be deleted from the development area and can be used to meet open space requirements. The developer may request the Planning and Zoning Commission and the City that the density on the remainder of the developable area be increased, with the total resulting density no greater than if the entire area were developed to the permitted density under the Zoning Code.

**Section 525.070. Municipal Storm Water Management Plan.** [R.O. 2012 §525.070; Ord. No. A-5926 §VII, 6-9-1994]

- A. Whereas it has become apparent to the City Council of the City of Monett, Missouri that growth and development of residential, commercial, industrial, and institutional elements within the corporate limits is adversely impacted by unchecked storm water and surface water runoff, and that it is in the best interest of the health, safety,

and welfare of its citizens to provide for coordination, control, and planning of means to manage and control the routing, flow rate, detention, and discharge of these waters, the City Council of the City of Monett ordains as follows:

1. The Superintendent of Utilities is empowered and directed to implement reviews, studies, examinations, and surveys and to prepare and present to the City Council of the City of Monett, and to the various departments and administrative divisions thereof, a plan for the management and control of storm waters, surface runoff waters, and other waters resulting from precipitation in liquid and solid form;
  2. The Superintendent is empowered to retain the services of professionals and specialists experienced and skilled in the various disciplines required in the formulation and development of the plan;
  3. The plan shall include all areas within the present corporate limits, and address areas beyond the present corporate limits where topographic, geologic, and hydrologic features might generate, affect, impact, or influence the persons and property within the City of Monett.
- B. The plan shall be presented to the City Council for consideration and review within two (2) consecutive calendar years from June 9, 1994.

**Section 525.080. Enforcement and Liability.** [R.O. 2012 §525.080; Ord. No. A-5926 §VIII, 6-9-1994]

- A. In enforcing the provisions of the aforesaid Sections, in addition to the various remedies provided therein, the City shall have all other rights, powers, and authority granted to it by Missouri law, including without limitation the right to file civil suit against any person who violates or fails to comply with the aforesaid Sections. In the event of civil suit, the City may recover reasonable attorney's fees, court costs, and other expenses of litigation.
- B. No person issued a permit under the terms of the aforesaid Section shall have any recourse whatsoever against the City for any loss, cost or expense, or damage arising out of any of the provisions or requirements of these Sections, or because of the enforcement thereof by the City. These Sections shall not create liability on the part of the City, its officers, agents or employees as the result of reliance on any permits issued hereunder or as the result of any administrative decision lawfully made hereunder.

## ARTICLE II Storm Sewer and Drainage Design

**Section 525.090. Minimum Requirements For Storm Sewer and Drainage Design.** [R.O. 2012 §525.090; Ord. No. A-5926 part 1 §A, 6-9-1994; Ord. No. A-7097, 10-26-2001]

- A. *Drainage Area Plan.* A plan of the drainage area at a scale of one (1) inch = one hundred (100) feet with two (2) foot contour intervals using USGS Datum for areas less than one hundred (100) acres or a plan of the drainage area at a scale of one (1)

inch = three hundred (300) feet with five (5) foot contour intervals for larger areas. This plan shall include all proposed streets, drainage, and grading improvements with flow quantities and direction of flow at all critical points. All areas and sub-areas for drainage calculations shall be clearly distinguished.

- B. *Hydraulic Data.* Complete hydraulic data showing all calculations shall be submitted. A copy of all nomographs and charts used in the calculations shall be submitted if other than those included herein are utilized.
- C. *Plan And Profile.* A plan and profile of all proposed improvements at a scale of 1 inch = 40 feet horizontal and 1 inch = 4 feet vertical shall be submitted. This plan shall include the following:
  - 1. Locations, sizes, flow line elevations and grades, type of pipe, channels, boxes, manholes, and other structures drawn on standard plan-profile sheets;
  - 2. Existing and proposed ground line profiles along centerline of the drainage improvement;
  - 3. A list of the kind and quantity of material;
  - 4. Typical sections and reinforcement of all boxes and channels;
  - 5. Location of property lines, street paving, sanitary sewers, and other utilities, both public and private.
- D. *Field Study.* A field study of the downstream capacity of all drainage facilities and the effect of additional flow from the area to be improved shall be submitted. If the effect is to endanger property or life, the problem must be solved before the plan will be given approval.
- E. *Storm Water Flow Quantities.* Storm water flow quantities in the street shall be shown at all street intersections, all inlet openings, and at locations where flow is removed from the streets. This shall include the hydraulic calculations for all inlet openings and street capacities. Street flow shall be limited according to Table 1 at the end of this Article.
- F. *Sinkholes Or Karst Areas.* Sinkholes or karst areas shall be clearly defined. If any portion of the storm water from an area is to be drained into a sinkhole, all information available shall be obtained and the capacity of the sinkhole shall be studied and this study shall be submitted to determine the effect of the drainage and pollution on ground water and streams.
- G. *Additional Information.* Any additional information deemed necessary by the Superintendent of Utilities for an adequate consideration of the storm drainage effect on the City of Monett and surrounding areas must be submitted.
- H. Discharge flow from the storm water detention outlet structure shall be directed into existing channels, existing natural draws, watercourses, drainage easements or to public rights-of-way. Discharge flow shall connect to existing downstream storm sewers if directed by the City of Monett.

- H. *Discharge to Developed Property that Contains Existing Structures or Improvements:*
- H. The developer shall obtain drainage easements across already-developed property and construct facilities to drain to existing channels, existing natural draws, watercourses, drainage easements, or to the public right-of-way.
- H. *Discharge to Undeveloped Property that Does Not Contain Existing Structures or Improvements:*
- H. The developer shall discharge water to a point, existing channel, existing natural draw or water-course that will contain a drainage easement in the future when the property develops.

**Section 525.100. Requirements Relating To Improvements.** [R.O. 2012 §525.100; Ord. No. A-5926 part 1 §B, 6-9-1994]

A. *General Design Requirements.*

1. All bridges shall be designed to accommodate a one hundred (100) year frequency rain. Box culverts, pipe culverts, channels, and ditches shall be designed to accommodate a one hundred (100) year frequency rain at all locations having a drainage area in excess of 1.00 square mile. Locations having a drainage area of less than or equal to 1.0 square mile shall be designed to accommodate a twenty-five (25) year frequency rain.
2. Channel improvement types shall be as follows:
  - a. Improvements with a capacity of up to and including 10 C.F.S. shall be open and (1) sodded; or (2) concrete paved invert; (3) concrete lines; or (4) closed conduit;
  - b. Improvements with a capacity above 10 C.F.S. up to and including 100 C.F.S. shall be closed conduit;
  - c. Improvements with a capacity above the 100 C.F.S. up to and including 250 C.F.S. may be open and (1) concrete paved invert; or (2) concrete lined; or (3) closed conduit;
  - d. Improvements with a capacity above 250 C.F.S. shall be open and (1) concrete lined; or (2) have a 100 C.F.S. low flow paved invert.

B. *Specific Requirements For Various Improvements.*

1. *Bridges and culverts.* Bridges, box culverts, or concrete pipe culverts shall be provided where continuous streets or alleys cross watercourses. The structure shall be designed in accordance with City specifications for materials and to carry HS-20 loadings in all cases.
2. *Closed storm sewers.* Closed storm sewers shall either be reinforced concrete box or pipe of approved type designed for HS-20 loadings. Reinforced

concrete pipe or reinforced concrete boxes must be used within two (2) feet of the back of the street curb and under paved areas.

2. All storm sewers having trench walls within two (2) feet of the back of the street curb shall be backfilled with granular material. The use of corrugated steel, zinc-coated pipe and extra strength clay pipe, will not be permitted within two (2) feet of the curb or under pavement areas. All pipe materials shall meet the requirements of the latest revision of the City of Monett Standard General Conditions and Technical Specifications for Public Works Construction.
2. Grades for closed storm sewers shall be designed so that the velocity shall not be less than three (3) feet per second nor exceed twelve (12) feet per second. All other structures such as junction boxes or inlets shall be in accordance with the Standard Drawings adopted by the City of Monett.
2. Closed storm sewers shall extend to the furthest downstream point of development with consideration given to velocities and to providing discharge energy dissipators to prevent erosion and scouring along downstream properties.
3. *Open paved concrete channels.* Grades for open paved channels shall be designed so that the velocity shall not be less than three (3) feet per second nor exceed twelve (12) feet per second. Such concrete channels may be of different shapes according to existing conditions; however, a channel with a flat bottom and 4:1 to 5:1 side slopes is the most desirable type and shall be used whenever possible. The thickness of channel paving shall depend on conditions at site and size of channel; however, a minimum thickness of six (6) inches is required. A six (6) inch freeboard must be provided. An eighteen (18) inch toe wall is required at both the outlet and inlet ends of the channel.
4. *Open ditches (earth channels).* Ditches shall have a gradient that limits the velocity within 1.5 to 5.0 feet per second depending on existing soil conditions. Such ditches shall have a minimum side slope ratio of 3:1. The designer's attention is directed to the fact that the Subdivision Regulations prohibit encroachment of buildings and improvements on natural or designated drainage channels or the channel's flood plains. Such flood plains are areas of land adjacent to an open paved channel or an open sodded ditch that may receive a flood condition from a one hundred (100) year frequency rain. The limits of such flood plains shall be indicated on drainage improvement plan.

**Section 525.110. Runoff Calculations.** [R.O. 2012 §525.110; Ord. No. A-5926 part 1 §C, 6-9-1994]

- A. The rate of runoff concentrated at any point shall be determined by the Rational Formula:

$$Q = CIA, \text{ in which}$$

- Q = Runoff in cubic feet per second
- C = The runoff coefficient for the area
- I = Design rainfall intensity in inches per hour over the area based on time of concentration and rainfall intensity curves included as a part of this Article.

A 5-minute time of concentration is the minimum permitted.

A = Drainage area, in acres.

1. *Runoff coefficient.* The runoff coefficient "C" is the variable in the Rational Formula least susceptible to precise determination and the one that requires the greatest exercise of engineering judgment because of the many area characteristics which affect the coefficient. Among the factors to be considered in influencing the runoff coefficients are the following: present and future zoning; terrain; local ponding or depressions; the amount of pavement; roofs, turf, and other areas having different degrees of imperviousness.
1. The selection of a coefficient should take into consideration the probable ultimate development of presently undeveloped areas. Suggested values of runoff coefficients are included in the following table:

**Suggested Runoff Coefficients "C"**

<b>"C" Value</b>	<b>Surface Conditions</b>
.10-.15	Tall grass, brush
.15-.20	Parks, golf courses, farms, and one (1) acre single-family residences
.35	Single-family residences on lots of not less than 15,000 square feet
.45	Single-family residences on lots of not less than 10,000 square feet
.47	Single-family residences on lots of not less than 7,500 square feet
.51	Single-family residences on lots of not less than 6,000 square feet
.90	Gravel surfaces
.95	Asphalt and concrete surfaces
1.00	Buildings and other structures

2. *Rainfall intensity.* The average frequency of rainfall occurrence used for design determines the degree of protection afforded by a drainage system.
2. Maximum intensity of rainfall of a given expectancy is greater for a short period of time than for longer periods. Therefore, it is assumed that the maximum runoff will occur as soon as all parts of the drainage area under consideration are contributing. The length of time from the beginning of rainfall until runoff from the most remote point in the drainage area reaches the point under consideration is called the time of concentration. This may include overland flow time and channel or gutter flow time. Nomographs

which may be used for determining time of concentration are reproduced at the end of this Chapter. Once the time of concentration is known, the design intensity rainfall may be determined from the rainfall intensity curves developed from U.S. Weather Bureau data.

**Section 525.120. Sizing of Storm Sewers and Drainage Structures.** [R.O. 2012 §525.120; R.O. 2012 Tbl. 1 to Section 525.120; Ord. No. A-5926 part 1 §D, 6-9-1994; Ord. No. A-5926 Tbl. 1, 6-9-1994]

A. The size of closed storm sewers, open channels, culverts, and bridges shall be designed so that their capacity will not be less than the runoff computed by using the Manning Formula:

A.  $Q = 1.486/n ar^{2/3} s^{1/2}$

A. Q = Capacity = Discharge in cubic feet/sec.

A. a = Cross sectional area of water in conduit or channel in square feet

A. r = Hydraulic radius of water in conduit or channel = area/wetted perimeter

A. s = Mean slope of hydraulic gradient in feet per foot

A. n = Roughness coefficient based on condition and type of material of conduit or channel lining

B. Values of "n" for various kinds of pipe for use in Manning Formula

Concrete Pipe	0.013
Corrugated Metal Pipe	0.024
Concrete Lined Channel	0.015
Earth Channels	0.030 to 0.050

C. *Design Tabulations.* For systems of storm sewers with inlets in various locations, the time of concentration at any point will be time of concentration at the most remote inlet upstream, plus the flow time in the storm sewer to the point under consideration. Computations for systems lend themselves readily to tabulation showing the drainage area, time of concentration runoff, and capacity of each inlet and section of sewer under consideration. This data is to accompany the improvement plans.

**TABLE 1 TO SECTION 525.120.STREET FLOW**

Street flow shall be limited by pavement encroachment and depth of flow as follows:

Street Classification	*Maximum Encroachment of a two (2) year storm
Local	No curb overtopping. Flow may spread to crown of street

Collector No curb overtopping. Flow spread must leave the equivalent of one (1) ten (10) foot driving lane clear of water.

Arterials No curb overtopping. Flow spread must leave the equivalent of two (2) ten (10) foot driving lanes clear of water.

\*Where no curbing exists, encroachment shall not extend past property lines.

The storm sewer system shall commence at the point where the volume of flow equals 5 cfs.

### ARTICLE III

#### **Storm Water Detention Requirements For Public and Private Improvements**

**Section 525.130. Generally.** [R.O. 2012 §525.130; Ord. No. A-5926 part II §A, 6-9-1994]

- A. Storm water runoff and the velocity of discharge are considerably increased through development and growth of the City.
- B. Prior to the development of the land, surface conditions provide a higher percentage of permeability and longer time of concentration. With the construction of buildings, parking lots, etc., permeability and the time of concentration are significantly decreased, resulting in an increase in both the rate and volume of runoff.
- C. These modifications may create harmful effects on properties downstream. Therefore, to minimize these effects, the following minimum storm water detention requirements have been established.

**Section 525.140. Storm Water Detention Plans.** [R.O. 2012 §525.140; Ord. No. A-5926 part II §B, 6-9-1994]

- A. A complete set of storm water detention plans and calculations shall be provided for all construction projects that increase storm water runoff.
- B. Plans for the construction of public improvements shall be submitted to and approved by the Superintendent of Utilities.
- C. The required storm water detention plans for private improvements shall be submitted, along with the building plans, to the Superintendent of Utilities for review and approval. An escrow for storm water detention will not be accepted.

**Section 525.150. Method of Evaluation.** [R.O. 2012 §525.150; Ord. No. A-5926 part II §C, 6-9-1994]

- A. Differential runoff evaluation consists of the determination of the rates of runoff, before and after development, determination of required volume of detention, and verification of adequacy of discharge and control structures. The one hundred (100)

year (frequency) runoff coefficients shall be used. Differential runoff rates shall be evaluated by equation:

$$R = (Cd \times 1100) - (Cu \times 1100).$$

Where:

- R = Differential Runoff Rate
- Cd = Runoff Coefficient for developed conditions
- Cu = Runoff Coefficient for undeveloped conditions
- 1100 = Intensity for one hundred (100) year storm

"C" values shall be determined from the following table:

### Suggested Runoff Coefficients

"C" Value	Surface Conditions
.10-.15	Tall grass, brush
.15-.20	Parks, golf courses, farms, and one (1) acre single-family residences
.35	Single-family residences on lots of not less than 15,000 square feet
.45	Single-family residences on lots of not less than 10,000 square feet
.47	Single-family residences on lots of not less than 7,500 square feet
.51	Single-family residences on lots of not less than 6,000 square feet
.90	Gravel surfaces
.95	Asphalt and concrete surfaces
1.00	Buildings and other structures

- B. Use the Appendix A included to find time of concentration (tc) then use Appendix B included to determine intensity (1). A five (5) minute time of concentration is the minimum permitted.

**Section 525.160. Volume of Detention.** [R.O. 2012 §525.160; Ord. No. A-5926 part II §D, 6-9-1994]

- A. Volume of detention for areas less than twenty (20) acres shall be evaluated according to the "Simplified Volume Formula". For areas larger than twenty (20) acres, other methods may be used upon the approval of the Public Works Department. The "Rational Formula" method will generally be accepted for areas greater than twenty (20) acres.

- A. Total volume of detention shall be computed by the equation:

$$V = R \times A \times tc \text{ (min.)} \times 60 \text{ (sec./min.)}$$

- V = Total volume of detention (cu. ft.)
- R = Differential Runoff Rate
- A = Area of project in acres

tc = Time of concentration as determined for use with differential runoff rates

B. The design volume of detention shall be determined from the following table:

<b>Calculated Volume Design Volume</b>	<b>Calculated Volume Design Volume</b>
1 cu. ft. thru 500 cu. ft.	500 cu. ft.
501 cu. ft. thru 4,999 cu. ft.	Round up to nearest 500 cu. ft.
5,000 cu. ft. thru 9,999 cu. ft.	Round up to nearest 1,000 cu. ft.
10,000 cu. ft. thru 49,999 cu. ft.	Round up to nearest 5,000 cu. ft.
50,000 cu. ft. thru 99,999 cu. ft.	Round up to nearest 10,000 cu. ft.
100,000 cu. ft. and above	Round up to nearest 25,000 cu. ft.

**Section 525.170. Method of Detention.** [R.O. 2012 §525.170; Ord. No. A-5926 part II §E, 6-9-1994]

A. The following conditions and limitations shall be observed in the selection and use of method of detention:

1. *General location.* Detention facilities shall be located within the parcel limits of the project under consideration, with the following exceptions:
  - a. No detention or ponding will be permitted within public road rights-of-way without specific written approval of the Superintendent of Utilities.
  - b. Location of detention facilities immediately downstream of the project will be considered by special request if proper documentation is submitted with reference to practicality, feasibility, proof of ownership, or right-of-use of the area proposed, and provisions are made for perpetual maintenance.
2. *Dry reservoirs.* Wet weather ponds or dry reservoirs shall be designed with proper safety, stability, and ease of maintenance features. Maximum side slopes for grassed reservoirs shall not exceed one (1) foot vertical for three (3) feet horizontal (3:1). In no case shall the limits of maximum ponding elevation be less than two (2) feet vertically below the lowest sill elevation, nor should the maximum limits of ponding be designed closer than ten (10) feet from a building unless waterproofing of the building and pedestrian accessibility are properly mulched, sodded, or paved. A minimum of one (1) foot of freeboard is required above the spillway. The outlet structure shall be concrete or other equivalent material. Spillway areas shall be paved with a minimum of six (6) inches of concrete.
3. *Open channels.*
  - a. Normally permitted open channels may be used as detention areas provided that the limits of the maximum ponding elevation are not closer than thirty (30) feet horizontally from any buildings with habitable areas below ground level, and less than two (2) feet below the

lowest sill elevation of any building. In no case should the maximum limits of ponding be designed closer than ten (10) feet from a building unless waterproofing of the building and pedestrian accessibility are properly documented. No ponding will be permitted within public rights-of-way without specific written approval of the Superintendent of Utilities. Maximum depth of detention in open channels shall be four (4) feet. Minimum flow line grade shall be 0.5 percent.

- b. For trapezoidal sections, the maximum side slopes of the detention area of the channel shall not exceed one (1) foot vertical for three (3) horizontal (3:1). For design of other typical channel sections, the features of safety, stability, and ease of maintenance shall be observed.
- c. The entire reservoir area of the open channel shall be seeded, fertilized, and mulched, sodded, or paved.
- d. The hydraulic elevations resulting from channel detention shall not adversely affect adjoining properties.

4. *Permanent lakes.*

- a. Permanent lakes with fluctuating volume controls may be used as detention areas provided that the limits of maximum ponding elevations are no closer than thirty (30) feet horizontally from any building and less than two (2) feet below the lowest sill elevation of any building.
- b. Maximum side slopes for the fluctuating area of permanent lakes shall be one (1) foot vertical to three (3) feet horizontal (3:1) unless proper provisions are included for safety, stability, and ease of maintenance.
- c. Maximum fluctuation from permanent pool elevation to maximum ponding elevation shall be three (3) feet.
- d. The entire fluctuating area of the permanent reservoir shall be seeded and fertilized and mulched, or sodded or concrete paved. Any area susceptible to or designed as overflow shall be paved with concrete.

5. *Parking lots.*

- a. Detention will not be permitted in primary parking lots. A primary parking lot will be considered to be the most accessible eighty percent (80%) of total parking for a facility.
- b. In non-primary parking lots, detention will be permitted to a maximum depth of twelve (12) inches.
- c. In no case should the maximum limits of ponding be designed closer than ten (10) feet from a building unless waterproofing of the building and pedestrian accessibility are properly documented.

- d. When detention is being effected on parking lots by means of retaining walls or curbs, these retaining walls and curbs must be constructed of reinforced concrete.
  - e. The minimum freeboard from the maximum ponding elevation to the lowest sill elevation shall be one (1) foot.
6. *Other methods.* Other methods of detention, such as seepage pits, french drains, etc., will not be approved.
  7. *Retention areas.* In drainage basins where sinkholes provide the only outlet for storm sewer runoff, and those basins are greater than three hundred twenty (320) acres in area, a retention area capable of storing the first inch of runoff is required for any development within the basin. It shall have a four (4) inch outlet pipe to insure eventual discharge.

**Section 525.180. Verification of Adequacy.** [R.O. 2012 §525.180; Ord. No. A-5926 part II §F, 6-9-1994]

- A. Analysis of all elements of design shall be performed by a professional engineer licensed in the State of Missouri. The following outline is provided to ascertain that certain critical elements of design are in workable compliance to the aims of design.
  1. Volume of detention for the total project
  2. Tributary (Q) peak runoff to basin
  3. Sizing of the overflow facilities
  4. Stability of detention dikes
  5. Safety features
  6. Maintenance features
- B. Routing calculations shall be submitted in legible tabulated form. Proof of adequacy of the volume of detention and sizing computations for low-flow structure shall also be submitted. Features of stability and safety will also need to be documented if the scope of the project requires special attention in this area of design.
- C. Spot elevations shall be included in sufficient detail on the site plan so that the final direction of water flow can be determined, and so that the volume of detention can be ascertained. Projects over two hundred (200) acres in area shall provide documented verification of adequacy according to scope and complexity of design.

**Section 525.190. Control Structures.** [R.O. 2012 §525.190; Ord. No. A-5926 part II §G, 6-9-1994]

- A. Detention facilities shall be provided with obvious and effective outlet control structures. These outlet structures may include v-notch weirs or rectangular weirs, as well as pipe. Plan view and sections of the structure with adequate detail shall be included in plans.

- B. The design discharge (Q) for the low-flow outlet shall not exceed the existing runoff for the one (1) year storm. The maximum discharge shall be designed to take place under total anticipated design-head conditions. The design-head storage volume is not to be considered as part of the volume of detention required.
- C. Sizing of a low-flow pipe shall be by inlet control.
- D. Low-flow pipes shall not be smaller than four (4) inches in diameter to minimize maintenance and operating problems, except in parking lot and roof detention, where minimum size and configuration of opening shall be designed specifically for each condition. The low-flow pipe shall be provided with a bar-screen on a minimum 2:1 slope to reduce blockage by debris.
- E. Overflow spillways will be required on all detention facilities that have storage volumes of one thousand (1,000) or more cubic feet.
- F. The overflow opening or spillway shall be designed so that the combination flow of the low flow outlet and the flow over the spillway will not exceed the total peak runoff for the improved area. The total peak runoff is to be determined from a twenty-five (25) year frequency rain for drainage areas less than 1.0 square mile and from a one hundred (100) year frequency rain for drainage areas 1.0 square mile or greater.
- G. The overflow spillway shall exit into a natural or improved drainageway. If the drainageway does not provide for public access, then topographic detail, along with a profile of the centerline of the drainageway shall be provided from the overflow spillway to the point of public access. This detail shall show all topography within ten (10) feet of the centerline of the drainageway, centerline profile, typical cross section, and capacity of the drainageway.
- H. If the capacity of the existing drainageway is inadequate to carry the total peak runoff, necessary improvements to the drainageway may be required to provide for the total peak runoff.

**Section 525.200. Easements.** [R.O. 2012 §525.200; Ord. No. A-5926 part II §H, 6-9-1994]

- A. Two (2) types of easements shall be provided for storm water detention.
  - 1. *Access easement.* All detention reservoirs, with the exception of parking lot and roof detention, shall be enclosed by an access easement. The limits of the easement shall extend ten (10) feet beyond the maximum anticipated ponding area. The limits and designation of detention facilities shall be shown on the project plans of final plat.
  - 2. *Drainage easement.* A minimum ten (10) feet wide drainage easement shall be provided within the reservoir area, connecting the tributary pipes and the discharge system, along the most direct possible routing of a piping system for possible future elimination of detention. The limits of the drainage easement shall be shown on the project plans of final plat.

**Section 525.210. Maintenance.** [R.O. 2012 §525.210; Ord. No. A-5926 part II §I, 6-9-1994]

Detention facilities are to be built in conjunction with the storm sewer installation and/or grading. Since these facilities are intended to control increased runoff, they must be fully operational soon after the clearing of the vegetation. Silt and debris connected with early construction shall be removed periodically from the detention area and control structure in order to maintain full storage capacity.

**Section 525.220. Temporary Detention.** [R.O. 2012 §525.220; Ord. No. A-5926 part II §J, 6-9-1994]

It may be advantageous in some situations to delay the building of the permanent detention facilities until after the completion of the other improvements. In these situations, temporary detention facilities must be provided. The permanent or temporary detention facilities must be constructed and be functional before proceeding with any other construction.

**Section 525.230. Off-Site and Regional Detention Concepts.** [R.O. 2012 §525.230; Ord. No. A-5926 part II §K, 6-9-1994]

- A. *Off-Site Detention.* Storm water detention facilities designed and constructed off-site or outside the limits of the proposed development will be considered for approval. This approval is contingent upon documentation being furnished to verify that drainage easements have been obtained for the channel area from the proposed development to the detention facility and including the detention area. The drainage easements must clearly set out provisions for maintenance.
- B. *Regional Detention.* Detention facilities designed and located to provide detention on major drainage channels will be considered as a regional detention facility. The drainage area considered for a regional detention facility must be one hundred sixty (160) acres or greater. The facility must provide a detention volume for a one hundred (100) year storm for the entire drainage area, and must be designed with a variable control outlet structure that has a one (1) year maximum outlet opening. The regional detention facility must be designed with a low flow concrete channel through the limits of the basin. Upon conceptual approval of the location and final approval of the design and construction, the City of Monett will accept the responsibility for the maintenance of the regional facility. Drainage and access easements will be required giving the City of Monett the authority to gain vehicular access to the facility from a public street.
- C. As additional development occurs upstream of the regional facility, on-site detention requirements may be waived, provided the regional detention basin has been designed for full development of the basin, or if modifications are made to the regional facility by the developer to provide for the additional volume of detention required for the new development. Easements must be provided along the drainage channel from the new development to the regional facility and the channel must be constructed to carry the peak rate of runoff from the one hundred (100) year storm for the entire basin upstream from the regional facility.