

**MARYVILLE
LAND DEVELOPMENT
AND
PUBLIC WORKS STANDARDS
PART 1 –
DRAINAGE AND CONSTRUCTION
STANDARDS**



**CITY OF MARYVILLE
MARYVILLE, TENNESSEE**

**1988
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PART I

**CONSTRUCTION STANDARDS, SPECIFICATIONS, DESIGN CRITERIA, POLICIES
AND GUIDELINES FOR THE GOVERNING OF THE STORMWATER UTILITY
OF THE CITY OF MARYVILLE, TENNESSEE**

101 DEFINITIONS

1. ACCEPTED STREET

A street or avenue located within the City of Maryville that has been accepted by the City for maintenance.

2. ADEQUATE DRAINAGE

Hydraulic characteristics to accommodate the maximum expected or specified flow of storm waters for a given watershed or portion thereof, for a specified duration and intensity of rainfall.

3. AREA OF SPECIAL FLOOD HAZARD

Land in the floodplain within a community subject to a one percent or greater chance of flooding in any given year.

4. BASE FLOOD

The flood having a one percent chance of being equaled or exceeded in any given year. Also known as the 100-year flood.

5. CITY

The City of Maryville, Tennessee

6. CUSTOMER

Any citizen who benefits from stormwater services provided by the City.

7. DEVELOPMENT

Developments include any of the following activities:

1. The improvement of one lot or two or more contiguous lots, tracts or parcels of land for any purpose involving:
 - i. one or more residential or nonresidential buildings, or a single nonresidential building on a lot or lots regardless of the number of occupants or tenure; or
 - ii. the division or allocation of land or space, between or among two or more existing or

prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups or other features.

2. A subdivision of land.

8. DEVELOPER

Any person, firm or corporation, both public and private, engaged in the development of land, such as subdivisions and other land improvements.

9. DWELLING

Any single structure occupied by one or more persons for residential purposes.

10. EASEMENT

A legally dedicated right-of-way for the City to manage/maintain stormwater flow in lines or swales within specified boundaries.

11. EXISTING DEVELOPED AREA

A developed area within the corporate limit having streets, stormwater conveyances and appurtenances that have been accepted for operation and maintenance by the City.

12. FLOODPLAIN

Any area susceptible to being inundated by water from the base flood (100-year flood).

13. FLOODWAY

The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one (1) foot.

14. ILLICIT DISCHARGE

Any discharge to the stormwater system that is not composed entirely of stormwater and not specifically exempted in the Stormwater Discharges Ordinance.

15. MULTIPLE UNIT DEVELOPMENT

Any multi-unit complex, such as: apartments, small business, etc., under one roof.

16. NEW SUBDIVISION

The division of a tract or parcel of land into two or more lots, sites, or other divisions requiring new

streets or utility construction, or any subdivision of less than 5 acres for the purpose, whether immediate or future, of sale or building development and includes re subdivision and, when appropriate to context, relates to the process of re-subdividing or to the land or area subdivided.

17. PERSON OR TENANT

Firms and corporations, as well as individuals.

18. PREMISES

Any structure or group of structures, including land, operated as a single business or enterprise.

19. UNIT

An individual part of a multiple unit development.

NOTE:

Whenever the context shall admit or require words used herein in the singular shall include the plural; words used in the plural shall include the singular; words used in the masculine shall include the feminine; and words used in the feminine shall include the masculine.

102 SYSTEM DESIGN

102.1 General Considerations

a) All developments shall be constructed and maintained so that adjacent properties are not unreasonably burdened with surface waters as a result of the property development. More specifically:

1. No development may be constructed or maintained so that such development unreasonably impedes the natural flow of water from higher adjacent properties across such development, thereby unreasonably causing damage to such higher adjacent properties.
2. No development may be constructed or maintained so that surface waters from such development are unreasonably collected and channeled onto lower adjacent properties at such locations or at such volumes as to cause substantial damage to such lower adjacent properties.

b) Floodplains

1. If any modification to a floodplain is anticipated with regard to any development or construction project, the developer should meet with staff from the engineering and planning departments before a preliminary plat is submitted.
2. Where in the opinion of the City of Maryville Engineering & Public Works (EPW) Department topographic data, engineering, and other studies are needed to determine the effects of flooding on a proposed structure or fill and/or the effect of the structure or fill on the flow of water, the Director of Engineering and Public Works or his/her designee may require the applicant to submit such data or other studies prepared by competent licensed engineers and other professionals. The granting of approval of any structure or use shall not constitute a representation, guarantee, or warranty of any kind or nature by the City of Maryville or by an officer or employee thereof, and shall create no liability upon or cause action against such public body, officer, or employee for any damage that may result pursuant thereto.

c) Overall Drainage System

The overall drainage system is divided into two parts, the minor system and the major system. The minor drainage system (normally the 25-year design storm) consists of storm sewer appurtenances and conduits such as: inlets, catchbasins, manholes, junction boxes street gutters, roadside ditches, swales, small underground pipe and small channels which collect the storm water runoff and transport it to the major system. The major system (including the less frequent storm up to the 100-year level) consists of natural waterways and large man-made conduits. In addition, the major system includes some less obvious drainage ways such as overland relief swales and infrequent temporary ponding at storm sewer appurtenances. The major system includes not only the trunk line system that receives the water from the minor system, but also the natural backup system which functions in case of overflow from or failure of the minor system. Overland relief must not flood or damage houses, buildings or other property.

d) No surface water may be channeled or directed into a sanitary sewer.

102.2 Pre-design Conference

Prior to the design of any stormwater drainage system extension, the design engineer should first confer with the City of Maryville Planner in regard to growth potential and density that may be expected in the general area of the extension being planned. A conference with the stormwater engineering staff should follow to discuss system standards and requirements, as well as any problems related to the system being extended. The design engineer must have a license to practice in the State of Tennessee.

102.3 Design Period

In general, stormwater collection extensions shall be designed for the estimated ultimate density and impervious surfaces of the area.

102.4 Plans and Specifications Approval

a) Detailed plans and specifications for a proposed drainage system or extension must be submitted to the Director of

Engineering and Public Works or his/her designee at the City of Maryville for approval. Plans should be on sheets 24 inches by 36 inches.

- b) Upon completion of the project, the **design engineer** shall revise the detailed plans to reflect "As-Built" information of the installed storm drainage system and submit the revisions for review to the Director of Engineering and Public Works or his/her designee along with a completed As-Built Checklist found in the City of Maryville Policy Manual for Stormwater Quality Management, Appendix C. Upon acceptance of the "As-Built" the **design engineer** shall furnish EPW with one electronic copy file in dwg or dgn format and three paper copies of the "As-Built" drawings.
- c) Each plan sheet shall bear an appropriate title block showing the name of the project, location, owner, engineer, date, scale in feet, true north where applicable, sheet number and revision date.

Each sheet shall contain a blank area at least 4 inches by 6 inches near the title block for imprinting the official "Approved for Construction" stamps of the EPW Stormwater Department of the City of Maryville. Plans shall be clear and legible and shall conform to the requirements of EPW Standards.

- d) Plans of Storm Drainage Systems: A plot plan of the existing and proposed storm drainage system shall be submitted for projects involving substantial additions to the existing storm system. The plan view of all storm sewer details shall indicate the proper location of the storm drainage, appurtenances, size of line, capacity, flow direction, detention areas, easements and other details relating to the storm drainage system. The plan shall show sufficient detail to include exact locations, proper ties into existing permanent reference points, proper angles, and distances from other utilities to be placed or presently in the street right-of-way.

The profile of all storm sewers and swales shall show the necessary slope, existing and proposed street grades, locations of angles and appurtenances, and proper elevations for existing outfall ditches. The profile shall indicate the size of line and the capacity of each line as determined by the design engineer. Calculations and hydraulics of pipe inlets shall be shown. Velocity heads shall be calculated as well as hydraulic profiles

of flows upon request by EPW personnel. The total area of drainage to each basin and the flow that will be required to be dissipated at that point shall also be indicated, on either plan or profile.

All drainage systems receiving discharge from the project shall be shown to be adequate. A vicinity map must accompany all storm system extensions. For projects involving multiple storm drainage, include a project map showing the overall layout of the entire project.

e) Detail Plans: Detail plans shall be submitted. Plans and profiles are required for all stormwater drains. Profiles should have a horizontal scale of not more than 50 feet to the inch. The vertical scale of profiles shall not be more than 10 feet to the inch. The plan view should be drawn to a corresponding horizontal scale. Plans and profiles shall be drawn on the same sheet and will show:

1. Drainage structures with size, location and elevation including location of streets and storm drains; line for the existing and proposed ground surface; location and description of survey benchmarks; size, material and type of pipe for all storm sewer lines; length between catch basins; invert and surface elevation at each catch basin; location and size of lines tying in; and grade of line between each two adjacent catch basins. All catch basins shall be numbered on the plans and correspondingly numbered on the profiles. Stationing of the storm line at 100-foot intervals and locations of all appurtenances by stationing shall be shown on the plan and profile.
2. Locations of all drainage features such as detention areas, swales, and other conveyances or storage shall be shown on the plan.
3. Natural features such as wetlands, sinkholes, ponds, lakes, streams, etc. shall be shown on the plan.
4. A topographical map of sufficient scale to indicate the watershed areas and tributary areas to be developed. Determine the ridgelines of the tributary area and establish the general routing of the proposed storm drainage system. Indicate connecting storm drainage systems, appurtenances, street grades, and all other information pertaining to the location of the proposed storm drainage system.

5. Additional existing and proposed information to be shown shall include:
 - i. Boundary Survey by a Registered Land Surveyor, including lot lines
 - ii. Utility and drainage easements
 - iii. Right-of-ways
 - iv. Contour lines, minimum 2-foot intervals
 - v. Roads within, adjacent or intersecting, with names, exact location and elevation shown
 - vi. Physical features of site
 - vii. Exact location of existing buildings
 6. All known existing structures both above and below ground which might interfere with the proposed construction, particularly water mains, sanitary sewer mains, gas mains, etc.
 7. No other utilities shall be drawn on the sheet except for clarification or reference.
 8. Detail drawings of the proposed outlet structures shall be shown on the plans.
 9. Sufficient detail shall be shown on the plans to allow for materials take off and location of lines in the field by a third party.
 10. A Site Plan Review Checklist must be completed and turned in with the site plan. The site plan will not be reviewed without a completed checklist.
- f) The Following Note(s) Must Be Included In The Plan Sets:
- THE CONTRACTOR SHALL NOTIFY TENNESSEE ONE CALL AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION FOR UTILITY LINE LOCATES. ANY DISCREPANCIES BETWEEN THE PLAN LOCATIONS AND THE ACTUAL FIELD LOCATIONS SHALL BE IMMEDIATELY COMMUNICATED TO THE DESIGN ENGINEER AND THE CITY OF MARYVILLE, STORMWATER ENGINEER.

102.5 Design Factors

a) In determining adequate drainage and the required capacities of the storm drainage system, the following factors must be considered:

1. Both off-site and on-site stormwater,
2. Honor natural drainage divides,
3. Convey the stormwater to a stream, water channel, natural drainage-way, or existing facility,
4. Discharge the stormwater into a natural drainage-way by tying into the drainage-way at natural elevations.
5. Required design storm.
6. Drainage structures that can be maintained at reasonable cost.

b) Upstream considerations

Determination of the size and capacity of an adequate drainage system shall take into account the planned development of the watershed or affected portions thereof. The design shall not adversely affect upstream, adjacent, or neighboring properties.

c) Downstream Considerations

1. The owner or developer of property shall not concentrate and discharge stormwater on a downstream property where it was not concentrated before unless an easement has been acquired for the conveyance of stormwater across that property, and the other lower lying properties, until a natural and well-defined drainage system is reached.
2. If such a natural drainage swale exists from the developing property's boundary downstream and the developer is proposing drainage improvements on the developing property which require off-site work within an easement on the downstream property, the developer may, if unable to acquire said easement, pull the point of discharge back so it is entirely within the developing property's boundary, provide easements on the developing property and post escrow in the amount required to extend the system to the property line. This provision in no way relieves the developer of his obligation to ensure that the post developed discharges would not cause erosion or flooding on the

downstream property.

3. If there is no natural and well-defined drainage system into which the concentrated flow can be discharged, plans will not be approved until a storm drainage easement extending to the man-made drainage system has been obtained and recorded.
4. The owner or developer may continue to discharge stormwater that has not been concentrated onto a downstream property if the developed peak rate does not exceed the pre-developed peak rate and there is no existing drainage problem on the downstream property. However, if the run-off is being increased or may aggravate an existing problem the developer must provide a drainage system, satisfactory to the Director of Engineering and Public Works or his/her designee, to preclude an adverse impact upon the adjacent property.
5. If a natural and well-defined drainage system exists across the downstream property, the maximum run-off quantity rate based on an intensity of rainfall determined for the 25-year (return period) resulting from the development of the property must be a flow rate and velocity that the downstream drainage way can handle. The 100-year frequency (return period) maximum run-off quantity rate shall be determined for the purpose of estimating the amount of potential damages that may be incurred on the downstream property as a result of the development of the property. The 100-year flood routing shall be shown in the development calculations.
6. The Director of Engineering and Public Works or his/her designee or his designee shall have the authority to require the 100-year frequency (return period) design in critical areas or in cases where the design will cost little more than the 25-year design.

102.6 Design Basis

- a) Flood protection detention shall be required if there is a net increase of 1 cfs or more in runoff from pre-development to post-development conditions or if $\frac{1}{2}$ acre or more of impervious area is created. Detention for water quality and stream bank protection is required even if flood protection detention is not required. Refer to the City of Maryville Stormwater Quality Management and Vegetated Buffers Ordinance for details.

b) Design Storm: Storm systems serving residential development shall be designed on the basis of the 1, 2, 5, 10 and 25-year storm.

c) Storm Drainage Design

1. Ultimate Development - Storm drainage shall be based on the estimated ultimate density and impervious surfaces of the area. The designer must confer with the City of Maryville Planning and EPW Departments to obtain information with respect to the determination of the restricted ultimate density and impervious area.
2. Run off - Establish and indicate curb grades, outline the runoff area and indicate the flow rate in cubic feet per second by increment at each point of interception.
3. Curb Capacities - Calculate curb capacities for each side of the street independently. Differences in curb elevations, off center crowns, etc. must be taken into consideration.
4. Inlets - When calculations indicate that curb capacities as limited by 6 and 7 in this Section 102.6 are exceeded beyond that point, drainage structures shall be used to intercept flow at that point. Flow shall be picked up by an inlet.
5. Inlet and Pipe Capacity - Calculate capacities for inlets and pipes.
6. Maximum Depth of Gutter Flow - Drainage water shall not exceed the depth of the curb at any point. Generally, the maximum depth of drainage water at the curb will be limited as stipulated in the following paragraph.
7. Maximum Spread of Gutter Flow in the Street - The gutter flow width to prevent encroachment on the center width of street pavement shall be limited as follows:

(continued)

<u>Street</u>	<u>Min. Width of</u>	<u>Design Storm</u>
<u>Classification</u>	<u>Pavement Not to be</u>	<u>Calculations</u>
	<u>Encroached Upon</u>	
	<u>(feet)</u>	

Minor	11	2 year
Local	13	2 year
Cul-de-sac	11	2 year
Sub collector	14	10 year
Collector	16	10 year
Arterial	24	10 year

The gutter flow width at all pedestrian crosswalks shall be limited to 3.0 feet.

d) Hydrologic Design

1. In general:

- the Rational Method is recommended for small, highly impervious drainage areas such as parking lots and roadways draining into inlets and gutters, or small highly homogenous drainage areas; and
- the USGS regression equations are recommended for drainage areas with characteristics within the ranges given for the equations. The USGS equations should be used with caution when there are significant storage areas within the drainage basin or where other drainage characteristics indicate that general regression equations might not be appropriate; and
- the TVA regression equations are used for stormwater system design, choosing the more conservative solution from between the results of the applicable USGS regression equation and the TVA regression equation.

Note: Users must realize that any hydrologic analysis is only an approximation. The relationship between the amount of precipitation on a drainage basin and the amount of runoff from the basin is complex and too little data are available on the factors influencing the rainfall-runoff relationship to expect exact solutions.

The following table lists acceptable hydrologic methods and constraints for their use:

Constraints on Using Recommended Hydrologic Methods

Method	Size Limitations ¹	Constraints
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Rational	0 – 10 acres	Method can be used for estimating peak flows and the design of small site or subdivision storm sewer systems. Not to be used for storage design.
USGS Rural	0.36 mi ² to 21,400 mi ²	Method can be used for estimating peak flows for all design applications in rural areas.
USGS Urban	0.21 mi ² to 24.3 mi ²	Method can be used for estimating hydrographs for all design applications in urban areas.
TVA	> 0.36 mi ²	Method can be used for estimating peak flows for storm system design applications such as culverts, channels, etc.
SCS ^{2,3}	0 – 2000 acres	Method can be used for estimating peak flows and hydrographs for all design applications.
Water Quality	Limits set for each Structural Control	Method used for calculating the WQv

1 - Size limitation refers to the drainage basin for the stormwater management facility (e.g., culvert, inlet).

2 - There are many readily available programs (such as HEC-1) that utilize this methodology.

3 - 2,000-acre upper size limit applies to single basin simplified peak flow only.

Rainfall depths for design storms shall be:

<u>Design Storm</u>	<u>24-hr rainfall amount</u>
1	2.9 inches
2	3.4 inches
5	4.4 inches
10	4.9 inches
25	5.8 inches
50	6.5 inches
100	6.7 inches
500	7.6 inches

2. Rational Method

The runoff coefficient (C) is the variable of the Rational Method least susceptible to precise determination and requires judgment and understanding on the part of the design engineer. While engineering judgment will always be required in the selection of runoff coefficients, typical coefficients represent the integrated effects of many drainage basin parameters. The following table gives the recommended runoff coefficients for the Rational Method.

Land Use	Runoff Coefficient (C) by Hydrologic Soil Group and Ground Slope											
	A			B			C			D		
	<2%	2 -6%	>6%	<2%	2 -6%	>6%	<2%	2 -6%	>6%	<2%	2 -6%	>6%
Forest	0.08	0.11	0.14	0.1	0.14	0.18	0.12	0.16	0.2	0.15	0.2	0.25
Meadow	0.14	0.22	0.3	0.2	0.28	0.37	0.26	0.35	0.44	0.3	0.4	0.5
Pasture	0.15	0.25	0.37	0.23	0.34	0.45	0.3	0.42	0.52	0.37	0.5	0.62
Farmland	0.14	0.18	0.22	0.16	0.21	0.28	0.2	0.25	0.34	0.24	0.29	0.41
Res. 1 acre	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.4	0.31	0.35	0.46
Res. 1/2 acre	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.46
Res. 1/3 acre	0.28	0.32	0.35	0.3	0.35	0.39	0.33	0.38	0.45	0.36	0.4	0.5
Res. 1/4 acre	0.3	0.34	0.37	0.33	0.37	0.42	0.36	0.4	0.47	0.38	0.42	0.52
Res. 1/8 acre	0.33	0.37	0.4	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Industrial	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.9	0.89	0.89	0.9
Streets: ROW	0.76	0.77	0.79	0.8	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Parking	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.65	0.67	0.69	0.66	0.68	0.7	0.68	0.7	0.72	0.69	0.72	0.75

Note that the coefficients given are applicable for storms of 5 to 10-year frequencies. Less frequent, higher intensity storms require modification of the coefficient by multiplying the right side of the Rational Formula by a frequency factor Cf.

Frequency Factors for Rational Formula	
Recurrence Interval (years)	Cf
10 or less	1
25	1.1
50	1.2
100	1.25

- Any variations from the design methods required shall be permitted only upon approval of the Director of Engineering and Public Works or his/her designee or his designee.

103 DESIGN OF CLOSED CONDUIT STORM DRAINAGE SYSTEMS

103.1 Design Flow

The closed conduit storm drainage system shall be designed for a 25-year rainfall frequency when its intended use is to function as the minor drainage system. Design flows will be determined by the amount of run-off actually entering the system. The Director of Engineering and Public Works or his/her designee or his designee shall determine the size storm for design of the major system.

103.2 Storm Drainage Pipes and Culverts

- a) Determination of pipe and culvert diameters shall be based on calculations using Manning's Formula.
- b) Minimum Pipe Size
 - 1. Storm sewer and culvert pipe shall be a minimum of 15" inside diameter.
 - 2. Side drainpipe for residential driveways shall be a minimum of 15" inside diameter.
 - 3. Landscape and planter drains may be smaller than 15 inches if approved by the Director of Engineering and Public Works or his/her designee.
- c) The length between access openings shall not exceed 350 feet for pipes. Access opening may be in the form of an inlet, catch basin, manhole, junction box or other approved appurtenance.
- d) Alignment
 - 1. Storm drainage lines shall be designed with straight alignment between catchbasins, manholes and junction boxes.
 - 2. Connection between separate storm drain lines shall be with a structure. (See Standard Drawings)
- e) Increasing Size
 - 1. There may not be a reduction in pipe size along the direction of flow.
 - 2. When a smaller storm line upstream joins a larger one, the invert of the larger storm line should be lowered sufficiently to maintain the same energy gradient. An

acceptable approximate method for securing these results is to match the crown elevations.

g) Joints and Infiltration

Pipe joints should be designed to minimize infiltration and to prevent the entrance of roots.

- h) Minimum cover for storm sewer pipe shall be two feet from finish grade to the outside top of pipe, except where structural correction approved by the Director of Engineering and Public Works or his/her designee or his designee is provided when cover requirements cannot be met.

- i) Minimum easement widths shall be determined as follows:

<u>Pipe Size</u>	<u>Easement Width</u>
15" to 30"	20'
36" to 48"	25'
54" to 72"	30'
72" and above	To be determined by EPW

Where multiple pipes are installed, edge of easement shall be ten feet clear or outside of pipe. Where easements do not generally follow established lot lines, add ten feet to the easement width on side toward the building. Storm drainage lines to be maintained by the City of Maryville EPW Department shall be within dedicated "Storm Drainage Easements".

- j) Storm sewers shall be designed to provide an average velocity when running full of not less than three feet per second and not more than 12 feet per second.
- k) The need for concrete anchors must be investigated on storm sewer lines with slopes of 20% or greater. If anchors are required, the design engineer will show a detail on the plans with spacing requirements.

- 1) Where storm sewers are provided, they shall not outfall in the front yard of a lot.
 1. Where a defined, natural and stable drainage way is located on the property, the storm drainage line shall be extended to outfall within this drainage way.
 2. Where there does not exist a natural drainage way, then the storm drainage line shall be extended to a point where a constructed, stable drainage way (swale) can be built to carry the water flow to a natural drainage way.
 3. All storm sewers shall be extended to at least 20 feet beyond the rear of proposed building site of a house as a minimum.

If the storm sewer outfalls on a lot or adjacent to a lot, on which a building exists that will remain, the building must be shown with topography of the area between the building and the outfall. Floor elevations shall be provided.

103.3 Drainage Structures

Drainage structures include catchbasins, manholes, junction boxes, and culverts.

1. All inverts are required to be U-shaped.
2. The access entrance shall be at least 24 inches in diameter.
3. Approved catch basin grates in the City of Maryville are:

Standard Curb and Gutter	Neenah R-3246-AL EJIW 00751004
Maryville Modified Curb and Gutter	Neenah R-3246-AM (with R-3000-A environmental message)
Roll Type Curb and Gutter	Neenah R-3580
No Curb Opening	Neenah R-3210-L
Area Drain	Neenah R-3807

Approved equivalents will also be allowed. All catch basins must be stamped "DUMP NO WASTE, DRAINS TO STREAM" or approved equivalent.

103.4 Closed Conduit Design Calculations

In general, design calculations required for submittal to the City of Maryville Engineering Department are as follows:

1. Storm water run-off quantities
2. Inlet capacity calculations.
3. Energy loss calculations at storm sewer junctions when required by the Director of Engineering and Public Works or his/her designee or his designee.
4. Hydraulic grade line (HGL) calculations. Inlet surcharging and possible manhole lid displacement can occur if the hydraulic grade line rises above the ground surface.
5. A copy of the drainage plan showing drainage divides, contributing areas and existing or future rezoning. Consult with the City Planner to determine which zoning to apply.

103.5 Protection of Water Supplies

- a) Water Supply Interconnections: There shall be no physical connection between a potable water supply line and a storm line or appurtenance thereto which would permit the passage of any stormwater or polluted water into the potable supply.
- b) Relation to Other Utilities: There shall be no other utility lines installed in the same trench parallel to existing storm drain lines.
- c) Relation to Water Mains:
 1. Horizontal Separation: Whenever possible, storm sewers should be laid at least 10 feet horizontally from any existing or proposed water pipe. Should local conditions prevent a lateral separation of 10 feet, a storm sewer line may be laid closer than 10 feet to the water main if it is laid in a separate trench and if the elevation of the top of the storm sewer pipe is at least 18 inches below the bottom of the water pipe.
 2. Vertical Separation: Whenever a storm sewer must

cross under a water main, the storm sewer shall be laid at such elevation that the top of the storm line is at least 18 inches below the bottom of the water main. When the elevation of the storm sewer cannot be varied to meet the above requirement, the water main shall be relocated to provide the separation or reconstructed with ductile iron pipe for a minimum distance of 10 feet on each side of the sewer. At least one full length of water main should be centered over the storm sewer so that both joints shall be as far from the storm sewer as possible.

103.6 Force Mains

No force mains will be allowed in the storm drainage system.

104 DESIGN OF OPEN CHANNEL STORM DRAINAGE SYSTEMS

104.1 General

Open channels shall be sized to carry design rates of flow without significant damage or erosion to the channel. Channels shall be fenced, sloped, or otherwise protected to prevent injury to the public. The required design shall be the maximum run-off quantity rate based on an intensity of rainfall determined for the 25-year frequency for the minor system.

104.2 Connections

Structures entering channels shall not project into the normal waterway area.

104.3 Velocity

Channel design shall include lining or treatment of the invert and sides as required to minimize erosion. Minimum treatment shall include sod. Channel inverts and sides shall be lined to a height 1.0 foot above the hydraulic grade line produced by a flow rate of the design storm or as directed by the Director of Engineering and Public Works or his/her designee or his designee in accordance with the following table:

Mean Flow Velocity	Type of Lining
5 F.P.S. and less	Sod

6 - 15 F.P.S	Riprap, concrete, or suitable turf reinforcing grid.
Over 15 F.P.S.	Concrete Paved

104.4 Capacity

Open channels shall be sized to carry design flow rates with 1.0 foot of freeboard and not overtop during the 100-year storm event.

104.5 Sections

Channel sections shall be compatible with the type of lining and maintenance practice to be used. Side slopes of three (3) horizontal to one (1) vertical or less is preferable but shall not be steeper than two (2) horizontal to one (1) vertical. Channels lined with sod, grass, or other vegetative ground cover and having slopes steeper than three (3) horizontal to one (1) vertical are not readily susceptible to mowing. Friction factors used in design shall ultimately dictate the type of lining.

104.6 Check Dams

Temporary check dams may be used to control flow velocity in open channels during construction. Check dams shall be designed to prevent flow bypass by undercutting or erosion around the ends. Adequate paving or riprap shall be provided at the downstream toe of check dams to prevent erosion or loss of foundation support by undercutting.

104.7 Natural Channels

Natural channels that design calculations show to be of adequate capacity, and having stable banks and inverts, may be used without modification.

105 DESIGN OF DETENTION OF STORMWATER

105.1 General

Temporary on-site detention of stormwater in a permanent facility shall be required for all developments to reduce the adverse effects of increased stormwater runoff.

105.2 Design Criteria

- a) The design storm shall be a storm of 24-hour duration and having a return period of 1, 2, 5, 10 and 25 years. The Director of Engineering and Public Works or his/her designee or his designee may require longer return periods if warranted by downstream conditions.
- b) The release rate from any temporary detention facility shall conform to current Tennessee Department of Environment & Conservation requirements.
- c) Detention storage areas shall have adequate capacity to contain maximum required volume of tributary storm drainage runoff with 1.0 foot of freeboard. The 100-year storm shall be routed to assure safe passage through pond structure and maintain 1.0 ft of freeboard. Adequate provisions and allowances shall be made for the accumulation and removal of silt.
- d) Outlet works shall be designed to limit peak outflow from detention storage areas.
 1. Outlet works shall not include any mechanical components or devices and shall function without requiring attendance or control during operation.
 2. Size and hydraulic characteristics shall be such that pond drains no sooner than 24 hours, but within 72 hours of the end of the design rainfall. Extended detention may be required by EPW.
 3. Outlet pipe shall be water tight reinforced concrete pipe as specified in Section 106.1 with rubber gaskets when used in earthen berms.
 4. Special care must be taken to ensure that any pipe passing through an earthen berm does not leak or allow seeping water to erode the soil around the pipe. The soil used to construct the berm must be properly selected and compacted so as to prevent seepage around any pipe. Measures such as anti-seep collars to reduce the potential or control seepage and piping along the pond outlet pipe should be considered for use on detention basins and shall be used at all permanent pool facilities or whenever the embankment height is 10 feet or greater. A concrete cradle (flowable fill)

should be used extending up the sides of the pipe at least 50 percent of its outside diameter with a minimum thickness of 6 inches to reduce the potential for piping.

5. Risers are to be structurally designed to withstand all water and earth loads anticipated on the device. All risers should be analyzed for the possibility of floatation by performing buoyancy calculations. This analysis should assume that all outlet devices are clogged. The factor of safety against floatation shall be 1.25 or greater (i.e. downward forces = 1.25 x upward forces).
- e) The designer should attempt to minimize the proposed final depth of ponded water in the basin to the maximum practical extent. To minimize the potential hazards associated with open water, the ponded depth should be limited to 2 feet maximum for water quality, and 4 feet maximum for quantity control of the design storm. Total maximum depths to 3 feet are preferred, but the maximum depth of ponded water should be less than 10 feet. A shallow basin with a large surface area will perform better than a deep facility with the same volume. Construction, maintenance, and safety should be considered during the planning.
1. A maximum side slope of 3H:1V, especially when embankment heights exceed 6 feet, and in no case shall embankment slopes be steeper than 2H:1V. The maximum side slope of 3H:1V is based on the ability of maintenance vehicles or conventional mowing equipment to safely traverse the side slopes.
 2. The top of all earthen embankments shall be graded to provide positive drainage.
 3. Facilities should not be located on fill slopes or on or near slopes exceeding 15%.
 4. The bottom of a detention facility should be sloped no more than 2% and no less than 1% from the inlet toward the outlet device to allow for positive drainage of the facility.
 5. The design engineer shall specify on the site plans the requirements for soil type and soil compaction for earthen detention pond berms.
- f) Emergency spillways shall be provided to permit safe passage of water from storms producing runoff in excess

of the design storm.

105.3 Design Data Submittal

The following design data shall be submitted for the Director of Engineering and Public Works or his/her designee's or his designee's approval for all projects including temporary detention facilities:

- a) Runoff hydrograph plotted in units of inches per hour runoff rate of the tributary area as ordinates, and time from the start of runoff as abscissas. The runoff hydrograph shall be developed to include all storms of lesser duration within the 24-hour storm.
- b) Area - Capacity curve for proposed detention facility plotted in units of datum elevation as ordinates, and cumulative volume of storage as abscissas.
- c) Discharge characteristics curve of outlet works and water surface elevations for required storms.

105.4 Land Requirements

All areas for detention facilities shall be shown in an easement that extends a minimum of 10 feet from the top of the berm on a plat properly recorded by the Blount County Register of Deeds. The plat shall contain the following:

- a) The detention area and any other areas necessary to allow access to the facility clearly marked and labeled.
- b) A note indicating who is responsible for the maintenance of the facility.
- c) A note indicating the detention area cannot be altered or further developed without submission of an alternate facility design and the approval of the City of Maryville Director of Engineering and Public Works or his/her designee or Stormwater Engineer.

105.5 Maintenance

- a) Residential Developments

All detention facilities located in residential developments, including condominium developments, shall

be maintained by and at the expense of a homeowners association as outlined in the Maryville Land Development Regulations. When a property undergoes development or redevelopment, the property owner must enter into permanent maintenance agreements for structural and non-structural BMPs located on the property as a condition of approval of the WQMP. This is accomplished by completing and submitting the "Covenants for Permanent Maintenance of Water Quality Best Management Practices" (also called the "Maintenance Covenants").

b) Non-residential Developments

All detention facilities located in non-residential developments shall be maintained by the property owner(s). When a property undergoes development or redevelopment, the property owner must enter into permanent maintenance agreements for structural and non-structural BMPs located on the property as a condition of approval of the WQMP. This is accomplished by completing and submitting the "Covenants for Permanent Maintenance of Water Quality Best Management Practices" (also called the "Maintenance Covenants").

106 PRODUCTS

Pipe and all accessory fitting and appurtenances, etc., shall be made in America where possible unless approval is obtained from the EPW Department for the use of a product that is not made in America. This requirement shall be construed in a manner that does not violate the North American Free Trade Agreement, any amendments thereto, or any other free trade or other laws.

106.1 Pipe Materials

Approved storm pipe is as follows:

1. Reinforced Concrete Pipe (RCP):
 - a. ASTM C76/AASHTO M86M
 - b. ASTM C506/AASHTO M206M
 - c. ASTM C507/AASHTO M207M.
2. Spiral Rib Metal Pipe (SRMP):
 - a. ASTM A760/AASHTO M36.
3. Corrugated Steel Pipe (CMP):
 - a. ASTM A760/AASHTO M36.
4. Thermoplastic Pipe (HDPE, PVC):
 - a. High Density Polyethylene (HDPE): ASTM F2306/AASHTO M252 Type S and M294 Type S.

b. Polyvinyl Chloride (PVC): ASTM F949.

Acceptable pipe material selection shall adhere to the following table:

Fill Height (feet)					
	Up to 10 ft	Over 10 ft up to 18 ft	Over 18 ft up to 27 ft	Over 27 ft up to 41 ft	> 41 ft
Expressways, Major and Minor Arterial, Major and Minor Collector					
Cross drains	RCP CL III	RCP CL III	RCP CL IV	RCP CL V	Note 3
Transverse median drains	RCP CL III	RCP CL III	RCP CL IV	RCP CL V	Note 3
Longitudinal storm drains	RCP CL III	RCP CL III	RCP CL IV	RCP CL V	Note 3
Residential Sub-Collectors, Local Street, Minor Street					
Cross drains	RCP CL III HDPE Note 1 PVC Note 1	RCP CL III HDPE Note 1 PVC Note 1	RCP CL IV	RCP CL V	Note 3
Transverse median drains	RCP CL III HDPE Note 1 PVC Note 1	RCP CL III HDPE Note 1 PVC Note 1	RCP CL IV	RCP CL V	Note 3
Longitudinal storm drains	RCP CL III HDPE Note 1 PVC Note 1	RCP CL III HDPE Note 1 PVC Note 1	RCP CL IV	RCP CL V	Note 3
Residential Areas in Drainage Easements					
	RCP CL III HDPE Note 1 PVC Note 1 Aluminized SRMP Note 2	RCP CL III HDPE Note 1 PVC Note 1 Aluminized SRMP Note 2	RCP CL IV	RCP CL V	Note 3
Offsite Drainage Conveyance					
	RCP CL III HDPE Note 1 PVC Note 1	RCP CL III HDPE Note 1 PVC Note 1	RCP CL IV	RCP CL V	Note 3
Commercial					
	RCP CL III HDPE Note 1 PVC Note 1 SRMP Note 2 CMP	RCP CL III HDPE Note 1 PVC Note 1 SRMP Note 2 CMP	RCP CL IV	RCP CL V	Note 3

Note 1: Where site conditions permit and at the discretion of the design engineer.

Note 2: Spiral rib metal pipe. Minimum gauge as follows: 15 to 30 inch 16 gauge, 36 to 42 inch 14 gauge, 48 to 72 inch 12 gauge. CMP shall not be substituted for SRMP. Bands for pipe ends shall use rubber o-ring seals.

Note 3: Structural, hydraulic, and cost analysis required for pipes with a fill height of over 41 feet.

106.2 Pipe Fittings

- a) Pipe shall be fitted together per pipe manufacturer's recommendation.
- b) A structure shall be installed when connecting dissimilar pipe materials or sizes.

106.3 Concrete Materials

Concrete used in conjunction with the installation or repair of storm drain lines and appurtenances shall be as follows:

1. Minimum compressive strength: 28 days, 4,000 psi average any 3 cylinders.
2. Coarse aggregates: Size No. 57 crushed limestone.
3. Fine aggregates: Natural sand or manufactured limestone sand proportioned by dry weight of fine to total aggregates between 30-45 percent.
4. Slump: 2-4 inches.
5. Mixing Water: Maximum 6.0 gallons per sack of cement. Deduct the moisture content of the aggregate from the amount of mixing water required.
6. Cement: Use Portland cement meeting the requirements of ASTM Standard C150. Use minimum 6.6 sacks of cement per cubic yard of concrete.
7. Dry aggregate per cement sack: Coarse aggregate-280, fine aggregate using manufactured limestone sand-194, fine aggregate using natural sand-187.

106.4 Drainage Structures

Drainage structures include catchbasins, manholes, junction boxes, and culverts.

a) General Requirements

All structures shall be precast reinforced concrete meeting the requirements of ASTM Standard C478 except as may be provided otherwise in the following: (See Appendix I for standard drawings)

1. Inside diameter shall be based on required pipe diameter. Structures used within the public right of

way and in residential applications within drainage easements should be sized on the following criteria:

Pipe Diameter	Structure Inside Dimensions
15 inches to 36 inches	48 inch diameter 36 x 48 inch or 48 x 48 inch
36 inches to 48 inches	60 inch diameter or 72 inch diameter 62 x 62 inch
54 inches to 60 inches	84 inch diameter 84 x 84 inch

2. Wall thickness shall be a minimum of 5 inches.
3. The minimum compressive strength of precast risers, bases, cone or top sections, and grade rings shall be 4,000 psi.
4. The access opening in cone or top sections shall be a minimum of 24 inches.
5. Joints: The reinforced concrete base and riser sections, excepting grade rings, shall be formed with male and female ends, so that when the base, riser, and top are assembled they will make a continuous and uniform structure.
6. Lift eyes or holes may be provided in each section for the purpose of handling but must not protrude through the concrete walls.
7. Poured-in-place reinforced concrete structures or polyethylene structures may be used with prior permission of the City.

b) Precast Reinforced Concrete Bases:

1. The base riser sections shall be precast with integral floors.
2. Heights of bases for pipes shall be according to the manufacturer's specifications, subject to prior approval of the City.

c) Precast Reinforced Concrete Tops:

Precast tops shall be of the following two types:

1. Eccentric Cone

2. Flat Slab Top

d) Precast Reinforced Concrete Grade Rings:

1. Grade ring wall thickness shall be a minimum of 5 inches.

2. Grade rings shall match the structure being used and be either 2 inches, 4 inches or 6 inches in height.

3. The combined height of grade rings shall be a maximum of 12 inches.

e) Steps:

1. Steps shall be fabricated from aluminum alloy 6061, T6.

2. Steps shall be corrosion resistant, free from sharp edges, burrs, or other projections which may be a safety hazard and shall be of sufficient strength to have a live load of 300 pounds imposed at any point.

3. The minimum width of cleat shall be 10 inches.

4. The legs and struts shall be of sufficient length for the cleat to project a minimum clear distance of 4 inches from the wall when the step is securely imbedded in the structure wall.

5. The top surface of the cleats shall be designed to prevent foot slippage.

6. Steps should be positioned vertically and at a maximum spacing of 16 inches.

7. Steps shall be the same size, projection, spacing, and alignment in each structure.

f) Pipe Entrance Requirements:

1. Pipe openings made in the field in existing structure walls for pipe installation shall be one of the following:

- i. Concrete structures shall be cored in the field. All pipe shall be grouted both inside and outside to the structure.
 - ii. Existing brick structures shall be evaluated in the field for replacement with a precast concrete structure. Whenever new lines are to connect to an existing brick structure, it shall be replaced unless approval is obtained from EPW to leave the existing structure in place. If a connection is made it shall be cored and new pipe grouted both inside and outside to the structure.
 2. Other specially designed products may be approved by the Maryville EPW Department.
- h) Covers:
1. Frames and covers shall be of gray cast iron meeting the latest requirements of ASTM Standard A48, Class 30, (30,000 psi). The total weight of the frame and cover shall not be less than 375 pounds.
 2. Covers shall be round and machine ground horizontally.
 3. Frames shall have clear openings of 24 inches, heights between 7 & 8 inches, and overall base diameters between 35 & 37½ inches. The base shall have four uniformly spaced holes for attachment to the structure using 5/8-inch diameter bolts. The maximum bolt circle diameter shall be 33 inches.
 4. Covers shall have a thickness as specified by manufacturer and diameters of 26 inches.
 5. Covers shall have two non-penetrating pick holes for lifting purposes.
 6. The top face of the covers shall be embossed with the words "STORM SEWER" with letters approximately two (2") inches in size.

107 **EXECUTION**

All construction on the City of Maryville's stormwater drainage system that is not performed by the City of Maryville shall be executed by a person, firm, or

corporation licensed to engage in municipal utility contracting as set forth in the Tennessee Contractors Licensing Act of 1976 (TCA 62-601). This requirement shall apply to all construction regardless of the amount of work involved.

107.1 Preparation

a) Precautions and Permit to Excavate:

1. Notify utility companies to locate existing facilities.
2. Abide by other utility companies' requirements when repairing, replacing or disturbing existing facilities.
3. Prior to trench excavation within any public right-of-way, including public alleys, a permit shall be obtained from the governing authority to perform such excavation. As a minimum, the trench backfill and street repair shall be made in accordance with the Maryville Land Development and Public Works Standards.

b) Prior to laying pipe, prepare suitable bedding. Brush is not considered acceptable bedding.

c) Before placing pipe in trench, field inspect for cracks or other defects; remove defective pipe from construction site.

d) Remove all undesirable material from the interior of the pipe, including connection points.

107.2 Installing Storm Drainage Pipe

All storm drain pipe systems installed in the City of Maryville shall conform to the standards listed below.

a) Trench excavation details and dimensions shall be as specified by the design engineer on the approved site plan. Minimum trench width should provide clearance on each side of the pipe between the outside diameter of the pipe and the trench wall equal to ½ the nominal pipe diameter, but not to exceed 18 inches.

Suggested Minimum Trench Widths

Nominal Pipe Size (Inches)	Trench Width (Inches)	Distance to Sidewall (Inches)
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15	32	8
18	39	9
24	52	12
30	66	15
36	78	18
42	83	18
48	89	18
54	96	18
60	102	18

- b) If the trench walls or bottom are found to be unstable the contractor shall consult with the design engineer for an alternative trench design.
- c) Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.
- d) Laser equipment should be used and offset hubs should be provided at intervals of 100 feet and at every drainage structure location for the purpose of checking grade between sections.
- e) Accurately establish the centerline of each pipe using a transit.
- f) Carefully inspect all pipe and each fitting prior to its placement in the trench, and reject any defective pipe or fitting from the job site.
- g) Lay pipe progressively upgrade on a minimum 6 inch bedding of Class Ia or Ib material (ASTM D2321), with bell upstream in such a manner as to form close, concentric joints with smooth bottomed inverts. Joining of all pipe shall be in accordance with manufacturer's specifications. Metal pipe bands shall have rubber o-ring gaskets.
- h) Backfill pipe using clean Class Ia or Ib material (ASTM D2321) using the following criteria:

Open Areas	
Pipe Material	Backfill Depth
Thermoplastic and Metal	To the top of pipe.
Concrete	To the pipe spring line.
Under Roadways	
All	To the road sub-grade.

- i) Keep the pipe free of all unneeded material, and upon completion of a section between any two drainage structures, it shall be possible to view a complete circle of light when looking through the pipe.
- j) When laying pipe ceases, close the open ends of the pipe with a suitable plug to prevent the infiltration of foreign materials.
- k) A structure shall be used when joining dissimilar pipe.
- l) Headwalls and endwalls shall be used at open pipe inlets and outfalls.
- m) Outlet protection shall be provided in the form of either riprap aprons, level spreaders, outlet basins, or baffled outlets based on the potential for erosion or scour caused by concentrated flow from the outlet pipe. Riprap aprons shall have a geotextile underlayment.

107.3 Installing Drainage Structures

All storm drain structures installed in the City of Maryville shall conform to the standards listed below.

- a) Structures shall be furnished as provided under Section 106.4 of these Standards.
- b) Depth of structures shall be the vertical distance from the lowest invert in the structure to the base of the cover frame.
- c) Backfill with the same material used for pipelines.
- d) Prepare sub-grade on undisturbed earth. Remove all loose earth prior to placing crushed stone base or concrete slab. Fill all disturbed areas below subgrade level with compacted bedding stone.
- e) Structures having a depth of less than 12 feet shall be set on compacted Class Ia or Ib (ASTM D2321) bedding material at a minimum 6 inches thickness. Structures having a depth of 12 feet or more shall be set on a 6-inch thick concrete slab having a minimum diameter 1 foot greater than the outside diameter of the base section. The concrete slab shall be poured on a minimum 6-inch thick compacted crushed stone bedding. Concrete shall meet the conditions of Section 106.3 of these Standards.
- f) The base shall be placed on dry consolidated and, when possible, undisturbed soil.

- g) Structures shall be set plumb.
 - h) Inverts shall be accurately shaped, using concrete, to a smooth surface texture. Invert flow channels shall be shaped having the same radii as those of the pipes for which the channels are being provided. The depth of the channels shall be a minimum of 1/3 the diameter of the pipes being accommodated.
 - i) Inlets and outlets shall be finished smooth and flush with the sides of the structure wall so as not to obstruct the flow of stormwater through the structure.
 - j) When completed, the structure shall be free from channel obstruction and leakage.
 - k) Lift holes shall not completely penetrate the structure walls.
 - l) Precast concrete grade rings shall be set using Portland Cement Mortar and/or flexible butyl resin sealant. Care should be exercised so as not to allow too much water in the Portland Cement Mortar, which may cause shrinkage. All cover frames that are attached to 2 or 4-inch grade rings shall be attached to the grade rings using Portland Cement Concrete mortar and/or butyl resin sealant. A minimum of 2-inch thickness of mortar shall also be placed over the lip of the cover frame as shown on standard drawings. Joints of precast concrete grade rings and frames shall be made so as to prevent leakage.
1. Alternate attachment for 6-in height grade rings and direct attachment to the cone:

The following alternate may be used in lieu of Portland cement mortar for attaching frames to grade rings 6 inches in height or directly to the cone. Frames shall be bolted by means of 4, 5/8 inch anchor bolts and shall be set in a bed of flexible butyl resin sealant. No Portland Cement Mortar will be required around the frame when this alternative is used.

107.4 Private Storm Drainage Systems

Private storm drainage systems tying into the public stormwater drainage system must be connected to the system in accordance with City of Maryville requirements. Customer shall meet with EPW Stormwater personnel for requirements and approval.

107.5 Initial Inspection of Storm Systems

The City of Maryville is required by its NPDES Phase II Permit to accept responsibility of all stormwater runoff discharging into waters of the state. In an effort to prevent premature system failures, which can lead to illicit discharges, the City reserves the right to inspect any storm drainage installations. In order to establish confidence in the installation and avoid the unnecessary delay of final acceptance all stormwater installations shall be inspected by the Director of Public Works or his/her designee. Any defects shall be corrected. The installation contractor should be aware that any defective pipe or pipe joint will require the line to be dug up and repaired. Great care should be exercised to ensure a proper installation. Other utility installations should be closely supervised to ensure that the stormwater drainage system is not damaged during construction.

107.6 Final Inspection of Storm Systems

Before a final subdivision plat is issued (or in the case of commercial construction a certificate of occupancy) the City will perform a visual inspection. A TV-inspection of the line may be required. All visible defects shall be repaired.

107.7 Annual Inspection

Approximately twelve (12) months following acceptance of the storm drainage utility line, a follow-up inspection will be made to determine if any failures or deficiencies have occurred as a result of Contractor's or Developer's work and/or materials. Present at this inspection will be a stormwater representative of the City of Maryville EPW Department and the Developer or other appropriate parties. In the event that a representative of the Developer is not present, the EPW Department representative shall complete the inspection, and a notice of the inspection and its findings shall be forwarded in writing to the Developer. The Developer will be responsible for correction of all failures or deficiencies of a mechanical nature and for failures or deficiencies caused by the work and/or materials of Developer and/or his agents that occur in the first year of operation. The Developer is further responsible for any additional damages done in completing the required repairs. Within ninety (90) days of notification of the findings of the one-year inspection, it is the responsibility of the Developer to ensure that any and

all changes and/or repairs have been completed. If the Developer is in compliance and no changes or repairs are needed either initially or within the ninety (90) day cure period, any bond posted shall be returned to the Developer within sixty (60) days of completion and acceptance of the work by the City following the one year inspection. If the Developer fails to complete any required repairs or changes and the ninety (90) day cure period passes after notice, any bond posted shall be paid immediately to the City of Maryville for the purpose of remedying any of the deficiencies and/or for completion of the project. Such funds shall remain the sole property of the City of Maryville, even to the extent that the actual costs of the work done are less than the amount of the bond forfeited to compensate the City of Maryville for the additional time and manpower needed to complete the work or to see that the work is completed. The EPW Department will oversee completion of the needed work at the expense of Developer and will charge Developer any overage incurred over the bond amount for the cost of the completed work. The Developer is responsible for such charges. If a bond has not been provided, the City may file suit or make other collection efforts against the Developer or any other appropriate parties immediately after the expiration of the ninety (90) day cure period for the cost of the work done or to be done to bring the property into compliance. The City shall receive from the Developer or any other appropriate party its reasonable litigation costs incurred as a result of Developer and/or other appropriate defendant failing to timely complete the required repairs identified in the one-year inspection. Such litigation costs include, but are not limited to, reasonable attorney's fees, court costs and deposition fees.

107.8 Bond Requirement

The EPW Department shall maintain a list of delinquent developers who are in default and have not in the past performed repairs required by the City of Maryville or the EPW Department after the ninety (90) day cure period following the inspection done at the one-year warranty period. These developers shall be required to perform or pay for the required repair work and any and all prior projects for which the developer is responsible; otherwise, the developer will be required to post a performance bond acceptable to the City of Maryville to the EPW Department before commencement of any new

stormwater projects involving the EPW Department. Such bond shall be in an amount equal to at least ten percent (10%) of the contracted cost of the storm drainage utility installation for the development. The performance bond shall be payable to the City of Maryville and shall be executed by a surety company duly authorized and qualified to do business in the State of Tennessee. This bond shall be conditioned upon the developer's completion of all requirements of the EPW Department as set forth in any contractual agreement with the City and in the Rules, Regulations, Rates and Policies for the City of Maryville, Stormwater Utility pertaining to warranty work and required repairs to the stormwater utility systems for the project.

108 EASEMENTS

108.1 Drainage Easements

Permanent drainage easements shall be obtained for all storm drainage lines and open drains that are not within a public dedication, with the right of entry for inspection and maintenance. An easement will be required if storm water drainage is designed to be transported from other properties.

108.2 Permanent Easements

Permanent easements shall be obtained for a detention dam site with spillway and release facilities and floodage rights for temporary detention and conveyance of storm drainage. Easements and floodage rights shall include all necessary provisions and sufficient land for entry to inspect and maintain facilities. Deeds and easements shall be properly recorded.

109 ENFORCEMENT

Deviations from these standards or failure to comply with any of the requirements established shall constitute a violation subject to a "Stop Work Order" being issued to the owner, developer, contractor or any other person responsible for the work being performed. The Director of Engineering and Public Works or his/her designee or his designee shall issue the "Stop Work Order". Additionally, regardless of whether a stop work order was issued, these standards are enforceable in a court of equity through

injunction or any other equitable means. Furthermore, any violation of these standards constitutes a Class C misdemeanor and as a violation of a City ordinance punishable in City Court with a fine of up to \$50.00 per day for violation. The above remedies are cumulative and pursuit of one remedy shall not prevent pursuit of any other remedy employed for enforcement of this ordinance. Enforcement powers of the City shall be to the maximum extent permitted by law.

110 STANDARDS FLEXIBILITY

110.1 Interpretations of these Standards and Design Criteria

Interpretations of these Standards and Design Criteria or the determination of any other EPW stormwater standards and design criteria not covered under these standards shall be at the discretion of the Director of the EPW Department of the City of Maryville. The decision of the Director of the EPW Department shall be based on past practices, traditional policies, widely accepted professional principles and practices of the industry.

110.2 Right of Appeal

Any disagreement with the interpretations or determinations made by the Director of the EPW Department of the City of Maryville with respect to these Standards or any other standards not covered herein may be appealed to the City Manager or his designee.

111 STORMWATER RULES, REGULATIONS, & POLICIES

111.1 Stormwater Charges

Stormwater charges shall be applied to all impervious surfaces as outlined in the Stormwater Utility Ordinance. Rates will be in accordance with the City of Maryville Customer Service Policy Manual.

111.2 Sewer Service Connections

All stormwater connections to an existing City storm drainage system shall be made at suitable locations selected by authorized personnel of the City.

The service line shall be installed, owned, and maintained at the expense of the applicant. Service lines must pass inspection before being covered over and placed into service.

111.3 Extension of Stormwater Lines

The extension of storm drainage lines shall be made in accordance with and subject to the conditions as set forth in PART I, Section 1.12, of this document.

112 STORMWATER RATES AND CHARGES:

Rates, fees and other charges for the storm drainage system will be in accordance with current City of Maryville fee schedule as located in the Customer Service Policy Manual. Fees not included in the above policies will be charged based on actual costs.

113 STORM DRAINAGE EXTENSIONS

In addition to the following regulations, each proposed storm drainage extension shall be evaluated for acceptance or rejection.

In general, and insofar as possible, each extension should be economically viable and self-sustaining on its own with minimal impact on the utility ratepayers as a whole.

113.1 Extensions

All storm drainage extensions within areas being developed within the corporate limit of the City of Maryville shall be installed by and at the expense of the developer. However, should the City determine that the design capacity of the line should be increased to allow the service of the areas other than the development; the City will pay the difference between the cost of the line sized for the development (including installation) versus the cost of the main to serve the expanded area. The size of such larger mains shall be at the discretion of the City.

The City may connect a storm line to, or extend a line from any previously installed in accordance with the above terms without obligation to the developer of the newly developed subdivision.

113.2 Off-Site Improvements

In the interest of the health, safety and welfare of all, when the appropriate land use has been determined for any area to be developed, the Maryville Regional Planning Commission has the right to require the developer to show

that off-site downstream drainage can be accommodated (considering the planned development of the contributing watershed) without damage to existing facilities or properties before such development is approved for construction.

a) Proportionate Share

Where a developer chooses to contribute a proportionate share towards the correction of off-site outfall deficiencies, the City of Maryville may accept such contributions towards the correction, and accepts the responsibility to its citizens for the initiation and prosecution of projects for the alleviation and/or correction of storm drainage deficiencies insofar as funds can be made available for their accomplishment. The proportionate cost of such downstream improvements is represented by the ratio that the developed runoff from the property bears to the total runoff expected within the watershed or the affected portion of the watershed.

b) Proportionate Cost

When a general drainage improvement program has been established, a pro-rata share of the total cost of the program shall be determined as follows:

1. The estimated increased flow of storm water runoff for the drainage shed when fully developed in accordance with the adopted comprehensive plan shall be computed.
2. The increase flow of storm water runoff caused by a subdivision or development shall be computed.
3. The ratio of the flow of storm water runoff caused by a subdivision or development to the estimated total volume and velocity of storm water runoff for the drainage shed, expressed as a percentage, shall be applied to the total cost of the drainage improvement program for the drainage shed. The resultant figure shall be the pro-rata share for the subdivision or development.
4. When storm water retention/detention facilities are incorporated in the drainage design for a development plan to reduce storm water runoff and thereby reduce or eliminate the pro-rata share cost, an agreement must be made with the City of Maryville to insure that construction of such facilities will be in accordance

with approved plans and specifications prepared by an engineer licensed to practice in Tennessee, and that the facilities will be adequately maintained. The agreement will be executed before the development plan is approved.

c) Proportionate Payment

The payment of the pro-rata share shall be due prior to the approval of the Storm drainage plans for a development. Where a subdivision has been previously approved or where the subdivision of land does not occur, the payment of the pro-rata share shall be prior to the issuance of any building permits in accordance with the Maryville Municipal Code.

Payment of the amount due will be acknowledged by depositing the amount due in an interest bearing escrow account with the City of Maryville Recorder. Escrow agreements shall be effected in a form approved by the City Recorder.

Payments received shall be expended only for the construction of drainage facility for which the payment was calculated. Until expended, interest shall accrue to be benefit of the depositor.

113.3 Exception

The regulations governing the extension of storm drainage shall not limit the City from participating in the cost of storm drain extensions when the application warrants consideration due to high use or favorable return on investment.

114 Responsibility

a) Drainage Channels

1. The City of Maryville assumes the responsibility for the maintenance and improvement of all drainage channels located within a public right-of-way where the maintenance or improvement of that channel would clearly benefit the general public welfare.
2. The City does not assume any responsibility for maintenance or improvements on any drainage channel that is located on private property.

3. On private property where a drainage easement exists, the City may maintain or improve a drainage channel where the maintenance or improvement of that channel is necessary to ensure the safety of the public. The City will not make improvements to a channel in an easement for the following:
 - i. To improving aesthetics.
 - ii. Aid in the development of property.
 - iii. Replace ongoing, normal maintenance that is the responsibility of property owner.

b) Storm Sewers

1. The City of Maryville assumes the responsibility for the maintenance and improvement of all storm sewers located within a public right-of-way where the maintenance or improvement of that storm sewer would clearly benefit the general public welfare. The City does not assume responsibility for the construction or improvement of storm sewers on the right-of-way for the following:
 - i. Storm sewer desired by the property owner for the purpose of improving aesthetics.
 - ii. Storm sewer desired by the property owner or required by the City to provide access or to aid development. Also see Title 12, Chapter 5, Section 12-501 of the Maryville Municipal Code.
 - iii. Storm sewer desired by the property owner as a replacement or alternative to a properly functioning existing drainage channel.
2. The City does not assume any responsibility for maintenance or improvements on any storm sewer that is located on private property.
3. On private property where a drainage easement exists, the City may maintain or improve a storm sewer where the maintenance or improvement of that sewer is necessary to ensure the safety of the public or

protect water quality. The City will not make improvements to a storm sewer in an easement for the following:

- i. To improve aesthetics.
- ii. Aid in the development of property.
- iii. Replace ongoing, normal maintenance that is the responsibility of the property owner.

114.2 Implementation

a) Improvements

1. Improvements to existing drainage systems or the construction of new systems shall be prioritized according to the need and benefits of any improvement or construction.
2. The City will consider the design regulations in force at the time a facility was approved by the City and/or the Maryville Regional Planning Commission to be acceptable when determining whether a drainage system is adequate in design and function.
3. The City will not improve a drainage system for the sole reason of bringing that system into compliance with a newer or more restrictive design regulation.

b) Maintenance

The EPW Department shall maintain all drainage facilities that are the responsibility of the City.

115 SINKHOLES AND CLOSED DEPRESSIONS

115.1 Purpose

The City of Maryville has established a policy for land development within and adjacent to sinkhole areas. This policy is intended to minimize the risks associated with development near or around known or suspected sinkhole areas. While the City does not categorically prohibit development in these areas it is to be clear that such developments are discouraged.

The City stipulates that certain provisions and requirements be satisfied when land development is to occur within and adjacent to sinkhole areas. This policy outlines those provisions and requirements for all new developments either fully or partially containing sinkholes or closed depressions.

115.2 Survey Requirements

- A. Sinkholes or closed depressions occurring either fully or partially within a proposed development shall be located accurately by survey performed by a surveyor licensed in the State of Tennessee. This survey will provide topographic information having a minimum 2-foot contour interval and be tied to a permanent, fixed reference point. This survey shall be the basis for the developer's consultant's subsequent studies and will be incorporated into preliminary and final plan/plats, including any defined sinkhole/closed depression non-buildable areas or remediation/treatment areas.
- B. The applicant or applicant's representative shall identify and locate all springs, well heads, and other sinkholes within a 1,000-foot radius or within the drainage area of any sinkhole fully or partially within a proposed development. The drainage areas associated with such springs and well heads shall be delineated and shown on the development plans.

115.3 Regulatory Requirements

- A. The applicant or applicant's representative shall verify any requirements of the U.S. Environmental Protection Agency (EPA) or Tennessee Department of Environment and Conservation (TDEC) are met; specifically, Injection Well Permits or Aquatic Resource Alteration Permits (ARAP) that may be required to protect Waters of the State. Such verification shall be submitted in writing with preliminary and final plan/plat approval including any permits obtained.
- B. The applicant shall provide sinkhole specific measures to prevent debris, brush, trash, fill, and sediment from entering the sinkhole depression defined by the sinkhole lip. These sinkhole specific measures shall be included in the applicants Stormwater Pollution Prevention Plan

(SWPPP) and Stormwater Management Permit for Construction Activities as required by Title 19 Chapter 3 of the Maryville Municipal Code (Grading, Soil Erosion and Sedimentation Control).

Refer to http://www.ci.maryville.tn.us/Laurie/chpt_3.pdf for more information.

115.4 Development Requirements

A sinkhole shall not be used in any part for surface runoff of a proposed development unless the following conditions are met:

- A. The applicant demonstrates that diversion of surface runoff away from the sinkhole in part or completely has been explored and demonstrates to the reasonable satisfaction of the Director of Engineering and Public Works or his/her designee that these options are not environmentally or economically feasible.
- B. The applicant shall provide a study report by a registered professional engineer proficient in the field of hydrology, hydrogeology and hydraulics that any change in the volume or rate of surface runoff due to the development will not aggravate flooding on the proposed development, adjacent existing property, or connected/adjacent subsurface flow systems. Such reports must be substantive and based on field studies and evaluation of the specific sinkhole system. The study must evaluate open throat flow conditions and plugged (no flow) conditions for the subject sinkhole or closed depression. The study should include the entire sinkhole/closed depression drainage area.
- C. The applicant demonstrates that the design of the development incorporates appropriate "low impact" design features also known as "Better Site Design Practices" that reduce the volume and rate of runoff. At minimum these features will control and treat the "water quality" volume of runoff as defined in the City of Maryville Policy Manual for Stormwater Quality Management. Refer to http://www.ci.maryville.tn.us/Pam/Maryville%20PC%20PolicyManual_Final_031208.pdf for more information.
- D. The runoff from the development site during construction or after development shall not be allowed to discharge directly to the sinkhole. Controlled discharges from the

development site shall be regulated so that flow rate into the sinkhole or closed depression shall not exceed that of the development area prior to site development for each of each of the following storm events: 1-year, 2-year, 5-year, 10-year, 25-year, and 100-year NRCS storms. It shall be shown by study that any outflow from the development site will not aggravate flooding on the development site or downstream properties for any of these storms assuming the plugged (no flow) condition of the sinkhole.

- E. Where a portion of the sinkhole/closed depression is offsite, the runoff leaving the subject property to be developed must be shown to be no greater in flow rate or in volume than that which existed before development and written approvals must be submitted from owners of property where the water must travel to reach the lowest closed contour of the closed depression or sinkhole. Easement areas shall be approved based upon the calculations of the registered professional engineer of the developer on the proposed ponding elevation considering the plugged (no flow) condition.

115.5 Structure Location Requirements

- A. Structures are not permitted within the closed contour of a sinkhole closed depression unless all of the provisions of Sections 115.3-115.7 are met.
- B. Structures located within or adjacent to a sinkhole/closed depression drainage area shall not be permitted to have a basement or first floor elevation lower than an elevation being at least two (2) foot above the 100 year 24-hour NRCS design storm event (maximum) assuming plugged (no flow) conditions. Minimum Floor Elevations for such buildings are to be referenced and shown on the plat. The survey information from **115.2 Survey Requirements** of this document shall be used for evaluation of elevations and for water surface elevation calculations.

115.6 Geotechnical Requirements

- A. A study shall be performed by a licensed geotechnical engineer to explore foundation and sub-grade support conditions for new developments having features (buildings, pavements, etc) located within the highest

elevation closed contour interval of existing sinkholes or closed depressions. At minimum, such explorations will include subsurface testing of the soil within the zone from the existing ground surface to bedrock sufficient to identify open voids in the soil overburden, zones of soft soil overlying bedrock, or other conditions favorable for sinkhole formation.

- B. The study shall include an assessment of the risks associated with development adjacent to the sinkhole or closed depression area and provide the results and locations of the subsurface tests. The locations of the tests shall be referenced using the Survey provided in **115.2 Survey Requirements** of this document.
- C. The results of this study shall be used to establish the limits of any non-buildable areas, foundation and sub-grade support recommendations, and/or recommendations for remediation or treatment of structures located within or adjacent to a sinkhole/closed depression drainage area.
- D. Should the results of the study allow for construction located within or adjacent to a sinkhole/closed depression drainage area; verification and certification of foundation and sub-grade construction in accordance with the recommendations of the study by the geotechnical engineer will be provided prior to final plat or plan approval. Similarly, should the results of the study allow for treatment/remediation to allow construction located within or adjacent to a sinkhole/closed depression drainage area, verification and certification of the treatment/remediation in accordance with the recommendations of the study by the geotechnical engineer will be provided prior to final plan or plat approval. Final plat or plan approval may not be granted until treatment/remediation has been performed and completed in accordance with the study.

115.7 Submittal Requirements

The following shall be incorporated as required into the preliminary or final plats, plans, and approval documentation for any development having sinkholes or closed depression or portions thereof:

- A. Initial and final plats and plans submitted for approval shall incorporate survey information required in **115.2**

Survey Requirements of this document showing the location of the sinkhole or closed depression, or any portion thereof.

- B. Initial and final plats and plans submitted for approval shall include as a separate attachment a statement of compliance with the regulatory requirements of **115.3 Regulatory Requirements** of this document. Any regulatory permits obtained shall also be submitted as an attachment with the plan or plat approval documents.
- C. A statement indicating **115.4 Development Requirements** of this document are to be met along with the developer's consulting engineer's and/or hydrologist's study documenting compliance with the stated requirements. In the event a development contains multiple sinkholes/closed depressions, the surface drainage alternative and corresponding study documentation for each feature shall be clearly indicated on a copy of the survey from **115.2 Survey Requirements** of this document and included with the consultant's study. This documentation shall be submitted as a separate attachment during preliminary and final plat and plan approval. As required by **115.4 Development Requirements**, **E** written permission from property owners and easement boundaries must be provided as separate attachments, where applicable, or indicated on a final plat of the development.
- D. The following plan/plat shall note: "Structures located within or adjacent to a sinkhole /closed depression drainage area shall not be permitted to have a basement or first floor elevation lower than an elevation being at least two (2) foot above the 100 year 24-hour storm event (maximum) assuming plugged (no flow) conditions from the sinkhole/closed depression. Minimum floor elevations for such lots are referenced and indicated on the plat."
- E. The results of the study required as part of **115.6 Geotechnical Requirements** of this document shall be included as an attachment to preliminary and final plans and plats. The following plan or plat notations shall be required depending upon the results of the geotechnical study:
 - 1. If non-buildable sinkhole/closed depression areas are identified in the study they shall be clearly marked on

the plans or plats and the following note included: "Any sinkhole/closed depression non-buildable area identified here has been determined unsuitable for construction activity and no buildings, parking areas, or other structures shall be permitted within this area."

2. If the developer's geotechnical engineer provides options for foundation support, sub-grade support, or treatment/remediation to allow development within or adjacent to the sinkhole/closed depression area the following note shall be incorporated on plats or plans: "Identified sinkholes or closed depressions were investigated at the site. This investigation was performed by _____ (Geotechnical Engineer) on _____ (Date) and is on file with The City of Maryville. The report details the subsurface test methods used to explore these areas and provides recommendations, treatments, or remediation options which may allow construction." If a proposed development includes more than one sinkhole/closed depression area, or any portion thereof, the consultant's study should clearly identify each feature on a copy of the survey from **115.2 Survey Requirements** of this document and provide recommendations for each area in the study.
 3. If the developer's geotechnical engineer provides options for treatment/remediation to allow development within or adjacent to the sinkhole/closed depression area, a statement of observation of foundation, sub grade, sinkhole/closed depression treatment or remediation which indicates that the developer's geotechnical engineer has observed foundation excavations, deep foundation construction, or sinkhole/closed depression treatment/remediation in accordance with the recommendations of the study from **115.6 Geotechnical Requirements**. The statement of observation shall be provided in a letter bearing the seal of the geotechnical engineer prior to final plat or plan approval.
- F. The following plat or plan note: "Based upon the supporting evidence required by City of Maryville ordinance, sinkhole or closed depression areas have been identified on this plat/plan. Final approval of this plat/plan by the City of Maryville is not to be interpreted as any assurance or guarantee that future sinkhole or closed depression related property distress, including loss of foundation support, sub-grade support, and/or flooding, will not occur due to either natural or manmade activities."

115.8 Sinkholes Occurring During Construction

In the event that a sinkhole, closed depression, or portions thereof, are not indicated on the referenced maps and documentation but are determined, discovered, or occur during the course of construction, or any identified sinkhole exhibits a physical change in size or character, the applicant shall:

- A. Notify the City of Maryville Stormwater Department, where applicable, immediately.
- B. Provide all documentation, studies, and any related information to the City of Maryville Stormwater Department, as requested, as if the sinkhole, closed depression, or portions thereof were identified prior to approval and noted on the preliminary plats of plans as required by all of the requirements of this policy.
- C. Upon determination of a sinkhole, closed depression, or any portions thereof, or noticeable changes in the sinkhole; any prior approvals of preliminary or final plats or plans, shall not constitute automatic approval and shall not be grounds for the continuation of any construction or development activity within the identified area until such time as the required documentation and applicable detailed studies are completed and accepted.

APPENDIX I - DETAIL SHEETS "STANDARD DETAIL DRAWINGS"

APPENDIX II - EASEMENTS

- Dedication and Transfer of Utility Lines, Easements, and Facilities

DEDICATION AND TRANSFER OF UTILITY LINES, EASEMENTS AND FACILITIES

This indenture, made and entered into on this _____ day of _____, _____, by and between _____ of _____, party of the first part, (hereinafter referred to as Developer), and THE CITY OF MARYVILLE, TENNESSEE, of Blount County, Tennessee, party of the second part, (hereinafter referred to as the City).

Witnesseth that whereas, said developer has caused to be constructed the following described utility facilities:

Whereas, said Developer desires that said utility facilities be attached to and become a part of the City's existing storm sewer system and desires to dedicate, transfer and convey said facilities, including all easements and rights connected therewith, to the City and has requested that the City accept the same into its system.

NOW THEREFORE, in consideration of the City accepting said utility facilities into the City's system, said Developer hereby dedicates, transfers and conveys unto the City, its successors and assigns, all of the aforescribed utility facilities together with all easements and rights connected therewith.

The Developer further warrants that all labor and materials in connection with the construction and installation of said facilities have been fully and completely paid and that there are no liens or other encumbrances existing against said facilities.

The Developer further warrants that said utility facilities are free and clear of all defects in material and workmanship, that said facilities were constructed and installed in strict compliance with all requirements of City rules, regulations, and orders, and does hereby agree to indemnify and save harmless the City from any and all loss, costs, expense or damage which the City may suffer as the result of any defect or defects which occur within one year from the acceptance of this instrument in said facilities.

IN WITNESS WHEREOF, said Developer has hereunto caused these presents to be executed on the day and date first above written.

BY: _____
(Signature)

(Title)

