CITY OF MEMPHIS

DIVISION OF ENGINEERING

DESIGN AND POLICY REVIEW MANUAL

REVISED JUNE 28, 2015

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SECTION 100 - INTRODUCTION

The purpose of this policy manual is to document the City of Memphis, Division of Engineering policies not expressly covered by the Subdivision Regulations Code of Ordinances and other published documents. Policies contained herein will not supercede information provided by any of the aforementioned documents.

The policies are intended to provide direction to designers and clarification of the Division of Engineering's interpretation of the various codes, regulations and ordinances. The policies contained herein are based on sound engineering principles and past practices of the Division of Engineering.

SECTION 200 – SIGNALIZATION (Revised 6/28/15)

The following policies are in reference to traffic signalization which includes traffic signal and flasher installations. The policies relate to both city and developer installations.

201 – SIGNAL DESIGN POLICY

201.1 - Private Streets and Driveways

A. Signalization of private streets and driveways is the responsibility of the developer. If signalization of a public street and private street or driveway is to be considered as part of a development, an appropriate traffic impact study must be completed by a Tennessee registered professional engineer. Since each location is different, the specific elements to be addressed in the study should be approved by the City Traffic Engineer.

B. In general, the traffic impact study must respond to the signalization warrants contained in the current edition of the *Manual on Uniform Traffic Control Devices* (MUTCD). Certain warrant(s) must be satisfied to justify the installed of a traffic signal at a new location.

201.2 – Traffic Signal Installation Warrants Evaluation - The intent of this policy for the installation of new traffic signals is to provide a uniform standard by which requests are evaluated.

A. While traffic signal installations do facilitate better traffic flow at intersections under certain conditions, they can produce negative results when circumstances do not justify the installation. Oftentimes, lesser controls or modifications (i.e. stop signs, adding a turn lane, etc.) will provide improvements in traffic flow at an intersection. While the minor street approach may experience some periodic traffic delay, the impact on the overall flow of traffic is the primary consideration. The installation of

traffic signals at unjustified locations along an arterial street will have a detrimental impact on traffic flow even when signal coordination is considered. Memphis is a large urbanized area with the corresponding traffic demand. Unlike smaller cities and rural areas, the expectation of motorist in Memphis is that some minor delay on side streets is expected. Therefore, the justification of a new signal installation will not be based on minimum thresholds.

B. The current edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) establishes warrants to be used in the evaluation of a traffic signal installation request. The MUTCD clearly states that satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal. The City of Memphis traffic signal warrant policy is shown in the following sections.

C. Unless otherwise approved by the City Traffic Engineer, all traffic counts for existing intersections will provide 12 hours of data between the hours of 6:30 a.m. and 6:30 p.m. with count periods in 15-minute intervals.

D. Only warrants 1(Eight-Hour Vehicular Volume), 4(Pedestrian Volume) and 7(Crash Experience) will be used in the evaluation of new traffic signal installations. The 80% and 70% adjustments identified for warrant 1 will not be applied. The minimum volumes on the higher-volume minor-street approach (one direction only) for the 100% level of warrant 1, condition B, shall be increased by 30%.

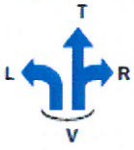
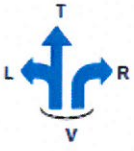
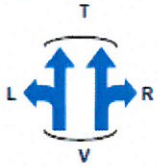
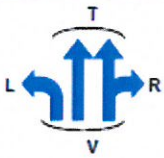
E. Traffic volume for use in evaluating warrant 1 may be estimated for a requested signal installation at a new intersection. The procedure for estimating the traffic volume is based on utilization of the current edition of the *ITE Trip Generation* manual for the appropriate land use. The weekday, average daily traffic (ADT), trip generation rate should be used for all volume projections. The assumption is made that the 8th highest hour volume on the minor approach is equal to 6.25 percent of the average weekday trips exiting the site. The projected site traffic exiting at the signalized driveway will be reduced by 15% for each additional full-movement driveway proposed for the site (reduced by 10% for each additional "Right-in, Right-out" driveway). Detailed trip distribution information may be provided as a supplement to the driveway reduction factors listed above.

F. If actual counts from similar land uses are available, they may be used in lieu of the traffic projections with the approval of the City Traffic Engineer. Traffic volumes shall not be adjusted based on vehicle classification. After projecting the 8th highest hour volume on the minor approach, directional assignments shall be made to determine the

anticipated direction of the turning movements at the intersection. Once the turning movement assignments are made, the adjustments for right-turning vehicles from the minor approach shall be made in accordance with following directions.

1. Warrants 4 and 7 can only be utilized at existing intersections. No projections of pedestrian volumes or vehicular crashes will be accepted.

2. Adjustments shall be made for right-turn vehicles from the minor approach. Right-turning vehicles experience fewer conflicts than left-turn or through movement vehicles. Therefore, they can enter the traffic stream with less delay. The volume of right-turn vehicles on the minor approach shall be reduced based on the following table:

Minor Street Adjustment Factor (f_{minor})			
Case	Lane Configuration	Volume Condition	f_{minor}
1		R > 0.7V	0.60
		0.7V ≥ R > 0.35V	0.40
		R ≤ 0.35V	0.20
2		R > 3T	0.60
		3T ≥ R > T/3	0.40
		R ≤ T/3	0.20
3		Any configuration with an exclusive right turn lane ≥ 500 ft. long. (See note* for shorter right turn lanes)	0.75
4		R > (T+L)	0.65
		L > (T+R)	Use Case 2
		L ≈ T ≈ R (±10 veh)	0.40
		L ≈ T > 3R	0.20
		R ≈ T > 3L	0.50
		all other conditions	0.30
5		R > T	0.75
		T ≥ R > T/2	0.50
		T/2 ≥ R > T/4	0.30
		R < T/4	0.15

Source: Illinois Department of Transportation

***Note: The City of Memphis will accept a min. right turn lane length of 100ft. Shorter right turn lanes should be considered "exclusive" only if they permit right turn traffic to flow freely past queued traffic.**

Mainline Congestion Factor (f_{main})			
Mainline volume per lane (veh/hr/lane)	f_{main}	Mainline volume per lane (veh/hr/lane)	f_{main}
0 - 399	0.0	1100 – 1199	0.40
400 – 499	0.05	1200 – 1299	0.45
500 – 599	0.10	1300 – 1399	0.50
600 – 699	0.15	1400 – 1499	0.55
700 – 799	0.20	1500 – 1599	0.60
800 – 899	0.25	1600 – 1699	0.65
900 – 999	0.30	1700 – 1799	0.70
1000 – 1099	0.35	1800 - 1899	0.75

Source: Illinois Department of Transportation

$$R_{adj} = R \times [1 - (f_{minor} - f_{main})]$$

where:

R_{adj} = adjusted right turn volume (veh/hr)
R = raw right turn volume (veh/hr)
f_{minor} = minor street adjustment factor
f_{main} = mainline congestion factor

*note: if $(f_{minor} - f_{main}) \leq 0$ then $R_{adj} = R$

The mainline volume is always the stream into which the right turning vehicles are entering. The factor (f_{main}) is computed for the thru movement associated with the minor street approach used to compute the factor (f_{minor}). For example, when computing the adjusted right turn volume for a northbound minor approach leg, the associated through movement would be the eastbound thru movement. If there is no mainline exclusive right turn lane, the mainline right turn volume is added to the thru movement volume when determining the factor (f_{main}).

201.3 - Signal Installation Timing Plans

All signal timing will be designed by the City of Memphis Traffic Engineer's office. A minimum of 30 days notice shall be given to the City Traffic Engineer prior to the turn-on of any new signal.

201.4 - Signalization Upgrades

A. The developer will be responsible for the upgrade of any public traffic signal installation required due to a new or expanded development. The upgrade may be requested by the developer or required as a condition by the City Traffic Engineer. A Tennessee registered professional engineer shall conduct any necessary studies and/or development or modification of signalization plans. The signal modification shall include layout, phases, and equipment as directed by the City Traffic Engineer.

B. The installation and/or modification of intersection ADA ramps shall be considered as part of any traffic signal installation. Ramps shall be installed or modified to satisfy the requirements of the Americans with Disabilities Act (ADA).

C. All salvageable signal equipment and materials shall be delivered to the City of Memphis Traffic Signal Shop.

201.5 - Signalization Plan Layout

A. All traffic signalization plans shall be developed at a scale of 1" = 20' unless otherwise directed by the City Traffic Engineer. The layout of the signal plan set shall be consistent with the historic typical layout. Sample plan sets for use as examples may be obtained or purchased from the City Traffic Engineer, Room 668, City Hall, 125 North Main Street, Memphis, Tennessee 38103.

B. Information contained on the plans shall include, but not be limited to, placement of all poles, signal heads, conduit, detection zones, lead-in cable, interconnect cable, pavement markings, signage, pull boxes, handicap ramps, and controller cabinet. The plans should also include the location of sidewalk, right-of-way, curb line, and easements; if required. When signalization plans are being designed to control a private street or driveway, the developer shall be required to provide a permanent easement adequate for the placement of the pad-mounted controller cabinet adjacent to the right-of-way near a signal pole. The location shall be determined by the City Traffic Engineer. The easement will also be sufficient to allow City of Memphis, Traffic Signal Technicians access to the controller cabinet for all necessary maintenance activities.

C. The signalization plans should include charts and diagrams for signal head and detection zone identification, phasing sequence, loop amp assignment (if needed), pedestrian pushbutton orientation and phase assignment, preemption (if required), display wiring schematic and general wiring diagram.

D. The City of Memphis typical legend shall be used for all signalization design. A copy of the typical legend can be obtained from the City Traffic Engineer's Office at City Hall, 125 North Main Street, Room 668, Memphis, Tennessee 38103.

201.6 - School Zone Flashing Beacon

A. Request for school zone flashing beacons and/or reduced speed flashing beacons for public schools shall only be accepted from the appropriate designated official of the Shelby County School System. Requests will not be accepted from individual citizens or schools, with the exception of a private school or charter school request. The intent of this policy is to assure that all appropriate measures have been taken by the Shelby County School System prior to the evaluation of any additional signal control devices. The School System (public, private, or charter) shall be responsible for funding the design and construction of any proposed School Zone Flashing Beacon.

B. Supplementary flashing beacons for school zones shall be installed only at properly designated school crossings protected by school crossing guards assigned by the Memphis Police Department. The intent of the flashing beacon is to supplement the police crossing guard as he/she regulates both vehicular and pedestrian flow.

C. The design of any school zone flashing beacon should be coordinated through the City Traffic Engineer's office. The design engineer should make an appointment for a meeting and provide a scaled layout of the school crossing and vicinity for use in identifying flashing beacon locations.

201.7 - Reduced Speed Flashing Beacon for Schools

A. It is the purpose of this policy to allow the establishment of a Reduced Speed zone with flashers adjacent to school property where flashers have been requested by the school system and a School Speed Limit zone with flashers are not justified. The Reduced Speed zone with flashers will be installed in accordance with the conditions of this policy. This policy will apply to all elementary and middle schools (public, private, or charter). The School System (public, private, or charter) shall be responsible for funding the design and construction of any proposed Reduced Speed Flashing Beacon.

B. School Speed Limit zones will continue to be signed with a 15 mph speed limit. A School Speed Limit zone with flashers and a Reduced Speed zone with flashers will not be established on the same street within 600 feet of the other zone. A School Speed Limit zone with flashers will have priority over a Reduced Speed zone with flashers.

C. This policy does not apply to non-school related reduced speed zones, nor does it apply to reduced speed zones installed at crosswalks not adjacent to a school.

D. A Reduced Speed zone will be established only on streets with a posted speed limit of 35 mph or higher.

E. A Reduced Speed zone will be signed for 15 mph below the posted speed limit.

F. The location and length of the Reduced Speed zone will be established by the Traffic Engineering Department on a case-by-case basis.

G. The flashers will operate only during the normal school year unless otherwise approved by the City Traffic Engineer. The flashers will operate a set time before and after school begins and a set time before and after school closes. These times will be determined by the Traffic Engineering Department. The beginning and closing school times will be supplied by the school to the Traffic Engineering Department a minimum of two months prior to the beginning of each school year.

H. Private schools must supply a contact person's name and telephone number each year, no less than 30 days prior to school beginning.

I. A Reduced Speed zone will not be established at a signalized intersection. The minimum distance from a signal to a flasher shall be 300 feet.

J. The design of any reduced speed zone flashing beacon should be coordinated through the City Traffic Engineer's office. The design engineer should make an appointment for a meeting and provide a scaled layout of the school location and vicinity for use in identifying electronic flashing beacon locations.

201.8 - Signalization Equipment

A. All signalization equipment used as part of a new traffic signal installation or upgrade shall conform to City of Memphis specifications. The controller installed shall be compatible with the current City of Memphis inventory to be consistent with existing maintenance practices. All controllers shall be delivered to the City of Memphis Signal Shop at least 30 days prior to installation for inspection and testing.

B. L.E.D. indications shall be used for all newly installed signal displays and pedestrian signals. All pedestrian heads shall provide a countdown display.

C. Fire preemption shall be included as part of any new traffic signal installation or upgrade. The fire preemption equipment shall be the 3M/GTT Opticom system.

D. The City Traffic Engineer shall be given a minimum of 72 hours of notice prior to the turn-on of a signal installation for an inspection of all signal equipment.

E. Fiber optic cable shall be installed and extended to the nearest existing traffic signal installation to provide interconnection for the City of Memphis traffic signal system. If the new traffic signal is installed along an existing interconnect system, the developer shall be responsible for bearing any and all cost necessary to incorporate the new installation into the existing system. This work will be done at the direction of the City Traffic Engineer. The City Traffic Engineer will identify the type and amount of cable (fiber optic) necessary for an acceptable installation.

202 – PARKING METERS

202.1 Out of Service

Any parking meters temporarily taken out-of-service due to construction must be approved by the City Traffic Engineer. Out-of-service parking meters shall be bagged or removed by the City Traffic Engineer.

202.2 - Daily Rates

The contractor will be responsible for paying the daily rate for each parking meter removed from service. The daily rate is established by the City Traffic Engineer based on the parking rate charged for the individual meter.

202.3 - Notification of Removal

The City Traffic Engineer shall be notified if any parking meter needs to be removed due to construction. The City Traffic Engineer will be responsible for removing the parking meter. The contractor shall be responsible for removing any poles. Upon the completion of construction, the contractor shall be responsible for installing a new pole. The contractor shall coordinate with the City Traffic Engineer on specific pole requirements. The contractor shall also be required to construct the appropriate concrete foundation for any multi-space parking meter. If construction requires the reconfiguration of the parking meter layout, a plan shall be developed by a Tennessee registered professional engineer and the poles and markings shall be installed by the developer.

SECTION 300 – MARKING AND SIGNING

301 – DEFINITIONS

301.1 - Markings
Any lines, symbols or messages applied to the street surface. This may include, but not be limited to, paint, thermoplastic, tape, plastic polimer film, etc.

301.2 - Signing
Any message, word or symbol, displayed vertically on material within the public right-of-way.

301.3 - Banners
Temporary signs fabricated from flexible material installed for a specific event for a limited period of time. Banners do not provide information for traffic control. Permission shall be obtained prior to the installation of any banners.

302 – NEW PAVEMENT MARKINGS

All new pavement markings shall be either hot thermoplastic or 3M plastic polimer film, as directed by the City Traffic Engineer.

303 – PAVEMENT MARKING REMOVAL

Whenever existing pavement markings are removed by grinding, an asphalt overlay will be required prior to installing the new pavement markings. The limits of the asphalt will be defined by the length of existing marking removal.

304 – SIGNING AUTHORITY

The City of Memphis will follow signing guidelines and policies as defined in the current edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) which has been adopted as law in the State of Tennessee. Signs should be used only where justified by engineering judgement or studies. Regulatory and warning signs should be used conservatively because these signs, if used to excess, tend to lose their effectiveness. The use of these signs should be kept to a minimum as the unnecessary use of warning signs tends to breed disrespect for all signs.

305 – WARNING SIGNS

Warning signs call attention to unexpected conditions on or adjacent to a street and to situations that might not be readily apparent to the road users. Warning signs alert road users to conditions that might call for a reduction of speed or an action in the interest of safety and efficient traffic operations. Conditions that can reasonably be expected by a motorist in an urban or suburban environment should not be signed.

306 – DEVELOPER RESPONSIBILITY

306.1 – Installation
The developer will be required to install all traffic control signs. A signing plan shall be developed by a Tennessee registered professional engineer and shall be approved by the City Traffic Engineer. The developer shall be required to provide funding for the incorporation of any new signs into the City of Memphis GIS Sign database. All signs shall be in conformance with the MUTCD.

306.2 – Speed Limit Sign Installation
The developer is responsible for installing speed limit signs for any street that is not designed for 30 mph.

307 – STREET NAME SIGNS

All public street name signs shall conform to the MUTCD and standards accepted by the Traffic Engineering Department. Street name signs for private streets shall be similar to public street name signs with a blue background and shall be fabricated and installed by the developer.

308 – STOP AND YIELD SIGNS

308.1 – Developer Required Stop Sign Installation
Stop signs shall be installed by the developer at any intersections that do not meet the intersection sight distance (ISD) criteria established by ASSHTO. Stop or yield signs may not be required in residential developments where the intersection sight distance is adequate.

308.2 – Vegetation
The City will immediately trim and/or cut any vegetation blocking the view of any STOP or YIELD sign. Notices will be sent to property owners to maintain vegetation growth within the public right-of-way so as not to block the view of any sign properly installed by the City and/or State of Tennessee.

309- POLE BANNERS

309.1 – Approval
Pole banners may be permitted for non-profit and civic organizations, if approved by the City Chief Administrative Officer. Approval will be determined based on the nature of the mission of the non-profit organization or civic institution and the degree of support and involvement of the City in the event being promoted. Non-profit organizations will be allowed to display banners promoting sporting events, cultural events, milestone anniversaries and festivals. Convention-related banners or those promoting a specific commercial exhibition may only be displayed at those locations in the vicinity of the facility that is being used for the special event. A specified group of civic institutions such as non-profit colleges, universities, museums, parks, and government agencies may

display banners unrelated to a specific event. Any civic institution that wishes to be added to the specified group of approved institutions must submit a formal request to the City of Memphis.

309.2 – Advertising Banners
No for-profit, commercial enterprises will be allowed to hang banners to advertise or promote their businesses, merchandise, products or services.

309.3 – Banner Time Restrictions
Banners should generally be event-oriented. However, a specified group of civic institutions such as non-profit colleges, universities, museums, parks, and government agencies may display banners unrelated to a specific event. For events lasting one week or longer, banners may be installed 30 days before the event. For shorter events, banners may be installed 14 days before the event. All banners must be removed within 14 days after the event has concluded. Banners approved for civic organizations that are not related to a specific event may be displayed for a maximum period of (3) years. MLGW will be responsible for inspecting the banners for wear and tear in (1) year increments and providing the City of Memphis with annual inspection reports. If banners are not removed within the required time frame, and if the City crews must perform removal, the organization will be assessed the cost and may be denied future banner requests.

309.4 – Logo Restrictions
The name of a for-profit sponsor of a non-profit organization or event may appear at the bottom of the banner in letters no more than (3) inches in height. The total space occupied by the sponsor name may not exceed 5% of the total banner surface area. No logos are permitted. Within the Central Business Improvement District, logos may be permitted, with the Downtown Memphis Commission approval.

309.5 – Pole Banner Size
Pole banners shall be a maximum of five (5) feet in length and a maximum of 30 inches wide. The minimum distance from the bottom of the banner to the top of the curb shall be 14 feet.

309.6 – Banner Placement Fee
The exact location and poles where banners may be mounted will be approved by MLGW. The City Engineer will review these locations to ensure that banner placement does not conflict with any traffic control device. If a field check is required, a $50.00 fee will be assessed. Banners may be mounted on arterial streets, but not on streets with a speed limit of 50 mph or higher.

309.7 – MLGW Mounting
Memphis Light, Gas & Water (MLGW) has an application for pole-mounted banners if the banners are to be mounted on MLGW poles. A copy of the application is contained in the appendix and details MLGW procedures and fees.

310 – TRAFFIC CONTROL PLAN

310.1 – Traffic Control Plan Design

A traffic control plan (TCP) must be submitted for any work within the public right-of-way. The TCP is considered a critical element of any design. The TCP shall address both vehicular and pedestrian traffic, as appropriate. The TCP shall address all signing, markings and other devices necessary to identify the work zone and provide adequate protection for the public. The TCP shall address all construction phases of the project and be consistent with the most recent MUTCD. The TCP shall be designed by a Tennessee registered professional engineer.

310.2 – Closures

Any request for sidewalk and/or lane closures must be for the purpose of protecting the public from construction activities or for the purpose of constructing within the right-of-way. The closures shall be terminated immediately upon completion of the activity for each the closure was approved. No closures will be approved for the purpose of parking construction employee vehicles. If the City determines the approved closure is being used for the purpose of parking construction employees, the approved closure will be terminated. All workers are responsible for parking vehicles in an appropriate and legal manner. Construction workers will be no exception.

310.3 – C.B.I.D. Construction Employee Parking

Each construction project within the boundaries of the C.B.I.D. shall include a plan for parking of construction employees. Construction employees will not be allowed to park on public right-of-way within the limits of the construction zone. The plan should identify the locations where construction workers will park and what the impact on the existing parking supply will be. The approximate number of construction employee vehicles shall also be identified.

SECTION 400 - TRAFFIC CALMING

The City of Memphis has implemented a traffic-calming program to assist neighborhoods and the Memphis Police Department in controlling excessive speeding. The program is primarily limited to local neighborhood residential streets. While any reasonable methods may be used to help control excessive speeding, the procedures utilized must be cost effective and safe. Traffic calming procedures proposed should be documented as acceptable practice by *the Institute of Transportation Engineers* or other equally reputable organization. No traffic calming measures will be implemented that, based on engineering judgement or other documented factors, are considered to pose an increased crash risk. Horizontal clearances between the travel path of a vehicle and non-breakaway fixed objects are a major safety consideration to the Division of Engineering. The installation of multi-way stop signs at intersections which are not warranted by the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) will not be installed as a traffic calming device.

401 – VARIOUS MEASURES CONSIDERED UNDER TRAFFIC CALMING

401.1 - Curb extensions/bulb-outs.
Areas of expanded curbing that extend across a parking lane and may narrow a travel lane.

401.2 - Chicanes
Series of three or more bulb-outs, staggered at mid-block locations on alternating sides of the street.

401.3 - On-street parking
Provision of on-street parking that reduces roadway width.

401.4 - Traffic Circle
Raised island in the center of an intersection that required vehicles to travel counterclockwise around the circle. The traffic circle should be sufficient to alter the straight-line path of vehicles traveling along the street and allow emergency vehicles to pass through the intersection in a manner acceptable to the Memphis Fire Department (MFD) and the Memphis Police Department (MPD).

401.5 - Street Closure
The use of a cul-de-sac to close a roadway by extending a physical barrier across the entire width, obstructing all traffic movements. This can only be recommended with the approval of the MFD and MPD.

401.6 - Diverters
Directional closure created by physically blocking a portion of the street or intersection.

401.7 - Speed Humps

Speed hump installation is the preferred method for controlling excessive speeding on local residential streets. See City of Memphis Speed Hump Program for the program criteria.

402 – SPEED HUMP PROGRAM

402.1 – General Purpose

A. The City of Memphis receives frequent complaints regarding speeding vehicles on residential streets. Residents in such areas are concerned about the potential for personal injury and property damage. Enforcement of the speed limit by police departments is the most effective means for reducing speeds; however, limited resources do not allow such enforcement on a regular and permanent basis. To overcome these problems, many cities are focusing on alternative neighborhood traffic control measures. Some such traffic calming devices include traffic circles and speed humps. These alternative traffic management measures have been used to address residential area traffic problems in many cities around the world.

B. Realizing that motorist characteristics and driver expectations vary from country-to-country, state-to-state and city-to-city, various traffic calming devices may not be as effective in some areas as they are in other areas. Therefore, the intent of this program is to focus exclusively on speed hump installation on neighborhood streets experiencing frequent, documented speeding problems. Statistics from cities which have installed speed humps in residential areas show that this device is successful in reducing speeds on local streets without affecting the safe operation of motor vehicles. The speed hump program guidelines which are outlined in this report provide a basis for establishing the installation criteria for speed humps.

402.2 – Speed Hump Installation Policy

A. The purpose of this policy is to provide guidelines for the installation of speed humps, a relatively new approach to control vehicular traffic speeds along a residential roadway. A speed hump, is a gradual rise and fall of pavement surface across the width of the roadway. A speed hump differs from a speed bump, which is more abrupt, having a height of three to four inches over a length of one to three feet. The speed hump adopted for use in the City of Memphis is a flat-top hump which is 22 feet in length with a 10-foot plateau three to four inches in height with 6-foot long circular arc approaches. Due to gentle vehicle rocking, speed humps cause some driver discomfort and result in most vehicles slowing down at humps and between properly spaced successive humps.

B. Research has shown that speed humps are effective in safely reducing speeds along a street. However, there is a potential for traffic diversion onto adjacent streets as a result of motorists avoiding the speed hump street.

C. In order for speed hump installation to be effective, their provision should be in accordance with established transportation engineering criteria and documented facts. As is the case with all traffic control devices, meeting warrants or design criteria along with proper installation will encourage compliance and safe driving practices. This policy provides criteria and procedures for installation of safe and effective speed humps.

The City reserves the right to change any or all of the criteria and procedures in these guidelines if deemed necessary.

402.3 - Eligibility Requirements

All of the following criteria should be satisfied for a street to be considered eligible for speed hump installation.

A. Petition

1. A petition from the residents and business owners documenting that at least 75 percent of all households and businesses in the project area (which includes streets that traffic may be diverted to) support the installation of speed humps on the identified street. All residents within the project area should be presented the opportunity to sign the petition. The project area will be defined by the City Engineer.

2. A verification statement from the contact person confirming that the signatures on the speed hump petition are valid and represent at least 75 percent of the households/businesses adjacent in the project area.

3. A statement from the neighborhood association endorsing speed hump installation on the project street. The statement must be presented at a meeting of the neighborhood association or organization.

B. Operational and Geometric Characteristics of the Street

1. The street shall provide access (via a driveway or on-street parking) to abutting residential and/or commercial properties (residential local or collector streets). Residential properties include multiple dwellings such as apartment complexes.

2. The street should not be wider than forty (40) feet (pavement width) or have more than one traffic lane in each direction.

3. The street shall have a posted or regulatory speed limit of 30 mph or less as determined in accordance with city ordinances.

4. The 85th percentile speed exceeds the posted or regulatory speed limit by at least five mph.

5. The speed humps should not be located in a horizontal curve, on vertical curves where visibility of the hump is restricted, or on the approaches to these curves.

6. The street must be approved by the Police and Fire departments for installation of speed humps.

7. The City will conduct eligibility studies for speed humps after a request has been made. Requests made by neighborhood groups or associations will be given priority for eligibility studies.

8. The City Engineer will be responsible for designating or approving the number and location of speed humps (and associated signage/striping) along a street. If the appropriate number of speed humps (at appropriate locations and spacing) cannot be accommodated for reasons related to drainage, driveway/intersection locations, vertical and horizontal geometry, etc., then the petition for speed humps would be rejected.

402.4 - Project Prioritization

Speed hump projects will be prioritized on a citywide basis. This would ensure proper allocation of the City's resources. Once a project is proven to be viable per the engineering studies, the projects will be ranked according to the date that the neighborhood association endorsement statement form is received by the City Engineer.

402.5 - Cost Responsibility

The cost for speed hump installation (including humps, signs, pavement markings, and if necessary, special features) will be paid by the City as funds are available within the capital improvements program (CIP). The following section provides an option for private funding of speed humps. This will only be allowed if there is public funding available for the program in any given year.

402.51 – Private Funding Option

The section sets forth guidelines for the option of private (individuals and/or associations) to finance the installation of speed humps along a specific street.

All guidelines specified in Sections 402.2, 402.3, and 402.4 shall be followed. Along with the neighborhood petition approving the installation of speed humps a letter shall be submitted requesting that private funding for the complete speed hump system for the specific street be considered. Private funding shall be for 100% of the complete system plus a 5% administrative/inspection fee.

The request for private funding can only be made after the street has been evaluated, met the criteria, and the petition has been returned to the City. Requests for private funding will not be considered during the evaluation process since it will not be known if the street meets the criteria at that time.

Once the request for private funding has been received by the City, a cost estimate for the street will be developed. The cost estimate will be developed from unit cost contained in a current contract or the most recent contract. A 5% administrative/inspection fee will be added to the estimate. The estimate will be given to the designated contact person for the street. No action will be taken regarding construction of speed humps until funds based on the estimate are deposited with the City. The Division of Finance will deposit the funds in the account associated with the speed hump program.

At such time the funds are in the appropriate account, the street will be included in a current open contract. If there is not an open contract, the street will be placed in the next group of streets to have speed humps installed.

Once the privately funded street is in the contract, the existing construction procedures will be followed. Construction will be done by the contractor

There will be provisions to allow the Division of Engineering to readily amend current contracts for the purpose of adding private funding for the purpose of including privately funded speed hump installations.

402.6 - Speed Hump Locations

Reasonable efforts will be made not to locate speed humps in front of a property if the occupant objects to its placement or, in the case of multiple dwellings if the majority of the households on the property object to its placement. As stated on the petition, an approval signature indicates a household's willingness to allow the installation of a speed hump and/or associated features on the street in front of their property.

402.7 - Design, Construction, and Maintenance

Design standards and installation procedures for speed humps and related features such as signs and pavement markings shall be prepared by the City. The speed humps will be constructed of asphalt. A one-foot saw cut (approximately three- to four-inches deep) will be made into the existing pavement at both ends of the speed hump to anchor it to the existing pavement. The speed humps will be twenty-two feet in length and three- to four-

inches in height. Construction of speed humps will be administered by the City. The City will maintain the speed humps and all related features.

402.8 - Speed Hump Removal and Alteration

The process for speed hump alteration or removal requested by the residents is the same as the process for installation, except that there will be no City participation in the cost incurred. A petition approved by the neighborhood association, documenting that at least 75 percent of all households and businesses adjacent to the speed hump street are in favor of the speed hump removal, will be required.

In the case the City determines that an unforeseen problem exists due to the hump, it may be redesigned or removed by the City. In such case, the City will bear the full cost of speed hump removal.

402.9 – Speed Hump Installation Procedures

The following items describe the procedure to be followed for speed hump installation.

A. Project Request

Request for speed hump installation can be initiated by individual residents or neighborhood associations. A request may be made in writing to:

City Engineer's Office
125 N. Main Street, Room 654
Memphis, Tennessee 38103-2017

B. Preliminary Review

1. After a request for speed humps has been received, City staff will conduct an initial investigation and collect data to determine the street's eligibility in regards to the operational and geometric characteristics. This eligibility process includes approval from the City of Memphis Police and Fire Department. Collected data will include traffic volumes, laneage, speed surveys, etc. Due to number of request for all services, the eligibility study will be placed on the engineering department's priority list and conducted as resources become available.

2. If the operational and geometric requirements for eligibility are not met, the street will not be considered for speed humps and the requester(s) will be notified.

3. If after the initial study it is determined that the street qualifies for speed hump installation (assuming proper placement of speed humps and associated features can be achieved), a petition packet consisting of the

speed hump petition (which will include photographs of the installations and a map indicating the location of speed humps and signs for the street in question), a verification statement for the contact person, and an endorsement statement for the neighborhood association will be mailed to the requester(s). The project requester(s) will be responsible for circulating the petition in the petition area.

4. The petition should be presented to all of the households and businesses in the identified impact area. Signatures representing 75 percent of all the households and businesses within the petition area must be in favor of speed hump installation (including the locations of the humps and signs as identified on the attached map) for the process to proceed further. Multi-family dwellings with more than four units will be counted as four households, with the property owner or manager representing the households.

402.10 - Funding

The installation of speed humps will be funded by the Capital Improvements Program. The funds available each fiscal year are established by the City Council. The number of speed humps installed each year will be dictated by the funds available. In addition to the actual speed hump installations, the funding also provides for the evaluation of request and program administration.

402.11 - Speed Hump Installation Scheduling

Speed humps will be installed as scheduling and funding permits. The construction of humps and the placement of signs and markings will conform to the current design standards as established by the City.

402.12 – Project Approval Criteria

A. General Policy

Speed hump projects will be evaluated on the basis of existing speeds and volumes. Once a speed hump request has been evaluated and determined to meet the City's criteria, the request will be ranked according to the date a verification statement endorsing the speed humps is received from the neighborhood association or organization. For a street to be considered for speed humps, both Condition 1 (Speed) and Condition 2 (Volumes) must be met.

B. Speed

The speed criteria considers the difference between the posted (or regulatory) speed limit and the measured speed or vehicles over a 24-hour period. To be

considered, the 85th percentile speed along the street must exceed the speed limit by at least five mph.

C. Traffic Volume

The 24-hour traffic volumes (two-way) must exceed 600 vehicles or 60 vehicles during a single hour. The 24-hour volume (two-way) shall not exceed 2,750 vehicles. Streets exceeding 2,750 daily vehicles are considered to be collector streets and not eligible for speed humps.

403.13 - Design Standards for Speed Humps

A. Dimensions and Cross-Section

The approved hump is a flattop. It is approximately 22 feet in length consisting of a 10-foot long plateau with a six-foot long circular arc approach on either side. This flattop speed hump is three- to four-inches in height.

On streets with a standard curb section, a minimum 12-inch taper to the flag-line of the curb will be provided to accommodate proper street drainage. For humps installed on non-curbed roadways, special treatments such as delineator post should be considered to prevent vehicle run-arounds.

B. Spacing and Location

Speed humps will usually be placed between 400 and 700 feet apart. Other spacing may be considered when determining speed hump spacing. The following guidelines will be considered when determining speed hump spacing.

1. On single short blocks (300 to 800 feet), a single hump positioned near the mid-point is usually sufficient.

2. On single blocks of moderate length (500 to 1000 feet), a two hump configuration is usually adequate.

3. On very long blocks (1000 to 1600 feet) three or more humps may be necessary.

4. On lengthy continuous street segments or for humps provided over a series of blocks, interior humps may be placed 400 to 700 feet apart.

5. A speed hump should not be located in front of a driveway or within an intersection. Speed humps should not be located within 250 feet of a traffic signal or within 50 feet of an intersection.

6. Speed humps should not be located, or contain, manholes, or be located adjacent to fire hydrants.

7. For humps located near drainage inlets the hump should be placed just downstream of the inlet. If this is not feasible, special treatment should be considered for drainage.

8. Speed humps should not be located in horizontal curves. Speed humps can be located at the crest of a vertical curve, but placement should be avoid on the approaches to vertical curves.

9. If possible, humps should be located on property lines rather than directly in front of a residence. Efforts will be made to avoid placement of humps and associated features in front of residences that did not sign the petition requesting humps for the roadway.

10. The advantage of existing or planned street lighting should be taken when determining hump locations.

11. If the appropriate number and/or spacing of speed humps cannot be obtained due to the aforementioned criteria, then the project will be terminated and the contact person will be notified.

C. Traffic Control

Traffic control consisting of signs and markings should be provided to advise roadway users of a speed hump's presence and to guide their subsequent action. Traffic signs and pavement markings should conform to Manual on Uniform Traffic Control Devices (MUTCD) standards.

D. Signing and Marking of Speed Humps

1. Signs will be placed on the approach to each speed hump that read Speed Bump Ahead. The signs shall be 30-in. by 30-in. with a black on yellow legend. An advisory speed plate will also be installed and located under the Speed Bump Ahead sign.
2. The six-foot circular arc approach on both sides of each speed hump will be striped with white reflective paint in a saw tooth pattern. The striping with be supplemented with raised pavement markers.

SECTION 500 - PLAN SHEET LAYOUT

501 – PLAN SHEETS

501.1 – Materials

Plans submitted in the form of original drawings shall be ink or CADD-generated on polyester translucent matte film. Original matte film drawings shall have a matte surface on both sides and shall be a minimum of four-thousandths inch (0.004") in thickness.

501.2 – Sheet Size

All drawings shall measure twenty-four inches by thirty-six inches (24" x 36"), with trim lines one-half inch (½") from the top and bottom edges. Each sheet shall have a left-hand margin of one and one-half inch (1 ½"); a right-hand margin of one-half inch (½"), and a margin of one-half inch (½") between the top and bottom border of the drawings and trim lines.

501.3 – Font Size

Text on plans shall consist entirely of vertical capital letters. Minimum recommended text size shall be equivalent to Leroy 120 Guide. If lack of space dictates, limited amounts of text equivalent to Leroy 100 Guide may be accepted at the discretion of the City Engineer. Text smaller than Leroy 100 Guide is not acceptable.

501.4 – Title Block

Each submitted drawing shall have a border and a city standard title block in the lower right-hand corner of the drawing. Electronic copies of the border and title block may be obtained from the City Civil Design Engineer's office, Room 677, City Hall, 125 North Main Street, Memphis, Tennessee 38103.

501.5 – Electronic Format

The Division of Engineering may also require that drawings be submitted in an electronic format agreeable to both the engineer and the City.

501.6 – Endorsement

All submitted final plans sets shall be signed and sealed by a Tennessee registered professional engineer. Each sheet within the plans set shall be signed and sealed with the exception of any standard drawings provided by the City of Memphis. The engineer of record will be held responsible for information contained within the plans set.

502 – RIGHT-OF-WAY AND EASEMENT PLATS

All permanent easement plats shall be on polyester film 0.004" in thickness. All plats shall measure either 8 ½" x 11" or 8 ½" x 14" with a left hand margin of ¾" with top, bottom and right hand margins of ¼". Trim lines are not necessary. A key map shall be provided indicating the location of all parcels affected. All right-of-way and easement plats shall show bearings and distances on all property lines. Property ownership shall be confirmed prior to submitting final plats.

SECTION 600 - AMERICANS WITH DISABILITIES ACT (ADA)

The architect/engineer of record for any development requiring review and/or approval by the City Engineer's office shall be responsible for meeting conditions setforth by the most current ADA guidelines being recognized by the City of Memphis. This is intended to address curb ramps, curb cuts, tree grates, sidewalk or any features located within the right-of-way of a public street. The ADA shall be addressed when any modifications are being made to a public street. ADA requirements shall be met within the project limits of construction and/or street modification. Accessible curb ramps shall be provided on all street, drainage signalization projects at appropriate locations within the project limits. This is intended to include intersections where any type of signal modification is designed other than aerial adjustments of existing signal faces. A clear pedestrian path of not less than 48 inches shall be maintained along all pedestrian ways. A clear pedestrian path width in excess of 48 inches may be required in some instances.

SECTION 700 - CURB CUTS , DRIVEWAYS, MEDIANS, SIDEWALKS

Section 701 - DEFINITIONS

701.1 - Curb Cut
Typically, a private entrance from an improved public street where the entrance is formed by an apron crossing the curb, gutter and sidewalk.

701.2 – Driveway
A private entrance from a public street using a radius treatment. The existing curb, gutter and sidewalk is not extended across the opening. The installation of handicap ramps (in accordance with ADA guidelines) will be required. The driveway may resemble a public street intersection.

701.3 – Median
Typically, a raised or depressed street segment that separates the directions of travel along a street or roadway. The median can be grass, concrete or other materials. The median may include some utilities and/or drainage structures.

701.4 – Sidewalk
That portion of the street right-of-way reserved for pedestrian use. Generally, it is aligned parallel to the property line and the roadway and is constructed of a hard surface, typically concrete.

702 – CURB CUTS

The design and placement of new curb cuts should conform to Division of Engineering standards. Commercial curb cuts shall not be located within 300 feet of the centerline of the nearest intersecting street without the approval of the City Traffic Engineer. Approval will not be granted if conditions indicate that a driveway or joint-use driveway can be constructed beyond the 300-foot limit.

703 - DRIVEWAYS

Driveways are typically installed when the existing or anticipated volumes exceed those normally associated with curb cuts.

703.1 - Signalization
At any location where signalization of a driveway is approved, the driveway shall have radii at a size directed by the City Traffic Engineer and not have any curb across the driveway.

703.2 – Pavement Treatment
Any private driveway or street not adhering to curb cut design standards shall have a pavement treatment beyond the limits of the right-of-way that clearly distinguishes the private driveway from a public street. Typically, the pavement treatment should be no

less than ten feet in length and extend the width of the driveway. The City Traffic Engineer shall approve the specific treatment.

703.3 – Pedestrian Easements
Pedestrian easements will be required when the pedestrian is required to leave the public right-of-way due to the design of the driveway.

703.4 – Signal Maintenance Easements
Signal maintenance easements will be required when a private driveway or private street intersects a public street and is signalized.

704 – MEDIANS

704.1 – Median Purpose
Medians provide effective access control and act as buffers between vehicles moving in opposing traffic lanes. The median strip divides the pavement into two separate roadways that function independently to some extent. Medians provide pedestrian refuge at times and serves as a location to place signs or other traffic control devices. Medians also provide a scenic feature to the street or highway.

704.2 – Median Cuts
The City of Memphis discourages cuts in existing medians. Requests for median cuts will not be considered unless all related conditions in the subdivision plat have been met. One example is providing circulation among adjacent parcels. Median cuts will not be considered within 300 feet of an existing median cut or intersection. Median cuts to low trip generation sites will not be considered. Median cuts shall not be approved if conditions for internal circulation among parcels identified in an approved zoning case or planned unit development have not been adhered to. Any approved median cut will be the responsibility of the applicant. An acceptable design, including a traffic control plan, must be provided by a Tennessee registered professional engineer. A land development contact must be entered into with the City prior to any construction.

705 - SIDEWALKS
Rules governing sidewalks are contained in the City of Memphis Sidewalk Ordinances. Per the ordinance, the owner of every lot and parcel of land abutting on any street, avenue, parkway, boulevard or other public street of the city, for which an established grade has been lawfully fixed, and curbs and gutters are in place, is required to provide and maintain adjacent to his property a sidewalk in accordance with the specifications set out in the sidewalk ordinances when so ordered by the City Engineer or his authorized representatives. The property owner is also required to keep the sidewalk and/or walkways clear and open to public passage and in good repair and condition.

SECTION 800 - STREET DESIGN

801 – STREET CLASSIFICATION

For the purpose of identifying the intended and/or actual function of a street, the Division of Engineering has established a street classification system. The definitions are generally consistent with nationally accepted standards. Some definitions have been expanded on for clarity.

801.1 - Freeway/Expressway

Controlled access facility with grade-separated intersections providing for interregional and/or interstate travel at high operating speeds. Typically, expressways accommodate high volumes of traffic. These routes include the interstate system, Sam Cooper Boulevard and Bill Morris Parkway.

801.2 – Principal (Major) Arterial

Facilitates relatively long urban trip lengths at moderate to high operating speeds serving major activity centers. Service to abutting land uses should be subordinate to the provision of travel service to major traffic movements. Principal arterial streets generally serve major centers of activity in urban areas and have the highest traffic volume corridors. These are multi-lane streets that may include medians. Poplar Avenue, North Parkway, Germantown Parkway and Lamar Avenue are examples of major arterial streets.

801.3 - Minor Arterial

Provides somewhat shorter trip lengths than major arterial streets and generally interconnect with and augment major arterial routes at moderate operating speeds. Allows greater access to adjacent properties than major arterial streets. These are typically multi-lane streets but may be two lanes in more rural conditions. These generally include all arterial streets not classified as principal, limited-access, parkway or boulevard.

801.4 - Major Collector

Collects and distributes moderate amounts of traffic between arterial streets, minor arterial streets and local roads at moderate to low operating speeds. Major collectors provide for more accessibility to adjacent properties than arterial streets. Some major collectors may be residential in nature but provide access to areas beyond the local neighborhood. Major collectors may have traffic volumes sufficient to support signalized intersections. These streets oftentimes are identified as a trunk route for emergency service vehicles and may be up to 48 feet in width and provide the predominate route for non-neighborhood oriented traffic.

801.5 - Minor/Neighborhood Collector

Collects and distributes moderate amounts of traffic between arterial, major collector and local streets at relatively low operating speeds with greater accessibility than major collectors. These streets typically service local/neighborhood streets and are 40 feet or less in width.

801.6 - Local/Neighborhood Street

These generally provide access to abutting properties and possess relatively low traffic volumes, operating speeds and trip lengths with minimal through traffic movements.

801.7 - Cul-de-sac

A street with a bulb end treatment and only one outlet. Can be referred to as a Dead End street.

802 – DESIGN POLICY

All street, drainage, structural, traffic control and signalization plans submitted to the City of Memphis shall be endorsed by a professional engineer registered to practice in the State of Tennessee. The engineer who endorses the plans shall be the engineer of record. Should a project be submitted in which the aforementioned plans are only a portion of the overall project, a professional engineer shall endorse those sheets, documents, etc., within the project submittal for which an engineer is responsible. The Engineer of Record is responsible for designing streets in accordance with accepted Engineering practice. This includes but is not limited to adhering to criteria set forth in the American Association of State Highway and Transportation Officials (AASHTO) publication A Policy on Geometric Design of Highways and Streets. Further (more restrictive) criteria shall apply as spelled out in the Memphis, Shelby County Subdivision Regulations and this policy statement. Engineering review and endorsement of plans by the City Engineering Division indicates general compliance with City design policies only.

803 – SUBDIVISION REGULATIONS

The purpose of the "Memphis, Shelby County Subdivision Regulations" is to "supplement and facilitate" design policies of the City of Memphis (Subdivision Regulations, Section 102, B). The Subdivision Regulations shall be the major review criteria for plans submitted to the City Engineering Division for review. Review and approval of street design shall not, however, be limited to the Subdivision Regulations. Issues addressed in this Policy Statement as well as issues related to accepted engineering practice may also be addressed in a City Engineering Division review.

804 – HORIZONTAL AND VERTICAL GEOMETRY

Minimum criteria for horizontal and vertical street geometry shall be that designated in the Memphis, Shelby County Subdivision Regulations. It is the City's policy to provide adequate sight lines on City streets to allow motorist traveling at the anticipated travel

speed to see and avoid hazards in their path. To that end, design elements that meet all other design criteria, but, do not provide adequate sight lines shall be rejected.

805 – MINOR LOCAL STREETS

805.1 – Speed Limit Signs

Memphis, Shelby County Subdivision Regulations allow for horizontal and vertical street geometry elements that conform to a 20-MPH design speed. Current City ordinance provides a citywide speed limit of 30 MPH on unmarked streets. All street plans submitted with a design speed lower than 30 MPH shall have the design speed clearly noted on all Plan and Profile sheets immediately adjacent to the title block. It shall be the responsibility of the developer to provide signage posting the speed limit on all streets within the development with a design speed less than 30 MPH.

805.2 – Design Speed Indicated on Outline Plan

All streets that are to have a design speed of less than 30 MPH shall have their design speed indicated on the project Outline Plan to avoid confusion in later design phases.

805.3 – 20 MPH Design

Memphis, Shelby County Subdivision Regulations call for "consistent design elements for 20 MPH design". The intent of this statement is to design an environment in which the motorist will be discouraged from traveling at a speed greater than 20 MPH. For example, a long tangent section culminating in a 100' radius curve would be unacceptable. A motorist would tend to exceed the design speed in the tangent only to encounter the curve at the end of the tangent.

805.4 – 300-Foot Tangents

In order to provide for "consistent design elements for 20 MPH design," it shall be the policy of the City to require curvilinear design of streets with design speeds less than 30 MPH. Tangents shall not exceed 300 feet in length. Curves with a maximum radius of 150 feet and a minimum deflection angle of 30 degrees shall separate tangent sections.

805.5 – Through Streets

Design speeds of less than 30 MPH shall be discouraged for streets providing access through a project.

805.6 – Design Speed Limitations

Design speeds of less than 30 MPH shall be rejected for continuation of street segments with design speeds greater than 30 MPH except where stop sign or signal controlled intersection operates along the subject segment. Stop sign nor signal control shall be used for the purpose of speed control. Justification of Stop sign or signal control shall meet the appropriate criteria previously established in this policy document.

806 – INTERSECTION SIGHT DISTANCE

806.1 – Required Sight Distance

Intersection sight distance shall be set by AASHTO Case I (uncontrolled) unless otherwise approved by the City Engineer. All intersections that have an intersection sight distance other than Case I shall be indicated on the project Outline Plan to avoid confusion in later design phases. The designer shall be required to have written permission from the City Engineer before proceeding with a design that includes an intersection sight distance other than Case I. The engineer shall submit calculations with the plans indicating the case and required sight distance for each intersection submitted for review.

806.2 – Curvilinear Streets

Intersections of two curvilinear streets without providing an intersection tangent on at least one of the streets shall be discouraged. Certain combinations of streets, in curves, intersecting produce severe sight distance problems.

806.3 – Intersections Meeting Criteria Without Submittal

Intersections meeting the criteria below shall be deemed acceptable to the City Engineer without requiring the submittal of calculations.

Street Classification	Intersection Sight Distance
Minor Local	225 ft
Major Local	285 ft
Minor Collector	340 ft
Major Collector	400 ft
Arterial	680 ft

Intersection sight distance is measured along the centerline of the through roadway. To determine the clear sight area, a line must be constructed from the stopped vehicle driver's eye location 15 feet (ten feet on a local street) from the face of curb of the through street at a height of 3.5 feet above the pavement to the center of the lane of the approaching vehicle at a height of 4.25 feet. All of the through roadway within the limits of the required minimum intersection sight distance shall remain clear.

807 – INTERSECTION GRADES

807.1 – Grade Lines

Combinations of grade lines that make vehicle control difficult at intersections should be avoided. Substantial grade changes shall be avoided at all intersections. Grades at intersections shall be gentle with vertical curve transitions provided that are appropriate for the design speed of the intersecting roadways.

807.2 – Grade Breaks

Grade breaks at intersections may be allowed only under specific circumstances. Grade breaks shall only be allowed on minor local streets where they intersect other local

streets. The intersecting street shall form a "T" intersection with no leg opposite the leg with a grade break and no potential for a leg opposite the grade break in future development. The intersection leg with a grade break shall always be a stop condition. Differences in grades shall not exceed 5%. That is, for a standard section street with a 2% cross slope, the intersecting street shall have no more than a +3% grade or –7% grade away from the intersection. The grade break may occur at the extended curb line of the intersected street, although, some setback is encouraged. Curb radii shall be designed to provide a smooth transition from one street to another. Special attention shall be given to drainage details to assure stormwater from the minor street does not encroach into the traveled way of the through street.

808 – INTERSECTION CORNER RADII

Intersection corner radii shall be as specified in the "Memphis, Shelby County Subdivision Regulations" unless otherwise specifically authorized by the City Engineer. Right of Way, or as may be the case, pedestrian easements shall be located ten feet behind the curb line.

809 - GUARDRAIL

809.1 – Guardrail Purpose

Guardrail shall be provided where warranted. Circumstances which may require guardrail include non-recoverable slopes and roadside fixed object hazards such as pipe or culvert headwalls and exposed ends of concrete bridge rails.

809.2 – Private Property

Guardrail will not be installed for the sole purpose of protecting private property along arterial, collector or residential streets. The proximity of driveways and other street design features typically do not allow the distances required to provide proper end treatments to guardrail segments. Guardrail installed without proper protective end treatments may create a greater hazard than the condition intended to be protected by the guardrail installation.

810 – PLANS FORMAT

All plans shall be submitted in the format specified by the City Engineer. It is the responsibility of the designer to confirm the appropriate plans format prior to any submission for review and/or approval. Sample plans sets are available from the City Engineers office as a guide.

811 – DRAINAGE DESIGN

Storm drainage design shall conform with the latest edition of the "City of Memphis/Shelby County Storm Water Management Manual". The manual can by found on the City of Memphis web page under Government/Division of Engineering/Links.

Certain City C.I.P. funded projects may have more stringent design criteria. These are established at the discretion of the City Engineer.

812 – CONSTRUCTION SPECIFICATIONS

All construction of infrastructure to be assumed by the City of Memphis shall be completed in accordance with the "City of Memphis Construction Specifications."
The specifications can be found on the City of Memphis web page under Government/Division of Engineering/Links. Any use of materials or construction practices which differ from the "City of Memphis Construction Specifications" must be specifically authorized by the City Engineer in each instance.

813 – STRUCTURAL DESIGN

Structural design of roadway appurtenances which are not covered by City of Memphis Standards (retaining walls, box culverts, bridges, etc.) are subject to approval by the City Engineer.

814 – UNDERGROUND UTILITIES IN THE RIGHT-OF-WAY

The placement of underground utilities under curb and gutter is discouraged. Every effort should be made to place manhole access points outside of vehicular wheel paths so as to not compromise vehicular control and ride quality. Utility access in sidewalk areas is discouraged. Any such access shall meet Americans with Disabilities Act requirements to minimize hazards to pedestrians.

815 – STANDARD DRAWINGS

The use of City of Memphis Standard Details is required for any City project. Standard Drawings containing the details can be found on the City of Memphis web page under Government/Division of Engineering/Links.

SECTION 900 - UTILITIES

901 – RELOCATION RESPONSIBILITY
The relocation and/or installation of all utilities within the City of Memphis right-of-way are the responsibility of the developer. The developer's engineer shall coordinate all his utility-related efforts with the local utility companies to insure compatibility and accuracy with existing and planned utility locations in the immediate vicinity of the project.

902 – C.I.P. PROJECT
City of Memphis Capital Improvement Program (C.I.P.) projects require that utilities within the street right-of-way be relocated at the utility owner's expense.

The City of Memphis has ownership of the storm drainage system and sanitary sewers. All other utilities are owned and maintained by others.

SECTION 1000 - SEWER DESIGN (Revised 9-23-10)

1001 PLANS SUBMITTED FOR REVIEW

1001.1 - Engineer's Seal

The construction plans submitted to this office are expected to be complete and ready for construction. One part of that completeness is the seal and signature of the professional engineer who has performed the work and accepts responsibility for that work.
Therefore, to assure that the plans submitted to us are, in fact, complete and ready for review, we will require that all plans submitted be sealed and signed by the registered engineer who is responsible for those plans.

Any plans submitted without the engineer's seal and signature will be returned as incomplete.

1001.2 - Benchmark

All projects will be required to use the City of Memphis Benchmark System.

1001.3 - Certificates

1001.3.1 Approved for Construction Stamp

Under authority delegated by the State of Tennessee, the City of Memphis may approve sewer plans for gravity sewer up to 24 inches in diameter and pump stations up to 749 gallons per minute in size (inclusive). Plans prepared by City personnel must be approved by the State of Tennessee. All plans for public sewer approved by the City shall bear the following in a location above the title block of the plan:

> Approved for Construction
>
> The document bearing this stamp has been received and reviewed by the City of Memphis Division of Engineering under authority delegated by the State of Tennessee Department of Environment and Conservation Division of Water Pollution Control. It is hereby approved for construction by the City Engineer as evidenced by his signature in the title block below. Approval expires one year from the approval date below. This approval shall not be construed as creating a presumption of correct operation or as warranting by the City Engineer that the approved facilities will reach the desired goals.

1001.3.2 Private Sewer Certificate

As required by the Memphis and Shelby County Office of Code Enforcement, all plans for private sewer shall bear the following in a location above the title block of the plan:

> Private Engineer's Certificate
>
> The engineer whose seal and signature appear below hereby accepts the responsibility for inspection of the private sanitary sewer system shown hereon. After all of the system is installed and tested, the engineer will provide the Memphis and Shelby County Office of Code Enforcement with a letter certifying that the system has been installed and tested in accordance with applicable local standards or, where no local standards exist, the standards of the State of Tennessee. No private sanitary sewer system is to be used except for testing until this certification has been submitted and accepted by Code Enforcement.

1001.4 - Materials

Plans submitted in the form of original drawings shall be ink on polyester translucent matte film with original signatures. Original matte film drawings shall have a matte surface on both sides and shall be a minimum of four-thousandths inch (0.004") in thickness. CADD generated or wet stamp is acceptable.

1001.5 - Sheet Size

All drawings shall measure twenty-four inches by thirty-six inches (24" x 36"), with trim lines one-half inch (½") from the top and bottom edges. Each sheet shall have a left-hand margin of one and one-half inch (1 ½"); a right-hand margin of one-half inch (½"), and a margin of one-half inch (½") between the top and bottom border of the drawings and trim lines.

1001.6 - Font Size

Minimum recommended text size shall be equivalent to Leroy 120 Guide. If lack of space dictates, limited amounts of text equivalent to Leroy 100 Guide may be accepted at the discretion of the City Engineer. Text smaller than Leroy 100 Guide is not acceptable.

1001.7 - Format

All plans shall be submitted in the format specified by the City Engineer. It is the responsibility of the designer to confirm the appropriate plans format prior to any submission for review and/or approval. Sample plans sets are available from the City Engineer's office as a guide.

All sanitary sewer plan stationing shall begin at the downstream end and advance upstream. The plan and profile views shall be oriented with the downstream end of the sewer at the left side of the drawing.

1001.8 - Easement Plats

All permanent easement plats shall be on polyester film 0.004" in thickness. All plats shall measure either 8 ½" x 11" or 8 ½" x 14" with a left hand margin of ¾" with top, bottom and right hand margins of ¼". Trim lines are not necessary. A key map shall be provided indicating the location of all parcels affected. All easement plats shall show bearings and distances on all property lines. Property ownership shall be confirmed prior to submitting final plats.

1001.9 - Disposition of Plans

The approved original drawings become the official records of the City of Memphis. When the plans have been approved, the engineer of record will be notified so that he/she may pick up the originals in order that all necessary copies may be made. The original drawings with the adequate number of prints will be returned to the City of Memphis.

1002 GENERAL REQUIREMENTS FOR COLLECTION SYSTEMS

1002.1 - Construction Approval

Construction of new sewer lines is allowed only if the downstream collection system and sewage treatment plant are capable of adequately transporting and processing the added hydraulic and organic loads.

1002.2 - Design

The sanitary sewer system is designed and constructed in order to contain all sanitary wastes and exclude infiltration and inflow, I & I. The current allowable infiltration rate for sanitary sewer lines is zero gallons per inch diameter per mile of pipe per day. The details of the test procedures are included in the City's *Standard Construction Specifications* and applicable standards of the American Society for Testing and Materials (ASTM). Specific information concerning construction, including acceptable materials and performance requirements are provided in the City's *Standard Construction Specifications*.

The City of Memphis maintains separate systems for sanitary sewer and storm water drainage. Therefore, combined sewers—sewers that convey both wastewater and storm water—are not allowed.

All materials used for sewer construction shall conform to the requirements of the City of Memphis *Standard Construction Specifications*. All construction details will conform to the City's standard details unless approved by the City Engineer. The *Standard Construction Specifications* and the standard drawings/details are available on the City's website.

1002.3 - Calculations

The design and analysis of proposed and existing sewer collection facilities must be performed using the City's standard design criteria as presented in this manual or, in rare cases, as approved by the City Engineer. The engineer's calculations and other data used for design and/or analysis of the sewer facilities must be submitted to the City for approval.

1002.4 - Septic Tank Effluent Pump or Gravity (STEP/STEG) Sewer Projects
No STEP/STEG units will be allowed in the City of Memphis or its annexation reserve areas.

1003 DESIGN CONSIDERATIONS

1003.1 - General
Lateral, sub-main, main and trunk sewers should be designed for the ultimate development of the respective areas served.

1003.2 - Definitions
Lateral 1. A sewer line within the collection system that only receives flow from service connections that have been installed on it. 2. Under the old City criteria, a lateral sewer would be any sewer line less than 15 inches in diameter.

Main A sewer line within the collection system that receives flow from one or more sub-mains and may also have service connections installed on it. This is the same as a trunk sewer.

Sub-main A sewer line within the collection system that receives flow from one or more laterals and may also have service connections installed on it.

Trunk sewer 1. A sewer line within the collection system that receives flow from one or more sub-mains and may also have service connections installed on it. This is the same as a main sewer. 2. Under the old City criteria, a trunk sewer would be any sewer line 15 inches in diameter or larger.

1003.3 - Flow Estimation
For the design of lateral, sub-main, main and trunk sewers, the engineer will base the design on anticipated sewer flows for full development of the sewer basin. The flow estimates may be based on the projected future population and standard usage rates, or flow estimates may be based on the allowed or proposed uses within a basin. The larger flow estimate will govern the design. The allowed uses are a function of existing and/or proposed zoning, are subject to change from appeals to the planning agency, and should be approached with caution. The engineer would be well advised to remember the uncertainties associated with the planning agency when estimating the projected sewer flow. The usual usage is assumed to be 100 gallons per capita per day. It should be noted that this represents the average daily flow, and the engineer must determine the anticipated peak hourly flow to be used for design.

If available, data from existing developments of a similar nature may be used. For unusual cases, an alternative method may be used at the discretion of the City Engineer. Documentation of the alternative method must be provided by the engineer. It should be noted that these estimates represent the average daily flow, and the engineer must determine the anticipated peak hourly flow to be used for design.

A sewer flow estimate table is provided for reference. See Table 1003-1.

1003.3.1 Peak Factor

To account for the maximum hourly flow including I & I, the City now requires using a peak factor of 4.0 for laterals and sub-mains and a peak factor of 2.5 for larger lines. The required peak factors are the minimum acceptable; larger values may be used upon approval by the City Engineer. All sewers should be designed to carry, when running full, not less than the peak hourly flow.

Table 1003-1

SEWER FLOW ESTIMATE TABLE

ZONING	PERSONS [1] PER ACRE	GPM/AC [2] LATERAL [3]	GPM/AC [2] TRUNK
RS-15(43,560X.84 divided by 15,000) (3.5)	9	2.5	1.6
RS-10(43,560X.84 divided by 10,000) (3.5)	13	3.6	2.3
RS-8 (43,560X.84 divided by 8,000) (3.5)	16	4.4	2.8
RS-6 (43,560X.84 divided by 6,000) (3)	18	5.0	3.1
RTH/RML (43,560X.84 divided by 2,500) (2)	30	8.3	5.2
COMMERCIAL [5] 2,000 divided by 12X60		2.8	2.8
INDUSTRIAL [4] 2,000X2.5 divided by 16X60		5.2	5.2

NOTES

1. All persons rounded to next whole person
2. All gpm values rounded to nearest 0.1 gpm
3. load=100 gpcd with 2.5 peak factor Trunk and 4.0 peak factor Lateral line (Residential Only) 24 hr design basis
4. Industrial based upon 2 shifts per day
5. Commercial based upon 12 hr usage

1004 GRAVITY SEWERS

1004.1 - Minimum Size

No sewer shall be less than 8 inches in diameter.

1004.2 - Depth

Generally, sewers should not be less than six feet deep and should be set at an elevation low enough receive sewage from existing and proposed dwellings by gravity.

Sewer lines will be limited to a maximum depth of 15 feet.

1004.3 - Roughness Coefficient

The City of Memphis standard "n" value of 0.013 shall be used in Manning's formula for the design of all gravity sewers.

1004.4 - Slope

Gravity sewers are to be designed to provide a mean velocity when flowing full of two feet per second, except for eight inch diameter sewers. Eight inch sewers are the minimum size allowed for public gravity sewers and are restricted to a minimum grade of 0.50% which produces a greater than minimum velocity when flowing full. It is desirable to design the sewers with grades greater than the minimum required. Sewers shall be laid with uniform grade between manholes. The minimum slope for each size of pipe commonly submitted for review is provided in Table 1004-1.

Table 1004-1

Sewer Size (inches)	Minimum Slope (feet per 100 feet)
8	0.50
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08

Special provisions will be made for sewer lines where expected velocities are greater than 15 feet per second. Further, sewers laid on grades of 18 percent or greater shall be anchored with concrete or other approved anchoring mechanisms. Additionally, sewers on 18 percent grade or greater shall be anchored securely with concrete anchors or equal. The recommended minimum anchorage spacing is 36 feet or less, between anchors, for pipes on grades from 18 to 25 percent (inclusive).

1004.5 - Alignment

1004.5.1 General

Gravity lines are to be installed, honoring the natural flow of drainage. Gravity sewers shall be designed with straight alignment between manholes.

1004.5.2 Easements

a. All sanitary sewer easements will be located on one lot and will not be divided longitudinally by a lot line.

b. All sewer lines 15 inches and smaller shall have at least a 15 foot easement.

c. Any sewer line, regardless of size, greater than 15 feet in depth to the top of the pipe shall have at least a 30 foot easement.

d. Other lines greater than 15 inches, regardless of depth, shall have at least a 30 foot easement, preferably 50 feet.

1004.5.3 Alignments along streams

Particular attention must be paid to pipes generally running parallel to unimproved streams or ditches. All pipes shall be located outside of the tree canopy along the banks of the unimproved stream or ditch and as far as practical from the top of bank. Sewer easements should be located as follows:

1. the sewer easement will be located outside of the "natural drainage easement" area, at a minimum, where the "natural drainage easement" is an area having a width equal to five (5) times the width between the banks of the ditch and is centered on the ditch,
2. sewers greater than 18 inches in diameter will be at least 150 feet from the top bank of the ditch,
3. sewers 30 inches or greater in diameter will be at least 300 feet from the top bank of the ditch.

1004.5.4 Stream Crossings

All sewer lines crossing streams will cross the stream as close to perpendicular as possible. The top of all sewers entering or crossing streams will be a minimum of four feet below the natural bottom of the streambed to protect the sewer line. Minor stream crossings shall be stabilized with rip-rap or grouted rip-rap. The minimum acceptable stabilization for stream crossings shall be City of Memphis grade C rip-rap, placed 24 inches thick the full width of the sewer easement from top of bank to top of bank. Larger streams may require larger size rip-rap, greater quantities of rip-rap and/or a more significant structure to protect the sewer as determined by the City Engineer. The City Engineer must approve these structures.

1004.5.5 Alignments in streets

a. Sanitary sewers located within streets shall be located seven (7) feet north and/or west of the centerline of the street. Exceptions may be made for curvilinear horizontal street alignments and for existing streets with prior approval of the City Engineer.

b. Where sewers are to be constructed in streets with curvilinear horizontal alignments, a minimum of five (5) feet of separation between the face of curb and centerline of sewer must be maintained.

1004.5.6 Relation to Water Mains

Sanitary sewer lines are to be separated from existing or proposed water lines a minimum horizontal distance of 10 feet measured between the outside of the pipes.

Where sewer lines cross water lines, the sewer must be a minimum of 18 inches below the water line. If the sewer can not be lowered to maintain the required clearance, the water line must be moved in order to obtain the required separation. In order to provide the greatest possible separation between joints in the water line and the sewer, a full section of water pipe must be centered over the sewer at the crossing.

1004.6 - Increasing Size

At sewer manholes where a smaller sewer joins a larger one, the top of the pipes (crowns) will match or the crown of the smaller pipe will come in above the crown of the larger pipe. Where an 8" enters a 12" or larger sewer, the flowline of the 8" shall be set at the inside top elevation of the larger sewer or higher.

1004.7 - Ductile iron pipe requirements

Ductile iron pipe (DIP) shall be required:

(1.) when the proposed sewer is to be laid in an area requiring fill,
(2.) in all areas where there is four feet of cover or less,
(3.) on all new sewer including service connections which have less than one and one-half feet of clearance with drainage structures as measured between outside of pipes,
(4.) at all drop construction manholes beginning at the manhole and extending a minimum of twenty feet, and
(5.) DIP is required at sewer bores.

All DIP shall be lined with Protecto 401 or equivalent, subject to approval of the City Engieer.

1004.8 - Service connections

1004.8.1 8 and 10 inch sewer lines

Service connections are allowed on 8" and 10" sewer lines.

1004.8.2 12 inch sewer lines

Service connections may be allowed on 12" sewer lines if the following conditions are met:

1. The 12 inch sewer must be a new sewer line to be installed as a part of the overall development project.

2. The 6 inch connection to the 12 inch line must be accomplished through the installation of a 12 inch x 6 inch Wye that has been prefabricated. This Wye is to be installed at the same time the 12 inch sewer is laid. This prefabricated Wye must be similar to that available through GPK Products, Inc.

3. Prefabricated 12 inch x 6 inch Wyes must conform to the City of Memphis *Standard Construction Specifications*.

1004.8.3 Sewer lines larger than 12 inches

No service connections are allowed on pipes larger than 12 inches in diameter. The connection must be made at a manhole.

1004.9 – Hydrogen Sulfide Protection

All sewer lines 24 inches in diameter and larger and constructed of materials subject to hydrogen sulfide attack shall be provided with adequate corrosion protection. The lining or coating shall be as approved by the City Engineer.

1005 MANHOLES

1005.1 - Location

Manholes are required at angle points, at breaks in grade of the sewer line, and at the end of the sewer line. The maximum distance between manholes on sewer lines less than 24 inches in diameter is 400 feet. Manholes on sewer lines 24 to 42 inches in diameter may be spaced at a maximum distance of 500 feet.

1005.2 - Drop Construction

A drop connection shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted to prevent solids deposition. All drop construction shall comply with the City of Memphis *Standard Construction Specifications*.

1005.3 - Diameter

The minimum diameter of manholes shall be 48 inches; larger diameters are preferable. All sewer manholes shall comply with the City of Memphis *Standard Construction Specifications* and details.

Manholes used to connect certain industrial users (those subject to an industrial discharge agreement) to the system should be larger in order to provide space for monitoring and sampling equipment.

1005.4 - Rim elevations

Manhole rim elevations are to be set a minimum of 0.5' above final grade in yards, and a minimum of 1.5' above existing grade in unimproved areas. The City of Memphis may require, at its discretion, a rim elevation of up to 3 feet above the existing grade. Rim elevations shall also be set a minimum of 1 foot above the 100-year flood elevation. If the 100-year flood elevation is more than 2 feet above the existing grade, a sealed rim with vent stack shall be installed on the manhole. The maximum rim elevation shall be 3 feet above the existing grade. The vent elevation shall be a minimum of 1 foot above the 100-year elevation. Watertight manhole covers and vent stacks shall be used wherever the manhole tops may be flooded. Manholes of brick or segmented block are not acceptable.

1005.5 - Minimum depth

The minimum depth for sewer manholes is six (6) feet.

1005.6 – Hydrogen Sulfide Protection

All manholes on sewer lines 24 inches in diameter and larger and all inverted siphon structures and pump station wet wells shall be provided with adequate corrosion protection. The lining or coating shall be as approved by the City Engineer.

1006 INVERTED SIPHONS

1. Siphons are not allowed unless a gravity sewer line can not be routed across a major drainage way without interfering with the flow area of the drainage.
2. If a siphon is allowed, it will be designed such that a minimum three feet per second velocity is maintained in all barrels. All siphon barrels constructed of high density polyethylene (HDPE) shall be concrete encased. Siphon barrels shall be either HDPE or ductile iron pipe.
3. Siphons will be evaluated by the Sewer Design Department on a case by case basis.
4. All siphon crossings of streams should be sufficiently lowered below the bottom of the channel, at least 5 feet, to help prevent under cutting of the pipe. The banks shall be stabilized along the limits of excavation. (See section 1004.5.4 Stream Crossings.)
5. Inverted siphons shall have a minimum of two barrels, with a minimum pipe size of six inches and shall be provided with necessary appurtenances for convenient flushing and maintenance. The manholes shall have adequate clearances for rodding.
6. The inlet and outlet details shall be arranged so that the normal flow is diverted to one barrel. When inverted siphons are used, the design engineer must furnish hydraulic calculations with the plans. Proper access must be maintained.

1007 SEWAGE PUMP STATIONS AND FORCE MAINS

1007.1 - General

In general, pump stations are not allowed. Gravity lines are to be installed, honoring the natural flow of drainage. All proposed pump stations will be evaluated on a case by case basis.

1007.2 – Temporary pump stations

Temporary pump stations may be allowed for land development projects which have a fully bonded, executed contract for a gravity sewer extension. Temporary pump stations may also be allowed in certain cases as deemed necessary by the City. Pump stations will only be allowed to discharge to those systems with sufficient capacity to accommodate the additional flow as determined by the Sewer Design Department.

The maximum anticipated time of service for any private temporary pump station will be one year. The private temporary pump station shall be owned and maintained by the developer. Sufficient bond shall be held to protect the City in the event the developer fails to maintain the station.

1007.3 – Permanent pump stations

All permanent pump stations and force mains shall be designed to comply with the State of Tennessee *Design Criteria for Sewage Works* and as modified by the City of Memphis.

1007.4 – Force mains

The minimum size allowed for force-mains is 4 inches diameter unless a grinder pump is used. Force-mains will be designed to ensure a minimum velocity at pump capacity of 3 feet per second (fps). The maximum velocity in the force-main shall not exceed 8 fps. Sewer force-mains are to be constructed at a minimum depth of 4 feet.