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ARTICLE VIII - FLOODPLAIN REGULATIONS

8.1 - PURPOSE AND OBJECTIVES

8.1.1 FINDINGS OF FACT:

- 8.1.1.1 The Board of Commissioners of the city of Johnson City wishes to maintain eligibility in the National Flood Insurance Program and in order to do so must meet the requirements of 60.3(d) of the Federal Insurance Administration Regulations found at 44 CFR Ch. 1 (10-1-04 Edition) and subsequent amendments.
- 8.1.1.2 Areas of Johnson City are subject to periodic inundation which could result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare.
- 8.1.1.3 These flood losses are primarily caused by the cumulative effect of obstructions in floodplains, causing increases in flood heights and velocities; and by uses in flood hazard areas which are vulnerable to floods; or construction which is inadequately elevated, flood-proofed, or otherwise unprotected from flood damages.

8.1.2 PURPOSE:

It is the purpose of the Floodplain Regulations to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas. The Floodplain Regulations are designed to:

- 8.1.2.1 Restrict or prohibit uses which are vulnerable to water or erosion hazards, or which cause damaging increases in erosion, flood heights, or velocities;
- 8.1.2.2 Require uses vulnerable to floods, including community facilities, to be protected against flood damage at the time of initial construction;
- 8.1.2.3 Control the alteration of natural floodplains, stream channels, and natural protective barriers which accommodate flood waters;
- 8.1.2.4 Control filling, grading, dredging and other development which may increase erosion or flood damage;
- 8.1.2.5 Prevent or regulate the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards to other lands;

- 8.1.2.6 Protect karst drainage systems from sedimentation and debris, and
- 8.1.2.7 Protect groundwater resources from contamination due to pollution runoff into karst drainage systems.

8.1.3 OBJECTIVES:

The objectives of the Floodplain Regulations are:

- 8.1.3.1 To protect human life and health, and property;
- 8.1.3.2 To minimize expenditure of public funds for costly flood control projects;
- 8.1.3.3 To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- 8.1.3.4 To minimize prolonged business interruptions;
- 8.1.3.5 To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone, sewer lines, streets and bridges located in flood prone areas;
- 8.1.3.6 To help maintain a stable tax base by providing for the sound use and development of flood prone areas in such a manner as to minimize blight in flood areas;
- 8.1.3.7 To ensure that potential homebuyers are notified that property is in a floodable area; and
- 8.1.3.8 To establish eligibility for participation in the National Flood Insurance Program.

8.2 - GENERAL PROVISIONS

8.2.1 BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD:

The areas of special flood hazard within Johnson City, Tennessee, Community Number 475432 are identified by the Federal Emergency Management Agency (FEMA), Flood Insurance Studies (FIS) and the Flood Insurance Rate Maps (FIRM) for Washington, Carter and Sullivan Counties. These special flood hazard areas are shown more specifically for Washington County Map Panel Numbers 47179C0045D, 47179C0061D, 47179C0062D, 47179C0063D, 47179C0064D, 47179C0066D, 47179C0067D, 47179C0068D, 47179C0069D, 47179C0086D, 47179C0088D, 47479C0089D, 47179C0151D, 47179C0152D, 47179C0153D, 47179C0154D, 47179C0156D, 47179C0157D, 47179C0158D, 47179C0159D, 47179C0167D, 47179C0169D, 47179C0176D, 47179C0177D, 47179C0178D, 47179C0179D, 47179C0181D, 47179C0186D, 47179C0187D, 47179C0188D, effective dates

September 29, 2006; for Carter County Map Panel Numbers 0053 and 0065, effective dates October 16, 1996; and for Sullivan County Map Panel Number 47018C0290D, effective date September 29, 2006. These Flood Insurance Studies and Flood Insurance Rate Maps, subsequent map amendments and revisions that have been approved by the Federal Emergency Management Agency, and all other supporting technical data, are adopted by reference and declared to be part of this ordinance.

8.2.2 ESTABLISHMENT OF A SINKHOLE OVERLAY ZONE:

The city of Johnson City administratively establishes the geographic limits of application of this policy to any portion of the city through the use of a Sinkhole Overlay Zone. Properties with karst or sinkhole topography or development/redevelopment of properties that drain either partially or exclusively to karst or sinkhole topography, shall follow the applicable rules and procedures of this Article.

8.2.3 REQUIREMENT FOR DEVELOPMENT PERMIT:

A development permit shall be required in conformity with this Article prior to the commencement of any development activity.

8.2.4 INTERPRETATION:

In the interpretation and application of the Floodplain Regulations, all provisions shall be: (1) considered as minimum requirements; (2) liberally construed in favor of the governing body, and; (3) deemed neither to limit nor repeal any other powers granted under Tennessee statutes.

8.2.5 WARNING AND DISCLAIMER OF LIABILITY:

Conformance with this policy does not relieve the developer and his engineer from making sound engineering judgement and taking measures which go beyond the scope of this policy where necessary. The degree of flood protection required by the Floodplain Regulations is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. The Floodplain Regulations do not imply that land outside the Areas of Special Flood Hazard or uses permitted within such areas will be free from flooding or flood damages. The Floodplain Regulations shall not create liability on the part of the city of Johnson City, Tennessee or any officer or employee thereof for any flood damages that may result from reliance on the Floodplain Regulations or any administrative decision lawfully made hereunder. This policy is a regulations instrument only, and is not to be interpreted as an undertaking by the city to design any structure or facility.

8.2.6 ADMINISTRATION AND ENFORCEMENT OF THE FLOODPLAIN REGULATIONS:

The Chief Building Official's duties and responsibilities regarding the administration and enforcement of the Floodplain Regulations are provided in this Article and Article XVI, Penalties and Remedies.

8.3 - ADMINISTRATIVE PROCEDURES FOR THE FLOODPLAIN REGULATIONS

8.3.1 PERMIT PROCEDURES:

Application for a development permit shall be made to the Chief Building Official on forms furnished by the city of Johnson City prior to any development activity. The development permit may include, but is not limited to the following: plans in duplicate drawn to scale, showing the nature, location, dimensions, and elevations of the area in question; existing and/or proposed structures, earthen fill placement, storage of materials or equipment, drainage facilities, and the limits of the floodplain and floodway, with base flood elevations, across the property. Specifically, the following information is required:

8.3.1.1 Application stage:

- A. Elevation in relation to mean sea level of the proposed lowest floor of all buildings where base flood elevations (BFE's) are available, or to the highest adjacent grade or to the normal flow elevation of an adjacent stream when applicable under this ordinance. (see Subsection 8.3.1.2) A copy of the Certification of Elevation is included in the Floodplain Development Permit Guide.
- B. Elevation in relation to mean sea level to which any nonresidential building will be flood-proofed, where base flood elevation data is available, or to the highest grade or to the normal flow elevation of an adjacent stream when applicable under this Ordinance.
- C. Design certificate from a registered professional engineer or architect that the proposed nonresidential flood-proofed building will meet the flood-proofing criteria in Subsection 8.3.1.2, where base flood elevation data is available. A copy of the flood proofing-certificate is included in the Floodplain Development Permit Guide.
- D. Description of the extent to which any watercourse will be altered or relocated as a result of proposed development.

8.3.1.2 Construction Stage:

Within unnumbered A Flood Zones, where flood elevation data is not available, the Chief Building Official shall record the elevation of the lowest floor on the development permit. The elevation of the lowest floor

shall be determined as the measurement of the lowest floor of the building relative to the highest adjacent grade or to the normal flow elevation of an adjacent stream. The elevation of the highest grade adjacent to the structure and the normal flow elevation of the stream shall also be recorded. USGS Quadrangle maps may be utilized when no more detailed reference exists to establish reference elevations.

Within all flood zones where base flood elevation data are utilized, for all new construction and substantial improvements the Chief Building Official shall require: (a) that prior to installation the proposed elevation for the lowest floor or flood-proofing is verified as correct, (b) that upon completion of the lowest floor, or flood-proofing by whatever construction means, whichever is applicable, it shall be the duty of the permit holder to submit to the Chief Building Official an as-built certification of the elevation of the lowest floor, or flood-proofed elevation, whichever is applicable, as built, in relation to mean sea level. Said certification shall be prepared by, or under the direct supervision of, a registered land surveyor, professional engineer, or architect and certified by same. When flood-proofing is utilized for a non-residential building, said certification shall be prepared by, or under the direct supervision of, a professional engineer or architect and certified by same. Any work undertaken prior to submission of the certification shall be at the permit holder's risk. The Chief Building Official shall review the above-referenced certification data submitted. Deficiencies detected by such review shall be corrected by the permit holder immediately and prior to further progressive work being permitted allowed to proceed. Failure to submit the certification survey or failure to make said corrections required hereby, shall be cause to issue a stop-work order for the project, and/or deny issuance of a Certificate of Occupancy. Within unnumbered A zones, where flood elevation data is not available, the elevation of the lowest floor or flood-proofing shall be determined as the measurement of the lowest floor or flood-proofing of the building relative to the highest adjacent grade or the normal flow elevation of an adjacent stream.

For any altered or relocated watercourse, submit engineering data/analysis within six (6) months to the Federal Emergency Management Agency to ensure accuracy of community flood maps through the Letter of Map Revision Process. Assure that the flood carrying capacity within an altered or relocated portion of any water course is maintained.

8.3.2 PROVISIONS FOR FLOOD HAZARD REDUCTION:

8.3.2.1 General Standards:

In flood prone areas the following provisions are required:

- A. New construction and substantial improvements to existing buildings shall be anchored to prevent flotation, collapse, or lateral movement of the structure;
- B. Manufactured homes shall be elevated and anchored to prevent flotation, collapse, or lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This standard shall be in addition to and consistent with applicable state requirements for resisting wind forces;
- C. New construction and substantial improvements to existing buildings shall be constructed with materials and utility equipment resistant to flood damage;
- D. New construction or substantial improvements to existing buildings shall be constructed by methods and practices that minimize flood damage:
 - 1. Whenever possible, structures shall be constructed with the longitudinal axis parallel to the directions of flood flow; and
 - 2. So far as practicable, structures shall be placed approximately on the same flood flow lines as those of adjoining structures.
- E. All electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities shall be designed and/or located one (1) foot above the base flood elevation (or as specified by flood-proofing requirements) to prevent water from entering or accumulating within the components during conditions of flooding;
- F. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
- G. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters;
- H. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding by the base flood;

- I. Any alteration, repair, reconstruction, or improvements to a building, which is in compliance with the Floodplain Regulations, shall meet the requirements of new construction as contained in the Flood Plan Regulations; and
- J. Any alteration, repair, reconstruction, or improvements to a building, which is not in compliance with the provision of the Floodplain Regulations, shall be undertaken only if said non-conformity is not extended or replaced.

8.3.2.2 Specific Standards:

These provisions shall apply to all areas of special flood hazard as provided herein. In areas of special flood hazard where base flood elevation data have been provided, including flood zones A, A1-30, AE, AO, AH, and A99, and has provided a regulatory floodway, as set forth in Subsection 8.2.1, the following provisions are required:

A. Residential Construction.

Where base flood elevation is available, new construction or substantial improvement of any residential building or manufactured home shall have the lowest floor, including basement, elevated no lower than one (1) foot above the base flood elevation. Should solid foundation perimeter walls be used to elevate a structure, openings sufficient to facilitate equalization of the flood hydrostatic forces on both sides of exterior walls and to ensure the unimpeded movements of flood waters shall be provided in accordance with the standards of Subsection 8.3.2.2.C.

Within unnumbered A zones, where base flood elevations have not been established and where alternative data is not available, the Chief Building Official shall require the lowest floor of a building to be elevated or flood-proofed to a level of five and one-half (5.5) feet above the normal flow elevation of the adjacent stream channel or three (3) feet above the highest adjacent grade, whichever is greater. All applicable data including elevations or flood proofing certifications shall be recorded as set forth in 8.3.1.

B. Non residential Construction.

New construction or substantial improvement of any commercial, industrial, or non residential building, when BFE data is available, shall have the lowest floor elevated or flood-proofed no lower than one (1) foot above the level of the base flood elevation.

Within unnumbered A zones, where base flood elevations have not been established and where alternative data is not available, the

Chief Building Official shall require the lowest floor of a building to be elevated or flood-proofed to a level of five and one-half (5.5) feet above the normal flow elevation of the adjacent stream channel or three (3) feet above the highest adjacent grade, whichever is greater. All applicable data including elevations or flood proofing certifications shall be recorded as set forth in 8.3.1.

Buildings located in all A-zones may be flood-proofed, in lieu of being elevated, provided that all areas of the building below the required elevation are watertight, with walls substantially impermeable to the passage of water, and are built with structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy. A registered professional engineer or architect shall certify that the design and methods of construction are in accordance with accepted standards of practice for meeting the provisions above, and shall provide such certification to the Chief Building Official as set forth in 8.3.1.

C. Elevated Building.

New construction or substantial improvements of elevated buildings, that include fully-enclosed areas formed by foundation and other exterior walls below the base flood elevation, or required height above the highest adjacent grade, shall be designed to preclude finished living space and designed to allow for the entry and exit of flood waters to automatically equalize hydrostatic flood forces on exterior walls.

1. Designs for complying with this requirement must either be certified by a professional engineer or architect or meet the following minimum criteria:
 - (a) Provide a minimum of two (2) openings having a total net area of not less than one (1) square inch per square foot of enclosed area subject to flooding;
 - (b) The bottom of all openings shall be no higher than one (1) foot above grade; and
 - (c) Openings may be equipped with screens, louvers, valves, or other coverings or devices provided they permit the automatic flow of flood waters in both directions.
2. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door), limited storage of maintenance equipment used in connection with the premises (standard exterior door), or entry to the living area (stairway or elevator); and

3. The interior portion of such enclosed area shall not be partitioned or finished into separate rooms in such a way which impedes the movement of flood waters and all such partition shall comply with the provisions of Subsection 8.3.2.2.

D. Standards for Manufactured Homes and Recreational Vehicles.

1. All manufactured homes placed, or substantially improved on: (1) individual lots or parcels, (2) in expansions of existing manufactured home parks or subdivisions, or (3) in new or substantially improved manufactured home parks or subdivisions, shall meet the requirements of new construction, including elevations and anchoring.
 2. All manufactured homes placed or substantially improved in an existing manufactured home park or subdivision shall be elevated so that either:
 - A. 1. When base flood elevations are available the lowest floor of the manufactured home is elevated on a permanent foundation no lower than one (1) foot above the level of the base flood elevation; or
 2. Absent base flood elevations the manufactured home chassis is elevated and supported by reinforced piers (or other foundation elements) five and one-half (5.5) feet above the normal flow elevation of the adjacent stream channel or three (3) feet above the highest adjacent grade at the building site, whichever is greater.
 - B. All manufactured homes shall be securely anchored to an adequately anchored foundation system to resist flotation, collapse and lateral movement; and
 - C. In or outside of an existing or new manufactured home park or subdivision, or in an expansion of an existing manufactured home park or subdivision, on which a manufactured home has incurred substantial damage as the result of a flood, any manufactured home placed or substantially improved shall meet the standards of Subsections 8.3.2.2.D.2(a) and 8.3.2.2.D.2(b).
3. All recreational vehicles placed on sites shall either:

- A. Be on the site for fewer than one hundred eighty (180) consecutive days;
- B. Be fully licensed and ready for highway use. A recreational vehicle is ready for highway use if it is licensed, on its wheels or jacking system, attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached structures or additions;
- C. The recreational vehicle shall meet the requirements for new construction, including anchoring, and elevation requirements of Subsections 8.3.2.2.D.1 or 8.3.2.2.D.2(a) and 8.3.2.2.D.2(b) above if on the site for longer than one hundred eighty (180) consecutive days;
- D. In areas of special flood hazard where base flood elevation data or floodway data have not been provided, the provisions of Subsection 16.2.6.8 shall be utilized for requirements relative to the base flood elevation or flood ways.

8.3.2.3 Standards for Subdivisions:

Subdivisions and other proposed new developments, including manufactured home parks, shall be reviewed to determine whether such proposals will be reasonably safe from flooding. If a subdivision proposal or other proposed new development is in a flood-prone area, any such proposals shall be reviewed to ensure that:

- A. All subdivision proposals shall be consistent with the need to minimize flood damage;
- B. All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize or eliminate flood damage;
- C. All subdivision proposals shall have adequate drainage provided to minimize or reduce exposure to flood hazards; and
- D. Base flood elevation data shall be shown on plats and plans for subdivision proposals and for other proposed developments, including manufactured home parks and subdivisions. When base flood elevations have not been established for subdivisions that are greater than two lots or other proposed developments that are greater than one acre, the developer shall provide an engineering study with certification by a registered professional engineer, which will establish base flood elevations and designate floodway

locations. The engineering study should be supported by technical data that conforms to standard hydrologic and hydraulic engineering principles.

8.3.2.4 Standards For Areas of Special Flood Hazard With Established Base Flood Elevation and With Floodways Designated:

Located within the areas of special flood hazard established in Subsection 8.2.1, are areas designated as floodways. A floodway may be an extremely hazardous area due to the velocity of floodwaters, debris or erosion potential. In addition, the area must remain free of encroachment in order to allow for the discharge of the base flood without increased flood heights and velocities. Therefore, the following provisions apply:

- A. Encroachments are prohibited, including earthen fill material, new construction, substantial improvements, or other developments within the regulatory floodway. Development may be permitted, however, provided it is demonstrated through hydraulic analyses performed in accordance with standard engineering practices that the cumulative effect of the proposed encroachments or new development, when combined with all other existing and anticipated development, shall not result in ANY increase of the water surface elevation of the base flood level, velocities or floodway widths during the occurrence of a base flood discharge at any point within the community. A registered professional engineer must provide supporting technical data and certification thereof.
- B. New construction or substantial improvements of buildings shall comply with all applicable flood hazard reduction provisions of Subsection 8.3.2.2.

8.3.2.5 Standards for Areas of Special Flood Hazard Zones AE with Established Base Flood Elevations but Without Floodways Designated:

Located within the areas of special flood hazard established in Subsection 8.2.1, where streams exist with base flood data provided but where no floodways have been designated (Zones AE), the following provisions apply:

- A. No encroachments, including fill material, new structures, or substantial improvements shall be located within areas of special flood hazard, unless an engineering study with certification by a registered professional engineer is provided demonstrating that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not

increase the water surface elevation of the base flood more than one (1) foot at any point within the community. The engineering study should be supported by technical data that conforms to standard hydrologic and hydraulic engineering principles.

- B. New construction or substantial improvements of buildings shall be elevated or flood-proofed to elevations established in accordance with Subsection 8.3.2.2.

8.3.2.6 Standards for Streams without Established Base Flood Elevations or Floodways (A Zones):

Located within the Areas of Special Flood Hazard established in Subsection 8.2, where streams exist, but no base flood data has been provided (A Zones), OR where a Floodway has not been delineated, the following provisions shall apply:

- A. When base flood elevation data or floodway data have not been provided in accordance with Subsection 8.2, then the Chief Building Official shall obtain, review and reasonably utilize any scientific or historic base flood elevation and floodway data available from a Federal, State or other source, in order to administer the provisions of Subsection 8.3.2. ONLY if data is not available from these sources, then the following provisions, B and C may apply. B and C shall not be applied, if the size of the water shed above the development site is greater than 500 acres. If the development site is greater than 500 acres, then the following provision D shall apply.
- B. No encroachments, including fill material, new structures, or substantial improvements shall be located closer than three times the average width of the stream as it traverses the site or 30 feet, which ever is greater, measured from the centerline of the stream. The determination of the floodway limits is illustrated in the Floodplain Development Permit Guide. The width of the stream should be measured at all locations deemed appropriate to accurately reflect the variations in width along the length of the affected area. In floodway areas where the natural topography prevents the floodway from being equally distributed on each side of the stream, this estimated floodway width shall be shifted in the direction of lower elevations. A registered professional engineer shall determine the magnitude of the floodway shift, and the shift shall be based on actual ground elevations at the site.

- C. In special flood hazard areas without base flood elevation data, new construction or substantial improvements of existing structures shall have the lowest floor of the lowest enclosed area elevated or flood-proofed five and one-half (5.5) feet above the normal flow elevation of the adjacent stream channel or three (3) feet above the highest adjacent grade at the building site, whichever is greater. This situation is depicted in the Floodplain Development Permit Guide. Openings sufficient to facilitate the unimpeded movements of floodwaters shall be provided in accordance with the standards of Subsection 8.3.2.2.C, "Elevated Buildings".
- D. If the size of the water shed above the development site is greater than 500 acres, then an engineering study with certification by a registered professional engineer must be provided, which establishes base flood elevations and designates the location of the floodway. The study must demonstrate that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one (1) foot at any point within the community. The engineering study should be supported by technical data that conforms to standard hydrologic and hydraulic engineering principles.

8.3.2.7 Standards for Areas of Shallow Flooding (AO and AH Zones):

Located within the areas of special flood hazard established in Subsection 8.2.1 are areas designated as shallow flooding areas. These areas have special flood hazards associated with base flood depths of one (1) to three (3) feet where a clearly defined channel does not exist and where the path of flooding is unpredictable and indeterminate; therefore, the following provisions apply:

- A. All new construction and substantial improvements of residential and non residential buildings shall have the lowest floor elevated to at least one (1) foot above the flood depth number specified on the Flood Insurance Rate Map (FIRM), in feet, above the highest adjacent grade. If no depth number is specified, the lowest floor shall be elevated at least three (3) feet above the highest adjacent grade. Openings sufficient to facilitate the unimpeded movements of floodwaters shall be provided in accordance with standards of Subsection 8.3.2.2.C, and "Elevated Buildings".
- B. All new construction and substantial improvements of nonresidential buildings may be flood-proofed in lieu of elevation. The structure together with attendant utility and sanitary facilities

must be flood proofed and designed watertight to be completely flood-proofed to at least one (1') foot above the specified Flood Insurance Rate Map (FIRM) flood level, with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy. If no depth number is specified, the lowest floor shall be flood proofed to at least three (3) feet above the highest adjacent grade. A registered professional engineer or architect shall certify that the design and methods of construction are in accordance with accepted standards of practice for meeting the provisions of this ordinance and shall provide such certification to the Chief Building Official as set forth above and as required in Subsection 8.3.1.

- C. Adequate drainage paths shall be provided around slopes to guide flood waters around and away from proposed structures.
- D. The Chief Building Official shall certify the elevation or the highest adjacent grade, where applicable, and the record shall become a permanent part of the permit file.

8.3.2.8 Standards for Areas Protected by Flood Protection System (A-99 Zones):

Located within the areas of special flood hazard established in Subsection 8.2, are areas of the 100-year floodplain protected by a flood protection system, but where base flood elevations and flood hazard factors have not been determined. Within these areas (A-99 Zones) all provisions of Subsection 8.3 and Subsection 8.3.2.1 shall apply.

8.3.2.9 Standards for Unmapped Streams:

Located within Johnson City, Tennessee are unmapped streams where areas of special flood hazard are neither indicated nor identified. Adjacent to such streams the following provisions shall apply:

- A. In areas adjacent to such unmapped streams, no encroachments including fill material, new structures, or substantial improvements shall be located no closer than three times the average width of the stream as it traverses the site or 30 feet, which ever is greater, measured from the centerline of the stream. The determination of the floodway limits is illustrated in the Floodplain Development Permit Guide. The width of the stream should be measured at all locations deemed appropriate to accurately reflect the variations in width along the length of the affected area. In floodway areas where the natural topography prevents the floodway from being equally distributed on each side of the

stream, this estimated floodway width shall be shifted in the direction of lower elevations. A registered professional engineer shall determine the magnitude of the floodway shift, and the shift shall be based on actual ground elevations at the site.

- B. In areas adjacent to such unmapped streams, new construction or substantial improvements of existing structures shall have the lowest floor of the lowest enclosed area elevated or flood-proofed five and one-half (5.5) feet above the normal flow elevation of the adjacent stream channel or three (3) feet above the highest adjacent grade at the building site, whichever is greater. This situation is depicted in the Floodplain Development Permit Guide. Openings sufficient to facilitate the unimpeded movements of floodwaters shall be provided in accordance with the standards of Subsection 8.3.2.2.C, "Elevated Buildings".
- C. If the size of the water shed above the development site is greater than 500 acres, then an engineering study with certification by a registered professional engineer must be provided, which establishes base flood elevations and designates the location of the floodway. The study must demonstrate that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one (1) foot at any point within the community. The engineering study should be supported by technical data that conforms to standard hydrologic and hydraulic engineering principles.

8.4 - ADMINISTRATIVE PROCEDURES FOR THE SINKHOLE REGULATIONS

8.4.1 OVERVIEW:

Certain areas of the city and surrounding areas drain exclusively or predominantly to sinkhole systems. As such, these sinkhole systems must remain available for the temporary storage and drainage of surface runoff in a manner similar to established riparian floodways and floodplains. Sinkhole areas are also known to be unstable for construction and drainage. Structures placed on soil foundations in sinkhole areas may be subject to flooding, settling or collapse. All sinkholes are herein defined to have 25-year "no-build" and 100-year "floodplain" line locations and elevations which will restrict or modify development adjoining or draining to sinkholes. Some of these locations and elevations have been established by the city as part of its master planning or sinkhole investigation process. For those sinkholes that have not been evaluated, a person developing contiguous to or within the watershed draining to such sinkholes shall establish these elevations in accordance with the procedures described herein.

It is not possible to determine a generalized rule for sinkhole capacity. Each sinkhole behaves differently from all other sinkholes, and the discharge from each is a function of unknown subterranean stream configurations. Sinkholes must not be used as an integral part of the drainage system unless no other outlet is feasible, as shown in a study by a licensed professional with expertise in karst topography. The location of structures surrounding sinkholes shall be regulated. More strict requirements may be imposed if analysis demonstrates the possibility of water backing up through a sinkhole.

Sinkholes are also known to be part of fragile drainage systems. Any substance or object, including construction siltation, placed within a sinkhole has the potential of clogging the throat of the sinkhole and/or polluting groundwater. The immediate area surrounding a sinkhole must be disturbed as little as possible. Extreme care should be taken in planning, constructing and operating such land uses as may store and handle potential groundwater pollutants (such as gas stations) or in the design and construction of septic systems.

8.4.2 PURPOSE:

The purposes of the sinkhole policy are: to supplement the policies established in the Floodplain Regulations, to protect existing and future development from flooding due to sinkhole overflow and backup, to protect underground drainage systems from clogging due to sediment and debris, to protect the structural integrity of buildings and roads built near sinkholes, and to work with the State of Tennessee to protect groundwater resources from contamination due to pollutant runoff into sinkholes.

8.4.3 APPLICABILITY:

This policy shall be applicable to all areas of the city which drain either partially or totally to a sinkhole or underground karst system and which involves alterations to existing developments, the construction of new developments, disruption of the vegetative covering for land clearing activities, topographic alterations, or utility construction projects.

8.4.4 PERMIT PROCEDURES:

Application for a development permit shall be made to the Chief Building Official prior to any development activity. The development permit may include, but is not limited to, the following: plans in duplicate drawn to scale, showing the nature, location, dimension, and elevations of all pertinent features of the area in question, existing and/or proposed structures, storage of materials or equipment, drainage facilities, the location of the 25-year no-build line and the 100-year floodplain elevation or hydrologic and hydraulic calculations supporting methods to alter the flood elevation line(s), evidence of appropriate off-site easements, and evidence of the determination of need for a State of Tennessee permit. Specifically, the following information is required:

8.4.4.1 Application stage:

- A. A generalized site plan with all pertinent information, including the location and extent of all sinkholes involved, existing and proposed drainage structures, and the elevation in relation to mean sea level of the proposed lowest floor (including basement) of all structures;
- B. All plans and corresponding calculations shall be produced by a licensed professional having expertise in karst topography;
- C. If the site relies on any sinkhole(s) for any portion of its drainage, a hydrogeologic study will be required as part of the grading and drainage plan;
- D. For those sinkholes that have been previously evaluated, the location and limits of the 25-year no-build line(s) and the 100-year floodplain line(s);
- E. For those sinkholes that have not been previously evaluated, calculations supporting the establishment of 25-year no-build lines and 100-year floodplain elevations;
- F. For those sinkholes that have been previously evaluated and re-evaluation is desired, hydrologic and hydraulic calculations to support the alteration of the established flood elevation lines;
- G. Evidence of appropriate off-site easements for sites relying either partially or completely on off-site sinkholes for drainage;
- H. Description and location of all erosion and sedimentation control measures to be used, both on-site and off-site;
- I. Copies of applications submitted to the State Department of Environment and Conservation shall be submitted to the city prior to the issuance of grading or drainage permits. Permit issuance by the city may be made contingent on prior approval by the State; and
- J. Any additional supporting information deemed necessary by the Chief Building Official to ensure the protection of the site, surrounding properties, or the sinkhole system.

8.4.4.2 Construction Stage:

- A. All disturbed areas covered by this policy shall provide adequate structural and non-structural erosion and sedimentation controls

both on-site and around the perimeter of any sinkhole inlet receiving drainage to reduce the potential for sediment entering and clogging the sinkhole. On-site controls shall be initiated prior to commencement of clearing operations. Sinkhole perimeter controls shall be established prior to the initiation of any clearing and grubbing operations. All controls shall be inspected by a qualified and responsible party periodically and within 48 hours after heavy precipitation events. Adequate structural controls include but are not limited to: entrenched and staked straw bale barriers, synthetic filter fabric barriers, slope protection, temporary sediment traps and basins, improved sinkhole outlets with elevated openings, or other inlet protection and diversions. Adequate nonstructural controls shall include but are not limited to: limitation of clearing, temporary seeding, erosion control blankets and/or mulching, construction timing, location of debris and trash piles, and proper storage of construction related chemicals and petroleum products. All sinkhole openings shall be inspected and cleaned out after completion of construction and after establishment of permanent vegetative cover.

- B. The Chief Building Official shall require that, upon placement of the lowest floor, it shall be the duty of the permit holder to submit to the Chief Building Official a certification of the elevation of the lowest floor, as-built, in relation to mean sea level. Said certification shall be prepared by, or under the direct supervision of, a registered land surveyor, professional engineer, or architect and certified by same. The Chief Building Official shall review the floor elevation survey data submitted. Deficiencies detected by such review shall be corrected by the permit holder immediately and prior to further progressive work being permitted to proceed. Failure to submit the survey or failure to make said corrections required hereby, shall be cause to issue a stop-work order for the project, and/or deny issuance of a Certificate of Occupancy.

8.4.5 General Standards:

- 8.4.5.1 No person shall place or cause to be placed any substances or objects, other than stormwater runoff, in any sinkhole or in the depression of any sinkhole relied on for stormwater drainage, or place or cause to be placed any substances or objects in such a way so as to allow such substances or objects to be washed into a sinkhole inlet during storm events.
- 8.4.5.2 No person shall fill or obstruct the outlet to a sinkhole or system of sinkholes, or fill over a spring or sink outlet without first defining the flow area to that outlet or spring and ascertaining, through dye tracing or other means, the areas that rely on the outlet for drainage and that filling of such

outlet or spring will not increase flooding in the sink system through denial of use of the system or sink outlet.

- 8.4.5.3 Extreme care should be taken in planning, constructing and operating such land uses as may store and handle potential groundwater pollutants (such as gas stations) or in design and construction of septic systems.
- 8.4.5.4 The immediate area around a sink must be disturbed as little as possible. The use of mechanized equipment near the subterranean drain shall be done with caution.
- 8.4.5.5 Flow exiting from culverts or other concentrated drainage should be carried by riprap or concrete drain to the drain inlet, with the inclusion of energy dissipators as appropriate. Where an identified throat exists which is to be improved, a steel grate of adequate proportions should encase the inlet to prevent debris stoppage. The city must approve throat improvement methods and designs prior to construction.
- 8.4.5.6 The city strongly recommends that appropriate geotechnical studies be done and measures taken to insure structure foundations are designed to take into account potential sinkhole locations and instability. Such studies should account for potential foundation problems for both undisturbed sink areas and those previously filled by others. In addition, the placement of fill material within sinkholes is generally undesirable because the placement of fill reduces the volume within the sink available for stormwater storage.

Geotechnical studies for sites within karst terrain routinely include, but are not limited to, drilling to assess subsurface conditions, recommendations for site preparation, and a discussion of specific geologic hazards such as sinkhole collapse and subsidence. The impact on foundation alternatives, such as shallow or deep foundations, may be presented as a cost versus risk decision to the property owner/developer.

8.4.6 Estimated No-Build and Floodplain Line Locations:

- 8.4.6.1 An estimated “no-build line” shall be established and indicated on all preliminary and final plans and drainage easements dedicated which indicates the level to which water would rise assuming no outflow for the 4 percent probability (25-year return period), 6-hour storm. This runoff volume is to be calculated by assuming that the 4 percent (25-year), 6-hour storm depth of four inches over the whole drainage basin to the sink flows into the sink with no outflow. The area encompassed by this line shall be defined as a “no-build” zone for all structures. No portion of any development can be located within this zone.

- 8.4.6.2 An estimated sinkhole 1 percent storm (100-year storm) floodplain line shall be delineated on all preliminary and final plans which indicates the level to which water would rise, assuming no outflow for the 1 percent (100-year), 6-hour storm. This runoff volume is to be calculated by assuming that the 1 percent (100-year), 6-hour storm depth of five inches over the whole site flows into the sink with no outflow. The lowest habitable floor elevation for any habitable structure shall be located a minimum of one (1) foot above this floodplain elevation.
 - 8.4.6.3 Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities shall be designed and/or located at least one (1) foot above the 1 percent storm floodplain line (or as specified by flood-proofing requirements) to prevent water from entering or accumulating within the components during conditions of flooding.
 - 8.4.6.4 The estimated no-build and floodplain line locations must be established after volume lost to anticipated fill or structure placement within the sink has been removed. If the established lines overtop the sink and there is a surface outflow the line shall be approximately located one (1) foot above the sink top.
 - 8.4.6.5 These estimated line locations shall remain intact unless adjusted and potentially lowered using the analysis procedure given in Subsection 8.4.7.
- 8.4.7 Adjustments to No-Build and Floodplain Line Locations:
- 8.4.7.1 Two basic methods to potentially lower the line elevations and reduce the building setback are discussed in the following paragraphs. The methods require the routing of watershed runoff hydrographs through the sink areas in a manner similar to detention pond design. The runoff hydrographs shall be developed using the SCS 24-hour storm and curve number methodology. The city reserves the right to approve runoff flow and timing factors. The methods can be used alone or in combination.
 - 8.4.7.2 Any applicable software may be used. However, the use of software with which the city is familiar will expedite review. In any case the designer must submit the following information: rainfall amounts, curve number and time-of-concentration tabulations, inflow and outflow hydrograph (in graphical and tabular form), stage-discharge curves (in tabular form) based on site topographic survey with control mapping included, site layout sketch plan showing the 4 percent (25-year) and 1 percent (100-year) setback lines and elevations, the location and elevations (ground and first habitable floor where applicable) of all adjacent structures, and sketch plan of the sinkhole system showing the outlet points and giving pertinent information on increased flow rates and downstream system capacity.

8.4.7.3 The no-build and floodplain limits can be reduced through the provision of a surface overflow to a suitable receiving point or points. In such cases, to establish the applicable delineated zones, the runoff hydrograph from the (4 percent) 25-year, 24-hour and (1 percent) 100-year, 24-hour storms shall be routed through the sinkhole calculating the surface overflow in a manner similar to detention pond design routing. Other engineering means to lower the floodplain line can also be used such as: upstream manmade holding ponds (retention), detention, diversions, storm drain piping and pump stations. Full buildout conditions in the entire watershed draining to the sink shall be used for all routing analyses.

8.4.7.4 The establishment of the no build and floodplain line limits may also rely on outflow from the sink and routing of the runoff hydrographs from the 4 percent (25-year), 24-hour and 1 percent (100-year), 24-hour storms. This can be done only if no flooding would occur with total sink blockage for the 4 percent (25-year), 6-hour storm; the developer submits a hydrogeologic study which indicates, using appropriate methods, the calculated flow rates (stage-discharge curve) through the sinkhole considering the possibility of high groundwater table or downstream flow backing into the sink to reduce or stop outflow during wet or flood conditions; the outlet point(s) from the sink is (are) established through dye tracing; full buildout conditions for the entire watershed draining to the sink are used for all routing analyses; the throat of the sink has been permanently improved in a manner approved by the city; State approvals (if necessary) are obtained; and the city grants permission to use the sink outflow.

8.4.8 Off-Site Sinkholes:

8.4.8.1 For flow into an offsite sinkhole, the developer must perform the routing analysis contained in Subsection 8.4.7 using either existing or improved sink conditions (if permission for sink improvement or modification is granted by the property owner). There are two cases which may occur. Either existing qualified structures are located within the 4 percent chance (25-year) storm no-build line or below the one percent chance (100-year) elevation, or no existing qualified structure is so located.

8.4.8.2 In the case where existing structures are located within the limits of the no-build or floodplain lines a development may not increase flow elevations to sinks which are located on another's property without obtaining the written permission of the sink owner. All other requirements shall apply for use of such offsite sink. Full buildout conditions shall be used for all routing analysis. If such permission cannot be obtained the upstream property owner must design his site such that the peak flow elevations within the sink are no greater than at predevelopment

conditions. This can normally be accomplished using on-site detention or retention or finding another suitable outlet site.

- 8.4.8.3 In the case where no structures are located within the calculated lines no controls are required as long as the proposed development would not expand the no-build and floodplain lines established by routing according to Subsection 8.4.7.