CITY OF JOSHUA ENGINEERING DESIGN STANDARDS AND SPECIFICATIONS

ADOPTED
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ENGINEERING DESIGN STANDARDS AND SPECIFICATIONS

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PART 1. GENERAL

1.1 PURPOSE

The purpose of the Engineering Design Standards and Specifications (EDSS) manual is to provide a set of guidelines for designing water, sewer, streets, drainage facilities, and other public improvements, and for preparing construction plans and specifications for such facilities which are to be owned, operated, and/or maintained by the City of Joshua, Texas.

1.2 APPLICABILITY

The scope of the Engineering Design Standards and Specifications manual includes the various design elements, standards, and instructions required for the design of water lines, wastewater lines, streets and arterials, drainage facilities, and other public improvements. These guidelines shall be used by the City and consulting engineers for both public and private developments in the City of Joshua and its extra-territorial jurisdiction (ETJ). This manual also applies to redevelopment and additions to previously developed and subdivided areas. These guidelines shall also be used for plat approval, the issuance of building and earthwork/grading permits, construction plan approval by the City, site plan approval, and for other construction within public right-of-way and easements.

1.3 AUTHORIZATION

The guidelines provided in the manual shall be effective immediately upon adoption by the City of Joshua. The engineer of record shall bear sole responsibility for meeting the engineering standard of care for all aspects of the design, meeting the City's design and construction requirements, and providing a design that is suitable to the site-specific conditions and intended use of the facilities. The design criteria may be modified by administrative action and subsequent City ordinance at such times as may be appropriate.

1.4 CORRELATION TO SUBDIVISION ORDINANCE

The Engineering Design Standards and Specifications manual and City of Joshua Subdivision Ordinance are complementary, and what is required by one document shall be binding as if required by both. In case of conflict between the EDSS manual and the Subdivision Ordinance, the more stringent criteria shall apply.

1.5 ADOPTION OF NCTCOG SPECIFICATIONS AND STANDARDS

The specifications and standards set forth by the latest edition of the North Central Texas Council of Governments (NCTCOG) *Public Works Construction Standards* shall be used for all projects

within the City except as modified by this manual. In case of conflict between the NCTCOG standards and the criteria described in this manual, the criteria described in this manual shall take precedence.

PART 2. WATER AND SEWER

The City of Joshua does not own or operate any water distribution or wastewater collection systems. The City is served by the Johnson County Special Utility District (JCSUD) and the Bethesda Water Supply Corporation for these utilities. The area served by each provider can be determined by contacting the Texas Commission on Environmental Quality (TCEQ). The design of these systems should be coordinated with the facility owner. The requirements of the facility owner are in addition to the requirements below.

2.1 WATER

2.1.1 Capacity Standards

Water distribution systems should be designed for domestic flow demands in addition to fire flow demands in accordance with PUC/TCEQ regulations. A minimum available fire flow of 1000 gpm shall be provided in all single family areas. A minimum available fire flow of 1500 gpm shall be provided in other areas or where future extensions are expected to serve non-single family properties. The fire chief is authorized to increase or decrease the required available fire flows as authorized by and pursuant to the International Fire Code as adopted at the time of Plat approval. Evidence that the required fire flow will be available shall be presented to the City Engineer before approval of the Preliminary Plat. Where development is proposed in areas of existing service, the available fire flow capacity shall be determined by the provider and provided to the City Engineer and Fire Marshal.

2.1.2 Fire Hydrants

Fire hydrants shall be installed at each street intersection and at a minimum of five hundred foot spacing along the street in single family areas and three hundred foot spacing in other areas. This requirement applies to extensions of water lines that are 6 inches and larger along existing roads without hydrants.

For single family occupancy, no buildable portion of the lot shall be more than 600 foot hose lay from a hydrant. In other areas, no point of the perimeter of any structure shall be more than 400 foot hose lay from a hydrant. This distance is measured along a fire lane or public roadway if the distance is more than 150 feet. The Fire Marshal may waive or modify these requirements.

Fire hydrants shall be installed no more than 9 feet and no less than 2 feet from the edge of pavement. Hydrants should not be located in sidewalks or within ditches and shall have 3 feet clear on all sides.

2.1.3 Backflow Prevention

All fire lines are required to have a double gate detector check valve backflow preventer assembly. The maximum length of line from the main to the backflow preventer is 100 feet.

Irrigation systems are required to have a double check valve backflow preventer assembly installed at the meter or tap location.

Backflow prevention assemblies may be required for other installations based on occupancy of the affected facility or as required by code.

2.2 **SEWER**

2.2.1 Capacity Standards

The sewer service provider is solely responsible to verify adequate capacity is available in their system for any proposed flows. The provider's acceptance of the plans is required to indicate capacity is available.

2.3 **POLICY ON WELL AND SEPTIC**

In all cases, connection to a public water distribution system is required to provide adequate water service to a property. The property owner and/or service provider are responsible for the extension of service to any location to be considered for development.

Connection must be made to a public wastewater collection system except where proposed lots are a half acre or more in area and approved by the City Engineer. If, under unusual circumstances, a lot is not served by a public water supply then it must be an acre or more in area. On-site sewage facilities must be permitted by the City of Joshua. A plan showing the type of facility and location within the lots must be submitted to the City for review. Rules for permitting, design, and construction of OSSF shall be in accordance with Title 30 TAC, Chapter 285, Subchapters A& D.

PART 3. STREETS

3.1 TRAFFIC IMPACT ANALYSIS (TIA) STANDARDS

The Traffic Impact Analysis Standards supplement the requirements established in the City of Joshua Subdivision Ordinance. These standards outline staff's expectations and facilitate a coordination of the scope, analysis contents, parameters and assumptions of a TIA.

3.1.1 Purpose

The purpose of a TIA is to assess the effects of specific development activity on the existing and planned roadway system.

3.1.2 When a TIA is Required

A. A TIA is required with every application for a proposed development that generates traffic in excess of one thousand (1,000) average daily trips based on data published in the latest edition of the Institute of Transportation Engineers (ITE) *Trip Generation Manual*; or,

B. When the City Engineer determines that the characteristics of the proposed subdivision necessitate analysis.

C. An updated TIA is required with submittal of a final plat if, in the opinion of the City Engineer, the final plat changes significantly (i.e., adds lots, modifies or adds street connections, etc.) from an approved Preliminary Plat.

D. All or a portion of the requirement for the TIA may be waived by the City Engineer depending upon the size and potential impact of the proposed subdivision and the traffic to be generated. Waivers will be considered on a case-by-case basis upon submittal of a waiver request and corresponding City Engineer review. Technical justification must be provided by the applicant when requesting the waiver.

3.1.3 TIA Requirements

A. All elements of the TIA must be prepared under direct supervision of and signed, stamped and dated by a Professional Engineer licensed to practice in the State of Texas with specific expertise in transportation and traffic engineering, preferably certified as a Professional Traffic Operations Engineer.

B. The analysis is required to contain at a minimum, the following:

1. Traffic Analysis Map

    a. Land Use, Site and Study Area Boundaries, as defined

b. Existing and Proposed Site Uses

c. Proposed Land Uses on both sides of boundary streets for all parcels within the study area for TIAs where land use is the basis for estimating projected and existing traffic volumes

d. Existing and Proposed Roadways and Intersections of boundary streets within the study area of the subject property, including geometrics, traffic signal control, and volumes

e. All major driveways and intersecting streets adjacent to the property will be illustrated in sufficient detail to serve the purposes of illustrating traffic function. This may include showing lane widths, traffic islands, medians, sidewalks, curbs, traffic control devices (traffic signs, signals, and pavement markings), and a general description of the existing pavement condition.

f. Photographs of adjacent streets of the development and an aerial photograph showing the study area

2. Trip Generation and Design Hour Volumes

a. A trip generation summary table listing each type of land use, the building size assumed, average trip generation rates used (total daily traffic and a.m./p.m. peaks), and total trips generated shall be provided. Trip generation information is to be based on data published in *Trip Generation*, latest edition, by the Institute of Transportation Engineers (ITE).

b. Vehicular trip generation may be discounted in recognition of other reasonable and applicable modes, e.g., transit, pedestrian or bicycles. Trip generation estimates may also be discounted through the recognition of pass by trips and internal site trip satisfaction. All such estimates shall be subject to the approval of the City.

C. Proposed trip generation calculations for single-story commercial properties shall be based on a floor-to-area (building size to parcel size) ratio of 0.25 or more.

1. Trip Distribution (provide figure by Site Exit/Entrance). The estimates for percentage distribution of trips by turning movements to/from the proposed development.

2. Trip Assignment (provide figure by site entrance and boundary street). The direction of approach of site-attracted traffic via the area's street system.

3. Existing and Projected Traffic Volumes (provide figure for each item). Existing traffic volumes are the numbers of vehicles on the streets of interest during the time periods listed below, immediately prior to the beginning of construction of the land development project.

Projected traffic volumes are the number of vehicles, excluding the site-generated traffic, on the streets of interest during the time periods listed below, in the build-out year.

a. A.M. peak hour site traffic (including turning movements) if significant impact

b. P.M. peak hour site traffic (including turning movements)

c. Weekend peak hour site traffic (including turning movements)

d. A.M. peak hour total traffic including site-generated traffic and projected traffic (including turning movements)

e. P.M. peak hour total traffic including site-generated traffic and projected traffic (including turning movements)

f. Weekend peak hour total traffic including site-generated traffic and projected traffic (including turning movements)

g. For special situations where peak traffic typically occurs at non- traditional times, e.g., major sporting venues, entertainment venues, large specialty Christmas stores, etc., any other peak hour necessary for complete analysis (including turning movements)

h. Total daily existing traffic for street system in study area

i. Total daily existing traffic for street system in study area and new site traffic

j. Total daily existing traffic for street system in study area plus new site traffic and projected traffic from build-out of study area land uses

4. Capacity Analysis (provide Analysis Sheets in Appendices)

a. A capacity analysis shall be conducted for all public streets, intersections and junctions of major driveways with public streets, which are significantly impacted (as designated by the City), by the proposed development within the previously defined study boundary.

b. Capacity analysis will follow the principles established in the latest edition of the Transportation Research Board's *Highway Capacity Manual (HCM)*, unless otherwise directed by the City. Capacity will be reported in quantitative terms as expressed in the *HCM* and in terms of traffic level of service.

c. Capacity analysis will include traffic queuing estimates for all critical applications where the length of queues is a design parameter, e.g., auxiliary turn lanes and at traffic gates.

5. Level of Service Determination

    a. A table indicating the level of service for near-term and long-term traffic projections for all streets within the study area shall be included.

    b. Level of service “C” is the design objective for all movements. Under no circumstances shall the level of service be less than “D” unless deemed acceptable for site and non-site traffic by the City Engineer.

6. Conclusions and Recommendations

    a. The TIA must include a summary of the findings regarding impacts of the proposed development on the existing and proposed street system.

    b. If the analysis indicates unsatisfactory levels of service or safety problems, a detailed description of proposed improvements to remedy deficiencies and a sketch of each improvement showing pertinent geometric features shall be included. Assumptions regarding future capacity recommendations shall be approved by the City Engineer.

    c. For phased construction projects, implementation of traffic improvements must be accomplished prior to the completion of the project phase for which the capacity analyses show that they are required. Plats for project phases subsequent to a phase for which a traffic improvement is required may be approved only if the traffic improvements are completed or bonded.

7. Other Items

    a. The City Engineer may require other items be included in the TIA in addition to those listed above.

3.2 FUNCTIONAL CLASSIFICATION AND STREET DIMENSIONS

This section further defines the functional classifications, street types, and design dimensions defined in the City of Joshua Comprehensive Land Use Plan, the Master Thoroughfare Plan and Subdivision Ordinance.

3.2.1 Street Classification

Street classifications and standard dimensions for each street section designation are listed in the following table.

Table 3.1 Street Classifications and Standard Dimensions

Functional Classification	Dimensional Classification	Section Designation	Lane Width (ft)[1]	Pavement Width (ft)[2]	Shoulder Width (ft)[3]	Median Width (ft)[1]	Parkway Width (ft)[2]	Normal ROW (ft)
Principal Arterial	7-Lane Undivided	P7U	6-12	87	n/a	14[4]	16.5	120
	4-Lane Divided	P4D	4-12	50	n/a	15	18	100
	4-Lane Undivided	P4U	4-12	49	n/a	n/a	15.5	80
Minor Arterial	4-Lane Undivided	M4U	4-11	45	n/a	n/a	17.5	80
Collector	4-Lane Undivided	C4U	4-11	45	n/a	n/a	12.5	70
	2- Lane	C2U	2-18	37	n/a	n/a	11.5	60
	Rural	C2U-R	2-11	28	3	n/a	16	60
Local	Urban	L2U	2-15	31	n/a	n/a	9.5	50
	Rural	L2U-R	2-11	28	3	n/a	11	50

[1] Measured from face of curb

[2] Measured from back of curb or edge of shoulder

[3] Measured from edge of pavement

[4] Two Way Left-turn Lane

3.3 ACCESS CONTROL

The following standards shall be used in the location of street intersections, median openings, and driveway approaches which affect access to streets from adjoining properties. Section 3.4.2 Street Design Elements provides the geometric design requirements for streets, medians, and driveway approaches.

3.3.1 Intersections and Median Openings

A. Intersection Requirements

1. All street intersections along one side of an existing cross-street must, wherever practical, align with existing intersections on the opposite side of the cross street.
2. There shall be a minimum of 2,000 feet between intersections of arterial streets and/or collector streets.
3. Block lengths shall be in accordance with the Subdivision Ordinance.

B. Median Opening Requirements

1. Spacing is measured between the centerlines of the median openings.
2. Spacing between median openings should be no more than 1,200 feet.
3. Mid-block median openings and median openings serving non-arterial streets and driveway approaches along a divided thoroughfare should occur no closer than 300 feet.
4. Median openings shall not occur in left turn storage lanes or left turn transition curb areas.
5. Median openings shall be located wherever feasible to serve both sides of the street.
6. Median opening noses are typically 12-15 feet beyond the projection of the curb or driveway edge.
7. Median openings may require the construction of left turn lanes. Typical storage length is 150 feet with 150 feet transition. Storage lengths may be altered based on projected traffic volumes.
8. Existing median openings may be relocated if:
    a. The existing opening does not provide service to a public or private street.
    b. The proposed median opening meets the spacing requirements stated herein.
    c. The existing opening is no longer in use and the owners of the properties being served by the existing opening sign a document requesting or approving the change, and the document is approved by the City Engineer.
    d. If approved, all costs associated with the median opening shall be paid by the Owner/ Developer.

3.3.2 Drive Approaches

A. Streets shall be designed to conform to existing or proposed driveway openings.

B. Where a residential subdivision will abut or contain an existing or proposed arterial street, driveway access to the thoroughfare is prohibited.

C. To the greatest extent possible, no more than 20 percent of the total centerline length of a residential collector street may have residential lots fronting onto the collector on each side of the street without construction of a wider alternative section.

D. Driveway approaches including turnout curb transitions shall be located entirely within the frontage of the property served by the approach.

3.4 GEOMETRIC DESIGN

3.4.1 Design Criteria

All engineering designs shall be based on national standards and best practices. The American Association of State Highway and Transportation Officials (AASHTO) published *A Policy on Geometric Design of Highways and Streets*, referred to as the AASHTO Green Book. This manual is updated periodically and contains design considerations and criteria applicable to roadway design. The AASHTO Green Book shall be used for guidance for designing geometrics, including intersection design, and other street features. The National Association of City Transportation Officials (NACTO) *Urban Street Design Guide* shall be considered where AASHTO does not fully address city street issues. Roadway designs should comply with the following standards.

A. Intersections Standards

1. An intersection shall not have more than four street approaches.
2. No offset is permitted at intersections of two thoroughfares.
3. When conditions require the centerlines of local streets to be offset, a minimum of 125 feet offset distance is required for local street intersections and 200 feet offset distance for thoroughfare street intersections. Centerline offsets less than the minimum must be approved by the City Engineer. Offsets greater than the minimum may be required by the City Engineer when necessary for traffic safety.
4. No street intersecting an arterial street should vary from a 90-degree angle of intersection by more than 5 degrees. Streets intersecting collector streets should not vary from a 90-degree angle of intersection by more than 10 degrees. All other street intersections should not vary from a 90 degree angle of intersection by more than 15 degrees.

B. Design Speed

1. All streets shall be designed to accommodate the design speeds in the following table.

Table 3.2: Street Type Design Speed

Functional Classification	Section Designation	Design Speed (MPH)
Principal Arterial	P7U	50
	P4D	45
	P4U	45
Minor Arterial	M4U	45
Collector	C4U	40
	C2U	35
	C2U-R	35
Local	L2U	30
	L2U-R	30

C. Horizontal and Vertical Control

1. Horizontal Control - All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System.

2. Vertical Control - Vertical control shall be tied to NGVD 29.

D. Minimum Radius

1. The required radius for curb returns at intersections shall be as follows:

Street Types	Min Radius
Arterial / Arterial	30 feet
Arterial / Collector	30 feet
Arterial / Local	30 feet
Collector / Collector	30 feet
Collector / Local	30 feet
Local / Local	20 feet

2. The minimum radius from the face of curb on a cul-de-sac shall be 40 ft.

E. Sight Distance

At controlled or uncontrolled intersections of any public street, sight triangles (visibility triangles) are required. The sight triangle shall be the triangle made by extending 25 feet along each property line from the property corner at an intersection. Within this triangle there shall be no tree, shrub, plant, sign, soil, fence, retainer wall or other view obstruction having a height greater than 2 feet. This height shall be measured above a line drawn between the top of curb or edge of pavement of both streets at the point where the referenced line intersects the top of curb or edge of pavement.

An intersection sight distance analysis in accordance with the AASHTO Green Book (the chapter titled *Intersections*) should be undertaken to confirm that sufficient stopping distance is available.

Additional sight distance may be required based on topography, roadway curvature, vegetation or other sight hindrance. The AASHTO Green Book describes the process the designer should follow to determine whether a vehicle entering or crossing an intersection from a minor road can see, and be seen by, a vehicle on the major road when there is an obstruction, such as a change in the vertical profile of the road, in time to avoid a collision (section titled *Identification of Sight Obstructions within Sight Triangles*).

Deviations from the minimum intersection sight distance requirements may be allowed provided that the owner has demonstrated that the area proposed will provide adequate sight distance based on AASHTO standards. All deviations must be approved by the City Engineer.

3.4.2 Street Design Elements

A. Horizontal Alignment

1. The curvilinear requirements in the Subdivision Ordinance must be accommodated.

2. The following minimum centerline radii shall be used in the design of all street construction.

Street Type	Min Centerline Radius
Arterial	1040 feet
4-lane Collector	765 feet
2-lane Collector	510 feet
Local	335 feet
Cul-de-sacs	50 feet radius to right-of-way line

3. Reverse curves shall be separated by a tangent section in accordance with the following table:

Street Type	Min Tangent Length
Arterial	100 feet
4-lane Collector	100 feet
2-lane Collector	50 feet
Local	As approved by City Engineer

4. Major collector or arterial roadways intersecting other major collector/arterial roadways shall have the following minimum horizontal centerline approach tangent section length as measured from the nearest right-of-way line of the intersecting street, unless such requirement is waived by the City Engineer.

Street Type	Intersecting with	Min Approach Tangent
Arterial	Arterial	200 feet
4-lane Collector	Arterial	150 feet
4-lane Collector	4-lane Collector	100 feet

B. Vertical Alignment

1. All streets shall be designed and constructed to a minimum grade of 0.5%; unless the required geotechnical report indicates the soil has a PI greater than or equal to 40, a minimum grade of 1% shall be required. All streets shall have a maximum grade as follows:

Street Type	Maximum Grade
Arterial	6.0%
Collector	8.0%
Local	10.0%

2. In order to maintain adequate sight distance, all streets shall be designed and constructed to comply with the following minimum vertical curve length for each algebraic percent difference in grade K, where K = curve length (L) / algebraic difference in grade (A). Grade changes where the algebraic percent difference is one percent or less are not required to use vertical curves for design speeds less than or equal to 45 mph.

Street Type	Design Speed	Crest Curves (K)	Sag Curves (K)
Arterial	45	65	80
4-lane Collector	40	45	65
2-lane Collector	35	30	50
Local	30	20	40

3. The following maximum intersection grades involving arterial and collector roadways shall be used at controlled intersections.

Design Street Type	Intersecting with	Design Street Maximum Grade	Distance
Arterial	Arterial	2%	300 feet
Arterial	4-lane Collector	3%	300 feet
4-lane Collector	Arterial	3%	200 feet
4-lane Collector	4-lane Collector	3%	200 feet
2-lane Collector/Local	Arterial/Collector	4%	150 feet

4. No valleys across arterials or collectors will be allowed. To accomplish a smooth transition, cross-fall toward the median of one lane of each thoroughfare may be required. The use of storm drainage inlets in the median shall be avoided if possible.

C. Street Cross Section

For curbed streets, the right-of-way shall be graded to drain to the street at a typical slope of 1/4 inch per foot. Street back slopes and embankment slopes shall not be steeper than 3:1. Streets shall typically be rooftop crowned with 2 percent cross slope unless otherwise approved by the City Engineer.

D. Sidewalks

1. All sidewalks shall conform to state regulations for barrier free construction.
2. Sidewalks shall be at least 4 feet wide in residential subdivisions and at least 5 feet wide in non-residential subdivisions and along arterials and collectors.
3. Sidewalks shall not be located within ditches.
4. One foot of width shall be added to all sidewalks abutting retaining walls.

E. Medians

1. The standard median width is 16 feet with a 6-foot-wide median in left tum lanes as measured from face of curb to face of curb.
2. All median areas which are less than 8 feet wide shall be paved with 4-inch-thick non-reinforced concrete median pavement. Alternate paving materials and designs may be used upon approval of the City Engineer.
3. Fall or rise in curb elevations across medians shall not exceed 1/2 inch per foot at any paving station. Differentials in curb elevations on narrow median strips will vary from 0 to 3 inches.

F. Driveway and Curb Openings

Design of driveways shall comply with applicable requirements of the City of Joshua Subdivision Ordinance and this manual.

1. Driveways should intersect streets at or near 90 degrees.
2. The driveway edge should be located equal to or greater than 5 feet from each side of the property line.
3. No portion of any driveway should be located within 3 feet of any fire hydrant, electrical pole, or any other surface public utility.
4. Driveways shall be designed with a sidewalk crossing meeting accessibility requirements.

5. The minimum driveway grade within the street right-of-way is set using 1/4 inch per foot (2 percent) rise above the top of curb to the property line. The elevation of a driveway at the right-of-way line shall be no lower than the top of curb to ensure proper street drainage is maintained.

6. The grade break at the gutter line, and at any point within 10 feet of the gutter line, must not exceed 12 percent in order to avoid car bumper drag from occurring. Streets with a 1/4 inch per foot crossfall to the gutter (-2 percent) will limit the maximum approach grade to 10 percent.

7. Driveway connections to rural road sections across bar ditches shall be installed in accordance with the following: The culvert shall be sized by the owner's engineer. The minimum culvert size is 15 inches and shall be reinforced concrete. For thoroughfares, the maximum slope from the edge of driveway to the top of culvert pipe shall be 6:1 and the end of the pipe shall have sloped end treatment. Positive grading shall be provided upstream and downstream so that drainage can flow through the culvert without ponding. Rural driveways shall have a minimum width along the pavement edge of 18 feet to facilitate turning movements.

8. Throat width at right-of-way shall be as follows:

   Residential – 12-25 feet
   Commercial – 25-35 feet
   Industrial – 25-35 feet

9. Minimum curb radius shall be as follows:

   Residential – 5 feet
   Commercial – 10 feet
   Industrial – 15 feet

10. Minimum centerline spacing of driveways shall be as follows:

Type Street	Residential	Commercial	Industrial
Arterial	n/a	100 feet	100 feet
4-lane Collector	100 feet	100 feet	100 feet
2-lane Collector	15 feet	45 feet	55 feet
Local	15 feet	45 feet	55 feet

11. Minimum distance from driveway to intersection shall be as follows (measured from the nearest driveway edge to the projected curb line of the intersecting street):

Type Street	All Driveways
Arterial / Arterial or 4-lane Collector	55 feet
Arterial / 2-lane Collector	40 feet
Collector / Local	40 feet
Local / Local	30 feet

3.4.3 Accessibility Requirements

All plans and specifications for the construction or alteration of public buildings and facilities, privately owned buildings and facilities and pedestrian facilities must be in compliance with the Texas Accessibility Standards (TAS) and must conform to the standards required by regulations issued by the Texas Department of Licensing and Regulation (TDLR), under the Architectural Barriers Act, codified as Article 9102, Texas Civil Statutes.

3.5 PAVEMENT STRUCTURE DESIGN

3.5.1 Pavement Design

All new roadways within the City of Joshua shall be constructed of reinforced Portland cement concrete or hot mix asphalt concrete pavements. The use of RAP (Reclaimed Asphalt Pavement) and RAS (Recycled Asphalt Shingles) is not allowed. Work and materials shall be in accordance with the North Central Texas Council of Governments *Public Works Construction Standards,* current edition. The following is minimum required pavement thickness for pavement and subgrade requirements for certain soil conditions for various street and thoroughfare types. Alternative pavement designs, if used, shall be performed in accordance with the Texas Department of Transportation (TXDOT) *Pavement Manual*, current edition.

3.5.2 Temporary Turnaround Pavement

Temporary turnarounds shall be constructed with a minimum section of 2" asphalt on 8" flex base. The subgrade shall be treated with lime or cement, as appropriate, to a minimum depth of 6".

Table 3.3 Minimum Pavement and Subgrade Thickness

Facility Type	Section Designation	Concrete Pavement			Asphalt Pavement			
			Subgrade Thickness			Subgrade Thickness		
		Concrete Thickness[1]	if P.I. ≤ 15, Cement Treat[2]	if P.I. > 15, Lime Treat[3]	Asphalt Thickness[4]	Flex Base[5]	if P.I. ≤ 15, Cement Treat[2]	if P.I. > 15, Lime Treat[3]
Principal Arterial	P7U	9”	10”	10”	3.5”	14”	10”	10”
	P4D & P4U	8”	10”	10”	3.5”	12”	10”	10”
Minor Arterial	M4U	8”	10”	10”	3.5”	12”	10”	10”
Collector	C4U	7”	8”	8”	3”	10”	8”	8”
	C2U & C2U-R	6”	6”	6”	2”	8"	8"	8"
Local	All Sections	6”	6”	6”	n/a	n/a	n/a	n/a
Driveways	All sections	6”	6”	6”	n/a	n/a	n/a	n/a

[1]NCTCOG Class C with 3,600 psi 28 day compressive strength.

[2]Minimum 3% by dry unit weight of Portland cement.

[3]Minimum 6% by dry unit weight of hydrated lime.

[4]NCTCOG Type D asphaltic concrete fine surface course.

[5]Crushed limestone compacted to 95% standard proctor density at optimum moisture.

3.5.3 Geotechnical Investigation

A. A geotechnical investigation must be performed for all new developments containing public streets. The investigation must be based on samples obtained from drilling or from excavations on the site. The geotechnical investigation must be performed by a qualified geotechnical firm. A report with findings and recommendations must be prepared and shall bear the seal of a Professional Engineer licensed in the State of Texas. As a minimum, the study must address the following:

1. General soil and groundwater conditions
2. Earthwork recommendations
3. Recommendations for pavement subgrade treatment type, depth, and concentration
4. Guidelines for concrete and / or HMAC pavement construction

B. Samples must be tested in a laboratory. Tests must include as a minimum:

1. Moisture content and soil identification
2. Liquid and plastic limit determination
3. Unit weight determination
4. Eades and Grim lime series tests
5. Soluble sulfate tests

3.5.4 Pavement Widening

Pavement widening projects may require a special pavement analysis and alternate pavement subgrade design. If the subgrade soil P.I. exceeds 20, a special pavement analysis shall be performed by the designer and, if warranted, the designer shall perform a special pavement subgrade design. When existing pavement sections are widened or when old pavement is removed and replaced with a widened section, differential upward pavement deflections can occur over short distances in a transverse direction (across the width) due to non-uniformity of subgrade moisture conditions.

A. Sample borings shall be drilled along the proposed alignment to determine the differential in potential vertical rise (PVR) value between the existing paved and unpaved areas:

1. Sample borings shall be drilled on 1,000 foot spacing along the existing pavement and 500 foot spacing along the proposed (unpaved) area.
2. Moisture content tests, hand penetrometer tests and swell tests shall be performed to determine the differential soil PVR along the proposed alignment.

B. If the differential PVR exceeds 2 inches, the designer shall propose an alternate pavement subgrade design that shall reduce the differential PVR to less than two 2 inches.

3.5.5 Pavers and Other Materials

Special paving treatments can be selected from a range of options including unit concrete pavers, bricks, textured and colored concrete, natural stone pavers, and concrete with exposed or special aggregate or other finish treatments. Design detailing must address the needs of ADA and TAS compliance in areas of crosswalks or walkways. In all locations within public rights-of-way, the materials must perform for the serviceable life of the street without significant degradation or requiring ongoing maintenance by the City.

3.6 PERMANENT PAVEMENT MARKINGS AND SIGNAGE

Permanent pavement markings and signage shall be installed in accordance with the *Texas Manual on Uniform Traffic Control Devices* (TMUTCD), current edition, and the direction of the City Engineer.

3.7 LANDSCAPING SYSTEMS

The following standards shall be used for landscaping public rights-of-way. These requirements do not replace those required by Zoning or other ordinances.

3.7.1 Requirements

A. All unpaved public medians and parkways shall be landscaped with a minimum of 4 inches of topsoil, sodded or seeded and irrigated with a properly designed and installed system.

B. Minimum landscape requirements will be established by the City.

C. Trees or upright plantings must not be planted within 30 feet of intersections or utility poles. The City may require greater setback for safety based on line-of-sight issues.

D. An 8-inch wide concrete mow strip shall be installed between all planting beds and grassed areas.

E. No plantings or irrigation facilities shall be permitted within median areas 5 feet or less in width or in median noses.

F. Seeded or sodded areas of medians shall be bermed a minimum of 6 inches.

G. Only trees with a mature height less than 30 feet may be planted closer than 20 feet either side of an overhead line. No trees shall be directly under utility lines.

H. Trees to be planted within the medians of divided roadways that are ultimately planned for widening by constructing additional lanes in the median shall not be planted within the path of future lanes. Trees shall not be planted within 5 feet of existing or proposed curbs. Future lane widening shall be shown on the landscape plans.

I. Trees shall not be planted within 5 feet of existing or proposed water lines or within easements.

J. Irrigation systems in public rights-of-way shall be designed by an individual with a valid irrigation license granted by the State of Texas.

3.7.2 Metering

All water usage shall be metered and paid for by the developer until landscaping is accepted by the City. Developers shall pay all fees required by the water provider, including impact fees/system development fees for any water meter to be installed.

3.8 STREET LIGHTING REQUIREMENTS

Streetlights shall be designed and installed in accordance with the following criteria:

3.8.1 Street Lighting Type

A. All lights will be 100 watt high pressure sodium mounted on a galvanized steel pole using underground wiring at a minimum 25 foot height above the roadway surface for local streets and 30 foot for collectors and arterials.

B. Street lighting shall be designed for thoroughfares to meet the lighting criteria in the latest version of the Illuminating Engineering Society (IES) Roadway Lighting Report 8 and the latest version of the National Electric Code (NEC).

C. Decorative lights may be approved on a case by case basis.

3.8.2 Placement and Spacing

A. Lights will be placed at all street intersections except at thoroughfares where median lighting is existing.

B. Lights will be spaced a maximum of 600 feet along local and collector streets. Lights will be spaced a maximum of 200 feet along arterial streets.

C. Additional lights may be required for intersections, in cul-de-sacs, and where curves or grades require additional lighting.

D. All cul-de-sacs longer than 200 feet from centerline of street to center point of cul-de-sac shall have a light at the street intersection and at the end of the cul-de-sac.

E. Lights shall be placed so as to gain the maximum use of existing and proposed physical characteristics.

F. Electric service to the streetlight shall be underground.

G. Streetlights shall not be constructed in conflict with the sidewalk.

PART 4. DRAINAGE

4.1 ADOPTION OF *iSWM TECHNICAL MANUAL*

The City of Joshua hereby adopts the methodologies and standards included in the NCTCOG *iSWM Technical Manual* for all drainage analysis and design within the boundary of the City and within its extraterritorial jurisdiction (ETJ). Clarifications and modifications to the *iSWM Technical Manual* shall be applied as indicated in the following sections.

4.2 ANALYSIS CRITERIA

The following section describes specific requirements for drainage analysis to supplement the techniques and methods described in the Hydrology and Hydraulics sections of the *iSWM Technical Manual*.

4.2.1 Peak Runoff

The Rational Method (Q=CIA) shall be used for calculating peak runoff from watersheds of 200 acres or less. For watersheds of more than 200 acres, methods generating runoff hydrographs shall be used.

A. Runoff Coefficients

The runoff coefficient shall be determined for each drainage area based on a weighted average of the land uses listed below.

Table 4.1: Runoff Coefficient Values

Land Use	C value
Single Family Residential (≥3/4 acre lots)	0.45
Single Family Residential (1/2 acre lots)	0.55
Single Family Residential (1/8 acre lots)	0.65
Multi-Family Residential	0.75
Commercial	0.85
Industrial	0.85
Parks and Undeveloped Areas	0.30

Runoff coefficients other than those listed above may be used if justified by the development site plan and approved by the City Engineer. Composite runoff coefficients will be determined by direct proportion when more than one land use exists within a drainage area. C_f factors shall not be applied to the runoff coefficients.

B. Intensity

Rainfall intensity shall be determined using the rainfall data for Johnson County from the Hydrology section of the *iSWM Technical Manual.*

C. Time of Concentration

The time of concentration may be calculated using methods other than those described in the iSWM Technical Manual with the approval of the City Engineer. The minimum time of concentration shall be 15 minutes for residential and undeveloped areas and 10 minutes for commercial and industrial areas.

4.2.2 Downstream Assessment

A downstream discharge assessment shall be performed to confirm that the proposed development does not result in increased flooding or increased erosion potential in areas downstream of the development when compared to the existing condition.

The assessment shall extend from the outfall of the proposed development to a point downstream where the discharge from the proposed development no longer has a significant impact on the downstream system. For sites draining a watershed less than or equal to 100 acres at a proposed outfall, the downstream assessment may use the 10 percent rule of thumb as described in the *iSWM Technical Manual* or a detailed study in order to determine the zone of influence. For all other watersheds, the zone of influence will be defined by a detailed hydrologic and hydraulic analysis.

For site outfalls with less than or equal to 25 acres of proposed development with proposed detention, a downstream assessment is not required. The detention design must only demonstrate the increase in discharge due to the proposed development is mitigated to existing conditions at the outfall.

The downstream assessment must demonstrate that the following conditions are met with the proposed development:

A. No new or increased flooding (0.00 feet) of existing structures

B. No increase greater than 0.1 feet in 1-, 5-, 25- and 100-year creek flood elevations over existing roadways

C. No increase greater than 0.1 feet in 1-, 5-, 25- and 100-year creek flood elevations, unless contained in existing channel, roadway, drainage easement, and/or right-of-way

D. No increase greater than 5 percent in 1-, 5-, 25- and 100-year velocities in existing creeks and channels unless it can be demonstrated that this condition does not cause an adverse effect and is accepted by the City Engineer

E. No increase in downstream discharges caused by the proposed development that, in combination with existing discharges would result in the design capacity of the downstream storm drainage system or existing ROW to become exceeded for any of the design events.

The developer shall provide all supporting calculations to confirm that the above criteria have been satisfied for the limits of the study. If the existing drainage systems do not have capacity to convey the increased runoff from the development, additional stormwater infrastructure will be necessary to discharge runoff without causing new or increased flooding or erosion potential downstream of the proposed development.

F. Acceptable Outfall Conditions

No development may outfall concentrated discharge on adjacent property unless discharged into a public or private drainage system or existing defined swale, channel, or creek. Where drainage features are available to receive concentrated runoff, the design storm shall be collected on-site and conveyed to the feature. When offsite grading is required or the development discharges concentrated flow on an adjacent property without a receiving feature as described above, a notarized letter of permission from the affected property owner(s) shall be required. This letter shall be filed in the County records.

4.3 **DESIGN CRITERIA**

The following section describes specific criteria for storm drain, detention ponds, channels, culverts, and bridges.

4.3.1 Design Storm Frequencies

Capacity requirements for the storm drainage facilities in the City of Joshua are as follows:

Table 4.2: Design Frequencies

Facility Type	Design Frequency (Years)
Street Right of Way in Combination with Storm Drain	100
Sump Inlets	100
On-Grade Inlets and Street Section with Curb and Gutter	5
Permanent Bar Ditch and Associated Culverts	5
Detention Ponds	1, 5, 25, 100
Channels and Creeks	100
Culverts and Bridges	100

At least one lane shall remain dry during the 5-year storm for all collector streets, and at least one lane in each direction shall remain dry during the 5-year storm for all arterial streets. For all other streets with curb and gutter, the flow in the street during a 5-year storm shall not exceed curb height. On all streets, the runoff from the 100-year storm shall be contained within the street right-of-way and shall not exceed 0.2 feet above the lowest top of curb.

For streets with bar ditches, the 100-year storm shall be contained within the right-of-way and the flow shall not exceed the street crown elevation. Culverts under driveways shall be designed to carry the 5-year storm at a minimum, but larger ditches and culvert may be required to convey the 100-year storm within the right-of-way.

4.3.2 Offsite Areas

In all cases, drainage facilities should be designed for fully developed upstream conditions. Where future runoff must be calculated for undeveloped lands with no planned development, the City of Joshua Future Land Use Plan identified in the City of Joshua Comprehensive Plan shall be used.

4.3.3 Storm Drain Requirements

The following section describes specific requirements for the design of storm drain systems.

A. HGL Requirements

The hydraulic grade line (HGL) for the pipe discharge resulting from the 100-year event pipe and the associated calculation worksheets shall be shown on the plans and shall be demonstrated to be below the road gutter elevation. For systems located outside of pavement, the HGL shall be at least 1.5 foot below ground level. The HGL shall start at the inside top of pipe or at the HGL of a connecting feature, whichever is higher. For systems that begin at an

outfall the engineer should determine the appropriate starting HGL based on an investigation of downstream hydraulic features.

B. Pipe

Underground systems shall be constructed with a minimum Class III reinforced concrete pipe. A higher class of pipe may be required with shallow or deep construction. Alternative pipe materials (e.g. HDPE, PP, PVC etc.) shall not be allowed under street pavement but may be allowed in other installation conditions with approval of the City Engineer.

A minimum size of 18 inches shall be used for all storm drain. A typical minimum depth of 3 feet of cover from the gutter to top of pipe shall be used to allow utility services to cross above the pipe.

All pipe bends and fittings shall be prefabricated. All connections to existing systems shall be made with a collar or prefabricated fitting. Radius pipe is allowed and shall be placed in accordance with the manufacturer's standards and requirements. Pulled joints may not be used to achieve the pipe curvature.

C. Manholes

For storm drain lines of 48 inch diameter and smaller, manhole access shall be provided every 600 feet to provide access into the closed system. For larger storm drain lines, required spacing for manhole access shall be determined by the City Engineer but generally should not exceed 1,000 feet. Additional manholes should be provided at the junctions of trunk mains.

D. Inlets

Curb inlets shall be a minimum of 10 feet in length. Recessed curb inlets are required on all curbed streets with more than two travel lanes. Grate inlets are not allowed on public systems. Drop/Y inlets may be utilized in rear yards to intercept multiple lot to lot drainage or intercept offsite drainage.

E. Intake and Outfall Structures

Headwalls or sloped end treatment shall be constructed at all storm drain intakes and outlets. Storm drain systems that outfall to a creek shall be extended to the flowline of the creek or shall have an engineered drop structure. All outfalls should be evaluated for erosion protection as described in the *iSWM Technical Manual.* Headwalls in areas accessible to pedestrians and/or vehicles should include an appropriate guardrail.

F. Easements

Storm drain easements shall be a minimum of 15 feet in width with at least 5 feet of distance between the outside of the pipe and the easement line.

4.3.4 Detention Pond Requirements

The following section describes specific requirements for detention ponds in the City of Joshua. These requirements apply to the design of both private and public facilities.

A. Design Criteria

Detention basins shall be analyzed for the 1-, 5-, 25-, and 100-year storm events. Ponds shall be designed to limit the peak rate of discharge from the basin for the design storm events to a rate which will not cause an increase in downstream flooding or erosion potential.

Grass-lined sloped sides for detention basins shall not be steeper than 4H:1V for ease of maintenance. All detention basins shall be stabilized against erosion. Detention basins shall be designed to be maintainable by mechanized equipment. Level access routes for equipment shall be provided to all parts of the pond.

Due to the difficulty in coordinating the effective operation of multiple ponds and changing upstream conditions, ponds may not be constructed in-line with the water course. Exceptions will be allowed where the entire drainage area is contained within a single development or the pond is a component of a master planned drainage system approved by the City.

Private detention ponds must be designed in accordance with good engineering practices and reviewed and inspected by the City. Maintenance for private detention ponds shall be the responsibility of the developer/owner. Access shall be provided to all private drainage facilities where there may be a public safety concern for inspection by the City. Detention ponds may not be used to meet park dedication requirements.

Impoundment of surface waters may require a water rights permit from the TCEQ. For the approval of ponds which retain water a completed permit or written documentation stating that a permit is not required must be provided.

B. Design Calculations

The Modified Rational Formula shall only be used for detention basin design for drainage areas of 25 acres or less. Modified Rational calculations shall be performed using the method described in the *iSWM Technical Manual*. A routed hydrograph method shall be used for watersheds larger than 25 acres. Various hydrograph methods and computer programs are available. Hydrograph study requirements shall be approved by the City Engineer.

Storage volume and outlet discharge calculations shall be provided for all storm events and shown on the construction plans along with tabulated stage-storage-discharge values. Outlet discharge calculations shall take into account backwater conditions at the outlet structure. For detailed calculations of unit hydrograph studies, a separate report shall be provided. A minimum of 1 foot of freeboard shall be added to the design water surface elevation to set the minimum pond top of bank.

C. Safety Requirements

An emergency spillway shall be provided for ponds with an embankment greater than or equal to 4 feet above adjacent grade. The spillway should be located at or above the 100-year maximum storage elevation with adequate capacity to convey the fully developed 100-year storm, assuming blockage of the storm drain outlet with six inches of freeboard. Ready access to the emergency spillway system shall also be provided. Spillway requirements must also meet all appropriate state and federal criteria. Design calculations shall be provided for all spillways.

Fencing is required around all ponds with vertical walls or steep side slopes to provide fall protection. The engineer should consider additional fencing based on site conditions to protect the public from any safety hazards.

Detention basins which retain water shall have a level safety ledge extending 3 feet into the basin from the shoreline and 2 feet below the normal water depth.

4.3.5 Channel Requirements

The following section describes specific requirements for channels in the City of Joshua.

A. Design Criteria

Large drainage channels are generally not considered acceptable for new public drainage systems. Drainage shall be conveyed in a pipe except where calculations demonstrate that a storm drain greater than 72 inch in diameter would be necessary to convey the required flow. In most cases where pipe construction is infeasible creeks should be left in a natural state. If approved by the City Engineer, grass-lined engineered channels are acceptable. A concrete pilot channel shall be provided where feasible. Channel side slopes ranging from 3:1 to 4:1 are acceptable, although it is recommended that 4:1 side slopes be implemented when possible. Where channel top widths would exceed 60 feet it will be required to leave the creek in a natural state. Concrete lined channels shall only be acceptable for minor channels where approved by the City Engineer.

All channels shall be designed to convey the design flow with a minimum of one foot of freeboard. Channels shall also be designed to resist erosion from the design discharge as described in the *iSWM Technical Manual*. Alternate materials such as concrete and gabions may be used to protect portions of the channel from erosion as necessary. Additionally, in areas where potential excessive erosion or head cutting may occur, grade control structures, drop structures, or other structures may be required to provide stability.

B. Erosion Hazard Zones

An erosion hazard zone (EHZ) shall be delineated for any development adjacent to a natural drainage feature. The erosion hazard zone shall be defined as the horizontal area encompassed by projecting the existing toe of the bank on a 4:1 slope to the natural ground elevation as shown in Figure 4.1. Detailed topographic data such as field survey must be used when developing the EHZ. Alternatively, the EHZ can be delineated based on a detailed study of the expected long-term longitudinal stream degradation and lateral slope stability based on the steps described below.

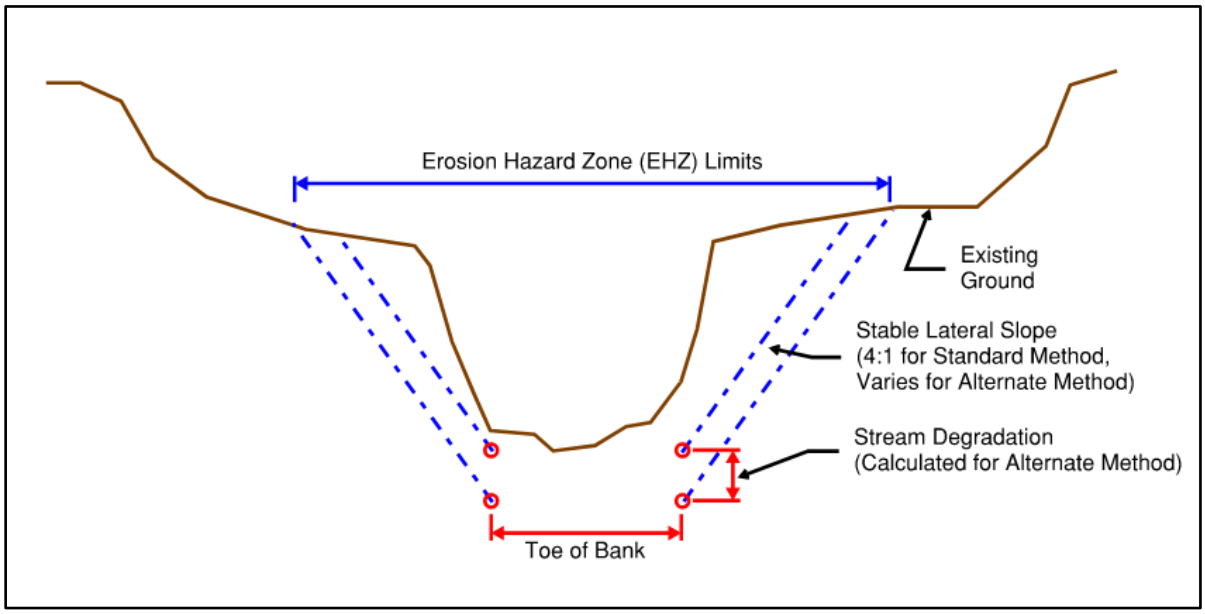
1. Long-term Longitudinal Stream Degradation: The estimated equilibrium slope shall be calculated from the nearest downstream hardpoint such as road crossing or drop structure. The equilibrium slope shall be calculated using three “degradation as limited by a stable slope” computations: Meyer-Peter Muller, Schoklitsch, and Lane’s *Tractive Force* (Pemberton and Lara, 1984). The average of these results shall be used to estimate the potential downcutting. Results differing from others by at least an order of magnitude should not be included in the average. The potential downcutting depth shall be calculated along the stream from the equilibrium slope to determine the degradation depth.

2. Lateral Slope Stability: Lateral slopes must be defined based on global stability calculations performed by a licensed engineer that specializes in geotechnical engineering. The minimum acceptable global factor of safety shall be 1.5. The EHZ is determined by locating the intersection of the current top of each bank and the estimated downcutting depth, and then projecting the stable lateral slope from this point to natural ground.

3. The EHZ analysis should be based on a hydraulic model developed by a Professional Engineer and representative bedload sediment samples or pebble counts from each stream reach.

4. Deviations from the methodology to determine the EHZ or the use of slope stabilizing techniques to increase the lateral slope must be supported by engineering calculations and requires the approval of the City Engineer.

Figure 4.1: Erosion Hazard Zone Determination



C. Channel and Floodplain Easements

Channel easements shall have a minimum of 10 feet between the top of the channel bank and the easement line on both sides of the channel to provide room for maintenance. It must be demonstrated that any channel which carries public runoff is maintainable and that access to and along the channel is provided.

Natural creeks shall have a dedicated drainage easement encompassing the greater of the area of the 100-year fully developed floodplain and the EHZ. If no fully developed floodplain is currently identified for the area of development, one shall be delineated by the developer. Where appropriate models are unavailable, the City Engineer may allow the 500-year floodplain shown on the Effective FEMA Flood Insurance Rate Map to be used for this purpose. In areas of low risk, the City Engineer may accept a conservative estimate of the floodplain based on engineering judgement. No development, including fencing, shall be located within the easement. The easement should not be included in newly subdivided residential lots, but rather fully encompassed in a homeowners association maintained common area. For non-residential areas, the area is to be fully encompassed by a private drainage easement or within a property owners association maintained common area.

4.3.6 Culvert and Bridge Requirements

The following section describes specific requirements for culverts and bridges in the City of Joshua.

A. Design Criteria

All culverts shall have headwalls at the upstream and downstream ends. Culverts should be designed to have one foot of freeboard measured from the top of the curb or edge of pavement at the road low point. Bridges should be studied for scour potential and scour mitigation measures shall be incorporated. The low chord on the bridge structure shall be at least one foot above the 100-year water surface elevation. All headwall and bridge structures should provide appropriate guardrails to protect pedestrian and vehicular traffic.

4.3.7 Lot Grading Standards

The following grading standards shall be met for residential subdivisions in the City of Joshua consisting of half acre lots or smaller.

A. Grading Plan Requirements

All residential subdivisions are required to provide a grading plan designed so as to avoid concentration of runoff onto lots. The grading plan shall show proposed spot elevations at each property corner, at grade break points, and finished pad elevations. One foot contours showing existing and proposed elevations shall also be shown unless this requirement is waived by the City Engineer.

B. Lot-to-Lot Runoff

Lots should be graded such that no lot drains across another where feasible. In no case shall more than one lot drain through another. In unusual situations where multiple lots must drain through another, an engineered swale or other conveyance improvement and drainage easement should be provided where approved by the City Engineer.

C. Lot Grading Requirements

Lot grading shall conform to the following standards:

1. Lots shall be graded away from the pad at a minimum slope of 5 percent for a distance of 10 feet in all directions (or to the lot line).
2. Front or rear swales should be provided where necessary to carry runoff around the pad.
3. Side lot line and front or rear swales shall have a minimum slope of 1 percent although higher slopes are preferred where feasible.
4. Side lot line swales must have a minimum depth of 3 inches at its shallowest point (and a typical depth exceeding 6 inches) below the lowest adjacent pad elevation. Where steep

grade between lots makes this infeasible, a retaining wall shall be constructed to reduce the grade differential such that a conforming swale can be constructed on the higher lot.

5. Slopes shall not exceed 4:1 on residential lots unless approved by the City Engineer. A typical max slope of 10 percent should be used.

PART 5. APPENDIX DESIGN CHECKLIST

When available, Design Checklists will be made available as a part of this appendix.