WASHINGTON COUNTY

DESIGN AND CONSTRUCTION STANDARDS MANUAL

Approved by Commissioners Court on

March 31st 2026

Washington County
Engineering and Development Services

ORDER OF ADOPTION

Rules, regulations, and requirements relating to the approval and acceptance of improvements in subdivisions and development

THE STATE OF TEXAS §

COUNTY OF WASHINGTON §

On this, the 31 day of March, 2026, at a regular meeting of the Commissioners Court, sitting as the governing body of Washington County, came on to be considered the necessity of adopting rules, regulations and requirements providing for the supervision of the development of new subdivisions and development in Washington County, Texas, outside the legal limits of any incorporated city or town in Washington County in accordance with Chapter 232 of the Texas Local Government Code, Chapter 12 of the Property Code and VTCA.

Upon due consideration, the Court was of the opinion that there exists a necessity for establishing such rules, regulations and requirements and that these rules, regulations and requirements shall supersede all existing rules, regulations or requirements heretofore passed by the Commissioners Court;

NOW, THEREFORE, by and under the authority vested in the Commissioners Court, upon the motion of Commissioner Bullock Seconded by Commissioner Corn, duly put and carried, it is ordered, adjudged and decreed that the following rules, regulations, and requirements relating to the supervision of new subdivisions or re-subdivisions in Washington County and hereby adopted as conditions precedent to the approval, by the Commissioners Court, of plats or subdivisions or re-subdivisions for recording and shall be in full force and effect from March 31, 2026 to wit:

1. Whenever the Court in its judgement deems it to be in the best interest of the public to change any part of these rules and regulations, said changes shall be published in a newspaper of general circulation in the county at least thirty days (30) in advance of formal consideration by the Court.

2. These rules, regulations and requirements, any and all future additions thereto and changes thereof, will be binding on all new subdivisions or re-subdivisions in Washington County. Said rules, regulations and requirements must be complied with before approval or acceptance of the roads, roads, storm sewers, drainage ditches and drainage easements of a subdivision or re-subdivision and shall be recorded with the County Clerk after same has been first approved by the Commissioners Court as set forth herein.

3. The roads in previously approved subdivisions which have not been taken into the County Road System shall be considered on individual merits. This policy shall not apply to any roads now being maintained by Washington County, Texas.

4. A final plat of each proposed subdivision or re-subdivision shall be submitted in compliance with the following sections hereof to the Commissioners Court of Washington County. All plans and plats shall be drawn to conform to the requirements set forth herein.

5. In all newly developed subdivisions, a final plat must be submitted and approved by the Commissioners Court of Washington County prior to the issuance of permits or authorization of inspection.

6. It shall be the duty of the developer to see that layout and construction, subject to inspection by the County Engineer or representative of the County Engineer follow the approved plans as presented with the final subdivision plat.

7. Access to all new subdivisions shall be from an adequate County maintained road or a state or federally maintained road.

8. All road construction specifications, regulations and bonding requirements shall apply to proposed private roads as well as proposed County and public roads.

Approved by the Commissioners Court of Washington County, Texas, this 31 day of March, 2026.

John Durrenberger
County Judge

Misti Corn
Commissioner, Pct. 1

Candice Bullock
Commissioner, Pct. 2

Kirk Hanath
Commissioner, Pct. 3

Dustin Majewski
Commissioner, Pct. 4

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Section 1 – General Provisions

1.01 Authority

These design standards are adopted under the authority of the Constitution and laws of the State of Texas, including particularly:

1. Texas Local Government Code
    a. **Chapter 232, County Regulations of Subdivisions**
    b. **Chapter 242, Authority of Municipality and County to Regulate Subdivisions In and Outside Municipality's Extraterritorial Jurisdiction**
    c. **Chapter 245, Issuance of Local Permits**
2. Texas Transportation Code
    a. **Chapter 251, General County Authority Relating to Roads and Bridges**
    b. **Chapter 252, Systems of County Road Administration**
    c. **Chapter 253, County Improvements of Subdivision Roads**
    d. **Chapter 254, Drainage on Public Roads**
    e. **Chapter 255, County Regulation of Sight Distances**

1.02 Purpose

It is the intent of these general Design and Construction Guidelines of Washington County, Texas, to state the requirements for subdividers, developers, engineers, surveyors, realtors, and other persons interested and involved in the development of land. Furthermore, it is the intent, purpose, and scope of these Design and Construction Standards to promote and protect the health, safety, and general welfare of the public.

Presented herewith are the general requirements of the Engineering and Development Services Department for designing drainage facilities, paving, water lines, and wastewater lines within Washington County. These requirements are the standards to inform the design engineers and contractors performing work in Washington County of the Department's policies and procedures. In no way does the following information provide all answers to design and construction questions or situations; however, it does provide a means to initiate the design and construction of facilities in the manner utilized by the Washington County Engineering and Development Services Department.

The design of any public utility or paving must be approved by the respective Utility Provider and/or the County Engineer prior to construction authorization. The construction of all public utilities and street paving shall be approved by the respective Utility Provider and/or the County Engineer before final acceptance and maintenance.

1.03 Control of Work

Many new road, drainage and utility construction projects within Washington County are performed by commercial and residential property developers. These constructed roadway, drainage and utility networks are intended to be conveyed to the County at the time of acceptance and turned over to the County for operation and maintenance. These facilities frequently represent significant additions to Washington County's maintenance and operational responsibilities. The establishment of adequate quality control procedures for these types of projects is extremely important because the County is not able to exercise day-to-day control of the work.

1. Authority and Duties of Engineer of Record

The Engineer of Record shall provide for inspection, sampling and testing necessary for day-to-day job control. The Engineer of Record or their representative shall inspect all work performed and all materials furnished to the project and bring any deficiencies in work or materials to the attention of both the Contractor and the County. The Engineer of Record shall see that all sampling and testing required by specifications or job site conditions are performed by an independent Material Testing Laboratory. The Engineer of Record shall also issue a letter of certification, at the completion of the work, acknowledging that the project was constructed in accordance with County approved plans, specifications, and special provisions.

2. Authority of Washington County Engineering and Development Services Department

The Engineering and Development Services Department representative will decide all questions which may arise as to the quality or acceptability of materials furnished and work performed, the manner of performance, the interpretation of the County's construction requirements, and the acceptable fulfillment of the Developer/Contractor's obligations.

3. Authority and Duties of County Inspector

County inspectors will be authorized to inspect the work done and all materials furnished. A County Inspector will be assigned to the work by the County Engineering and Development Services Department and will report to the County as to the progress of the work and the manner in which it is being performed, also to report whenever it appears that the material furnished and the work performed by the Developer/Contractor fail to fulfill the requirements of the specifications and to call attention of the Contractor to any such failure or other infringement. Such inspection will not relieve the Developer/Contractor from any obligations to perform the work in accordance with the requirements of the specifications. In case of any dispute arising between the Developer/Contractor and the County Inspector as to materials furnished or the manner of performing the work, the Inspector will have the authority to reject materials or suspend work until the question at issue can be referred to and decided by the Engineering and Development Services Department. The County Inspector will not be authorized to approve or accept any portion of work. They will in no case act as foreman or perform other duties for the Developer/Contractor. The place, frequency and thoroughness of inspection will vary depending of the construction activity and the quality of work exhibited by the construction organization. The presence of a County Inspector does not relieve the Engineer of Record of their inspection responsibilities.

4. Cooperation of Contractor

The Contractor shall give the work his constant attention to facilitate the progress thereof and shall cooperate with the County and the Engineer of Record in every way possible. The Contractor shall have at all times a satisfactory and competent superintendent on the work site.

1.04 Control of Materials

1. Quality of Materials

All materials shall be new and of a quality conforming to the requirements of these specifications. Whenever the quality or kind of materials is not particularly specified, the materials shall be of the best grade in quality and workmanship obtainable in the market from firms of established good reputation.

2. Samples and Test

All properly installed materials, before being incorporated in the work, shall be inspected, tested, and approved. Subject to the approval of the Engineering and Development Services Department, pre-tested sampling and testing will be provided at the developer's expense, by a materials-testing firm approved by the Engineering and Development Services Department. All tests of materials shall be made in accordance with the County specifications and recognized practices.

3. Storage of Materials

Materials shall be stored and protected in accordance with manufacturer's recommendations to insure the preservation of their quality and fitness for the work.

4. Defective Materials

All materials which do not conform to the requirements of the County specifications shall be considered as defective, and all such materials, whether in place or not, shall be rejected and immediately be removed from the site of work, unless otherwise permitted by the Engineering and Development Services Department. Rejected materials, the defects of which have been subsequently corrected, shall have the status of new materials, as approved by the Engineering and Development Services Department.

5. Hauling of Materials

Any vehicle, truck, truck-tractor, trailer or semi-trailer or combination of such vehicles, when used to deliver materials to a project shall comply with the State and County laws concerning gross weight and load limits. Special haul routes for construction traffic may be designated by the Engineering and Development Services Department within the unincorporated portions of Washington County. The Developer/Contractor is responsible for the protection of all existing roads and small structures traveled by his material haulers. Any damage by the use of construction equipment shall be restored to its original condition or replaced at the Contractors/Developers sole expense.

1.05 Legal Relations and Responsibilities to the Public

1. Laws to be observed

The Developer/Contractor shall make themselves familiar with and at all times shall observe and comply with all Federal, State, and Local laws, ordinances, and regulations which in any manner affect the conduct of the work and shall indemnify and save harmless the County and its representatives against any claim arising from the violation of any such law, ordinance, or regulations, whether by himself or by his employees.

2. Permits, Licenses, and Taxes

The Developer/Contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work.

3. Sanitary Provisions

The Developer/Contractor shall, at their entire expense, provide and maintain in neat, sanitary conditions such accommodations for the use of his employees as necessary to comply with the requirements and regulations of the State Department of Health or of other authorities having jurisdiction.

4. Public Safety and Convenience

The safety of the public and the convenience of traffic shall be of primary importance. Unless approval has been given by the Engineering and Development Services Department, all portions of a roadway shall be kept open to traffic. It shall be the Contractor's entire responsibility to maintain and/or provide ingress and egress to adjacent private property. The Contractor shall plan and execute their operations in a manner that will cause minimum interference with traffic. The Contractor shall secure the Engineering and Development Services Department's approval of their proposed plan of operation, sequence of work, and methods of providing for the safe passage of traffic before it is placed into operation. If at any time during construction, the approved plan does not accomplish the intended purpose due to weather or other conditions affecting the safe handling of traffic, the Contractor shall immediately make necessary changes therein to correct the unsatisfactory conditions. All equipment and materials shall be stored in such a manner and at such locations so as not to interfere with the safe passage of traffic. If in the opinion of the Engineering and Development Services Department the above

requirements are not complied with, the Engineering and Development Services Department may direct such work as he may consider necessary, however, this shall not change the legal responsibilities. The expense for such work performed by the County will be borne by the Developer/Contractor.

5. Barricades and Danger, Warning, Detour Signs, and Traffic Handling

The Contractor shall have the sole responsibility for providing, installing, moving, replacing, maintaining, cleaning, and removing upon completion of the work all barricades, warning signs, barriers, cones, lights, signals, and other such type devices, and the handling of traffic. All barricades, warning signs, barriers, cones, lights, signals, and other such type devices shall conform to the Texas Manual of Uniform Traffic Control Devices for Streets and Highways, as amended.

6. Protection of Property

The Developer/Contractor shall take proper measures to protect private and public property which might be injured or damaged by any process of construction; and in case of any injury or damage resulting from any act or omission on the part of or on behalf of the Developer/Contractor, they shall restore, at their own expense, the damaged property to a condition equal to or better to that existing before such injury or damage was done, or they shall make good such injury or damage in an acceptable manner.

7. Responsibility for Damage Claims

The Developer/Contractor agrees to indemnify and be responsible for all damages or injury to property of any character occurring during the prosecution of the work resulting from any act, omission, neglect, or misconduct on his or his agents part in the manner or method of executing the work; or from failure to properly execute the work; or from defective work or materials. The Developer/Contractor's attention is directed to the fact that the location of pipelines and other underground installations are not always exact. The Developer/Contractor shall save and hold harmless the County from any and all claims resulting from these responsibilities.

Section 2 - General Design Procedures

2.01 Preliminary Research Requirements

Step one in the Preliminary Research Process is to contact all applicable County offices and discuss concepts outlining what is to be proposed and its usage. Depending on the location and size of development, the initial contact may be handled by phone or a meeting at the Engineering and Development Services Department. The Developer/Engineer should verify that no restrictions are existing that will deny the approval of the concept. The Developer/Engineer should research all existing utilities and right-of-way and easement information with the ETJ Authority (Respective City), State, County and other authorities whose approval will be necessary for the proper use of the development. The Developer/Engineer shall research all laws, ordinances, rules and regulations that may pertain to the development.

2.02 Preliminary Design Requirements

The Developer/Engineer shall provide the Engineering and Development Services Department with all maps, plans, and calculations to support the proposed design. These exhibits will not be considered unless they have been prepared under the direction of a Licensed Professional Engineer in the State of Texas. Sealed final plans by the Engineer of Record are required. All developments shall follow proper filing procedures through the County and comply with current regulations. A preliminary report proposing processes, methods or procedures not covered by these Design Standards or a request for an exception to any portion of the Design Guidelines, shall be submitted during preliminary design. Concurrence, at this point, between the Developer/Engineer and the Engineering and Development Services Department regarding the essential design data is desired to eliminate delay or inconvenience and to avoid the likelihood of having to re-design the detailed final plans.

2.03 Final Design Requirements

Final design requirements involve the review of detailed construction drawings to ensure that all proposed facilities are designed in accordance with all applicable regulations. All plans and specifications submitted for final review must be sealed and dated by a Licensed Professional Engineer in the State of Texas. Developer/Engineer shall submit adequate, complete plans for feasibility, preliminary and final review to the Washington County Engineer. Planning material submitted shall in all instances be in such detail as to permit a comprehensive review.

2.04 Plan Submittal Requirements

The following is a guideline of requirements for plan submittals to Washington County; plans shall be submitted digitally in pdf form:

1. Single pdf of the complete construction plans as described in **Section 3.02**
2. Accompanying documents:
    a. TxDOT approvals for driveway and drainage into their jurisdiction (if applicable);
    b. Pipeline company approvals on pipeline letterhead (if applicable);
    c. Engineer's Cost Estimate;
    d. An Engineer's Summary Letter shall be submitted outlining the nature of the project and any requests for the use of any deviations from the design standards with justification for such applications.
    e. Traffic Impact Assessment (if applicable)

2.05 Final Plan Approval

Approval from all governmental agencies, all utility providers, and applicable City with ETJ Authority must be obtained prior to final plan approval. All developments shall conform to the Washington County's current regulations. All easements and rights-of-way required for the construction of a proposed project must be accepted and approved by all applicable governing entities, and filed for record with Washington County.

2.06 "As Built" Requirements

When the work provided for in the approved plans and specifications has been satisfactorily completed, "As Built" plans will be required to replace the approved plans that are on file at the Washington County Engineering and Development Services Department office. These plans shall be labeled "As Built" and certified and dated by the Contractor.

Contractor As-Built Set Certification:

I, _____, General Contractor for _____, certify that the improvements shown on this sheet were actually built, and that said improvements are shown substantially hereon. I hereby certify that to the best of my knowledge, that the materials of construction and sizes of manufactured items, if any, are stated correctly hereon. _____ (General Contractor)

Engineer As-Built Drainage Certification:

"I hereby attest that I am familiar with the approved drainage plan and associated construction drawings and, furthermore, attest that the drainage facilities have been constructed in accordance with the Washington County Design Standards and in accordance with the approved construction plans or amendments thereto approved by Washington County Engineering and Development Services. Furthermore, we attest that any public or private detention pond constructed with the project is built within dimensional tolerances specified in the Washington County Design Standards and in accordance with the approved construction plan or amendments thereto."

_____

Licensed Professional Engineer

State of Texas No._____

An electronic set of the final as-built plans will be required to be submitted to the Washington County Engineering and Development Services office for future reference. All public facilities shall be shown to be located within public rights-of-ways or appropriate easement.

Section 3 - General Design and Plan Requirements

3.01 Survey Requirements

The following guidelines are suggested for use by Engineers in the development of plans. The intention of these requirements is to provide all the evidence available for the proper location of improvements within functional and legal boundaries. All survey activity shall be performed under the direction of a qualified professional and in accordance with **Texas Society of Professional Surveyors Manual of Practice** and **TxDOT Survey Manual.**

1. Field Work Required for Plans Field Work Required for plans

The transit or base line shall be monumented at its beginning, end, and at all angle points with markers of a permanent nature. Monuments shall be set on long lines at intervals not to exceed 1000 feet.

The existing right-of-way monuments or property corners that are found must be plainly shown on the plans and located by station and distance, “Right” or “Left” from the transit line or construction center line. Those monuments that were used to determine the construction center line, must be identified as “control points”, and their relationship to the construction center line and to proposed or existing right-of-way lines must also be shown.

NAVD 88 vertical datum must be used for elevations, and the complete numerical designation of the monuments must be identified on the plans, as well as the year of the datum of the monuments must also be identified on the plans. NAD 83 horizontal datum must be used on all projects.

Plans must show centerline angles of intersections of side roads with the main roadway and the centerline station on the main roadway. Where bearings are used, care should be taken so that bearings are shown on both base line and constructions center line. The source of the bearings shall be clearly stated.

All topographic features within the right-of-way must be shown. The topography on intersecting roads shall be shown twenty feet beyond the intersection of the right-of-way lines.

Where plans identify proposed utility lines, the location of manholes, service connections, angle points, valves, fire hydrants, bends, etc. must be identified by station and distance from transit or base-line with relationship to the right-of-way lines.

All existing pipelines, utilities, and other features that may conflict with design shall be field verified for actual location.

All cross sections taken will be made at intervals not to exceed 50 feet. Elevation shots shall be taken on the centerline of all driveways at approximately the existing or proposed right-of-way line.

2. Right-of-Way Maps

All maps shall be sealed, dated and signed by a Texas Registered Professional Land Surveyor.

3.02 Construction Plan Set Requirements

1. All construction plan sets shall consist of the following sheets, if applicable:
    a. Cover sheet with vicinity map, sheet index, signature block and preconstruction meeting note.
    b. Construction and or general notes;
    c. Overall project or site plan layout sheet;
    d. Topographic survey sheet(s);
    e. Final Plat;
    f. Typical Road Sections;
    g. Road Plan & Profiles (w/horizontal and vertical curve data);
    h. Paving Plan;

i. Striping and Signage Plans;
j. Traffic Control Plan;
k. Overall Drainage and Grading Plan Layout;
l. Culvert Plan and Profiles;
m. Stormwater Pollution Prevention Plan;
n. Utility Layouts, if applicable;
o. Utility Plan and Profiles (water, sanitary, storm, gas), if applicable;
p. Detail Sheets;
q. Specialty Sheets as needed; and
r. All plans shall show a Project Benchmark.

3.03 Graphic Requirements

1. All plans shall be prepared using AutoCAD. Plans shall be prepared on a standard sheet size of 24”x36”.
2. The seal, date, and original signature of a Licensed Professional Engineer in the State of Texas are required on each sheet.
3. Name, address, telephone number and email address of the Engineer of Record or firm responsible for the preparation of the plans.
4. County boundaries, city limits, and subdivision section and/or phase boundaries.
5. A cover sheet shall be required for all projects involving three or more sheets. All plan sheet numbers should be included on the cover sheet or area key map. A vicinity map should always be included to show the project location. For Public projects, add the note:

   “A PRECONSTRUCTION MEETING WITH WASHINGTON COUNTY ENGINEERING AND DEVELOPMENT SERVICES DEPARTMENT IS REQUIRED AT LEAST FIVE (5) WORKING DAYS PRIOR TO ON SITE CONSTRUCTION ACTIVITIES. CALL (979) 277-6275 FOR A MEETING DATE AND TIME. A PRE-CONSTRUCTION MEETING FOR THIS PROJECT MAY NOT BE SCHEDULED AND CONSTRUCTION OF THE PROJECT MAY NOT COMMENCE PRIOR TO WRITTEN APPROVAL OF THESE PLANS BY THE WASHINGTON COUNTY ENGINEERING AND DEVELOPMENT SERVICES DEPARTMENT.”
6. Key overall layouts may be drawn at a scale of 1” = 100’. Major thoroughfares or special intersections/situations plan and profile should be drawn at a scale of 1” = 2’ vertical; 1” = 20’ horizontal and plan. Local roads and easements plan and profile should be drawn at a scale of 1” = 5’ vertical; 1” = 50’ horizontal and plan, or 1” = 4’ vertical; 1” = 40’ horizontal and plan.
7. Details of special structures and standard details, such as stream and gully crossings, special manholes, etc., should be drawn with the vertical and horizontal scales equal to each other.
8. Temporary benchmarks and project datum shall be described on each sheet.
9. The construction plans shall indicate the location of the 100-year floodplain (as determined by the results of an engineering study or as established by FEMA if available).
10. A benchmark shall be established and indicated on the construction plans. The location, description and elevation of the benchmark are required to be identified within the construction plans. The elevation of this benchmark shall utilize the same vertical datum as that used in the engineering study or FEMA as applicable.
11. Label each plan sheet with road names, road widths, right-of-way widths, pavement width and thickness, type of roadway materials, curbs, intersection radii, curve data, stationing, existing utilities type, location, etc.

12. Stationing must run from left to right, except for short roads or lines originating from a major intersection where the full length can be shown on one single plan and profile sheet.
13. A north arrow is required on all sheets and should be oriented either upward or to the right. It is the intent of this requirement that all stationing should start from cardinal points of the compass and proceed in the direction of construction.
14. Show all lot lines, property lines, right-or-way lines, and easement lines.
15. If a roadway exists where plans are being proposed to improve or construct new pavement or to construct a utility, this roadway should be labeled as to its existing width, type of surface, and base thickness.
16. All utility lines within the right-of-way or construction area should be shown in the profile view. All utility lines, regardless of size, should be shown in the plan view.
17. Show flow line elevations and direction of flow of all existing ditches.
18. Show natural ground profiles and proposed ditch flowline at each ditch centerline.
19. The diameter and length for each culvert shall be labeled on the construction plans. A plan and profile for each culvert shall be provided.
20. Resolve all construction conflicts of proposed utilities and facilities with existing or future utilities or facilities.
21. If the roads within the subdivision will be private, a sign shall be placed at the entrance of the subdivision clearly stating that the roads in the subdivision are privately maintained roads. The location of this sign shall be shown on the construction plans.
22. All road alignments shall be shown on plans. Plans shall be drawn to accurate scale, showing proposed pavement typical cross section and details, lines and grades, and all existing topography within the road right-of-way; and at intersections, the cross road shall be shown at sufficient distance in each direction along the cross road for designing adequate road crossings.
23. Centerline grades are acceptable for paving without curbs and gutters. Curb return elevation for deceleration/acceleration lanes shall show in the profile. Grades should be labeled for the top of the curb.
24. Centerline length of each road in the proposed subdivision and its design speed shall be indicated on the construction plans.
25. The surface elevation at the property line of all existing driveways should be shown in the profile.
26. The design of both roadways is required on all pavement sections with a median. Station all median noses, both existing and proposed.
27. Station all P.C.'s, P.T.'s, radius returns, and grade change P.I.'s in the profile with their respective elevations.

3.04 General Utility Locations

All other utilities; electric, gas, communications, and cable TV should be located in perimeter lot easements and back-to-back lot easements wherever possible. These utilities shall not be located in a public right-of-way or a specified easement, prohibiting its use, without the approval of the Washington County Engineering and Development Services Department. The locations of these utilities within general utility easements shall be in accordance with the guidelines stated below.

For all new developments that have less than one-hundred (100) feet of right-of-way, all utilities shall be installed within a public utility easement located outside of the dedicated right-of-way.

If approved by the County Engineer, utilities in all new developments that have 100 feet or greater of right of way shall be installed within designated locations based upon the type of utility. The location shall be as follows: (measured from back of right-of-way, and accommodated within the right-of-way).

- Power – 0-2 feet, nominally 1'
- Phone/Cable/Internet/Fiber – 2-4 feet, nominally 3'
- Gas – 4-6 feet, nominally 5'

3.05 Easement Requirements

Easements shall be provided for all drainage and utilities per the easement requirements outlined in the most current **Washington County Subdivision Regulations, Section 6.**

1. Slope Easements

   In the case where a road is constructed with significant cut or fill wherein the required slope or safety end treatments extends beyond the dedicated right-of-way then a slope easement shall be required. This slope easement shall span from the right-of-way to a minimum of two (2) feet past the ditch. Fencing and other structures shall not be permitted within the slope easement.

Section 4 - Road Design (Pavements and Geometrics)

4.01 General

Standards established by Washington County for the design and construction of its roads shall provide for pavements with long service life and low maintenance. Excess maintenance of inadequate pavements is an unnecessary drain on tax dollars. An investment in adequately designed and constructed roads needing little maintenance over a long service life frees more dollars for capital improvements necessary to serve the community.

Pavements are designed for both economy and long service. The Engineer of Record shall take into consideration the road classification and traffic which will include the axle weights and volumes, thickness design, surface material quality, base material quality, sub-grade material quality, geometric design, and jointing.

Standards of this publication shall be considered minimum for any specific location and the Engineer of Record should base his design upon the actual conditions which exist within the development under consideration for design.

Provisions must be made for the uninterrupted extension of main thoroughfares. In the case of disagreement between the plans, the County Engineer shall provide clarification. Roads must provide for free circulation within developments and interconnectivity to adjacent developments.

4.02 County Engineer Review Authority

The County Engineer will review all plans for construction or upgrading of roads in the County Road System to include, but not limited to:

1. New construction
2. Staged development of roadways (overlays)
3. Roadway widening
4. Appurtenant roadway improvements such as storm drains and curb and gutter
5. Encroachments

To be eligible for acceptance into the County Road System, a road must be designed and constructed in accordance with these standards and approved by the County Engineer. In general, roadways should be designed for the anticipated traffic volume twenty (20) years from the proposed date of construction. Special conditions such as long-range planning studies, industrial parks, proposed interstate facilities, etc. should be considered in the design.

4.03 Roadway Design Standards

1. Design Standards

Design standards, unless specifically identified, shall be standards that are found in common usage by the Texas Department of Transportation. Design guidelines shall conform to the formulae, principles, and guidelines set forth in A Policy on Geometric Design of Highways and Streets, latest edition, as developed by the American Association of State Highway and Transportation Officials (AASHTO). All references to "mountainous terrain" shall not apply to the County.

Roadway Classifications

Roadways shall be classified based on the criteria established in A Policy on Geometric Design of Highways and Streets. For the purposes of these Regulations, roadways shall be designed to handle the average daily traffic (ADT) estimated to occur for a period of twenty (20) years following completion

of construction of the roadway, with the pavement sections and widths required to accommodate the design ADT at the applicable speed limits adopted by the County.

At a minimum, pavement sections and widths shall conform to the suggested minimum requirements established by AASHTO for the specified classification of roadway or to those shown in Table 1 for the specified classification of roadway.

i. Major Arterials provide a high degree of mobility by serving travel between major destinations or activity centers, as well as long distance travel that goes through or bypasses an area. They are designed to minimize travel time by providing high posted speed limit, offering physical separation from other roadways and limiting access points. Major Arterials shall meet the following requirements.

   (1) In order to promote the movement of traffic on arterial roads, the spacing of signalized road intersections on major roads shall not be less than 2,600-feet unless approved by the Commissioners Court. In general, the spacing of road intersections along an arterial shall not be less than 1,300-feet, unless sight -distance or topography dictates a lesser road spacing. Medians may be required along major roads where intersection spacing is less than 1,300-feet, or driveway spacing is less than 200- feet. Median breaks shall be located at intersections with arterials, collectors, industrial roads, and driveways to major traffic generators.

   (2) Required right-of-way and pavement widths shall be Washington County regulations or based on projected traffic volumes and road capacity as detailed in a traffic study prepared by a qualified traffic engineer, or as shown on Table 1. All rights-of-way and pavement width shall be approved by the Commissioners Court.

   (3) Geometric design shall conform to the formulas, principals, and guidelines of A Policy on Geometric Design of Highways and Streets. All elements including geometric layouts and cross-sections shall be approved by the County Engineer on a case by case basis.

ii. Minor Arterials are intended to connect traffic into and between the principal arterial system and serve trips of moderate length by connecting smaller geographic areas. While they provide slightly less mobility than Major Arterials, overall they are characterized by relatively high travel speeds and low interference from cross traffic. Minor Arterials shall be extended to adjacent undeveloped property as approved by the Commissioners Court upon consideration of future circulation needs of the area.

iii. Collectors provide a balance between mobility and access, primarily serving to collect traffic from local roads and provide connections to Arterials. Collectors usually serve moderate traffic volumes. There are typically few discernible differences between collectors and local roads within a neighborhood because they provide access to adjacent residential and nonresidential lots. Collectors should be designed with the most favorable alignment and cross section practical. Collectors shall be extended to adjacent undeveloped property as approved by the Commissioners Court upon consideration of future circulation roads of the area.

iv. Local roads are any public road not designated as a major thoroughfare, freeway, or highway and not situated within the existing and/or planned pattern of roads in a manner to cause it to function as a collector. A local road should provide access to adjacent land over short distances. A local road primarily serves traffic within a neighborhood or limited residential district and is not continuous through several residential districts. The layout of residential roads shall consider the natural topography and deliberately discourage through traffic in neighborhoods. Local roads make up the bulk of the transportation system in terms of mileage. The Commissioners Court may require that residential roads be stubbed out to adjacent

undeveloped property in order to provide adequate circulation to adjacent tracts and ensure emergency ingress/egress.

v. Urban and Rural Subdivisions shall be as defined in **Section 5 of the Washington County Subdivision and Development Regulations.**

2. Design Requirements

Table 1 below summarizes roadway design requirements based on the roadway classification.

Table 1 – Summary of Washington County Roadway Design Standards

SUMMARY OF WASHINGTON COUNTY ROADWAY DESIGN STANDARDS					
Average Daily Traffic (one-way trips)	0-1,200	0-1,200	1,201-3,000	3,001-15,000	>15,000
Functional Classification	Local Road Rural Subdivision	Local Road Urban Subdivision	Collector	Minor Arterial	Major Arterial
Design Speed*	30 mph	30 mph	30 mph	45 mph	All elements including geometric layout and cross-section approved by the County Engineer on a case-by-case basis. No requirement shall be less stringent than requirement of minor arterial.
Number of Lanes	2	2	2	4	
Minimum ROW Width	60’	60’	80’	100’	
Width of Travel Lanes	11’	14’	12’	12’	
Width of Shoulders	N/A	N/A	3’ Paved	4’ Paved	
Minimum Centerline Radius	300’	300’	465’	940’	
Minimum Radius for EOP at Intersections	25'	25’	30’	35’	
Intersection Angle	75-105	75-105	75-105	80-100	
Minimum Grade	0.5%	0.5%	0.5%	0.5%	
Maximum Grade	10%	10%	6%	5%	
Minimum Stopping Sight Distance	200’	200’	250’	360’	
Minimum Intersection Sight Distance	Refer to the latest edition of AASHTO’s “Geometric Design of Highways and Streets”				
Ditch Front Slope	4:1 Max	4:1 Max	4:1 Max	6:1	
Ditch Back Slope	3:1 Max	3:1 Max	3:1 Max	6:1	
Min. Driveway Spacing (Approach Side)	25’	25’	75’	100’	

Min. Driveway Spacing (Departure Side)	25’	25’	50’	75’	
Minimum Cul-De-Sac ROW Radius	60’	60’	N/A	N/A	N/A
Minimum Cul-De-Sac Pavement Radius	45’	45’	N/A	N/A	N/A
Minimum Height Clearance	16’	16’	16’	20’	20’
Notes:					
Occasional short runs between intersections may exceed the amounts shown with County Engineer Approval, but maximum grade through intersections may not exceed grades shown.					
The entire side ditch shall be totally contained within the roadway ROW.					
Driveway spacing shall be measured from closest edge of driveway to edge of pavement.					
* Speed Limits may be altered from design speed where irregular geometric, pedestrian and/or other factors apply.					

a. Road Grades

i. Minimum cross slope grade of normally crowned roadways shall be 2% with a maximum slope of 3%.

ii. Approach grades on an intersecting road should be limited to 3% for at least fifty (50) feet unless sight distances are in excess of the AASHTO design guideline minimum for stopping on a grade level, in which case the approach grades should not be greater than those shown in Table 1.

b. Roadside Drainage

i. Roadside Design Details

(1) Roadside design details shall include rock riprap, safety end treatments for culverts, special design roadside ditches, retaining walls, etc.

(2) Rock riprap shall be used to control the erosive characteristics of drainage in roadside ditches. The rock riprap shall be designed to reduce drainage water velocity to an acceptable level and to prevent drainage water from encroaching on the driving surface. Rock riprap shall not project onto shoulder surfaces and shall blend into ditch lines so that normal roadside ditch maintenance is possible.

(3) Headwalls, catch basins or other culvert structures shall be designed in accordance with the drainage requirements of these specifications using TxDOT’s Typical Construction Details. No headwall, wing-wall or other structural member shall protrude above the surface of the traveled roadway. Safety End Treatments shall comply with TxDOT standard safety end treatment details.

(4) All special design of roadside ditches, retaining wall, etc., requires the specific approval of the County.

(5) Intersections of Curbed Streets/Driveways with Uncurbed Roads Curbed to uncurbed street/driveway intersections shall be designed with appropriate concern for the interfacing of the differing drainage systems.

(a) Where a curbed street/driveway intersects a continuing uncurbed street, standard curb and gutter shall terminate at the property line or as necessary to allow drainage from the curbed street/driveway to enter the uncurbed street bar ditch without erosion to shoulder areas. Concrete riprap or mortared rock riprap may be required to protect the shoulder area.

(b) Where an uncurbed street intersects a continuing curbed street, the curb line shall be cut and removed and a standard urban curb return shall be designed into the uncurbed street with the curb face at the ditch centerline of the uncurbed street. A concrete riprap transition shall be constructed to convey drainage out of or into the uncurbed ditch line.

(c) Care shall be taken in the installation to match existing pavement. Curbed street crown will be full crown (unless cross spilling) to at least fifty (50) feet from curb end to assure flow of drainage enters bar ditch.

c. Road Design Characteristics

i. Design Speed

Design speeds are shown in Table 1. by roadway classification for use with the design guidelines.

A proposed speed may be submitted to the County Engineer where unique roadway characteristics are present.

ii. Vertical Alignment

(1) Changes in grades of over 0.8% shall be connected by vertical curves.

(2) Vertical Curves

Minimum length (L) of vertical curves shall be one hundred (100) feet or shall conform to the formula:

L = KA , whichever is greater

where A is the algebraic difference in the tangent approach grades expressed as a whole number, and K is established in accordance with AASHTO's A Policy on Geometric Design of Highways and Streets, for sag and crest vertical curves, with credit given to the use of proper street lighting.

(3) Special consideration shall be given to streets where the horizontal alignment, overhead obstructions, or the presence of cross traffic or other natural or man-made conditions exist such that stopping sight distance would become the controlling parameter as it relates to the determination of a minimum length of vertical curve.

iii. Horizontal Alignment

(1) Minimum centerline radii and minimum tangents between reverse curves are shown in Table 1.

(2) Increased radius may be required where the street grades, street cuts, or other natural or man-made obstacles limit stopping sight distance on the curve to below that required by the design speed.

(3) Superelevation may be used to control surface drainage and centrifugal forces, but not to reduce the minimum centerline radius.

(4) Superelevation of roadways will only be required for Collector and Arterial type roadways requiring design speeds of forty (40) mph or greater. It will not be required for other roadway classifications unless otherwise directed by County Engineer.

(5) Design for horizontal curves including stopping sight distance and superelevation shall conform to the formula, principles, and guidelines of AASHTO's A Policy on Geometric Design of Highways and Streets.

iv. Islands

Natural or planted islands may not be used in the center of cul-de-sacs on urban and rural subdivisions.

v. Cul-De-Sacs and Dead-End Streets

All permanent dead-end streets are to terminate in a paved turnaround with a minimum paved radius and right-of-way radius as shown in Table 1.

vi. Intersections

(1) The centerlines of no more than two (2) streets shall intersect at any one (1) point. All angles and distances are measure relative to the intersection of the roadway centerlines.

(2) All intersecting roads should intersect at 90-degree angles. Where this is not possible, an adjustment up to the angles shown in Table 1 may be allowed if the right-of-way area located on the acute angle side of the intersection is fully cleared of all trees, brush and other obstructions for a distance of at least twenty-five (25) feet from both intersecting roadways. A right-of-way corner clip shall be further provided on the acute angle side.

(3) Intersections within a horizontal curve are permitted provided that the intersecting road has a one hundred and fifty (150) feet minimum tangent at the intersection and the required corner sight distance is maintained. Whenever possible, the tangent of the intersecting road is to be radial to the curve but in no case will it be vary from radial more than the intersecting road angles shown in Table 1.

vii. Curb radius shall be in accordance with those shown in Table 1.

d. Secondary Ingress and Egress

i. Subdivisions containing more than 30 lots shall have a platted and constructed secondary ingress and egress to a public road. Multi-family developments of 100 dwelling units or more shall have a platted and constructed secondary ingress and egress to a public road.

a. When there are more than thirty (30), but less than fifty (50) lots to be served by external street connections, the Commissioner's Court may allow at their discretion an improved all weather remote emergency access where development phasing or constraints of the land prevent the provision of a second street connection.

ii. A minimum of one (1) external street connection shall not be located over a creek where the one-hundred (100) year floodplain overtops the road.

4.04 Pavement Design and Construction

1. Flexible Pavement and Pavement Design

Competent design of flexible pavements provides a system that is stable, durable and cost effective. The primary principle that forms the basis for flexible pavements is that the vehicular loads can be dissipated through successive layers of properly engineered materials. The success of such design is based upon:

a. an evaluation of the subgrade soil;

b. the relative load support value of pavement components; and

c. the magnitude and repetitions of traffic loads.

The pavement values outlined in Tables 2 and 3 below are minimum standards of pavement design.

Table 2 – Flexible Pavement Standards

FLEXIBLE PAVEMENTS - HMAC			
STREET CLASSIFICATION	MINIMUM SUBGRADE TREAMENT	MINIMUM BASE MATERIAL	SURFACE TREATMENT
LOCAL ROAD	6” Subgrade Layer	6” Base Layer	2” HMAC
COLLECTOR	8” Subgrade Layer	8” Base Layer	2.5” HMAC
MINOR ARTERIAL	10” Subgrade Layer	10” Base Layer	3” HMAC
MAJOR ARTERIAL	Design based upon geotechnical report, but not less than minor arterial minimum standards.		

Table 3 – Rigid Pavement Standards

RIGID PAVEMENTS - CONCRETE			
STREET CLASSIFICATION	MINIMUM SUBGRADE TREAMENT	CONCRETE PAVEMENT	REINFORCEMENT
LOCAL ROAD	6” Subgrade Layer	6”	#4 Bars @ 24” C-C (Both)
COLLECTOR	8” Subgrade Layer	7”	#4 Bars @ 18” C-C (Both)
MINOR ARTERIAL	8” Subgrade Layer	8”	#4 Bars @ 18” C-C (Both)
MAJOR ARTERIAL	Design based upon geotechnical report, but not less than minor arterial minimum standards.		

2. Pavement Structure

a. Clearing and Grubbing

i. Remove stumps, main root ball, and root system to a depth of eighteen (18) inches below finished subgrade elevation in area bounded by lines two (2) feet behind edge of pavement.

ii. Clear undergrowth and deadwood without disturbing subsoil.

iii. Remove top six (6) inches of top soil.

b. Subgrade

i. The subgrade shall extend one (1) foot past the edge of pavement.

ii. The preparation of the subgrade shall follow good engineering practices as directed by the County Engineer in conjunction with recommendations outlined in the geotechnical report that is conducted after clearing and grubbing of the site is complete. When the Plasticity Index (PI) is greater than fifteen (>15), a sufficient amount of lime shall be added as described in Item 260 of the current edition of the TxDOT Standard Specifications for Construction until the PI

is less than fifteen (<15). If the addition of lime as described in Item 260 is not feasible, an alternate stabilizing design shall be proposed and submitted to the County Engineer for approval. The subgrade shall be prepared and compacted to achieve a density per TxDOT Item 132. In addition, proof rolling shall be scheduled with the County Inspector prior to application of base and/or surface treatment.

iii. The subgrade shall be inspected and approved by an independent testing laboratory and a certified copy of all inspection reports furnished to the County Engineer, who must approve the report prior to application of the base material. All density test reports shall include a copy of the work sheet showing the percentage of the maximum dry (Proctor) density.

iv. All subgrades shall be compacted to ninety-five percent (95%) standard proctor density prior to installation of flexible base material. The maximum lift shall not exceed six (6) inches. Compaction shall be accomplished by use of mixing and rolling equipment and construction methods approved by the County Engineer.

v. Testing iteration shall be performed on each lift a maximum of every three hundred (300) linear feet of roadway. Testing shall be performed approximately five (5) feet from edge of subgrade. Edge of subgrade shall oscillate to other side of roadway every testing iteration.

c. Base Material

i. The base material shall extend one (1) foot past the edge of pavement.

ii. The base material shall conform to Item 247, Flexible Base, of the current edition of the TxDOT Standard Specifications for Construction. The base material shall be Type A Grade 1/2, or as approved by the County Engineer.

iii. Each lift of base course shall be tested for in-place density and measured for compacted thickness. Testing iteration shall be performed a maximum of three hundred (300) linear feet of roadway. Testing shall be performed approximately five (5) feet from edge of subgrade. Edge of subgrade shall oscillate to other side of roadway every testing iteration.

iv. The base shall be prepared and compacted to achieve a minimum of 95% of the maximum (proctor) dry density. The maximum lift shall not exceed six (6) inches. The base must be inspected and approved by an Independent Testing Laboratory and a certified copy of the test results furnished to the County Engineer for approval. Prior to the placement of the first lift of base, the stockpile shall be tested for the specifications found in Item 247 of the current edition of the TxDOT Standard Specifications for Construction and the result furnished to the County Engineer for approval.

d. Bituminous Material

i. Subdivision roads may utilize a wearing surface of HMAC Type D as shown in Table 2. The mix shall be from a TxDOT certified plant. The mix design shall be submitted to the County Engineer for approval prior to placement of the material. Contractor's Quality Control (CQC) test reports shall be submitted to the County Engineer on a daily basis. As a minimum, daily CQC testing on the produced mix shall include:

(1) Sieve Analysis TEX-200-F;

(2) Asphalt Content TEX-210-F;

ii. The number and location of all HMAC tests shall be determined by the County Engineer with a minimum of three (3), four-inch (4") diameter field cores secured and tested by the contractor from each day's paving. Each HMAC course shall be tested for in-place density, bituminous content and aggregate gradation, and shall be measured for compacted thickness. The number and location of all HMAC test samples shall be determined by the County inspector.

e. Concrete Pavement

i. In lieu of bituminous pavement, portland cement concrete pavement may be used. In such cases, the pavement thickness shall be as indicated in Table 3. The mix shall be from a TxDOT certified plant. The mix design shall be submitted to the County Engineer for approval prior to placement of the material.

ii. Minimum compressive strength shall be 2,400 pounds per square inch at 7 days and 3,500 pounds per square inch at 28 days.

iii. All reinforcing steel shall be a minimum Grade 60, ASTM A615 and shall be placed as indicated in Table 3.

iv. All concrete shall be tested for compressive strength in accordance with ASTM C31. One (1) set of three (3) concrete test cylinders shall be molded for every two hundred and fifty (250) cubic yards of concrete or less placed for each class of concrete per day, or at any other interval as determined by the County Engineer. A slump test shall be required with each set of test cylinders. One (1) cylinder shall be tested for compressive strength at an age of seven (7) days and the remaining two (2) cylinders shall be tested at twenty-eight (28) days of age.

v. If the average compressive strength of two consecutive specimens falls below the minimum strengths specified above, or if the compressive strength of any single specimen falls more than 500 psi below the minimum strengths specified above; the Engineer may require the following:

(1) Change in mix design for the remaining portion of the work.

(2) Additional curing of the affected concrete followed by cores taken in accordance with the latest editions of ASTM C42 and ACI 318, all at the expense of the Contractor.

(3) If additional curing does not bring two average compressive strength of three cores taken in the affected area to at least the minimum strength specified, the Engineer may require that the contractor strengthen the structure by means of additional concrete and steel or may require that the contractor replace the affected portions.

(4) The cost of all such changes in mix designs and any modifications to or replacement of deficient concrete shall be borne by the Developer or Contractor at no cost to the County.

f. Concrete – General

i. Unless otherwise specified, concrete shall be in accordance with Item 421, Hydraulic Cement Concrete and Item 360, Concrete Pavement, of the current edition of the TxDOT Standard Specifications for Construction and be placed in accordance with the applicable item.

ii. All reinforcement shall meet Item 440, Reinforcement for Concrete, of the current edition of the TxDOT Standard Specifications for Construction.

iii. All concrete shall be tested for compressive strength. One (1) set of three (3) concrete test cylinders shall be molded for every two hundred and fifty (250) cubic yards of concrete placed for each class of concrete per day, or at any other interval as determined by the County Engineer. A slump test shall be required with each set of test cylinders. One (1) cylinder shall be tested for compressive strength at an age of seven (7) days and the remaining two (2) cylinders shall be tested at twenty-eight (28) days of age.

4.05 Roadway Culverts

1. Capacity

Culverts crossing roadways shall be sized for the ten (10) year design storm or eighteen (18) inches (whichever is greater).

2. Velocity

Culverts crossing roadways shall have a design velocity of not less than 2.0 feet per second (fps) nor more than 8.0 feet per second (fps) utilizing ten (10) year design flow.

3. Materials

Acceptable material for culverts crossing roadways shall be reinforced concrete pipe or box (Class III or greater).

4.06 Major Structures and Bridges

1. Design of structures shall be designed by a Licensed Structural Engineer in the State of Texas. All structures shall be designed per TxDOT standards and shall conform to the TxDOT's Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, latest edition. Bridge design loading and widths for roads shall conform to TxDOT design, or as directed by the County. Structures of this nature require the specific approval of the County.

4.07 Construction Requirements

1. Preconstruction Meeting

A preconstruction meeting shall be scheduled prior to the start of construction. The Design Engineer, Owner, Contractor, Subcontractors, County Inspector and County Engineer shall attend this meeting.

2. Inspections

a. All elements of roadway and storm drain system construction must be inspected and approved by the Washington County Engineering and Development Services Department as a prerequisite for acceptance by Washington County. This will include, but is not limited to:

   i. Right-of-way surface and subgrade after clearing and grubbing;

   ii. Storm drain system, culverts and all related structures;

   iii. Detention/retention ponds;

   iv. Embankments;

   v. Utilities relocated within the structural zone;

   vi. Subgrade for roads;

   vii. Base course;

   viii. Asphalt paving/concrete paving forms;

   ix. Finished grade of road right-of-way; and

   x. Permanent vegetation establishment

b. It is the contractor's responsibility to ensure the County Engineering and Development Services Department is notified upon completion of each phase of construction and has the opportunity to make their inspections before proceeding to the next phase. It should be understood that the inspections conducted by the County are for the protection of Washington County only. They are not intended to certify the contractor's satisfactory discharge of his obligation to the owner, nor do they relieve the project engineer from any of their responsibilities with regard to inspection and contract administration.

3. General Instructions to Contractors

The following procedures for implementation of the County's inspections and final approval shall be followed. It is recommended that these instructions be included in the contract documents for the construction contract.

a. Applicability

As a prerequisite to County approval and acceptance of new streets, all phases of construction must be inspected and approved by the County Engineer's office. This applies to all subdivision streets constructed under the jurisdiction of Washington County Subdivision Regulations whether they are to be dedicated to Washington County or not.

b. Specifications

All construction and materials shall comply with the latest edition of the TxDOT Standard Specifications for Highway Construction unless specifically noted otherwise herein. These requirements and TxDOT specifications shall supersede the engineer's specifications in the event of a discrepancy.

c. Testing

The contractor is responsible for providing all geotechnical and materials testing and the accompanying documentation at no cost to the County.

i. All materials shall be sampled and tested by an independent testing laboratory in accordance with the construction documents approved by the County Engineer. The Owner shall pay for all testing services and shall furnish the County Engineer with certified copies of these test results. All testing is to be identified on forms as to the exact location (Street name, Sta. No.'s, lifts and elevation in regards to finished grade).

ii. The County Inspector must approve the test results prior to constructing the next course of the roadway pavement structure. Unless otherwise stated herein, the proctor densities required under these procedures are standard proctor densities.

iii. Any material which does not meet the minimum required test specifications shall be removed and recompacted or replaced unless alternative remedial action is approved in writing from the County Engineer.

d. Notifications

After receiving approval of street, storm drainage and sediment and erosion control plans, the contractor or engineer must contact the County Engineering and Development Services Department with a start date for construction at least forty-eight (48) hours in advance. Upon completion of site clearing and grubbing and erosion control installation, the preconstruction meeting shall be held.

e. Erosion Control

Before starting any grading work, install sediment and erosion control measures per the approved plans to protect any downstream water bodies. The contractor is responsible for implementation and weekly monitoring of the sediment and erosion control plan in accordance with TCEQ regulations in order to ensure that silt and sediment do not leave the site.

f. Inspections

Requests for any inspection must be arranged with the County Engineering and Development Services Department office twenty-four (24) hours in advance.

g. Other Regulations

The developer and contractor are also responsible for compliance with all applicable regulations administered by other agencies, such as:

i. **Texas Commission On Environmental Quality (TCEQ)**

ii. **U.S. Army Corps of Engineers**

iii. **Texas Department of Transportation (TxDot)**

iv. **City of Brenham**

The County Engineer's office may withhold approval at any stage of construction, including final approval, for failure to comply with these regulations.

4. Required Geotechnical Testing and County Inspections

a. Mandatory Initial Subgrade Surface Inspection

After clearing and rough grading of streets but prior to placement of any storm drain or fill for road way embankments, a mandatory subgrade surface inspection is required.

The developer, contractor, project engineer, geotechnical engineer, any utilities that may be working within a structural zone and the County Engineer's office should be present. This inspection shall be set up by the contractor or the project engineer.

A backhoe, excavator, skid steer or motor grader is needed for this inspection in order to confirm that all stumps, roots and unacceptable soils have been removed. A proof-roll may be conducted during this inspection at the discretion of the County Engineers' office or geotechnical engineer. All deficiencies identified during this inspection must be corrected by the contractor before the next inspection is requested. The consulting engineer or geotechnical engineer as well as the County Engineer's office and contractor should be represented. This inspection shall be set up by the contractor or the consulting engineer.

b. Underground Utilities

Except for electrical lines, all underground nonferrous utilities within a right-of-way or easement must be accompanied by ferrous metal lines to aid in tracing the location of said utilities through the use of a metal detector.

c. Detention/Retention Ponds

Such areas to be considered Structural Zones. Pond dikes are to be constructed with fill approved by and signed off on by the geotechnical engineer; absolutely No Organics are permitted in dikes. Fill material is to be tested every foot (1-FT) in elevation and every one hundred (100) linear feet, with a minimum of two (2) tests per lift. Trenches through a pond dike are to be considered a Structural Zone and should be tested accordingly. All fill must be compacted to at least ninety percent (90%) of maximum proctor density.

d. Trenching and Backfilling

Storm drain or utility trench bedding and backfill must be a county approved material, be visually inspected, and signed off on by the geotechnical inspector and a copy of the inspection must be sent the Washington County. The contractor shall notify the County Engineer's office when backfilling of storm drainage or utility excavations within a Structural Zone is to take place. Backfill in these excavations shall be cement stabilized sand. County Engineer is to be copied on all testing. If not properly notified, or if the test results are unsatisfactory, the County Engineer's office may require excavation and re-compaction of the backfill. No proof-roll of the subgrade will be scheduled until the cement stabilized backfill compaction and strength has been documented.

e. Erosion Control

Install sediment and erosion control measures around storm drain inlets as they are constructed. Sediment basins and detention ponds must be in place(s) at this time. All erosion control shall be in accordance with the approved Erosion Control Plan.

f. Storm Drain Boxes

All boxes must be backfilled with cement stabilized sand.

g. Embankments

All stumps and large roots must be removed from the roadbed prior to placement to fill for embankments regardless of fill height. All roadway embankment and embankment fill must be approved by and signed off on by the geotechnical engineer. Roadway embankment fill to placed and compacted in lifts not exceeding eight inches (8”). The contractor is responsible for providing geotechnical testing and documentation that the embankment material has been compacted to ninety-five percent (95%) of maximum proctor density. Density testing of embankment fills to be performed every foot (1-FT) of fill every two hundred and fifty (250) feet alternating lanes with a minimum of two (2) tests per road, per foot (1 FT) of fill. County Engineer’s office is to be copied on all testing. No proof-roll of the subgrade will be scheduled until the compaction has been documented.

h. Embankment Modifications

Any roadway embankment modifications (extra stone, soil, cement, lime treatment, geo grid, etc.) must be approved by the geotechnical engineer and the County Engineer notified of such modifications.

i. Curb and Gutter Proof-Roll

Curb and gutter must be placed on compacted and approved subgrade or base material. Prior to scheduling a curb and gutter proof-roll the County Engineer’s office must be in receipt of all density testing data required to be completed at this stage of construction. The geotechnical inspector, contractor, project engineer and County Engineer shall be present for the proof-roll.

j. Subgrade Proof-Roll

Prior to scheduling a subgrade proof-roll, the County Engineer’s office must be in receipt of all density testing data (subgrade should have been tested every two hundred and fifty (250) feet, alternating lanes testing to be completed on cut or fill), required to be completed at this stage of construction. It is the responsibility of the contractor to provide independent density verification prior to proof-rolling and at no cost to Washington County. After fine grading of subgrade, but prior to placing base material, the subgrade must be proof rolled with a loaded tandem axle dump truck or pan. The contractor shall schedule this inspection. The geotechnical engineer, County Engineer’s office and contractor shall be represented. The County Engineer’s office reserves the right to conduct or require additional testing at any time. The minimum acceptable subgrade density is ninety-five percent (95%) of maximum proctor density.

No base course material or curbs should be placed prior to written approval of the subgrade from the County Engineer’s office.

Any completed and approved subgrade left exposed for over two (2) weeks or damaged by inclement weather must be re-inspected and approved by the County Engineer’s office. This may include another proof-roll if necessary in the judgment of the County Engineer’s office.

Any excavation within a tested and county approved subgrade shall be treated as new excavation and complete density testing and proof-rolling requirements must be met.

k. Catch Basins

The location and orientation of the catch basins relative to the curb and gutter, as well as the roadway width, should be confirmed at this time. Catch basins improperly placed must be relocated and/or reconstructed. All catch basins must have a temporary drain by which standing water can be drained from the surface of the subgrade and base during construction. These drains must be properly plugged before the final inspection is required.

l. Base Course

Placement of base course material is only permitted on a County approved subgrade. Flexible Base course material meeting TxDOT Item 247 Specifications or other alternatives as approved by the County Engineer (cement stabilized, geo grid, etc.). All base course materials are to be density tested every three hundred (300) feet in alternating lanes with a minimum of two (2) tests on any road no matter the length. Thickness of base of course material must be verified at each density test location. It is the responsibility of the contactor to provide independent density verification at no cost to Washington County.

m. Graded Aggregate Base Course

If base course is thicker than eight-inches (8") it shall be placed and compacted in equal lifts. If base course is less than twelve–inches (<12") it can be tested (not placed) as one (1) lift. If base course is twelve-inches or greater (≥12") it must be placed, compacted and density tested in equal lifts. Example: thickness is twelve-inches (12"), place, compact and test at six-inches (6") and place, compact and test at twelve-inches (12").

n. Base Course Proof-roll

Prior to scheduling a Base Court Proof-Roll the County must be in receipt of all base course density testing and thickness verification reports. If the average base course thickness is found to be deficient by more than one-half inch (½") or any individual measurement deficient by more than one inch (>1"), the deficiency will be corrected by scarifying, adding base material, re-compacting and density testing. Upon completion of the curbing and base course, the contractor shall schedule an inspection to proof-roll the base with a loaded tandem axle dump truck. The geotechnical engineer, County Inspector and contractor shall be represented. The contractor will provide proctor and gradation information on the base material from an independent testing firm as well as verification that all applicable compaction and depth requirements have been satisfied.

Any completed and approved stone base left exposed for over one week or damage by inclement weather must be re-inspected and approved by the County Engineering and Development Services Department. This may include another proof-roll if necessary in the judgment of the County Inspector.

o. Asphalt Prime

Asphalt Prime meeting TxDOT Item 300 (generally MC-30, SS-1 or A-EP) must be placed in accordance with TxDOT Item 310 applied as directed with sprayer at the rate of 0.20 gallons minimum per square yard of surface. Prime shall be allowed to cure for five (5) to seven (7) days prior to placement of Hot Mix Surface.

p. Proof-Roll of Roadway Right-of-Way

Right-of-Way should be properly graded and compacted according to plans. All water is to drain away from the roadway. A proof-roll will be conducted by the County Inspector. Proof-Roll is to be scheduled by the contractor prior to grassing. Proof roll shall be performed by a loaded dump truck. A maximum of one-inch (1") deflection is permitted during this proof-roll.

5. Paving

a. Asphalt Requirements

Unless another type has been approved in advance, by the County Engineer for a specific project, hot mix asphalt pavements shall meet: TxDOT Item 340, Dense-Graded Hot-Mix Asphalt.

b. Coordination

After approval of asphalt prime application to the base course, there must be coordination between the paving contractor and the County inspector with regard to the schedule for paving. If possible, a County inspector will be present during paving operations but it is not mandatory unless so designated by the County Engineer or their designee.

i. Asphalt is only to be placed on a county approved base.

ii. If more than two (2) weeks passed or there is one-quarter-inch (1/4") or more rain prior to paving and approved base, the base must be re-inspected by the County inspector visually, and possibly proof-rolled at the County inspector's discretion.

iii. Minimum asphalt thickness for initial/ first lift is two-inches (2"). If pavement thickness is greater than 2.5" it shall be placed in two stages.

iv. Placement of hot mix asphalt will not be authorized when surface temperatures are less than sixty degrees Fahrenheit (60°F).

v. The County inspector is to visually inspect pavement and review asphalt core test data at all phases of paving, binding, intermediate and surface course.

vi. Asphalt tack coat to be placed between all courses (no exceptions).

c. Final Surface Course

An existing asphalt concrete binder or vase course must be inspected and approved prior to placement of the asphalt surface course. Verification of in-place density and thickness of the binder or base course must be provided as a prerequisite to this approval. Failure to obtain this approval will make the street ineligible for final approval and acceptance by the County.

d. Asphalt Requirements

Asphalt verification testing will be conducted in accordance with TxDOT Standard Specifications for Highway Construction, 2014 Edition. The contractor shall be responsible for providing verification for the asphalt type, asphalt binder content, gradation and the average laboratory bulk specific gravity (BSG) for all asphalt mixes used on Washington County projects as well as the in-place asphalt density and thickness. The asphalt contractor must have an asphalt laboratory certified by TxDOT.

For each day's production, the contractor's asphalt lab must provide:

i. Asphalt binder content

ii. Gradation

iii. Mix type

The in-place density and thickness determination of asphalt surface and binder courses will be based on the core data for day's production. A minimum of three (3), four-inch (4") diameter field cores secured and tested by the contractor from each day's paving. Immediately after completion and the holes patched with hot asphalt from the same day's production. The cores will be taken and evaluated by either the asphalt contractor or an independent materials testing firm certified by TxDOT for state highway projects.

The pavement will be rejected, removed and replaced if the average in-place core density does not meet the requirements of TxDOT Item 340, Dense-Graded Hot-Mix Asphalt.

The average pavement thickness must be equal to or greater than the plan thickness with no individual core varying by more than 0.25". Pavements that are deficient with regard to thickness will either be removed and replaced or overlaid at the discretion of the County Engineer.

Documentation of the asphalt verification testing must be provided prior to requesting a final inspection. The Washington County Engineering and Development Services Department reserves the right to conduct or require additional verification testing at any time.

6. Final Approval

a. Final Inspection

Final Inspection may be requested once all the paving and all utility, storm drainage and associated work is completed as well as the following items:

i. Hydomulch application on road shoulders; cut and fill slopes and easements; ditches;

ii. Fence around detention ponds with side slopes steeper than 3:1;

iii. Street name signs (County Standard or an approved alternate);

iv. Traffic control signs (per Texas MUTCD); and

v. As-built or record drawings.

b. Documentation

As a prerequisite to conducting the final inspection, the following must be provided:

i. Digital submission of as-built or record drawings;

ii. Any outstanding right of way deeds or easements for roads and/or drainage system;

iii. Two (2) year maintenance bond for road and drainage systems; and

iv. Documentation of construction materials testing.

c. Punch List

A written punch list of deficiencies found during the final inspection will be provided. All items should be completed before requesting a re-inspection.

d. Final Approval

Upon satisfactory completion of all punch list items, a construction approval letter of the streets and drainage system will be issued by the County Engineer to the Washington County Commissioner's Court. Construction approval does not convey intent of Washington County to provide maintenance acceptance. Construction approval initiates the two (2) year warranty period as described in Washington County Subdivision Regulations Section 9.

Failure to comply with any of the above listed requirements could render the streets and storm drainage systems ineligible for acceptance by Washington County.

4.08 Signage

All signage shall meet the latest edition of the **Texas Manual on Uniform Traffic Control Devices (TMUTCD).**

1. Sign pole shall be 2"x2" (14 gauge) square galvanized post.
2. Sign pole shall be inserted into a 2 ¼" x 2 ¼" (12 gauge) square galvanized base.
   a. Base shall be 36" in length inserted 30" into natural ground.
   b. Base shall be encased in concrete.

3. All signs shall be extruded aluminum with high intensity prismatic reflective sheeting.

Section 5 - Traffic Impact Analysis

5.01 Traffic Worksheet

1. The purpose of this Section shall be to establish policies governing traffic flow and safety on Street facilities within the Washington County limits, in accordance with the Texas Transportation Code governing traffic flow. The purpose of these policies is to protect the general health, safety and welfare of the public by reducing traffic congestion, improving traffic safety and flow, and ensuring that Site Generated Traffic can be adequately and safely served by the existing and future Street system.
2. All proposed single-family residential developments (100 lots or greater), multi-unit residential developments (100 units or greater), or non-residential developments (10 acres or greater) are required to submit the Washington County Trip Generation Threshold Analysis Worksheet provided below, prepared by a licensed professional engineer in the State of Texas, with experience in transportation engineering, to determine if the development is expected to generate:
    a. 1,000 or more vehicle trips per day; OR
    b. Add 100 or more parking spaces; OR
    c. Generate 150 or more vehicle trips in the peak direction (i.e. inbound or outbound) during the site's peak traffic hour (typically AM, PM or Saturday peak); all developments must utilize their "total" buildout, including any future phases, to determine if they fall below the one-hundred (100) lot threshold.
3. The threshold analysis worksheet shall be submitted for review concurrently with the submittal of the final plat and plans.

Washington County, Texas – Trip Generation Threshold Analysis Worksheet

This form is to be completed to determine if a Traffic Impact Analysis is required.

Development Name: _____

Submittal Date: _____ Location: _____

Applicant: _____ Contact Phone #: _____ Contact email: _____

Proposed Land Use and Trip Generation Date for Buildout of Development

Trips shall be calculated using the most recent version of the ITE Trip Generation Manual

Proposed Land Use Type	Units *	ITE Code	Daily Total (Weekday)	AM Peak Hour			PM Peak Hour			Sat Peak Hour		
				In	Out	Total	In	Out	Total	In	Out	Total
		TOTALS										

Seal/signature/date

Notes:

#1 – A Traffic Impact Analysis ("TIA") will be required when the Development is expected to generate one thousand (1,000) or more vehicle trips per day OR one hundred (100) or more vehicle trips in the peak direction (i.e. inbound or outbound) during the site's peak traffic hour.

#2 – The County Engineer may require a TIA at any stage of a Development whether it meets this criteria or not if special circumstances exist that may warrant a TIA.

#3 – If a TIA is needed based on this Threshold Worksheet, the Developer shall contact the County Engineer to determine the actual study requirements regarding time periods, Study Area intersections, Study Area Boundary, etc.

* Units should be based on what is used for the trip generation rate (ie. Gross Floor Area, Acreage, etc), be sure to specify in the box.

Applicant Signature: _____ Date: _____

5.02 Traffic Impact Analyses

If a Traffic Impact Analysis ("TIA") is required based upon criteria determined through completion of the Threshold Analysis Worksheet, the TIA shall be prepared and sealed by a licensed professional Engineer in the State of Texas with experience in Transportation Engineering.

If required, a digital copy shall be submitted along with the plat and plan submittal package.

This section establishes requirements and procedures pertaining to traffic impact analyses ("TIAs"). This section is intended to inform the applicant of the County's expectations to ensure safe and adequate access to the development and adequate traffic flow on existing and proposed Roads.

The TIA is intended to form the basis for design of any proposed access/road system to ensure coordination of the proposed development with the transportation needs resulting there from. The County and the developer share responsibility to identify and solve transportation issues arising from land development.

1. Purpose

The goal of a TIA submitted is twofold: to assess the adequacy and safety of proposed access to adjacent existing or planned Roads (or designs proposed for such access or Roads); and to determine effects the Development may have on current Road systems in its study area. Generally, the TIA uses current and anticipated near-term traffic volumes and Road configurations for the analysis. The process should ensure that the Road system is, or will be, adequate to accommodate the proposed Development and that safe and adequate access will be provided for travel between the Development and the public roadway system.

Where the TIA shows levels of service falling below acceptable minimums on road systems in its study area the TIA will recommend appropriate mitigation measures and demonstrate their effectiveness. Example mitigation techniques may include adding/lengthening deceleration/turn lanes, improving driveway access, providing connectivity, and modifying traffic control devices. Combinations of these techniques and other techniques can be considered. A TIA for a development should not recommend mitigation measures that are inconsistent with any traffic or road provisions of the County's thoroughfare plan. The Washington County Commissioner's Court shall consider the findings of the TIA in approving or disapproving plats to the extent allowed by law.

2. Definitions

a. Trip Generation Rates

Trip Generation Rates are used to estimate the amount of vehicular traffic generated by proposed Development. TIAs shall use rates set forth in the latest edition of the Trip Generation Report published by the Institute of Transportation Engineers ("ITE"), unless the Report does not adequately address the type or intensity of the proposed Development. In this event the Applicant or his agent shall submit projected vehicle trips to the County Engineer for approval.

b. Design Year

The design year is the point in time upon which assumptions pertaining to land use, population, employment, and transportation facilities are based. All TIAs shall use a design year based on the expected date of development occupancy, and shall include consideration of nearby development that has been approved and will contribute traffic volume to the proposed project's study area.

c. Peak Periods

Peak periods relate to times of day experiencing the greatest hourly traffic flow rates. Two (2) "peaks" are to be addressed by a TIA: The morning and afternoon peak hours (or projected peak hours) of existing (or planned) Roads serving the proposed Development. Typically, road peak periods are between 7:00 and 9:00 a.m. and between 4:00 and 6:00 p.m.

d. Base Volumes

Base volumes shall be based on current traffic counts adjusted to the expected date of Development occupancy plus volumes generated by nearby future development (all phases) that has been approved by the County or city. In all cases where traffic counts are needed and are not available, the developer or his agent shall be required to collect such data according to guidelines approved by the County Engineer.

e. Level of Service (LOS)

Level of service is a measure of the extent of congestion experienced on roadways. It is measured through analysis of traffic operating conditions on Road links and at intersections, using techniques presented in the latest edition of the Transportation Research Board's Highway Capacity Manual.

3. Methodology

a. TIA Scope of Work Determination Meeting

A TIA scope of work consultation with the County Engineer is required to discuss whether a TIA is required and, if so, the relevant aspects thereof. The study area will be defined to include nearby land developments (existing or approved), the street network to be examined (the "study network"), and the minimum extent of analysis. In addition, details of the procedures, assumptions, data collection, and analysis methodology(ies) will be determined at this meeting. Traffic from other nearby developments that have been approved but not yet constructed will be accounted for in the TIA as determined by the County Engineer. The County Engineer may require other specific assumptions such as the percent of trucks to match local conditions.

a. TIA Content

Submittals of TIAs for Development shall include the following:

i. Study Area

A map(s) delineating the TIA study area, including land areas to be considered and all existing/planned Roads therein, and the "study network" (those Roads and intersections requiring specific analyses).The study area will be determined by identifying the geographical area most affected by the proposed development as determined by the County Engineer after conferring with the Applicant. In general the study area will cover all intersections through which at least ten (10) percent of the proposed development's site traffic passes, and shall extend to and include at least the first traffic signal in all directions if within one (1) mile of any portion of the site. Existing Roads and intersection capacities shall be shown.

ii. Existing Development

A description of existing development including land area (gross and net), square footage, density of hotel rooms, dwelling units, etc.

iii. Thoroughfare Network

A description of existing thoroughfares, signals, signal phasing and traffic volumes within the study area;

iv. Proposed Development

A description of the proposed development including land area (gross and net), square footage, density of hotel rooms, dwelling units, etc. Also a description of anticipated Road conditions expected by the date of occupancy of the proposed development shall be included.

v. Proposed Access

Identification of the proposed access driveways for the development. This shall include the location and number of lanes, proposed traffic controls, and relationship to on-site circulation features for each proposed point of access. It must also include any proposed modifications to adjacent Roads. Once the TIA and an access plan has been approved, the final location and design of all access points shall meet or exceed the current access management and Road design policies of the entity responsible for the condition of that portion of adjacent Road.

vi. Impact Determination

A determination of the level of service for all Roads and intersections in the study area shall be included and motor vehicle safety conditions along all the Road frontage of the Development. The analysis shall contain the following minimum information:

(1) Proposed Trip Generation

A calculation of the total trip generation by use within the study area assuming full development and occupancy, including both peak hour and twenty-four-hour information show any reductions attributed to passers-by, mixed use, etc. show trip generation by use in tabular form with land use trip generation rates and trips generated.

(2) Trip Distribution and Assignment

A calculation of trips generated by the proposed development as added to the base volumes projected for the design year. Peak hour volumes must be calculated. Distribution assumptions (and the bases therefore) and assignment calculations must be provided.

(3) Level of Service Analysis

A depiction shown in tabular form, twenty-four-hour and peak hour volume/capacity ratios for links and intersections within the study area. This analysis should be done for the following traffic conditions: existing traffic, existing traffic plus projected traffic. Capacity analyzes must be shown for all points of ingress and egress, median breaks, and turn lanes associated with the proposed site.

(4) Neighborhood Traffic Analysis

If the TIA calculations show that a proposed site project increases traffic on a minor collector or local residential roadway (street) by at least ten (10) percent, a neighborhood traffic analysis shall be performed. This analysis will include an evaluation of existing and projected traffic on the affected roadways. Mitigation to lower this traffic may be required.

(5) Conclusions

A summary of findings must be reported. It must show all adjacent Roads and intersections noting those that fail to provide level of service D or better, and the percent increase in total traffic produced by the proposed Development. In addition the report must demonstrate that the proposed access design will provide safe and adequate access to the Development. It also must identify any safety and operational problems (e.g., driveways, sight distances, median openings, and signalization) within the study.

vii. Mitigation

A description of the mitigation measures proposed for meeting acceptable traffic service thresholds shall be shown. Where the development is contributing five (5) percent or more of the traffic at locations failing to meet level of service D or better the total trips should be mitigated by the applicant to low enough levels to achieve the required standard (or to pre-development levels, whichever is greater). Acceptable measures for mitigating negative traffic impacts include any one (1), or a combination of, those listed below.

(1) Modifying the density or intensity of the Development, such as a reduction in square footage or the percentage of commercial use to result in traffic levels meeting level of service D or better;

(2) Phasing approval and construction of a development until additional road capacity becomes available;

(3) Improving the access plan by dealing with features such as overall site arrangement, the placement and design features of access points, provision of additional access points to Roads not immediately adjacent to the property, provision of alternate controls, or adjustments in the development's circulation system;

(4) Making off-site improvements including the construction of additional lanes, increases in storage lane capacities, or modification of signalization, to list some examples.

viii. Costs of Mitigation

Mitigation improvements which are attributable to the proposed development shall be funded at the developer's expense. Any other improvements shown which are consistent with the County Thoroughfare Plan may request reimbursement by the County in accordance with its cost sharing policies.

4. Criteria for Approval

The County shall consider the following standards in determining whether a proposed Development meets an acceptable level of service:

a. **Design Requirement**

The proposed Development is consistent with the County's Thoroughfare Plan and is consistent with the design requirements of the Texas Department of Transportation on Roads maintained by such agency.

b. **Level of Service D**

The desirable minimum level of service for the County is a level of service D as that term is described in the Transportation Research Board's Highway Capacity Manual.

c. **Determination of Adequate Mitigation**

Notwithstanding anything to the contrary herein, the County Engineer and the Washington County Commissioner's Court, shall, based on recommendations by a qualified traffic engineer, determine whether adequate mitigation has occurred to meet an acceptable level of service utilizing the requirements set forth herein.

Section 6 – Drainage

6.01 Hydrology

Hydrology is the study of precipitation. Policy makers and engineers must study and understand hydrology because they are interested in designing and building structures and systems to safely convey and discharge precipitation runoff while minimizing the potential of flooding. They must determine how much water should be collected and conveyed or stored, how fast this process must take place, how much can be safely discharged without adversely impacting surrounding properties, and what are other effects of the development being considered. The following sections discuss specific parameters and methods to be used in analyzing proposed developments in the unincorporated areas of Washington County.

1. Storm Frequency

All drainage improvements shall, at the minimum, be designed for the following storm frequencies. The return intervals listed here are minimums, and the individual design engineer or Washington County may choose to exceed these minimums given site specific requirements or constraints.

Table 4 – Minimum Design Storm Frequency

MINIMUM DESIGN STORM FREQUENCY	
Facility Type	**Storm Frequency**
Closed Conduit Storm System	2 Year
County Ditches, Channels and Culverts (Serving less than 100 acres)	10 Year
County Ditches, Channels and Culverts (Serving 100 to 500 acres)	25 Year
County Ditches, Channels and Culverts (Serving more than 500 acres)	100 Year
Bridges crossing County Ditches, Channels or Mapped Waterways	100 Year
Detention Facilities	100 Year

2. Peak Storm Runoff Rates

a. The Rational Method

The Rational Method can be used for determining peak runoff flow rate for both existing and proposed conditions. These peak runoff rates are used to estimate the impact of development and the conveyance requirements for drainage improvements. This method is applicable for small to medium drainage areas (generally less than 640 acres) where the flow domain is typically overland sheet flow or shallow surface ditch flow. Other methods should be used to estimate peak runoff rates for larger areas or those served by well-defined channels where flow routing in defined channels may be significant. The Rational Method takes the following form:

THE RATIONAL METHOD

Q = (C * I * A)			
Q = Peak Runoff Flow Rate (cfs)	C = Runoff Coefficient, See Table 5	A = Area of drainage basin being studied (acres)	I = Rainfall Intensity of the design storm (inches/hour)

Table 5 – Rational Method Coefficient "C" Values

RATIONAL METHOD COEFFICIENT "C"	
LAND USE OR LAND COVER	**RATIONAL COEFFICIENT "C"**
Raw, undeveloped acreage (Wooded)	0.25
Raw, undeveloped acreage (Pasture)	0.28
Improved, underdeveloped acreage (mowed, graded, etc.)	0.30
Residential	
Lots greater than 1 ½ acres	0.35
Lots 1 – 1 ½ acres	0.45
Lots less than 1 acre	0.55
Multifamily	0.75
Commercial/Industrial	0.85

b. HEC-HMS / HEC-RAS Computer Modeling

For basins over 640 acres in size, Washington County will require a HEC-HMS hydrograph analysis covering the site and the adjacent parts of the watershed utilizing Atlas 14 rates. This analysis should verify that the proposed improvements will not increase runoff rates anywhere in the system and therefore will have no negative impacts on adjacent properties. The engineer must submit a complete design report with sufficient detail (program input, program output and discussion of methods and assumptions used) for Washington County engineer to review.

3. Basin Time of Concentration (Tc)

The storm rainfall Intensity used in Rational Method will be selected based upon the return interval of the storm to be used (specified in the Storm Frequency Table above), and the duration of the storm to be used (based on the study basin's time of concentration). Time of Concentration (Tc) is defined as the length of time it takes a drop of water to travel from the most hydraulically remote portion of the drainage basin to its outlet. Tc is a property of the drainage basin reflective of its area, shape, surface gradient, land use, land cover, and soil type. Tc (in minutes) shall be estimated using the Kerby-Kirpich equation:

KERBY - KIRPICH EQUATION		
$T_c = T_{ov} + T_{ch}$		
T_c = Time of Concentration	T_{ov} = Overland Flow Time	T_{ch} = Channel Flow Time

a. Overland Flow Time (Kerby Method)

The overland flow time can be calculated utilizing the Kerby Equation:

KERBY EQUATION			
$T_{ov} = 0.828\ (L \times N)^{0.467} / S^{-0.235}$			
T_{ov} = Overland Flow Time	L = Overland Flow Length (in feet	N = Dimensionless Retardance Coefficient	S = Slope of Terrain conveying the overland flow (ft/ft)

Table 6 - Kerby Equation Retardance Coefficient Values (N)

KERBY EQUATION RETARDANCE COEFFICIENT VALUES "N"	
GENERALIZED TERRAIN DESCRIPTION	**RETARDANCE COEFFICIENT (N)**
Pavement	0.02
Smooth, bare, packed soil	0.10
Poor grass, cultivated row crops, or moderately rough packed surfaces	0.20
Pasture, average grass	0.40
Deciduous forest	0.60
Dense grass, coniferous forest, or deciduous forest with deep litter	0.80

b. Channel Flow Time (Kirpich Method)

The channel flow time can be calculated utilizing the Kirpich Equation:

KIRPICH EQUATION		
$T_{ch} = 0.0078 \times L^{0.770} \times S^{-0.385}$		
T_{ch} = Channel Flow Time, in minutes	L = the channel flow length, in feet	S =the dimensionless main-channel slope

Alternative methods for estimating the basin's time of concentration will be accepted for review by the County Engineer, and may be allowed for use if the method's applicability to a specific situation warrants its use over the Kerby-Kirpich Method.

4. Storm Intensity (I)

For small watersheds and individual developments, the storm intensity should be based upon the time of concentration of the basin being analyzed. For example, in the design of a detention facility serving a basin with a 2-hour time of concentration, an Intensity for a 100-year, 2-hour storm should be selected for use in the analysis. For large watersheds and regional studies, use a 24-hour duration storm for the analysis and design. Appropriate intensity-duration-frequency (IDF) coefficients relative to storm frequency are shown in Table 7 below.

Table 7 – NOAA Atlas 14 IDF Coefficients for Washington County

NOAA ATLAS 14 IDF COEFFICIENTS FOR WASHINGTON COUNTY			
$I = b/(T_c + d)^e$			
STORM FREQUENCY	**b**	**d**	**e**
2 Year	61.7232	12.7293	0.8177
5 Year	69.1487	12.1277	0.7838
10 Year	73.2181	11.6223	0.7603
25 Year	76.8759	10.9639	0.7307
50 Year	76.8675	10.1845	0.7054
100 Year	77.8660	9.7969	0.6832
500 Year	95.1482	12.1098	0.6623

6.02 Hydraulics

Hydraulics is the study of fluid flow behavior. Policy makers and engineers must study and understand hydraulics because they are responsible for designing and constructing conveyance and storage facilities capable of managing storm water runoff in a safe and effective manner while reducing the potential for flooding. The following sections discuss specific methods and parameters to be used in analyzing proposed developments in Washington County's service area.

1. Open Channel Flow

The vast majority of conveyance capacity within Washington County's service area is located in the network of open channels that Washington County builds and maintains. The Chezy-Manning equation will be used to estimate a ditch's conveyance capacity. This equation is in the following form:

CHEZY-MANNING EQUATION			
$Q = 1.486/n \times A \times R^{2/3} \times S^{1/2}$			
n = Manning's Roughness Coefficient (unitless)	A = Flow Cross-sectional area (sf)	R = Hydraulic Radius (ft)	S = Slope of the Hydraulic Grade Line (ft/ft)

Typical values for Manning's 'n' are included in Table 8 below. The flow area (A) is estimated from the ditch cross-section, and is the area that will be conveying water (also called the wet area). The hydraulic radius is calculated as the wetted area divided by the wetted perimeter. The wetted perimeter is defined as the length of water/surface interface around the perimeter of the wetted area (does not include the water/air interface length). For open channels, the slope of the hydraulic grade line is estimated to be the same as the ditch slope.

Table 8 – Manning's Coefficient "n" Values for Open Channel Flow

MANNING COEFFICIENT "N" VALUES FOR OPEN CHANNEL FLOW	
SURFACE/CHANNEL	**MANNING COEFFICIENT "n"**
Concrete Lined	0.013
Earth Channel, smooth	0.018
Earth Channel, Clean Maintained Vegetation	0.022
Earth Channel, Gravel Lined	0.025
Earth Channel, Pasture Maintained	0.030
Earth Channel, Riprap/Stone Lined	0.035
Floodplains – Pasture, Farmland	0.035
Floodplains – Light Brush	0.050
Floodplains – Heavy Brush	0.075

2. Closed Conduit (Pipe/Culvert) Flow

The Chezy-Manning equation presented earlier is also applicable for estimating flow capacity for closed conduits (i.e., pipes). There are some important distinctions to remember, including:

a. Manning's 'n' for pipe materials are significantly different (i.e., smaller) than those for bare earth or vegetative surfaces. See Table 8 above for appropriate 'n' values.

b. The assumption of hydraulic grade line slope being approximately equal to the pipe slope is only valid under free flow conditions. Once the pipe is full and experiences surcharge conditions, the hydraulic grade line slope will increase as flow increases.

Table 9 - Manning's Coefficient "N" Values for Closed Conduit Flow

MANNING'S COEFFICIENT "N" VALUES FOR CLOSED CONDUIT FLOW	
PIPE/CULVERT MATERIAL	**MANNING COEFFICIENT "n"**
Smooth Inner Wall Plastic Pipe (PVC & HDPE)	0.013
Concrete	0.013
Steel Riveted	0.019
Corrugated Inner Wall Plastic Pipe (PVC & HDPE)	0.022
Corrugated Metal	0.025

6.03 Outfall Restrictor Design

To comply with Washington County policy to avoid increasing flood risks or flood hazards, maximum allowable outflow rates from detention basins are restricted to the pre-development flows from the 100-year, 25-year and 10-year Storm, 24-hour events. If a downstream channel has less capacity than a 10 year event, also restrict the outflow to the amount the pre-development project site contributes to the channel when it is flowing full or at its flooding threshold. When detention basin modifications are necessary to accommodate a proposed storm sewer outfall or a proposed development, design the modifications such that the 100-year, 25-year and 10-year Storm, 24-hour events water surface profiles in the detention basin and downstream channels are not increased above existing conditions. If the outflow is into a roadside ditch or storm sewer, restrict the maximum allowable outflow to the rate allowed from the proposed site development using criteria adopted by the jurisdiction responsible for the roadside ditch or storm sewer.

1. Orifice Design

An orifice is a two-dimensional flow structure (i.e., a drilled hole in a concrete wall, a hole in plate steel or a very short section of pipe) with an estimated conveyance capacity dependent upon the difference in water elevations from one side of the orifice to the other and the orifice opening area. The general equation for estimating flow through an orifice is as follows:

ORIFICE FLOW CAPACITY				
$Q = C \times A \times (2 \times g \times H)^{1/2}$				
Q = Orifice flow capacity (cfs)	C = Orifice coefficient (unitless) [use 0.8]	Orifice coefficient (unitless) [use 0.8]	G =Gravitational acceleration constant (32.2 ft/s2)	H = Differential head across the orifice (ft)

For the design head differential (H) use the 100-year water surface elevation in the detention facility minus the 25-year water surface elevation in the receiving ditch (if known). If discharging directly into a roadside ditch or a storm sewer, use the difference between the 100-year water surface elevation at the entrance and the centroid of the orifice in feet when orifice is partially submerged. The orifice should generally be greater than 6" diameter to reduce problems with clogging and blockage.

2. Outfall Pipe

The engineer may use one or more a pipe sections as flow control devices. The conveyance capacity of the pipe(s) can be estimated using the Chezy-Manning equation. In using this method, the slope of the hydraulic grade line is equal to the head differential across the structure divided by the length of the pipe section. For the design head differential use the 100-year water surface elevation in the detention facility minus the 25-year water surface elevation in the receiving ditch (if known). If discharging directly into a roadside ditch or a storm sewer, use the difference between the 100-year water surface elevation at the entrance and the centroid of the orifice in feet when orifice is partially submerged. The restrictor pipe shall not be less than 6" in diameter.

3. Overflow Weir

An overflow weir can be used on an outfall structure to restrict and regulate outflow. One of the biggest advantages of this outfall structure is that they do not have a finite conveyance capacity, and can therefore be used for emergency overflows to control larger than 100-year flows. There are many types of weir designs to choose from when designing an outfall structure, and each has a slightly different equation for estimating flow capacity. One of the simplest to design and construct is a Cipoletti weir consisting of a horizontal weir (of width B) with triangular weirs on either side (at 4:1 slopes) and a depth of flow of H feet. Capacity of a Cipoletti weir can be estimate by the following equation:

Table 10 - Capacity of a Cipoletti Weir

CAPACITY OF A CIPOLETTI WEIR		
$Q = 3.367 \times B \times H^{3/2}$		
Q = Weir capacity (cfs)	*B = Weir length (ft)*	*H = Depth of flow across weir (ft)*

6.04 Detention Facilities

To meet Washington County's requirements for zero net increase in runoff rates and no negative impacts due to new development, most projects will need to provide on-site detention facilities. Each detention facility should be designed based upon site specific parameters and constraints using accepted engineering methods. Washington County will not allow in-line storage within County ditches, channels, or streams. Additionally, the use of hydrograph timing as a substitution for detention on any project is prohibited. No approvals will be given by Washington County for any proposed development until the County Engineer has been satisfied that the proposed design meet Washington County's requirements. The following paragraphs describe general design requirements and allowable methods for generating appropriate designs. The characteristics of an individual development may be such that additional calculations, plans, and details may be required both for proper review and for construction. The County Engineer shall notify the Developer or the Engineer or record as this need becomes evident.

1. General Requirements

As shown in Table 4, detention facilities will be designed to provide enough storage to accommodate a 100-year event for the sub-area it is intended to serve. Detention facilities may be designed to be wet (constant level ponds) or may be designed to drain completely. They must be designed and constructed with stable slopes (minimum 3:1), they must provide adequate access and maintenance berms around the entire perimeter (30' minimum), and they must have erosion control elements (i.e., backslope swales, drop pipes, slope pavement, etc.) as necessary to ensure a stable, low maintenance facility. All detention facilities must provide one (1) foot of freeboard. Outfall structures must be designed to restrict outflow from the detention facility at a rate not to exceed the pre-developed conditions, and must include a controlled release mechanism to safely discharge runoff from storm events in excess of the 100- year design storm.

Detention storage may not be placed in road-side ditches or in curb-and-gutter streets in public or private easements and rights-of-way.

2. Volume Requirements

The following paragraphs describe allowable methods for use in determining storage volume requirements. This is not an exhaustive discussion of all methods, but will provide developers and engineers with a variety of tools for use in the unincorporated area of Washington County.

a. Coefficient Method

For small developments (less than 5 acres for commercial or 10 acres for residential), the developer may choose to use this simplified method for detention volume estimation. Using this method, the developer would provide detention storage using the following equation:

Table 11 – Detention Coefficient Method

Coefficient Method	
Storage = 0.55 * A_{dev}	
Storage = Detention volume required (ac-ft)	A_{dev} = The area of the site that will include modified cover (acres).

Using this method, storage is only provided for the portion of the site that is being developed. For example, on a 4 acre commercial tract with 2.5 acres of building, parking, detention facilities and landscape areas, the developer would be required to provide (2.5 acres)*(0.55 ac-ft/ac) = 1.375 ac-ft of detention storage. This method will not be allowed where the total developed area (either proposed or in the future) will exceed 5 acres for commercial or 10 acres for residential developments.

b. Modified Rational Method

For drainage areas of less than 200 acres, a modification of the Rational Method can be used for the estimation or design of storage volumes for detention calculations. The Modified Rational Method uses the peak flow calculating capability of the Rational Method paired with assumptions about the inflow and outflow hydrographs to compute an approximation of storage volumes for simple detention calculations.

c. Natural Resource Conservation Service (NRCS) Methods

Technical Release No. 55 Methods are for use in determining stormwater discharges and hydrographs in the Secondary Drainage System only and for drainage areas not exceeding 2000 acres. For purposes of these standards these methods are applicable to drainage areas of 100 to 2000 acres. In the event a drainage area exceeding 2000 acres is to be analyzed, it must receive approval of the County Engineer.

6.05 Maintenance Responsibility

1. Private and Public Stormwater Maintenance

a. The County will not provide maintenance for drainage or Stormwater Facilities.

2. Maintenance of Detention and Retention Ponds

a. A Homeowner's Association (HOA) or Property Owners' Association (POA) shall provide a maintenance agreement for all Detention Pond(s) and Retention Pond(s) unless the Commissioner's court approves an alternative maintenance arrangement.

b. If a Detention Pond or Retention Pond fails to operate due to lack of maintenance, the County may hold the Landowner, Homeowners' Association (HOA) or Property Owners' Association (POA) in violation of the Washington County Subdivision Regulations.

Section 7 – Drainage System Design

7.01 Streets

1. **Road Capacity Requirements**

   Roads may be used in combination with roadside ditches to convey the runoff resulting from the 100-year storm and to meet the street drainage criteria outlined in Table 12. The allowable flow depth and spread requirements outlined in Table 12 shall be applied at the edge of pavement.

Table 12 – Roadway Allowable Flow Depth

Type of Street	Allowable Spread	Maximum Water Surface Elevation
Major/Minor Thoroughfare	One traffic lane in each direction to remain open	6”
Collector	One moving traffic lane to remain open	6”
Minor Road	n/a	6”

Roadside ditches shall be included in the street right-of-way section. Curb and gutter systems with storm sewer inlets and storm drain pipe may also be approved in lieu of parallel ditches by the County’s engineering representative or their designee, provided the other design requirements of this manual are met.

Additional street drainage considerations are listed below:

a. The maximum allowable spread shall not exceed the limits of the public right-of-way or drainage easement.

b. The maximum allowable concentrated flow to a street including flow from driveways and flumes is 3 cfs. Discharges of point flows exceeding 3 cfs are allowed into the side drainage features of the street but may require permanent erosion control mechanisms at the discretion of the County’s engineering representative or their designee.

c. At any intersection, only one street shall be crossed with surface drainage, and this shall be the lower classified street.

2. **Street and Gutter Flow Calculations**

Surface drainage along streets is a function of transverse and longitudinal pavement slope, pavement roughness, inlet spacing, and inlet capacity. The design of these elements is dependent on storm frequency and the allowable spread of stormwater. Flow in streets and gutters is governed by Manning’s equation for open channel flow:

Table 13 – Manning’s Equation

Manning’s equation				
$Q = 1.486/n * A R^{2/3} S^{1/2}$				
Q=average velocity (fps)	A=cross-sectional flowarea (ft2)	R=hydraulic radius (ft)	S=longitudinal slope (ft/ft)	N=Manning’s roughness coefficient

The iSWM Technical Manual for Hydraulics provides alternate forms of the Manning's equation with tables and nomographs to be used in the calculation of drainage capacities of streets with triangular, composite, and parabolic sections, as well as streets with curb splits.

7.02 Inlets

1. **Inlet Design Considerations**

   Inlets must be spaced to serve the runoff calculated using the appropriate hydrologic method. Curb inlets shall be spaced so that the maximum travel distance of water in the gutter will not exceed 700 feet one way for residential streets and 300 feet one way on major thoroughfares and streets within commercial developments. It is preferable that curb inlets be located on intersecting side streets instead of major thoroughfares on all original designs or developments. Do not place inlets in circular portion of cul-de-sac streets unless special conditions warrant otherwise. Place inlets at the end of proposed pavement, if drainage will enter or leave pavement. Special conditions warranting other locations of curb inlets shall be determined on a case by case basis by the County's engineering representative or their designee.

2. **Roadway Inlets**

   Inlets are drainage structures used to collect surface drainage and to convey this water to storm drains or direct outlet to culverts. The capacity of an inlet depends upon its geometry and the cross slope, longitudinal slope, total gutter flow, depth of flow, and pavement roughness. Inlets servicing roadway drainage can be divided into three major classes:

   a. Curb Inlets

   b. Grate Inlets

   c. Combination (Grate and Curb-Opening) Inlets

   Inlets may be classified as being on a continuous grade or in a sump. The term "on grade" refers to an inlet located on the street with a continuous slope past the inlet with water entering from one direction. The "sump" condition exists when the inlet is located at a low point and water enters from both directions.

   Artificial low points created by "seesaw" of street grades will not be permitted. All low point inlets shall be designed in accordance with additional standards outlined in **Section 4.2.4**.

   The procedures and technical criteria outlined in the iSWM hydraulic manual shall be used for the hydraulic design of stormwater inlets. Additional criteria for various inlet types are summarized in the following sections. Refer to the **Texas Department of Transportation (TxDOT)** ***Bridge Standards*** for inlet construction and material requirements.

3. **Drop Inlets**

   The County allows for the installation of drop inlets to collect water in nonpaved areas, such as ditches and swales. If used, grading plans to direct flow into drop inlets shall be included in the construction plans. Drainage interceptor swales or berms shall be used, as required, to direct runoff to the drop inlets. Where swales or other means of collecting and directing runoff into drop inlets are needed, they shall be contained in drainage easements according to the requirements outlined in Section 1.6.1.

   Drop inlet capacity shall be designed using a 50% clogging factor due to the tendency of these inlets to collect debris. Flow into drop inlets shall be calculated using either the weir flow formula for an unsubmerged inlet or the orifice flow formula when depth of flow exceeds the depth of the opening.

Table 14 - Unsubmerged Inlet Capacity Operating as a Weir

Unsubmerged Inlet Capacity Operating as a Weir			
$Q/P = 2.5y^{3/2}$			
Q = Flow Capacity (cfs)	2.5 = weir coefficient (3.1) adjusted for 50% clogged inlet throat	P = Perimeter of opening (ft)	Y= head/depth (ft)

Table 15 - Submerged Inlet Operating as an Orifice

Submerged Inlet Operating as an Orifice				
$Q = 0.6(2gH)^{0.5}$				
Q = Flow Capacity (cfs)	0.6 = orifice discharge coefficient	A = Area of inlet opening (ft^2)	G = acceleration due to gravity = 32.2 (ft/s^2)	H = Head above centerline of inlet opening (ft)

Both conditions should be evaluated, and the capacity shall be determined from the condition that produces the more conservative value. The capacity calculations for drop inlets will be limited to a maximum head of 1 foot above the flowline of the inlet throat.

4. **Positive Overflow Requirements**
   Inlets are required at all low points in the gutter profile. Additionally, the drainage system shall provide for positive overflow at all low points. The term "positive overflow" means that when the inlets do not function properly, or when the design capacity of the conduit is exceeded, the excess flow can be conveyed overland along an open course. Generally, positive overflow is provided along a street, but certain circumstances may require the dedication of drainage easement and construction of a concrete flume sized to carry the overflow. Reasonable judgment should be used to limit the easements on private property to a minimum.
   In areas where positive overflow is not feasible, flanking inlets are required on each side of the low point inlet to act in relief of the inlet at the low point if it should become clogged. Flanking inlets shall be located to function before water spread exceeds the allowable spread at the sump location and shall be designed with a combined capacity to match the capacity of the primary sump inlet.

7.03 Storm Drains (Closed Systems)

Flow in Storm Drains

1. **Hydraulic Grade Line**
   Storm sewers shall be constructed to flow in subcritical hydraulic conditions unless otherwise approved by the County's engineering representative or their designee. A plan and profile sheet and calculations of the hydraulic gradient shall be furnished by the design engineer.
   The hydraulic gradient shall be calculated assuming the top of the outfall pipe as the starting water surface. At drops in pipe invert, should the upstream pipe be higher than the hydraulic grade line, then the hydraulic grade line shall be recalculated assuming the starting water surface to be at the top of pipe at that point. For the design storm, the hydraulic gradient shall be below the gutter line for all newly developed areas. For approved streets with ditch sections, the hydraulic gradient shall be 0.5 feet below the edge of pavement or natural ground elevation, whichever is lower.
2. **Velocities**

Storm sewers shall be designed to have a minimum velocity of 3 feet/second when flowing full. Maximum velocities shall not exceed 15 feet/second. Maximum discharge velocities shall not exceed 6 feet/second without use of energy dissipation downstream.

3. **Head Losses**

   Head losses at structures shall be determined for manholes, junction boxes, wye branches, bends, curves, and changes in pipe sizes in the design of closed conduits. Head losses must be incorporated into the gradient profile. Minimum head loss used at any structure shall be one-tenth (0.10) foot. Refer to the iSWM hydraulic manual for the equations to calculate energy losses at pipe junctions, bends, manholes, inlets, and other situations.
   Pipe direction changes will be curves using radius pipe unless approved by the County's engineering representative or their designee. Ninety-degree turns on storm sewers or outfalls are prohibited. Laterals shall intersect the trunk line at 60 degrees.

4. **Pipe Size and Material**

   The pipe size shall be a minimum of 15 inches for all public systems. Storm sewers shall be constructed with Class III reinforced concrete pipe, either precast pipe, box conduits or cast in place pipe. Refer to the pipe manufacturer specifications for cover requirements. Higher classes of pipe shall be required where the ultimate D-load of Class III pipe is exceeded, and in other situations as required by the County's engineering representative or their designee.

   The use of High-Density Polyethylene Pipe (HDPE) is allowed in unpaved areas. The use of corrugated galvanized metal pipe or HDPE may be approved at the storm sewer outfall into unlined channels

5. **Storm Drain Alignments**

   Match crowns of pipe at any size change unless severe depth constraints prohibit. Pipe size shall generally increase downstream except in the following specific cases or where otherwise allowed by the County's engineering representative or their designee:

   a. Where construction constraints prohibit the use of a larger pipe downstream;

   b. Where the improvements are outfalling into an existing system; or,

   c. Where the upstream system is intended for use in detention.

   Headwalls or sloped end treatments shall be constructed at the pipe ends of all storm drain systems. Sloped end treatments are required along streets when the drainage feature is adjacent and parallel to traffic flow. The sloped end treatment shall be a minimum 6:1 (horizontal to vertical) end section.

   Storm drain systems that outfall to a stream, natural channel, or pond shall conform to the existing side slope of the channel and be connected to a headwall. Discharge flowlines of storm sewers are to be 6 inches above the flowline of creeks and channels, unless channel lining is present. Hard armor protection and energy dissipation shall be provided when discharge velocities exceed the maximum allowable velocity in Table 3 and when specified by the County's engineering representative or their designee.

7.04 Channels and Ditches

1. **Hydraulic Evaluation**

   The County requires a hydraulic analysis for any proposed open channels or ditches. Normal depth (uniform flow) calculations using the Manning's equation are to be used only for initial sizing. Exceptions for small outfall channels and ditches will be made at the discretion of the County's engineering representative or their designee.

The hydraulic analysis shall generally be performed using HEC-RAS. The analysis will be used to determine the headwater and tailwater elevations, head losses, capacity, freeboard, and floodplain impacts. For systems discharging into natural creeks, channels, or ponds, the tailwater shall be assumed to be the 100- year water surface elevation. If an approved flood hydrograph is available to provide a coincident flow elevation for the system's peak, the table of coincident design frequencies in the iSWM hydraulic manual can be used to assist with tailwater determination. Alternatively, a detailed hydrologic and hydraulic study may be provided.

For channels that require a flood study, a hydrologic routing model and hydraulic analysis will be required to determine impacts on existing floodplains and/or adjacent properties. If a stream or channel has an effective FEMA model and/or a County-adopted watershed model, the engineer will be required to use those models for the analysis.

Supercritical flow will not be allowed for designed channels. However, for lined channels, the HEC-RAS analysis shall include a mixed-flow regime analysis, to make sure no supercritical flow occurs for the designed channel. Mixed or supercritical flow may be allowed for analysis of existing conditions when required.

Upstream or downstream transitions from natural to modified channels along with channel outfalls will require a design based on a hydraulic study and will provide a non-erosive environment. Refer to the iSWM hydraulic manual for design of channel transitions and energy dissipation.

2. Allowable Depth and Freeboard

The 50-year hydraulic gradient shall be shown for each drainage ditch section and shall be below the edge of pavement or natural ground elevation, whichever is lower. The 100-year hydraulic gradient shall also be shown on the plans to confirm that flows are contained within the right-of-way and/or drainage easement. Freeboard must also be provided to meet the requirements for minimum finished floor elevations outlined in **Section 2.4.3**.

3. Setbacks

The minimum distance between the edge of the roadway shoulder and the adjacent edge of ditch bank shall be as shown on the County's Typical Roadway Sections.

4. Geometry

The following standards for the geometry of constructed channels and ditches shall apply:

a. The minimum bottom width for roadside ditches shall be 3 feet.

b. The minimum grade or slope of roadside ditches shall be 0.50%. In situations where the minimum slope cannot be achieved, concrete lining may be required by the Count's engineering representative or their designee. For grass lined sections, the maximum design velocity shall be 6 feet per second.

c. The minimum preferred unlined or unimproved roadside ditch section shall have a side slope no steeper than 3:1 (horizontal to vertical) configuration. Steeper slopes may be approved by the County's engineering representative or their designee when the existing right-of-way is limited or other construction features dictate the design.

d. Bank stabilization may be required at the discretion of the County's engineering representative or their designee.

7.05 Bridges and Culverts

1. Bridge and Culvert Capacity

The hydraulic design of bridges and culverts for roadway crossings of drainage feature shall conform to the methodology outlined in the TxDOT Hydraulic Design Manual. The minimum design frequencies of bridge and culvert facilities shall conform to the recommended design flood and check flood standards presented in the manual. Driveway culverts in roadside ditch sections shall be provided to allow sufficient cross drainage to meet the ditch capacity and freeboard requirements.

All bridge and culvert facilities must be evaluated to the 100-year storm, to ensure conformance with the County's downstream impacts and floodplain development criteria. Bridge and culvert design must meet the no adverse impacts standards outlined in **Section 2.3.1.**

2. Bridge Design Considerations

A hydrologic and hydraulic analysis using HEC-RAS is required for designing all new bridges, bridge widening, bridge replacement, and roadway profile modifications that may adversely affect the floodplain, even if no structural modifications are necessary.

3. Bridge Scour Analysis

A scour analysis shall be submitted with bridge design plans. Scour analysis shall be performed in accordance with the latest edition of the TxDOT Geotechnical Manual, based on the guidelines and procedures outlined in HEC-18 Evaluating Scour at Bridges (5th Ed.). The HEC-RAS scour routines shall generally be used to perform bridge scour computations.

Scour revetment shall be provided as needed and shall be designed using the methodology outlined in ***HEC-23 Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Guidance.*** Alternative methodologies for scour analysis and revetment may be approved at the discretion of the County's engineering representative or their designee.

4. Culvert Design Considerations

Culverts with headwalls will be placed at all driveway and roadway crossings, and other locations where appropriate. All driveways crossing open drainage ditches are required to be serviced by culverts; no paved dips will be permitted.

Culverts will be designed assuming inlet control. For safety reasons, headwater depth/culvert diameter ratio (HW/D) for road crossings shall not exceed 1.5 for the 100-year event peak flow. Variance to this criteria may be permitted by the County if justification is provided and sufficient measures are taken to reasonably avoid any safety impacts. Assessment of the impacts caused by exceeding the design headwater depth should account for:

a. Hazard to human life and safety.

b. Potential damage to the culvert, embankment stability and roadway.

c. Traffic interruption in the event of roadway overtopping.

d. Anticipated upstream and downstream flood risks, for a range of return frequencies.

If the culvert outlet is operating with a free outfall, the critical depth and equivalent hydraulic grade line shall be determined. If an upstream culvert outlet is located near a downstream culvert inlet, the headwater elevation of the downstream culvert will establish the design tailwater depth for the upstream culvert. For culverts discharging into natural creeks, channels, or ponds, the tailwater shall be assumed to be the 100-year water surface elevation. If an approved flood hydrograph is available to provide a coincident flow elevation for the system's peak, the table of coincident design frequencies in the iSWM hydraulic manual can be used to establish the tailwater elevation. Alternatively, a detailed hydrologic and hydraulic study can be performed to establish the tailwater elevation.

5. Roadway Culvert Size and Material

The minimum size culvert shall have a cross-sectional area equal to or greater than an eighteen (18) inch inside diameter pipe. Roadside culverts are to be sized based on drainage area. Calculations are to be provided for each block based on drainage calculations. All proposed and reasonably expected future culverts shall be included in the hydraulic profile. The size of culvert used shall not create an additional head loss of more than 0.2 feet greater than the normal water surface profile prior to placement of the culvert. Pipe culverts shall conform to ASTM Specifications C-76, Class III, for reinforced concrete pipe. Higher classes of pipe shall be required where the ultimate D-load of Class III pipe is exceeded, and in other situations as required by the County's engineering representative or their designee.

7.06 Storm water Storage Facilities

1. Storage Volume Calculation

The modified rational method is allowed only for detention facilities serving watersheds of 100 acres and less. The modified rational method is not acceptable for basins in series. Detention basins draining watersheds over 100 acres shall be designed using unit hydrograph methodology. The unit hydrograph method is also allowed for basins with watersheds less than 100 acres and may be required at the discretion of the County's engineering representative or their designee.

A calculation summary shall be provided on construction plans. For detailed calculations of unit hydrograph studies, a separate report shall be provided to the County for review and referenced with date, engineer, and title on the construction plans. Stage-storage-discharge values shall be tabulated, and flow calculations for discharge structures shall be shown on the construction plans. Reservoir routing calculations must be used to demonstrate that the storage volume and outlet structure configuration are adequate.

2. Pond and Spillway Geometry

The following criteria shall apply:

a. Detention basin embankments shall have a 10-foot crown width. For access to the pond bottom, provide a maintenance ramp of at least 10 feet wide with a maximum slope of 15%. Twelve (12) feet in width is required next to vertical walls.

b. Detention basins shall be designed with at least one 10-foot-wide maintenance access location, with a 15% maximum grade.

c. A freeboard of 1 foot based on the 100-year design depth will be required for all detention ponds.

d. Grassed side slopes shall be 4:1 or flatter and less than 20 feet in height. Slopes protected with concrete riprap shall be no steeper than 2:1. A detailed geotechnical investigation and slope stability analysis is required for grass and concrete slope pavement slopes greater than 12 feet in height. A concrete-lined or structural embankment can be steeper with County approval.

e. An emergency spillway shall be provided at the 100-year maximum storage elevation with sufficient capacity to convey the 100-year storm assuming blockage of the closed conduit portion of the outlet works with 6 inches of freeboard. Spillway requirements must also meet all appropriate state and federal criteria. Design calculations will be provided for all spillways.

f. Dry detention basins are sized to temporarily store the volume of runoff required to provide flood protection up to the 100-year storm, if required. Dry detention basin design should consider multiple uses, such as recreation. As such, pilot channels should follow the edges of the basin to the extent practical. The bottom of the basin shall have a minimum grade of 1%,

although swales may have minimum grades of 0.5%. Concrete flumes shall be provided for slopes less than 0.5% and may have slopes as shallow as 0.2%. They shall be at least 6 feet wide.

g. Safety fencing is required around the detention area if any of the following criteria are met:

   i. Where side slopes of the facility are steeper than 4:1.

   ii. Where the 100-year design depth of the facility exceeds 4 feet.

   iii. Where the facility is likely to experience significant exposure to children or the elderly (i.e. adjacent to schools, parks, or adult care facilities)

   iv. In other instances, as directed by the County's engineering representative or their designee.

h. Safety fencing shall be a minimum of 6-feet in height and shall be chain link. Maintenance access must be provided. Alternative materials or other means of preventing public egress (i.e. decorative fencing or privacy hedges) may be approved by the County's engineering representative or their designee.

3. Permitting and Dam Safety Requirements

All federal, state, and local laws pertaining to the impoundment of surface water relating to the design, construction, and safety of the impounding structure shall apply. Criteria established by the State of Texas for dam safety (TAC Title 30, Part 1, Chapter 299) and impoundment of state waters (Texas Water Code Chapter 11) shall apply where required by the state. The engineer is responsible for coordinating with the appropriate regulatory agencies to ensure compliance with these requirements.

Section 8 – Driveways

8.01 Driveway Culvert Requirements

1. Permit Required for All Driveway Culverts

No Person may construct a driveway culvert in the Public Right-of-Way or other County property listed in Section 12.01.B without first obtaining a Permit from the County under this Section 12.

2. Culvert Diameter

The minimum size for a culvert in the Right-of-Way is 18" in diameter.

3. Culvert Length

a. Residential Use:

i. Minimum length is 24'

ii. Maximum length is 40'

b. Commercial Use:

i. Minimum length is 24'

ii. Maximum length is 80'

1. Any culvert over 40' in length shall include a junction box with an incorporated inlet.

4. Culvert Material

The only acceptable driveway culvert materials shall be corrugated metal pipe (CMP) or reinforced concrete pipe (RCP).

5. Existing Culverts

The County will issue notice to any property owner with an existing culvert in poor condition. The owner will be given enough time to repair or replace the culvert before the County begins referral for enforcement proceedings.

6. Driveway Surface Maintenance

Driveway surface maintenance shall be the sole responsibility of the respective landowner.

7. Temporary Construction Entrance

a. Temporary Construction Entrances shall be utilized for no longer than one (1) year.

i. An extension may be granted for no more than six (6) months

b. High Density Polyethylene (HDPE) culverts may be utilized for a temporary construction entrance.

8. Corrective Culvert Measures by the County

The County reserves the right to remove and replace any substandard or blocked culverts; The County further reserves the right to take any necessary corrective measures within the Public Right of-Way to address a drainage issue in the Right-of-Way or on an Abutting property.

Public Nuisance and Abatement A Violation of this Section 12 is a public nuisance subject to abatement procedures, criminal and civil penalties, injunctions, liens, and cost assessments to repay the County the cost of abating or correcting the nuisance.

Section 9 – On Site Sanitary Sewer (OSSF)

9.01 OSSF Design and Construction Standard

Washington County adopted an **O**rder for On Site Sewage Facilities (OSSF). Commissioners Court has assigned the responsibility to the Washington County Engineering and Development Services Department to ensure each development adheres to the most recent up to date laws as regulated by the Texas Commission of Environmental Quality.

All developments or subdivisions, which include the use of on-site sewage facilities (OSSF), shall comply with the latest editions of 30 Texas Administrative Code (TAC) Chapter 285 On-site Sewage Facilities and the Rules of Washington County, Texas for Private Sewage Facilities. This reference shall be construed to include the most current edition, latest revisions, additions or amendments thereof.

All developers, landowners and developments must be in compliance with State laws regarding on-site sewage facility (OSSF) laws as regulated by the Texas Commission of Environmental Quality (TCEQ). Upon compliance, the Washington County Environmental Department will issue a statement of compliance, which must accompany the Final Plat when presented before Commissioners Court for approval.

Section 10 – Public Water and Wastewater Requirements

10.01 Public Water Design and Construction Criteria

All public water utility design and construction proposed within any platted subdivision shall comply with the latest edition of the Texas Commission on Environmental Quality (TCEQ) Water Quality Standards and **Chapter 3 of the City of Brenham Public Infrastructure Design Manual.**

10.02 Public Wastewater Design and Construction Criteria

All public wastewater utility design and construction proposed within any platted subdivision shall comply with the latest edition of the Texas Commission on Environmental Quality (TCEQ) Wastewater Quality Standards and **Chapter 4 of the City of Brenham Public Infrastructure Design Manual**.

Section 11 – Fire Suppression Requirements

11.01 Fire Suppression Pond Requirements for Subdivisions

Each subdivision that includes twenty (20) or more lots (which include subsequent phases) that does not include a potable water system with incorporated fire hydrants shall include adequately sized fire suppression pond(s) to ensure sufficient fire protection coverage and to meet local fire code requirements.

1. **Design and Capacity**

   Fire suppression ponds shall be designed to provide a minimum of four thousand (4,000) cubic feet of water for a subdivision up to fifty (50) lots. An additional fifty (50) cubic feet shall be provided for each additional lot.

   The pond shall maintain a usable volume that accounts for sedimentation, evaporation, and annual maintenance.

   Stormwater detention volume may not be utilized as fire suppression pond volume.

2. **Location and Accessibility**

   Ponds must be strategically located to ensure rapid and safe access for firefighting vehicles and personnel.

3. **Construction Standards**

   Ponds shall be constructed in accordance with county and state standards, including appropriate lining, overflow precautions, and erosion control measures.

   The pond shall have a stable spillway or overflow outlet designed to prevent flooding or erosion.

4. **Maintenance and Inspection**

   A maintenance plan shall be prepared and approved by the county, detailing procedures for regular inspection, sediment removal, and repair.

   The homeowner’s association or designated entity shall be responsible for ongoing maintenance.

5. **Standpipe Requirements**

   A standpipe shall be installed at each fire suppression pond or at strategic locations within the subdivision as approved by the County Engineer or their designee.

   a. **Specifications**

      All proposed piping from the standpipe to the inlet shall be no smaller than six (6) inches in diameter and composed of ductile iron pipe (AWWA C151) or stainless steel pipe (AWWA C220)

      The standpipe shall be capable of delivering a flow rate of at least 250 GPM when connected to firefighting hoses.

      The standpipe shall be equipped with appropriate caps, orifices, and fittings to facilitate firefighting operations.

   b. **Access and Signage**

      Standpipes shall be clearly marked and accessible to emergency personnel at all times.

      Signage shall indicate flow capacity, connection points, and required protocols for use.

   c. **Location**

      Standpipes shall be located in visible areas that are accessible to the local fire department.

6. Strainer

All fire suppression systems shall include a strainer located at the inlet.

a. Specifications

Strainers shall either be a perforated horizontal or vertical barrel design.

Strainer material shall be either stainless steel or PVC.

Strainer shall include a flush cover check valve.

b. Location

Strainer shall be installed with a vertical support that maintains the depth of the inlet strainer no less than two (2) feet from the bottom of the pond.

7. Additional Considerations

Incorporate signage indicating the presence of fire suppression ponds.

Section 12 – Floodplain Management

12.01 Floodplain Management

Washington County Commissioners Court adopted an order for Floodplain Management and has assigned the responsibility to the Washington County Environmental Department to ensure each development adheres to the most recent up to date laws as regulated by **FEMA, Federal Emergency Management Agency.** [Code of Federal Regulations]

Each developer must contact the Floodplain Administrator of the Washington County Engineering and Development Services Department to be certain all requirements are met. Upon compliance the Washington County Environmental Department will issue a statement of compliance, which must accompany the Final Plat when presented before Commissioners Court for approval.

ANY development showing any property which lies within the floodplain, as determined by the flood insurance rate map (FIRM), previously known as the flood hazard boundary map (FHBM), has specifications which are in addition to the subdivision platting requirements, and these specifications must be shown on the preliminary and final plat. To obtain these specifications and requirements the developer must contact the Floodplain Administrator of Washington County.

Section 13 – Addressing

13.01 Addressing Standards and Procedures

Washington County adopted an order for Addressing Standards and Procedures. Commissioners Court has assigned the responsibility to the Washington County Engineering and Development Services Department to ensure each development adheres to the most recent regulations by **Chapter 258 of the Texas Transportation Code**.

All developers, landowners and developments must comply with the current **Washington County Addressing Standards and Procedures.**

Subdivision infrastructure shall be deemed substantially complete by the Engineering and Development Services Department prior to addressing of lots within the development.

Subdivision and Road Name Approval Process

Washington County Addressing Department will issue a statement of compliance, which must accompany the Final Plat when presented before Commissioners Court for approval.

Section 14 – Variances

14.01 Variances

1. The Commissioner's Court of Washington County shall have the authority to grant variances from these regulations when the public interest or the requirements of justice demands relaxation of the strict requirements of the rules.
2. Any person who wishes to receive a variance shall apply to the County Engineer. All variance requests shall be submitted in writing to the County Engineer. The request must state the provisions to which a variance is being sought while illustrating the necessity for the variance. It must be further shown that the variance will not create adverse impacts to the public interest.
3. The decision of the Commissioner's Court whether to grant or deny a variance is at its complete discretion, and shall be final.
4. No variance shall be granted regarding bonding.

   Financial hardship to the applicant shall not be deemed sufficient reason to constitute the recommendation of a variance.

Section 15 – Penalties

15.01 Penalties

1. **Section 232.005 of the Texas Local Government Code** provides for the enforcement of the state subdivision laws and of these regulations.
2. A person commits an offense if the person knowingly or intentionally violates a requirement of these regulations and other appendices incorporated herein. Such offense is a Class B misdemeanor, as defined in the Texas Local Government Code as amended.
3. Under Texas Law, a person may be jointly responsible as a party to an offense if the person (acting with intent to promote or assist the commission of the offense) solicits, encourages, directs, aids, or attempts to aid another person to commit the offense. Thus, a real estate agent or broker, a lender, an attorney, a surveyor, an Engineer, a title insurer, or any other person who assists in violating these regulations may also face criminal penalties.
4. Besides prosecuting a criminal complaint, the County Attorney or other prosecuting attorney for the County may file a civil action in a court of competent jurisdiction to enjoin any violation or threatened violation of these regulations, and to recover damages.
5. A tract that has been subdivided without compliance with these regulations will be ineligible to obtain a permit for the construction or modification of a private sewage facility located on the tract.