ENGINEERING DESIGN CRITERIA

City of Claremore
Oklahoma

Prepared by:

INCOG

CITY OF CLAREMORE
ENGINEERING DESIGN CRITERIA

AMENDMENTS PAGE

PC	CITY	EFFECTIVE DATE	RESOLUTION OR ORDINANCE #	ACTION/DESCRIPTION
N/A	March 18, 2002	April 18, 2002	Ordinance No. 2002-09	Adopted as an Element of the Claremore Land Development Code

City of Claremore

Engineering Design Criteria

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INTRODUCTION

This assembly of Engineering Design Criteria and Standard Specifications for Construction has been prepared by the City of Claremore and adopted by the City Council by Ordinance 2002-09, dated March 18, 2002. These standards are provided to assist any person, firm, corporation or governmental entity in complying with said ordinances and resolutions. It is the purpose of these criteria to establish public policy for the development of privately, as well as publicly, financed public improvements.

The review and approval of water, sanitary sewer, storm water, and street plans by the City is a subsystem of the overall subdivision platting process. However, it is recommended that the developer and/or engineer coordinate the project with the City at the conceptual level so that the engineering staff, being familiar with the project, can process it expeditiously.

Criteria and Specifications set forth herein shall be considered as minimum criteria and specifications pertaining to development and construction of privately or publicly financed improvements. Promulgation hereof and adherence hereto shall not be considered as relieving persons or entities governed hereby from prudent, reasonable development design and construction practices.

The provision hereof these Engineering Design Criteria and Standard Specifications for Construction shall be effective on and after the 18th day of April, 2002. Any project beginning on or after such date shall be governed by the Engineering Design Criteria and Standard Specifications for Construction contained herein.

Improvement plans must be approved by the City prior to any construction of improvements. During installation of the improvements, an approved set of plans must be on-site at all times.

Maintenance bonds shall be required for all improvements, and the bonding period shall begin on the day of final acceptance of the improvement by the City of Claremore.

The purpose of the Engineering Design Criteria is to establish minimum standards for the design and development of construction plans prepared by a Professional Engineer. While certain interim requirements may be imposed, it is the intent of these Engineering Design Criteria that the Professional Engineer be fully and exclusively responsible for producing an acceptable set of construction plans in compliance with the Engineering Design Criteria. City of Claremore personnel, except as otherwise provided herein, will make reviews on behalf of the City to document that an acceptable product is produced.

The Engineering Design Criteria must not be interpreted in any manner that allows the production of an unacceptable product or endangers the health, safety or welfare of the general public. An acceptable product is essential.

SECTION 1 - GENERAL STANDARDS

NOTE: The design parameters listed in this document pertain to the design of any facility within the service/maintenance area of the City of Claremore. All other Federal, State and local regulations that stipulate other criteria not covered here must also be adhered to. All construction details shall meet or exceed the City of Claremore Engineering Design Criteria and Construction Specifications.

1. Bonds:

    a. City Owned Projects: For all construction projects performed for the City of Claremore, performance, statutory and maintenance bonds, in an amount equal to 100 percent of the construction costs as approved by the Claremore City Council, shall be posted prior to start of construction. The performance and statutory bonds shall expire once the project is completed and accepted by the City. The maintenance bond shall extend for a one-year period after the completion and acceptance of all improvements. In special circumstances, the City of Claremore reserves the right to extend the one-year maintenance bond requirement. All bonds shall be obtained from a company on the U.S. Department of Treasury List of Approved Surety (Circular 570)

    b. Development Projects: See Subdivision Regulations

2. Construction Costs: A detailed copy of the Construction Bid showing total costs and unit costs for all items on all projects shall accompany the bond or fee submittal.

3. Final Acceptance: The improvements are accepted by the City only when the City issues a letter of acceptance of the improvement to the developer.

4. Record Drawings: Upon completion of construction, the consulting engineer shall furnish the City a complete set of "Record Drawings" (plans of the improvements as they were actually installed). Three sets of record drawings shall be submitted on paper and also a computer disk of the Record Drawing files in .dxf *or* .dwg format.

5. Surveying

    a. Land Surveys: All land and boundary surveys for design and construction shall be performed by a surveying company and/or individual licensed to practice by the Oklahoma State Board of Registration for Professional Engineers and Land Surveyors.

b. Benchmarks

(1) All elevations shown on the plans shall be based on NAVD, 1988 adjustment, datum.

(2) Horizontal controls shall be on the basis of the NGS Oklahoma State Plane Coordinate System, NAD 83, latest revision.

(3) The permanent bench mark location and description used to extend level datum to the projects shall be noted on the plans.

(4) All temporary bench marks used for control of the project shall be designated on the plans stating elevation, location and description. The nearest such bench mark shall be shown on each sheet, on public projects only.

c. Alignment Surveys

(1) Alignment surveys for water, sewer, storm drainage and roadway designs shall begin at a station designated to the nearest hundred feet. Station 0+00 shall be used to start all surveys, unless back stationing is a possibility. Station 10+00 shall be the beginning station for all alignment surveys where back stationing may be needed. (Exceptions shall be considered on a case-by-case basis.)

(2) Alignment surveys for sanitary sewer and storm drainage projects shall begin at the downstream terminus and proceed upstream.

(3) Alignment surveys for roadway and water line projects should generally proceed from west to east or from south to north.

6. Drafting

a. Media Material

(1) Construction plans drawn and lettered by hand shall be prepared on a high quality reproducible medium that can be reproduced to make high quality blue-line or photo-copies.

(2) Construction plans prepared using computer aided design programs shall be prepared on reproducible velum sheets. Originals provided to the City of Claremore shall be on velum sheets that are plotter printed, not sepia copies.

(3) Black India ink shall be used on all drawings

b. Media Size

(1) Full Size Sheets: Standard sheets shall be 22" x 34" or 24" x 36" having a margin of 1.5-inch along the left border and 0.5-inches along the top, bottom and right borders. Full size sheets shall be used for submitting plans to the City for review and for bidding.

(2) Half Size Sheets: Half size sheets may be submitted to the City of Claremore, after prior approval from the reviewing City Engineer. Half size sheets may also be used at the request of the Contractor. The Design Engineer shall correct the scale on the half size sheets so the user does not have to convert scales from the full size drawings.

c. Lettering, Line Weights and Symbols

(1) All line work shall be of sufficient density to be reproducible by current reproduction processes. Any line work which does not reproduce satisfactorily may be cause for rejection of the plans by the City.

(2) Freehand lettering shall not be allowed.

(3) All lettering shall be at least 0.08 inch. All lettering must be legible at half size.

d. Scales:

(1) Water, Sanitary Sewer and Storm Sewer Lines/Storm Sewer Channels

(a) Plan and Profile Sheets

i. Congested Areas: 1 inch = 20 feet (1" = 20') horizontal and 1 inch = 5 feet (1" = 5') vertical (existing developed areas).

ii. Uncongested Areas: 1 inch = 50 feet (1" = 50') horizontal and 1 inch = 5 feet (1" = 5') vertical in lower congested areas (new subdivisions).

(b) Detail Sheets - 3/16 inch = 1 foot (3/16" = 1'- 0")

(c) Cross Section Sheets - 1 inch = 10 feet (1" = 10") horizontal and 1 inch = 5 feet (1" = 5') vertical.

(2) Streets/Roadways – See Street Design Standards

(3) Site Grading Plans - 1-inch = 50 feet (1" = 50')

7. Plans For New Improvements

a. Title Sheet: A title sheet shall be included on all plans. The following information shall be included:

(1) Project title

(2) Project location map (1inch = 2000 feet minimum)referencing plan sheet layout.

(3) Project owner's name, address, telephone number

(4) Funding source (if applicable)

(5) City Councilors /Public Works Authority Trustees (City of Claremore projects only)

(6) Contact person (other than the Owner)

(7) Engineer's name, address, and telephone number.

(8) Drawing index and legend

(9) Seal of the Professional Engineer responsible for the project. (Oklahoma registration only)

(10) Signature area for the City Manager and Public Works Director to approve drawings (City of Claremore projects only)

(11) OKIE One Call Logo

(12) Legend: A legend showing typical symbols to be used in the preparation of engineering plans is included at the end of this section. Topography for which symbols are not standardized shall be indicated and named on the plan and profile. The complete legend of symbols shall be shown on the cover sheet.

b. Plan/Profile and Detail Sheets: The design criteria for general information on plan sheets are the following:

(1) The title sheet shall not be used for a plan sheet on public projects.

(2) North or west should generally be oriented to the top or right hand side of all water line and street projects.

(3) Stationing shall increase from left to right.

(4) North shall be oriented as needed on all gravity line projects as long as the downstream end of the line is on the left hand side of the sheet.

(5) A title block shall be located in the lower right hand corner of each sheet and shall include the following:

(a) Project title

(b) Owner's name

(c) Engineer's name

(d) Drawing description

(e) Scale

(f) Sheet number

(g) Date the last revisions were made.

(h) Initials of the design engineer responsible for the drawing.

c. General Requirements for Plans

(1) References

(a) All base and plan maps shall reference existing and proposed land lines. (property, lot, setback, section lines, etc.). These lines, such as property lines, lot lines, right-of-way lines, easement lines, building lines, section and quarter section lines shall be located.

(b) At least one benchmarks (BM) or temporary bench marks (TBM) with known elevation to the hundredth shall be on a single site plan sheet. On multiple site projects, such as water, sewer, roadway, and storm drainage projects shall have at least two separate benchmarks referenced per plan and profile sheet on public projects.

(c) All benchmarks or beginning construction stations shall be referenced for future location.

(d) When more than one plan sheet is involved in a project, an overlap of not less than one inch at map scale with a match line should be provided.

(e) When unusual subsoil or drainage conditions are suspected, a geotechnical analysis shall be made and a special design prepared in line with good engineering practices.

(2) Existing Improvements: Each plan sheet shall show all improvements located above and below ground, horizontally and vertically. These should be items that could be effected by construction or a part of the construction.

(a) Structures
(b) Utilities
(c) Roadways
(d) Drainage

(3) No public improvements shall be installed without dedication of right-of-way or appropriate easements. These easements shall be submitted for review and acceptance prior to filing. Restricted easements will be filed by the City. Offsite easements shall be filed by the City.

(4) All structures (manholes, junction boxes, inlets, headwalls, etc.) shall be numbered and labeled both in plan and in profile and detailed on plans.

(5) Waterlines, sanitary sewer and storm sewer lines shall be identified on both plan and profile sheets.

(6) Drawings shall show all obstructions existing and proposed, above and below ground. These shall be located vertically and horizontally. The Engineer shall be responsible for contacting ALL utilities to obtain locations of their facilities. This also applies to various affected pipeline companies.

8. Site Grading Plan

a. Present Site Conditions:

(1) Topography: Existing site topography extending a minimum of 50 feet past property limits with contour lines at 2 feet maximum interval.

(2) Existing features:

(a) Easements and rights-of-way

(b) All utilities

(c) Drainageways with 100-year floodplain and floodway limits

(d) Buildings, fences, retaining walls, and other physical features

(e) Test hole locations

(3) Elevations on plans shall be U.S.G.S. datum. Benchmarks used for the project shall be noted on the first plan sheet of each project, and their location and elevation shall be clearly defined. At least one permanent benchmark shall be established per 20 acres of development or project site, with a minimum of one benchmark per development or project site. State plane coordinates for each benchmark shall be recorded with the benchmark.

b. Proposed Site Conditions:

(1) Proposed contours with match to existing contours of adjacent property

(2) Drainage flow arrows for individual lots

(3) Grade breaks and slopes 3:1 or greater

(4) Top of curb elevation at each property line extension

c. Proposed improvements:

(1) Sidewalks, bike paths, and other public improvements

(2) Storm drainage structures

(3) Fences, retaining walls and other physical site improvements (cross sections may be necessary to detail these features)

(4) Minimum finished floor elevations for buildings

(5) Driveway grades

d. DEVIATIONS: Deviations from the accepted site grading plan must be reviewed and accepted by the City Engineer to:

(1) Revise pad elevation

(2) Revise finished floor elevation

(3) Change drainage flow direction

(4) Revise other significant proposed features

9. Detention Plans

a. Present Site Conditions:

(1) Topography: Existing site topography extending a minimum of 50 feet past property limits with contour lines at 2 feet maximum interval.

(2) Existing features:

(a) Easements and rights-of-way

(b) All utilities

(c) Buildings, fences, retaining walls, and other physical features

(d) Test hole locations

(3) Elevations on plans shall be U.S.G.S. datum. Benchmarks used for the project shall be noted on the first plan sheet of each project, and their location and elevation shall be clearly defined. At least one permanent benchmark shall be established per 20 acres of development or project site, with a minimum of one benchmark per development or project site. State plane coordinates for each benchmark shall be recorded with the benchmark.

b. Proposed Site Conditions:

(1) Proposed contours with match to existing contours of adjacent property

(2) Grade breaks and slopes.

(3) Top of berm and bottom of pond elevations

(4) Outlet structure details and elevations

(5) Water surface elevation of pond during 100 year event shown with a dashed line

c. Proposed improvements:

(1) Sidewalks, bike paths, and other public improvements

(2) Storm drainage structures

(3) Fences, retaining walls and other physical site improvements (cross sections may be necessary to detail these features)

(4) Minimum finished floor elevations for buildings

(5) Driveway grades

d. DEVIATIONS: Deviations from the accepted site grading plan must be reviewed and accepted by the City Engineer to:

(1) Revise pad elevation

(2) Revise finished floor elevation

(3) Change drainage flow direction

(4) Revise other significant proposed features

10. Erosion and Sedimentation Control Plans

a. Drawing Contents

(1) General Location Map: A map shall be provided in sufficient detail to indicate the location of the project site. The map should be at a scale of 1" - 1000' to 1" = 2000' and should indicate the project site in relation to existing topographic, and transportation, features and land boundaries. The map shall show the drainage area of land tributary to the site.

(2) Sediment and Erosion Control Plan: Map(s) of the proposed development at a scale of 1" = 20' to 1" = 200' on 22" x 34" drawing sheets shall be included. The plan shall show the following:

(a) A boundary line survey of the site on which the work is to be performed.

(b) Existing topography at a maximum of two (2) foot contour intervals. The contours shall extend a minimum of 100-feet beyond the property line (if available).

(c) Proposed topography at a maximum of two (2) foot contour intervals.

(d) Location of any existing structure of natural feature on the site.

(e) Location of any structure of natural feature on the land adjacent to the site and within a minimum of 100 feet of the site boundary line. The map shall show the location of the storm sewer, channel, or creek receiving storm runoff from the site.

(f) Location of any proposed additional structures of development on the site, if known.

(g) Limits of clearing and grading - Areas which are to be cleared and graded.

(h) Proposed location of erosion control barrier.

(3) Detailed Drawings: Detailed drawings and structural practices used that are not referenced in this Manual and other information or detail as may be reasonably required by the City.

SECTION 2 - STREETS

1. General

   a. Street Classification:

      (1) Urban Streets: City streets shall be either asphalt or concrete pavement. Concrete paved streets shall have integral concrete curbs. Asphalt paved streets shall have concrete curb and gutter.

      (2) Alleys: City alleys shall be asphalt or concrete pavement, with an inverted crown and the curb omitted. Asphalt paved alleys shall have a concrete "V" drain along the centerline of the alley. All materials used in the construction of streets shall be in accordance with the City of Claremore's Standard Construction Specifications.

      (3) Residential Living Streets: RS-25, RS-40 and RS-60 Rural Residential Subdivisions and RS-25 CL, RS-40 CL and RS-60 CL Rural Residential Country Living Subdivisions being developed under the Country Living standards may utilize borrow ditches in lieu of the curb and gutter requirement.

   b. Design Plan View Requirements: The following information shall be shown on the plan portion of the drawing:

      (1) Width of pavement (gutter flow line to gutter flow line).

      (2) Curb radii with elevation and stationing at radius points.

      (3) Location and size of existing and proposed utilities and topographic features shall be shown.

      (4) Central angle, centerline radius, arc length and tangent distance of horizontal curves. Stationing of beginning and end of paving, PC and PT stationing of curves and ties to lot corners.

      (5) All lot dimensions, lot lines, easements, and alleys.

      (6) Proposed storm drainage system.

      (7) Scales:

         (a) Arterial Streets: Minimum scale: 1:200 (1 inch = 20 feet)
         (b) Collector Streets: Minimum scale: 1:500 (1 inch = 50 feet)
         (c) Residential Streets: Minimum scale of 1:1000 (1 inch = 100 feet)

(d) All intersections, cul-de-sacs, and other critical locations shall be shown in plan detail at the same scale as the street plan or a minimum scale of 1:500 (1 inch = 50 feet), which ever is greater, including direction for drainage, top of curb elevation at PC's, PT's and high or low points. All curve information and drainage structures shall be shown in detail.

c. Profile. The following information shall be shown on the profile portion of the drawing:

(1) Existing ground lines at both right-of-way lines.

(2) Proposed centerline grade and stationing. Roadway cross slope left and right.

(3) The PT, PI, and PC of vertical curves, and the sag or crest of vertical curves, and vertical curve station and elevation at 50 feet intervals.

(4) The vertical curve length.

(5) All existing and proposed drainage structures and utilities shall be shown whether they cross the new roadway perpendicularly or run parallel within the construction limits.

(6) Elevation and station of crests and sags.

(7) Scale: Profile for streets shown on plan and profile sheets shall be shown at the same scale with the stations for the profile immediately below the profile stations. Vertical scale shall be a minimum on 1:50 (1 inch = 5 feet).

d. Typical Section. See Standard Drawings for information needed on a typical section. As a minimum, the following is required:

(1) Dimensions
(2) Fill Slope
(3) Original ground
(4) Selected material or prepared roadbed
(5) Shoulder surfacing
(6) Subbase
(7) Base course
(8) Surface course
(9) Back slope
(10) Fore slope
(11) Shoulder slope

(12) Crown slope
(13) Right-of-way width
(14) Lane width
(15) Shoulder width
(16) Roadway width
(17) Roadbed width
(18) Type and thicknesses of materials including:

(a) Concrete Pavement
(b) Asphaltic Concrete Pavement
(c) Tack and Prime Coats
(d) Concrete Curb and Gutter
(e) Subgrade
(f) Aggregate Base
(g) Dowels
(h) Reserve Topsoil
(i) Temporary and Permanent Erosion Control

e. Cross Sections

(1) Cross sections shall also be required for all street construction.

(2) All cross sections within street rights of way shall be drawn to scale showing existing ground and proposed construction from building line to building line.

(3) Each section shall be stationed clearly and correspond to the plan and profile sheets.

(4) The beginning and ending points of a project shall be stationed and cross sections for both the stations shall be drawn.

(5) Maximum interval between cross sections shall be 100 feet. Additional cross sections shall be included were drainage pipe, storm drainage, and driveways are present.

(6) Sufficient roadside information shall be furnished to show that water will not pond behind curbs or in ditches.

(7) Scale for cross sections shall not be less than 1:50 (1inch = 5 feet) horizontal and 1:50 (1inch = 5 feet) vertical.

(8) On development projects, cross-sections may or may not be required, if enough information about the road, drainage, utilities and right-of-way is shown on the grading plan. Cross-section requirements will be reviewed on a case-by-case basis.

2. Street Design: In the preparation of paving design, the following criteria shall be observed:

a. Grades

Street Classification	Minimum	Maximum
Freeway	0.5%	4%
Arterials	0.5%	6%
Commercial / Industrial	0.5%	5%
Central Business District	0.5%	5%
Residential Collector	0.5%	8%
Local (Minor)	0.5%	10%
Cul-de-sac	0.5%	10%

b. Cross slope. The cross slope of the street shall be 1/4-inch per foot (2%) for urban streets and 3/8-inch per foot (3%) for residential living streets. Crowns shall be flattened off so that the crown never exceeds curb height.

c. Vertical curves:

(1) Vertical curves shall be the minimum length available for the two grades as defined by the AASHTO publication titled "A POLICY OF GEOMETRIC DESIGN OF HIGHWAYS AND STREETS."

(2) Minimum Grade: The minimum grade for gutters and centerline shall be 0.5 percent.

(3) Maximum Grade: The maximum grade for non-arterial streets shall be limited to 8 percent. Where the topography is hilly, grades will be permitted up to a maximum of 12 percent providing they do not exceed 500 feet in length from PT to PC, except in areas near intersections, where the 8% maximum will apply.

(4) Minimum Length: The minimum length of vertical curves for the various streets are as follows:

100 feet - Local (Residential) Streets
150 feet - Collector Streets
200 feet - Arterial Streets

d. Horizontal Curves. (Deflections greater than 10 degrees)

e.

Street Classification	Minimum centerline Radius	Minimum centerline Tangent
Freeway	500'	200'
Arterial	500'	200'
Commercial / Industrial	500'	200'
Central Business District	500'	200'
Residential Collector	270'	100'
Local (Minor)	75'	100'
Cul-de-sac	75'	100'

e. Minimum curb return radii at intersections

Street Classification	Minimum Curb Return Radius (*)
Freeway	40 feet
Arterials	40 feet
Commercial / Industrial	40 feet
Central Business District	40 feet
Residential Collector	30 feet
Local (Minor)	25 feet
Cul-de-sac (**)	25 feet

(*) When two streets of different classifications intersect, use the larger of the two radii shown in the table above.

(**) Refers to the entrance into the cul-de-sac's turnaround

f. Intersections

(1) When sidewalks are required, all curb returns shall be designed with a wheelchair ramp according to the ADA. Intersections shall be approached on all sides by leveling areas. Where the grade exceeds seven (7) percent, such leveling areas shall have a minimum length of 75 feet measured from the intersection of the centerlines, within which no grade shall exceed a maximum of four (4) percent.

(2) Right angle intersections shall be used whenever practicable. The angle of intersection of the street centerlines shall not be less than 70 degrees.

(3) Elevations at street intersections shall be computed by extending curb grades to the point of intersection (PI) of curb returns. A minimum fall of 0.5% around a curb return is required. Elevations

and centerline stationing at all radius points shall be shown on the plan. All pavement stationing shall be shown using back of curb data.

(4) Curb returns from driveways shall not encroach on adjacent properties. The back of the driveway apron shall be as high as the adjacent curbs.

(5) Proposed residential areas shall not use four (4) leg intersections within the development.

(6) Grades at collector/arterial intersections and 50 feet back of radius point shall not exceed 3%.

(7) Grades at residential/ residential intersections and 50 feet back of radius point shall not exceed 4%.

(8) Grades at residential /arterial intersections and 50 feet back of radius point shall not exceed 2%.

(9) Sight Distance

(a) The intersection sight area shall be kept free of obstacles by appropriate design and plat restrictions. The corner sight distances for streets are as listed below:

Mainline Design Speed (mph)	Stop Controlled Intersection (2x2 lanes) Feet	Stop Controlled Intersection (2x2 lanes) Feet	Stop Controlled Intersection (2x2 lanes) Feet
20	325	205	470
25	400	240	585
30	490	290	705
35	595	355	820
40	705	420	940
45	795	505	1055

(b) Sight Distance Triangle: To maintain sight distance, restrictions on height of embankment, locations of buildings, and screening fences may be necessary. Landscaping in the sight distance triangle shall be low-growing, and shall not be higher than 3 feet above the level of the intersecting street pavements. Tree overhang shall be trimmed to a line at least 8 feet above the level of the intersections.

g. Design Speeds: Design speeds shall be 25 mph on all residential and collector streets, 35 mph on secondary arterial streets and 45 mph on arterial streets, except as modified by the City Traffic Engineer.

h. Additional Lanes

(1) Right turns from a development are required if the projected vehicles turning right out of the development is greater than 300 vph.

(2) Left turns from a development are required if the projected vehicles turning right out of the development is greater than 150 vph.

(3) Deceleration lane is a right turn into a development that has a lane width of not less than 13 feet wide from a distance of not less than 100 feet plus corner radius, measured from the center line of the road on which the right turn is to be executed, and a thirty (30) to one (1) taper back to the existing arterial street width. They are required when 100 vehicles per hour (vph) turn right a during peak period.

i. Cul-de-sacs. See Standard Drawings for information needed on cul-de-sacs.

j. Barricade. At the end of a temporary cul-de-sac, a TYPE III ODOT barricade shall be installed.

k. Pavement Parameters

(1) Asphalt: Asphaltic Concrete shall be Types A, B and C per Oklahoma Department of Transportation Standard Specifications for Highway Construction, latest revision

(2) Concrete: Paving concrete shall be Class "AA" (4,000 psi), designed and proportioned in accordance with Section 701A, Standard Specifications for Highway Construction, ODOT, latest revision.

(3) Minimum Thicknesses:

(a) Industrial and commercial pavement sections shall have a minimum thickness of 10-inches asphaltic concrete or 8-inches Portland cement concrete.

(b) Residential pavement sections shall have a minimum thickness of 6-inches asphaltic concrete or Portland cement concrete.

l. Construction Joints: Joints in Portland cement concrete shall be located in accordance with Standard Specifications. A joint layout plan shall be reviewed by the City Engineer.

m. Soil Stabilization: The developer shall provide soil tests for all areas to be paved. Soil tests will be submitted to the City Engineer for review. If soil tests indicate that the soil has a plasticity index of 10 or greater, a minimum of eight (8) inches of subgrade shall be modified with a minimum of 5 percent hydrated lime by weight or Class C fly ash or other suitable material reviewed by the City Engineer. If the soil tests indicate that the soil is granular and unstable, the subgrade shall be stabilized with cement or fly ash. If desired, subgrade may be built of an accepted borrow material.

n. Base Material: Soils tests from the above requirement shall be used to determine the required aggregate base thickness. Six (6) inches shall be the minimum base thickness used on asphalt streets.

3. Curbs.

a. Concrete Streets: Portland cement concrete streets shall have an integrally placed curb of the same mix design as for street paving. Curbs shall be in accordance with the Standard Specifications and Construction Drawings.

b. Asphalt Streets: Asphaltic concrete streets shall have a Portland cement concrete curb and gutter. The curb shall be in accordance with the Standard Specifications and construction Drawings

c. Types: All curb sections shall be vertical curb or mountable type curbs. Where mountable curbs are used, driveway cuts shall be permitted upon approval of City Engineer.

d. Joints: Construction joints are required every 100 feet. Sawcut joints are required every 20 feet.

4. Driveway Approaches (City Owned Projects Only)

a. General

(1) A driveway approach sketch shall be submitted with the driveway permit application for review by the Engineering Division.

(2) A variance from the driveway approach standards described in this section and contained in the City's Standard Specifications and Construction Drawings may be granted upon review by the Director of Public Works and City Engineer. During the absence of either the Director of Public Works or City Engineer, the Traffic Engineer shall replace the absent party.

(3) A driveway approach installation and/or maintenance not meeting the requirements of the driveway approach standards may be corrected by the City if deemed necessary by the Public Works Department, at the expense of the property owner and after notice to the property owner to correct the problem.

(4) Specifications for all materials used in constructing a driveway approach shall be reviewed by the City Engineer.

(5) All subgrade shall be compacted to 95% standard proctor density before any paving material shall be placed. However, no tests will be required.

(6) All private roads, driveways, or streets serving residential, commercial, or industrial developments within the City, the use of which is not restricted, but is open to the public, either by connection with an existing street or because the design thereof does, in fact, constitute a thoroughfare accessible to the public, shall be constructed to specifications required for local streets.

(7) Driveway approaches entering a state or federally designated highway shall be approved by the Oklahoma Department of Transportation.

b. Grades

(1) High Volume Driveway, 3% max for drive, 0% desirable, 6% max for approach,

(2) Low Volume Driveway on arterial, 6% max for drive, 3% desirable, 6% max for approach

(3) High Volume Driveway on residential, 10% max for drive, 6% desirable, 14% max for approach

(4) Driveway approaches shall slope toward the street so that water stays in the curb and gutter.

c. Minimum Width: Minimum approach width is 10-feet

d. Special Conditions

(1) Type I Driveway Approaches (streets with side ditches)

(a) Neither the intersection point of the driveway approach with the edge of pavement or the end of drainage culvert pipe shall extend past the projected side property line, unless written permission is given by the affected property owner.

(b) Drainage pipe may be constructed of corrugated metal, reinforced concrete or high density polyethylene with smooth interior walls. The minimum pipe diameter shall be 18-inches.

(c) A drainage culvert pipe may not be required if the proposed driveway is located in an area with little to no contributing drainage area and a shallow ditch, 12-inches depth or less. The Engineering Division shall determine if a drainage culvert pipe is required.

(2) Type II Driveway Approaches (streets with curb and gutter)

(a) Type II driveway approaches shall be Class AA (4000 psi) concrete, 6-inch minimum thickness. For driveway thickness of 8-inch or greater, dowels are required at contraction joints and at joint connection with the street.

(b) At right-of-way line, the drive shall be at least the same elevation as the top of the existing curb.

(c) Connections to the existing curb will meet and match the old curb.

(d) Between driveways, construct a minimum 10-feet width pedestrian safety island at and parallel to the property line.

(e) Where the existing pavement is asphalt with concrete curb

and gutter, remove both curb and gutter, then construct driveway and gutter as one unit.

(f) Immediately after finishing operations, curing shall be accomplished by either wetted earth, cotton mats, wet burlap bags, membrane curing compounds, or other methods accepted by the City Engineer.

(g) Sawed contraction joints shall be made as soon as the concrete has set firmly enough to support the concrete saw without tracking. The joints shall be filled with rubberized asphalt or other material accepted by the City Engineer.

(h) All exposed edges shall be tooled to no less than one-quarter (1/4) inch radius (curb backs and slabs).

(i) Radii for the returns at the street shall be a minimum seven (7') feet

SECTION 3 - SIDEWALKS

GENERAL:

1. Outside edges of sidewalks shall be placed one foot within the street right-of-way.

2. Residential sidewalks shall have a minimum width of four (4) feet, and sidewalks in commercial and industrial areas shall have a minimum width of five (5) feet. Sidewalks on arterial streets shall be six (6) feet wide.

3. Whenever possible, sidewalks shall be in compliance with the ADA requirements.

4. The sidewalk plan shall show the sidewalk in plan view, and a typical section.

5. Sidewalks shall be designed in accordance to the City of Claremore Subdivision Regulations.

6. All sidewalks shall be of Portland cement concrete (3,500 psi). Sidewalks shall include pedestrian bridges across creeks and streams where applicable.

7. The finished thickness of Portland cement concrete sidewalks shall not be less than 4-inches and the width. Sidewalks across driveways shall be 6-inches thick.

8. Driveways may be utilized as appropriate, provided that the cross-slope of the driveway on each side of the sidewalk does not exceed 2%.

9. Transverse crack control joints shall be placed at intervals not to exceed 5-feet. Joints shall be tooled or sawed to a depth of 1-inch.

10. Expansion joints shall be placed at curbs, driveways, or abutting structures and no further apart than 100 feet.

SECTION 4 – STREET SIGNAGE/STRIPING

1. General: Street and traffic control sign plans shall be prepared by the City of Claremore. The developer shall be responsible for street name and intersection traffic control signage. Following is a list of signs for which the developer is responsible:

Designation	Description
OM	Object Markers
R1-1	Stop
R1-2	Yield
R2-1	Speed Limit
R4-7	Keep Right
R4-8	Keep Left
R5-1	Do Not Enter
R5-9	Wrong Way
R6-1	One Way
W8-5	Bicycle Crossing
W11A-2	Pedestrian Crossing Symbol
W14-1	Dead End or Not a Through Street
W15-1	Playground Ahead
	Slow! Children at Play
	School Crossing
	Street Signage

2. Traffic Control Signage: All traffic control signage shall be constructed in accordance to the Manual of Uniform Traffic Control Devices (MUTCD).

3. Street Signage: Street signs shall be placed at each intersection.

   a. Sign Width: 6-inches

   b. Sign Blade Thickness: 0.80 inches

   c. Orientation: Double-sided

   d. Color: Green (Public Streets)
      Red (Private)

   e. Length Alternatives: 24-inches or 36-inches depending on the length of the street name. Developer shall allow a 1-inch margin on each end of the sign.

   f. Signs shall be extruded.

4. Sign Posts and Breakaways:

   a. Sign Posts shall be 1-3/4 inches square tubing.

   b. Breakaways shall be 2-inch square tubing, 3 feet long

5. Lettering: Letters for street signs shall meet the following criteria:

   a. Street Name: 4-inch, white, heat activated letters

   b. Street Designation: 2-inch, white, heat activated letters (i.e. W, NE, Ave, Str.)

6. Special Themes: Upon approval by the City Engineer, special theme signs may be allowed for subdivisions.

7. A Work Zone Traffic Control Plan Shall be provided to the City Engineer for review before any work is done on existing streets.

8. Striping

   Plans for striping of streets requiring striping shall be reviewed by the City Engineer. Contractor shall be approved by City Engineer.

   Striping materials shall be in accordance with the City's Standard Specifications and Construction Drawings.

   Striping shall be in accordance with the following schedule:

Vehicles per Day	Striping Material
Over 4,000	Thermoplastic, full thickness
2,000 - 4,000	Thermoplastic, half thickness
Under 2,000	Paint

SECTION 5 – STREET LIGHTING

1. General

   a. The City of Claremore shall determine the number of lights and placement during review of the development construction plans. The following is a guideline for the lighting on minor streets and local collectors:

      (1) One 150 Watt High Pressure Sodium street light at each street or alley intersection.

      (2) One 150 Watt High Pressure Sodium at each end of each cul-de-sac or other permanently dead ended street.

      (3) One 150 Watt High Pressure Sodium street light at the approximate midpoint of curvilinear streets that prohibit visual contact between intersections.

      (4) One 150 Watt High Pressure Sodium street light midway between intersections that are space 700 feet or more apart.

      (5) The spacing and sizing of thoroughfare lighting shall be in accordance with the criteria of Roadway Lighting Handbook, U.S. Department of Transportation, Federal Highway Administration, current revision.

   b. The developer shall furnish the light pedestals and install them per the manufacturer's specifications.

   c. The City of Claremore shall install the light poles provided by the developer.

   d. The City of Claremore shall trench the underground conduit provided by the developer.

2. Safety

   a. Four basic objectives shall be considered in providing street lighting: aesthetics, traffic safety, security, and intersection identification. The objectives to be considered are directly related to the function of the street to be lighted.

   b. For major thoroughfares, the primary objectives are aesthetics and traffic safety.

c. For minor streets and local collectors, the primary objectives are security and intersection identification.

3. Scheduling: Street lighting shall be chronologically integrated with development. Street lighting shall not be installed until all required offsite improvements such as water mains, sanitary sewer mains, paving, and drainage structures are completed and accepted by the City, to avoid conflicts with other Contractors and workmen. However, street lighting shall be installed prior to extensive development to avoid interference with private landscaping. A good rule to follow is to order street lighting at the same time that street name signs are ordered.

4. Light poles shall be located a minimum of five (5) feet behind the back of curb or future curb, including left and right turn lanes, unless approved by the electrical superintendent.

5. Street lighting is required in all developments, except those developed under the Country Living standard.

6. Approvals

   a. Requests for street lighting shall be submitted to the Claremore Electrical Department. Lighting for all streets shall be reviewed by the Electrical Superintendent.

   b. The Electrical Superintendent shall approve all fixtures and poles prior to installation. Developer shall contact Claremore Electrical Department for list for list of accepted hardware.

7. Point of Delivery: Develop shall deliver poles to job site.

8. Special Themes: Upon approval by the Electrical Superintendent, special theme lighting may be allowed for subdivisions.

SECTION 6 - WATER DISTRIBUTION SYSTEM

1. General

   a. The minimum design criteria for all public water facilities shall be the latest edition of the Oklahoma Department of Environmental Quality (ODEQ) Public Water Supply Facilities and Construction Standards.

   b. All plans pertaining to distribution and treatment of public drinking water must be approved by ODEQ. The developer shall submit the appropriate number of sets of plans, as approved by the City, to ODEQ on behalf of the City for their review and approval. The developer shall be responsible for the plan review fee.

   c. The water distribution system includes the mains, valves, hydrants, consumer service pipes and meters and other appurtenances. The system shall be designed to provide an adequate supply of water to the consumers and for fire protection at all times.

   d. The plans for a water distribution system shall be drawn in plan and profile per segment and show the locations of all appurtenances, and also include a table listing the location of all appurtenances with a full description so that maintenance personnel can copy the table for reference.

2. Water Main Design

   a. Location. Water lines shall be located either in the street right-of-way or in a minimum 15- foot wide utility easement. Valves shall be located behind curb.

   b. Pressure. All water mains shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 25 psi at ground level within each development under peak flow conditions.

   c. Water Main and Sanitary Sewer Main Separation: In no case shall a water main be designed closer than 0.6m (2 feet) vertically or 3m (10 feet) horizontally of a sanitary sewer, unless the sewer line is replaced with pressure pipe. Water mains unable to cross sewer mains with the 2 foot minimum separation and the 2.5 feet surface coverage shall cross the sewer at a minimum distance of 2 feet under the sewer.

d. Water Main and Underground Storage Tank Separation: PVC water lines shall be located at least 50 feet from any gasoline storage tank, as measured from the edge of the pipe to the edge of the closest edge of the storage tank. Wherever the 50 separation cannot be met, ductile iron pipe shall be used.

e. Water Main and Septic Tank Separation: Water lines shall be located at least 15 feet from any septic tank, as measured from the edge of the pipe to the edge of the tank.

f. Water Main and Other Utility Separation: Water lines shall be located 10 feet from underground electric, oil lines, gas lines, storm sewer, underground cable and telephone lines. Deviation from these separation requirements will be reviewed on a case-by-case basis.

g. Alignment: Water mains shall be on the South or East side of right-of-way, 8-feet off property line, unless otherwise approved. Water mains not in street right-of-way shall be centered in a minimum 15-feet restricted waterline easement.

h. Pipe: The City of Claremore allows the following water pipe:

Polyvinyl chloride (PVC): ASTM D 2241, SDR-21, Class 200,
Polyvinyl chloride (PVC): AWWA C-900, DR 18, Class 150 (required in rocky areas)
Ductile iron pipe (DIP): C151, Class 150.
High Density Polyehylene (HDPE) AWWA C906 (In special circumstances)

i. Dead Ends: Dead end mains shall not be allowed unless in unavoidable situations. Length of dead-end mains shall not exceed 600 feet for main sizes 200mm (6") and smaller. Dead ends shall not be allowed in cul-de-sacs

j. Cover. Maximum permissible depth of cover is 8 feet, and minimum cover is 3 feet

k. Diameter: Sizes of new supply mains should be determined by a KYPIPE or other suitable analysis method.The following requirements for minimum diameter are required:

(1) All section and half-section lines – 12 inches

(2) Quarter-section and eighth-section lines – 8 inches

(3) All local and collector streets – 8 inches

(4) Cul-de-sacs not exceeding 500 feet in length – 6 inches for lines providing fire flow. 4" for lines not providing fire flow.

3. Service lines. All service lines shall meet the following minimum requirements:

a. Single-family residence - 3/4-inches diameter

b. Two family residence/ dual residential service - 1-inch diameter

c. Four to eight unit apartment - 2 inches

d. More than eight unit apartments or any commercial business shall have a service line size as determined by the City.

e. Service lines crossing under streets shall be placed in a PVC sleeve.

4. Cover. Maximum permissible depth of cover is 8 feet, and minimum cover is 3 feet, except at air relief valves and "4.5-feet-bury" fire hydrants, where a minimum of 4.5 feet is required.

5. Valves

a. Location:

(1) Positive closing valves should be located so that a single break in the line will require no more than 500 feet of pipe to be disconnected from service in high-value areas, nor more than 800 feet in other areas nor shall require the shutting down of an artery.

(2) Valves shall be located at street intersections so that they can be readily operated in case of a main failure. All small distribution lines branching from larger mains should be valved.

(3) Gate valves shall be installed on all four legs of a cross, three legs of a tee and a wye

(4) Gate valves shall be located on either side of a highway or major roadway crossing.

(5) Gate valves shall be equipped with 18" x 18" concrete aprons

6. Fire Hydrants

a. Location and Spacing.

(1) Coordination of hydrant and valve locations. The location of valves and fire hydrants shall be coordinated with the City Engineering Department and the City Fire Department for water line flushing and break isolation

(2) All hydrant locations are subject to the final approval of the City of Claremore Fire Marshall.

(3) Fire hydrants shall be spaced no more than 400 feet apart.

(4) In commercial districts, hydrants shall be spaced no more than 250 feet apart.

(5) Fire hydrants shall also be located at all subdivision entrance points.

(6) Fire hydrants shall be located in street right-of-way or dedicated easements.

b. Hydrant Leads. The hydrant lead shall be a minimum of six (6) inches in diameter. Auxiliary valves shall be installed in all hydrant leads.

c. Drainage. Drains from hydrant barrels on distribution systems shall not be connected to sanitary sewers or storm drains.

d. Fire hydrant operating nut shall not be over 120 cm (4 feet) above grade.

e. Cover. The minimum line cover at a fire hydrant connection is 4.5 feet .

f. Fire hydrants shall be equipped with individual gate valves and boxes.

g. Fire hydrants shall be placed on all unavoidable dead -ends for flushing.

7. Air Relief Valves:

a. Location: At high points in water mains where air can accumulate, provisions shall be made to remove the air by means air relief valves. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur.

b. Air Relief Valve Piping. The open end of an air relief pipe from automatic valves shall be provided with a screened, downward-facing elbow. The

pipe from a manually operated valve shall be extended to the top of the pit.

8. Blow-off Valves:

   a. Shall be located at low points in the development.

   b. Chamber Drainage. Chambers, pits or manholes containing blow-offs or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or air relief valves be connected directly to any sewer. Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water or to absorption pits underground.

9. Above-Water Crossings. The pipe for above ground piping shall be adequately insulated, supported and anchored, protected from damage and freezing and accessible for repair or replacement.

10. Underwater Crossings. A minimum cover of four feet shall be provided over the pipe for underwater crossings. When crossing watercourses which are greater than 15 feet in width, the following shall be provided:

    a. The pipe shall be of special construction, having flexible watertight joints.

    b. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible and not subject to flooding; and the valve closest to the supply source shall be in a manhole.

    c. Permanent taps shall be made on each side of the valve within the manhole to allow insertion of a small meter for testing to determine leakage and for sampling purposes.

11. Cross Connections and Interconnections. There shall be no cross connection made between the City water system and any private water system or other source of possible contamination.

12. Cooling Water. Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the potable water supply.

13. Tracer Wire

    a. 12 gauge copper tracer wire shall be installed on the exterior of all PVC water pipe.

    b. Tracer wire shall also be connected to 5F galvanic anodes placed at 600 feet intervals along the waterline and at the end of the

14. Tracer Tape. Tracer shall be installed within 12-inches of the top of the pipe

SECTION 7 - SANITARY SEWERS

1. General:

   a. The minimum design criteria for all wastewater facilities shall be the latest edition of the Oklahoma Department of Environmental Quality (ODEQ) Water Pollution Control and Construction Standards, which are amended as provided herein.

   b. All plans pertaining to collection and treatment of wastewater must be approved by ODEQ. The developer shall submit the appropriate number of sets of plans, as approved by the City, to ODEQ on behalf of the City for their review and approval. The developer shall be responsible for the plan review fee.

   c. Area Map. An area map shall be shown on the plans, indicating the entire area to be served by the proposed sewers and indicating the sheet number on which each segment of sewer line is drawn.

   d. Design Period. In general, sanitary sewer systems should be designed for the estimated ultimate tributary population. Similarly, consideration should be given to the maximum anticipated capacity of institutions and industries within said tributary.

   e. Sewer Extensions. Sewer extensions should be designed for projected flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension. A schedule for future down stream sewer relief will be required from the operating authority. The sewer extensions must conform with the most updated City of Claremore Wastewater Master Plan.

2. Sewer Main Design

   a. Location. All sewer lines shall be designed and constructed in the right-of-way or easement and not under the street pavement except at pavement crossings.

   b. Design Flows

      (1) Laterals and sub-mains that cannot be extended into future developments shall be designed based on a domestic sewerage flow of not less than 100 gallons per capita per day at full development.

      (2) Laterals and submains that are located in areas that can be extended into future developments shall be designed based on a

domestic sewerage flow of not less than 400 gallons per capita per day. Full development of the subdivision associated with the sewer system shall be used.

(3) Main, trunk, interceptor and outfall lines shall be designed based on a domestic flow of not less than 250 gallons per capita per day.

c. Minimum Separation

(1) Sanitary Sewer Main and Water Main Separation: In no case shall a sanitary sewer main be designed closer than 2 feet vertically or 10 feet horizontally of a water line, unless the sewer line is installed with pressure rated pipe.

(2) Sanitary Sewer Main and Underground Storage Tank Separation: PVC sewer lines shall be located at least 50 feet from any gasoline storage tank, as measured from the edge of the pipe to the edge of the closest edge of the storage tank. Wherever the 50 feet separation cannot be met, cast iron pipe shall be used.

(3) Sanitary Sewer Main and Other Utility Separation: Sewer lines shall be located 10 feet from underground electric, oil lines, gas lines, storm sewer, underground cable and telephone lines. Deviation from these separation requirements will be reviewed on a case-by-case basis.

d. Sewer Line Alignment

(1) Sewer lines shall be located on the rear of the property served, unless topography requires the location on the front or side of the property. Sewer lines located in the front of the property shall be located in the street right-of-way.

(2) Sewer lines not located on the street side easements shall be located in the south or west half of a minimum 22 feet wide back-to-back easement. The line shall be located 7 feet from the property line.

(3) Sewer lines may also be located in perimeter easements that are a minimum of 17.5 feet wide. The sewer line shall be located 12.5 feet from the property line.

(4) Side lot easement widths will be based upon other utilities in the easement and the location and depth of the sewer. Alignment, size and grade of lines shall be subject to review by City Engineer.

(5) Sewer lines shall be designed in a straight alignment and shall be designed with a uniform grade between manholes. Vertical curves are not permitted. Horizontal curves may be approved in special circumstances, but are subject to review by the City Engineer during design.

(6) Where the horizontal alignment deflection angle at a manhole is equal to or less than 45°, the invert of the downstream manhole shall be 0.20 feet lower than the invert of the lowest upstream line invert.

(7) Where a horizontal alignment deflection angle at a manhole is greater than 45°, the invert of the downstream manhole shall be 0.30 feet lower than the invert of the lowest line upstream invert.

(8) Sewer line size changes shall occur at a manhole only. Where a smaller sized line flows into a manhole and exits a larger size line without horizontal deflection, the invert of the larger downstream line shall be 0.10 feet lower than the invert of the smaller upstream line.

(9) Where deflection of a sewer line exceeds 90°, an additional manhole shall be installed on the line to decrease the angle.

(10) Any location not standard shall be reviewed by the City Engineer.

e. Allowable Pipe Materials: The City of Claremore allows the following sanitary sewer water pipe:

(1) Polyvinyl chloride (PVC): ASTM D-3034, SDR 35 (P.S. 46), gravity sewer 4" - 15".

(2) Polyvinyl chloride (PVC): ASTM F-679, SDR 35 (P.S. 46), gravity sewer 18" - 36"

(3) Polyvinyl chloride (PVC): ASTM 2241, SDR 32.5, pressure rated gravity sewer

(4) Ductile iron pipe (DIP): AWWA C151, AWWA C111 joints

f. Minimum Size. No public sewer shall be less than 8 inches in diameter.

g. Increasing Size. When sewers are increased in size or when a smaller sewer joins a larger one, the inside top of the pipes shall match.

h. Sewer Line Grade: All sanitary sewer lines shall be designed to provide a minimum velocity of 2.0 feet/second when flowing full, but not exceed 10 feet per second at average flows. The minimum and maximum slopes allowed for sanitary sewer pipe are listed below:

Minimum and Maximum Sewer Line Slopes

Sewer Line Nominal Diameter	Minimum Slope @ Full Flow (1 foot/100 feet)	Maximum Slope @ Full Flow (1 foot/100 feet)
4 inches	2.00	48.50
6 inches	1.00	28.28
8 inches	0.40	19.29
10 inches	0.29	14.34
12 inches	0.22	11.25
14 inches	0.17	9.16
15 inches	0.15	8.36
16 inches	0.14	7.67
18 inches	0.12	6.56
21 inches	0.10	5.34
24 inches	0.08	4.47
27 inches	0.07	3.83

i. Sewer Line Depth

(1) Sanitary sewers shall be designed deep enough to drain wastes from houses on both sides of the sewer line and to prevent frost damage.

(2) The sewer depth shall be designed great enough to permit extension of the sewer line where such extension is possible or practical.

(3) Where shallow depths are justified, the sewer line shall be protected from being damaged. Design should take into account superimposed loads and weights of the backfill material.

(4) Sewers shallower than 30 inches and deeper than 20 feet shall be ductile iron.

(5) All sewer pipe shall conform to the current specifications. Concrete cradles shall be used when centerline cut exceeds 16 feet and all installations in excess of 16 feet deep shall require special review for acceptance.

3. Manholes:

a. Location. Manholes should be installed as follows: at the end of each line; at all changes in grades, size or alignment; at all intersections; and at intervals of not more than 400 feet for sewers 15-inch or less in diameter and 500 feet for sewers 18-inch to 30-inch in diameter. Greater spacing may be permitted in larger diameter sewers and in those carrying a settled effluent. Lampholes may be used only for special conditions and shall not be substituted for manholes nor installed at the end of laterals greater than 250 feet in length.

b. Drop Pipe. A drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted to prevent solids deposition.

c. Drop Manholes. Drop manholes shall be constructed with an outside drop connection; no inside drop connections will be permitted. The outside drop piping shall be completely concrete encased.

d. Diameter. Minimum inside diameter shall be 4 feet for sewer lines 8 inches to 21 inches". Minimum size manholes for lines 24 inches to 48 inches is 5 feet diameter.

e. Flow Channels (Inverts). The flow channels through manholes should be made with concrete to conform to hydraulic requirements. Special care should be taken at changes in direction. Channels are recommended to be to the full depth of the largest pipe.

f. Top of Rim Elevation. In the paved areas, the top of manhole rims shall be flush with the pavement. In unpaved areas, the top of rim shall be installed a minimum of four (4) inches above final grade at the time of construction.

g. Inlet and Outlet Pipes. Such pipes shall be joined to the manhole with a gasketed flexible watertight connection or any watertight connection (Kor-n-seal) arrangement that allows differential settlement of the pipe and manhole wall to take place.

h. Connections to Existing Manholes. Core drilling is required on all connections to existing manholes.

i. Manhole Rings and Lids.

(1) Watertight manhole covers must be used. Locked manhole covers shall be required in isolated easement locations or where vandalism may be a problem.

(2) Construction and Materials. Manhole rings and lids shall be made of domestic gray cast iron.

(3) Traffic Areas. Solid manhole covers shall be used in traffic areas, such as, streets, alleyways or parking lots. Manhole rings shall be constructed on manholes so that no infiltration or inflow may enter the manhole.

(4) Rim elevations for all manholes shall be 1.0 foot minimum, above 100 year flood or high water level in these areas, or water tight, bolt down, gasketed manhole lids shall be installed.

(5) Manhole lids in paved areas shall be constructed flush with the pavement. Otherwise, manholes shall be constructed 4-inches above the surrounding ground.

h. Construction Materials:

(1) Manholes shall be pre-cast reinforced concrete, including the bottoms. Pour-in-place bottoms shall not be allowed, unless prior written approval has been obtained by City Engineer

(2) Cast-in-place nor masonry manholes shall not be allowed, unless special circumstances are warranted.

(3) Fiberglass or other alternate material may evaluated on a case by case basis.

i. Manhole Depth: Standard manholes shall be 4.0 feet deep minimum. Shallow manholes shall be specified where the manhole is less than 4 feet deep. Shallow manholes shall be 4 feet in diameter from the bottom to the top of the manhole.

j. Where sewer lines are installed in new or existing manholes, 12 inches of separation shall be maintained between the pipes.

k. Manholes shall project 15 feet into the property served. In areas where utility congestion prohibits this requirement, the distance may be reduced to 10 feet. (Special exempting may be allowed.)

l. Manholes shall be installed on the end of each line that can be extended past 300 feet and at all street intersections.

m. Manholes in highly corrosive environments shall be coated with a 10 mil thick epoxy coating designed to keep the chemicals from deteriorating the concrete.

n. Manhole steps shall not be allowed.

o. Manholes shall be sealed using Omni-Flex rubber gaskets, with a strip of bitumastic material of each side of the gasket for positive sealing.

p. Manhole lifting inserts shall be used for moving manhole sections. Pick holes that penetrate through the wall shall not be allowed.

4. Lampholes

a. Sanitary sewer lines terminating shall be equipped with a manhole or lamphole.

b. Where a lamphole is used, a long radius 90 degree elbow shall be installed.

c. A concrete base, a minimum of 18 inches by 18 inches, shall be constructed around opening of lamphole.

d. Lampholes shall not be more than 250 feet from the nearest manhole except as accepted by the City

e. Lampholes shall project 10 feet into the property served. In areas where utility congestion prohibits this requirement, the distance may be reduced to 7.5 feet.

5. Connections

a. In-line Wyes or Tees. In-line wyes or tees shall be installed for all platted lots and at any point where a sanitary sewer service connection is anticipated. The size and location shall be specified in both the plan and profile.

b. All service line connections shall be made during sewer line installation. Service lines under a street pavement are not recommended. If necessary, the service line shall be sleeved, and the sleeves crossing streets shall be installed prior to street construction.

c. In-line tees shall be installed for all platted lots and at any point where a sanitary sewer service connection is anticipated. For platted lots, the service connection shall be located 10 feet from the lot corner of lowest elevation as follows:

(1) 10 feet ± inside at lowest corner of the property.

(2) The service line grade shall be designed to allow for the following:

(a) Two percent (2%) minimum grade from the structure foundation to the in-line tee on the sewer main.

(b) A minimum service line depth of 1.5 feet for the entire length of line.

(c) A minimum depth of 26 inches from finished floor elevation to top of sewer line service.

(d) A minimum 1.5 feet drop from the service line to the sewer main.

(e) Only one (1) service line and connection shall be installed per structure.

d. Non-standard sewer taps shall be removed, the sewer main repaired, and the tap installed in accordance with the Standard Drawings.

6. Underground Creek Crossing

a. A minimum of 12 inches of cover is required where the sewer is located in rock.

b. Cover over sewer lines in other materials shall be 3 feet minimum.

c. Crossings with less cover will be reviewed on a case-by-case basis. Proposed crossings shall be designed with ductile iron pipe, concrete encasement backfill and in such a way as not to effect the flow of the stream. The ductile iron pipe shall extend a minimum of 10.0 feet into both banks.

d. Crossings shall be made as near to perpendicular as possible to the stream flow.

e. Sewer lines, manholes and structures designed parallel to a stream shall not be located in the stream flow-line or close enough to effect future stream widening or accumulate debris.

7. Aerial Stream Crossings

a. Proposed aerial stream crossings shall be reviewed by the City Engineer prior to design.

b. Aerial stream crossings shall be insulated or sloped to prevent freezing.

c. Expansion joints shall be used at the transition between below ground and above ground pipe

d. Where pipe enters stream banks, use concrete encasement or 12 inch rip-rap.

e. Aerial stream crossings shall be designed to withstand the worst of the 100 year storm flow.

f. The supports shall be designed so that the top of the footings are at least 2 feet below the bottom of the stream flowline. Supports shall be designed to prevent frost heave, overturning and settlement.

g. Crossings where the bottom of the sewer line is zero to 5 feet above the creek bottom shall be constructed to keep debris from becoming lodged on the pipe.

SECTION 8 - SEWAGE PUMPING STATIONS

1. General

   a. The minimum design criteria for all wastewater facilities shall be the latest edition of the Oklahoma Department of Environmental Quality (ODEQ) Water Pollution Control and Construction Standards, which are amended as provided herein.

   b. All plans pertaining to collection and treatment of wastewater must be approved by ODEQ. The developer shall submit the appropriate number of sets of plans, as approved by the City, to ODEQ on behalf of the City for their review and approval. The developer shall be responsible for the plan review fee.

   c. When sewage pumping stations are proposed for a development in a drainage basin where the City of Claremore Wastewater Master Plan shows a gravity sewer is to be built, the development shall fund an escrow account to fund the lift station maintenance for the time period until the planned gravity sewer is constructed and this lift station is taken out of service.

   d. In certain situations, Developers are responsible for designing the lift station for the complete drainage basin (service area), not only their development. Under this scenario, the City of Claremore shall share the cost of the lift station by funding the upgrade for the future development and being compensated as the other areas develops.

   e. The City of Claremore is in the process of retrofitting all lift stations in the existing system to submersible pumping stations, using Flygt pumps or approved equal. Therefore, all new sewage pumping stations shall be required to utilize Flygt pumps and the submersible pump station criteria referenced in this section.

   f. Betterments: When required by the City of Claremore, the developer shall design excess capacity to a lift station to accommodate future growth areas. The additional cost over the cost of the minimum required lift station for the development shall be the responsibility of the City of Claremore. The City of Claremore shall base the cost of the betterment on actual itemized statements provided by the developer to the City showing the actual cost for equipment, materials, labor and other ancillary costs resulting in the construction of the lift station. Invoices shall be included with the statements. These costs shall be used to determine the difference in cost of the excess capacity.

2. Lift Station

a. Design Flows

(1) Average Daily Flows: The average design flow shall be computed at the unit rates set forth in Section 7.2.b. Design calculations shall be provided to the City Engineer.

(2) Peak Flow: The lift station capacity shall be based on the peak flow and not the average daily flow. The projected peak flow of the lift station shall be determined by the following equation:

$$QMAX = QAVE \frac{18 + (P)1/2}{4 + (P)1/2}$$

where: QMAX = Maximum Rate of Sewage Flow (MGD, gpm)
QAVE = Average Daily Sewage Flow (MGD, gpm)
P = Service Population (in thousands)

b. Service Area: Wastewater lift stations shall be designed for total ultimate development. The average design flow shall be from all contributory areas. Contributions include the immediate gravity system, subsidiary sources, and known or projected future development within the designated station service area.

c. Cycle Time: The cycle time between each successive start shall range from 30 minutes to 3 hours, using average daily flows. The wet well capacity and operational levels shall be designed using the following equation or other approved method:

$$T = \frac{V}{D - Q} + \frac{V}{Q}$$

T = Total time between successive pump starts (min)
D = Rated pump delivery (gpm)
V = volume in wet well between "pump off" and "lead pump on" operating levels. (gallons)
Q = Average daily flow into wet well (gpm)

d. Pump Requirements

(1) Capacity: The selected wastewater pump shall have the minimum capability of pumping the design peak flow at the maximum computed system Total Dynamic Head (TDH) requirements.

(2) Minimum Flows: Minimum design flow for a lift station shall be 200 gpm.

(3) Minimum Solid Size: The selected wastewater pump shall be able to pass a minimum of a 3 inch solid.

(4) Duplex Lift Stations: At least two (2) pumps shall be provided for each lift station with independent piping for all lift stations under 1 MGD. The two pumps shall be identical.

(5) Triplex Lift Stations : Lift stations over 1 MGD shall be equipped with at least three (3) pumps. The lift station shall be able to accommodate the maximum sewage flow with one pump out of service.

(6) System Head Curves: System head curves shall be developed for each pump station and presented to the City Engineer with the design calculations. Two curves shall be provided for new systems indicating operational parameters for when the system is new and when the system is 20 years old. The curves shall be either computer generated or legibly hand prepared graph with the following information:

(a) Head of the system shall be plotted on the abscissa (Y axis) and measured in feet.

(b) Flow of the system shall be plotted on the ordinate (X- axis) and measured in either gallons per minute (gpm) or million gallons per day (MGD).

(c) The system head characteristics shall be plotted using the friction losses based on Hazen-Williams Formula. The Hazen-Williams friction factor for pipe shall be as follows:

Pipe Type	C- Factor
New PVC Pipe	140
Used PVC Pipe	120
New Ductile Iron Pipe	130
Used Ductile Iron Pipe	100

(d) The system head curve shall also take into account any other contributing lift stations to the same force main.

(e) Pump curves shall be plotted on the graph. The pump curves shall be:1) with lead pump on, and 2) the lead and lag pumps on. Lift stations with more than two pumps shall have pump curves for each possible sequence of operation.

(f) The efficiency of the pump shall also be plotted on the curve.

(g) The pump shut-off head shall be referenced on the graph.

(7) Efficiencies: Pumps shall be selected with the best possible operating efficiency. Pumps proposed with efficiencies less than 60% shall be approved on a case-by-case basis.

(8) Wet Well Design

(a) Materials: The wet well shall be composed of precast concrete.

(b) Diameter: The diameter of the wet well shall be a minimum of six (6) feet. The diameter shall be such that sufficient space is provided for pumping equipment, piping, rails and other necessary amenities.

(c) Capacity: A minimum of 24 inches shall be provided between the "pump off" elevation and the "lead pump on" elevation.

(d) Minimum Water Level: The minimum water level in the wet well shall be 12 inches above the wet well floor or 6 inches above the top of the pump volute.

(e) Maximum Water Level Elevation: The maximum water elevation shall not exceed the invert of the lowest gravity sewer line entering the manhole. The high water alarm shall be set at the same elevation as the invert of the lowest gravity sewer entering the manhole.

(f) Minimum Reservoir Depth: The minimum depth in the wet well as measured from the flow-line of the lowest pipe flowing into the manhole and the bottom of the wet well shall be eight feet.

(g) Wet Well Bottom: The bottom of the wet well shall be designed with fillets sloping from the interior wall face to the pump. The fillets shall be at a 1:1 slope and be constructed of concrete.

(h) Anti-Floatation: The wet well shall be designed to account for any ground water found on the site or historically present in the area. Where groundwater is present, the wet well shall be designed with either an over sized base or walls. The wet well shall be designed to over-come the hydrostatic pressure of the groundwater, with a minimum safety factor of 1.5. The following characteristics shall be used:

Reinforced Concrete	- 150 pounds per cubic foot
Groundwater	- 62.4 pounds per cubic foot
Quicksand	- 100 pounds per cubic foot
Safety Factor	- 1.5

(i) Access Hatches: All wet wells shall be equipped with locking aluminum, 2-leaf, access hatches. that are designed to allow adequate working space and allow the pumps to be removed without modifications to the wet well. Hatches shall be flush with the concrete lid and no a tripping hazard. Hatches shall be centered of the pumps.

(j) Vents: All wet wells shall be vented to allow gases to expel to the atmosphere. The minimum size vent shall be 4 inches and shall be designed with flanged ductile iron pipe and elbows. An insect screen shall be placed between the elbow flanges.

(k) Piping: All piping in the wet well shall be flanged ductile iron. All penetrations through the wet well wall shall be leak proof.

(l) Rail System: The pumps shall be installed and removed using a 2" diameter galvanized or stainless steel rail system designed by the pump manufacturer. The rails shall be rigid after installation. Intermediate supports shall be designed to keep the pumps from derailing during installation or removal.

(m) Wet wells in highly corrosive environments shall be coated with a 10 mil thick epoxy coating designed to keep the chemicals from deteriorating the concrete.

(9) Valve Vault:

(a) Materials: The valve vault shall be precast reinforced concrete pipe or cast-in-place reinforced concrete.

(b) Diameter: Valve vault shall be a minimum 5 feet in diameter. Piping shall have at least 24 inches of separation, as measured from the exterior walls of the piping. Piping shall also be installed at least 12 inches from the interior concrete walls.

(c) Valve Vault Bottom: The bottom shall be sloped to interior wall face nearest the exterior wall of the lift station wet well. A sump shall be installed with a 2 inch PVC drain line to the wet

well. The end of the drain line shall be designed with a flap valve.

(d) Piping: All piping in the valve vault shall be flanged ductile iron pipe.

(e) Valving: Valves in the valve box shall have a separate gate valve and check valve for each pump. The plug valves shall be hand wheel operated.

(f) Access Hatches: All valve vaults shall be equipped with locking aluminum access hatches, either one or two leaves, that are designed to allow adequate working space and allow the valves to be removed without modifications to the valve vault.

(g) Emergency Pump Connection: Emergency pump connections shall be installed on the piping in the valve vault with an isolation valve. A 4 inch male "Cam- Loc" coupling shall be installed on piping extending through the top of the valve vault.

(10) Controls: A Flygt Multitrode level monitoring and control system shall be installed on each lift station to meet the standardization practice of the City of Claremore. Floats shall not be allowed.

(11) Electrical:

(a) Electrical shall conform to the National Electric Code (NEC).

(b) Separate disconnects shall be installed for each pump the main power supply.

(c) Electrical service for the pumps shall be 3 phase, 480 volt unless otherwise stated.

(d) A single phase, 110 volt outdoor service outlet shall be provided for each lift station.

(e) Soft starters shall be installed for each pump over 25 HP

(12) Hoist: All lift stations shall be designed with room around the hatch so that a hoist anchor can be installed for the operation of a mobile hoist. Hoist anchor requirements can be obtained from the Wastewater Treatment Department.

(13) Frost-proof hydrant: A 2" minimum line shall be run to the wet well and a frost-proof hydrant installed for washing the area.

(14) Fence: An eight (8) foot chain link fence shall be installed around the perimeter of the wetwell/valve vault in high traffic areas. A six (6) foot chain link fence shall be installed in rural areas.

(15) Site Finish: The entire area within the fenced area shall be covered with a filter fabric and screenings.

(16) Emergency Power Connection: Each lift station shall be equipped with a manual override and connection for the back-up generator operated by the City of Claremore. Specifications for the connection shall be provided by the Claremore Sewer Treatment Department.

(17) Communutors and Bar screens: Where required, mechanically cleaned bar screens and communutors shall be designed to reduce solids entering lift stations.

(18) Variable Speed Pump Control System: Variable frequency drives may be required on larger pump stations. Each lift station proposal shall be reviewed on a case-by-case basis.

(19) Alarms:

(a) Lift stations shall have a visual (flashing red light) alarm.

(b) They shall activate under the following conditions:

i. When the water level is rises above the invert of the lowest gravity sewer entering the manhole.

ii. When the lead pump is called for and does not respond.

(20) Telephone Dialing System

(a) The automatic dialer shall call the City of Claremore when activated.

(b) The dialer shall be activated by the following conditions:

i. When the water level rises above the invert of the lowest gravity sewer entering the wet well.

ii. When the lead pump is called for and does not

respond.

iii. When the lag pump(s) are called for and does not respond.

iv. When the control panel is entered illegally.

v. When primary power is lost.

vi. When the reserve power source is called for and does not respond.

vii. Low voltage/ loss of phase

(21) Force Main Design

(a) Minimum Force Size: The minimum force main size shall be 4 inches.

(b) Minimum Velocities: The minimum velocity for the force mains shall be 2 feet/sec.

(c) Maximum Velocity: The maximum velocity for force mains 4 inches to 8 inches in diameter shall be 10 feet per second. Maximum velocity for force mains over 8 inches in diameter shall be 20 feet per second.

(d) Force Main Termination: Where a force main terminates into a structure, the influent shall be no more than 2 feet from the bottom of the structure.Force mains shall not be allowed to turn down inside the terminiation manhole, unless special circumstances warrant.

(e) Force Main/Water Line Separation: Force Mains shall not be located within 10 feet of a water main as measured horizontally from the outside of each pipe. Vertical separation shall be a minimum of 24 inches, measured as stated above.

(f) Minimum Depth: The minimum force main depth shall be 30 inches from the top of the pipe to the top of the natural ground elevation. Deeper depths may be required in special cases.

(g) Maximum Depth: The maximum depth of a force main shall be 8 feet from the top of the pipe to the top of the natural

ground elevation, unless special circumstances are addressed to the City Engineer.

(h) Isolation Valve: An isolation valve shall be installed underground just to the outside of the valve box.

(22) Sewage Air Relief Valve: Sewage air relief valves shall be installed at the high points along the force main.

SECTION 9 - STORMWATER DESIGN

1. General:

   a. All stormwater runoff shall be subject to review and approval by the appropriate public authority with regard to analysis, design and construction of drainageway facilities. The appropriate public authority shall have the right to maintain or to cause to be maintained the drainageway system for its intended purposes.

   b. Drainageway facilities, both public and private, shall consist of all elements necessary to convey stormwater runoff.

2. Rainfall Criteria

   a. Introduction: Presented in this section is the design rainfall data to be used for runoff hydrograph calculations and the Rational Method. All hydrological analyses for the City of Claremore shall utilize the rainfall data presented herein for calculation of storm runoff.

   b. Total Rainfall: US Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States was used for cumulative rainfall data of storm durations greater than one hour. The National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NWS HYDRO-35 was used for cumulative rainfall data of storm durations from 5 to 60 minutes. Rainfall data to be used for projects in the City of Claremore is contained in Table 9.1 below.

TABLE 9.1
TOTAL RAINFALL DEPTHS

DURATION	TOTAL RAINFALL - INCHES Frequency (Return Period)							
	1-year	2-year	5-year	10-year	25-year	50-year	100-year	500-year
5-minute	0.40	0.48	0.56	0.62	0.72	0.79	0.86	1.01
10-minute	0.71	0.84	0.99	1.11	1.27	1.41	1.54	1.83
15-minute	0.84	1.01	1.20	1.34	1.54	1.70	1.86	2.23
30-minute	1.14	1.40	1.73	1.96	2.29	2.55	2.81	3.39
1-hour	1.44	1.81	2.28	2.60	3.07	3.44	3.80	4.58
2-hour	1.70	2.13	2.80	3.30	3.85	4.44	5.00	6.12
3-hour	1.87	2.28	3.13	3.63	4.25	4.83	5.43	6.60
6-hour	2.19	2.71	3.64	4.30	5.08	5.71	6.40	7.80
12-hour	2.63	3.23	4.31	5.10	6.00	6.71	7.55	9.20

DURATION	TOTAL RAINFALL - INCHES Frequency (Return Period)							
	1-year	2-year	5-year	10-year	25-year	50-year	100-year	500-year
24-hour	3.00	3.75	5.15	5.88	7.00	7.78	8.75	10.68

Source: U.S. Weather Bureau Technical Paper No. 40 and HYDRO-35

3. Stormwater Runoff Determination

a. Approved Methods: TABLE 9.2 contains methods of runoff which analysis may be used for the design of components of the storm drainage system as applicable:

TABLE 9.2
RUN-OFF METHODS

	Applicable for		Minimum Drainage Area, AC	Maximum Drainage Area, AC
	Peak Q	Volume Calc.		
Rational Method	Yes	No	0	50
Modified Rational	No	Yes	50	200
SCS Method	Yes	Yes	5	2000
USGS Regression Equations	Yes	No	200	None

b. Rational Method

(1) Formula: The Rational Method is based on the formula: Q=CIA

Where:

"Q" the maximum rate of runoff in cubic feet per second.
"C" runoff coefficient of the area.
"I" the average intensity of rainfall in inches per hour for a duration equal to the time of concentration (T_c).
"T_c" The time of concentration is the time required for water to flow from the most remote point of the basin to the point being investigated and to reach a steady state condition.
"A" The contributing watershed area in acres.

(2) One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time

required for water to flow from the most remote part of the drainage area to the point under consideration.

(3) The time of concentration consists of overland flow time, T_o plus the time of travel, T_f, in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time, T_o, plus the time of travel in a combined form, such as a small swale, channel, or drainage. The latter portion, T_f, of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainage. Overland flow time, on the other hand, will vary with surface slope, surface cover and distance of surface flow. The infiltration rate of the soil, the presence of depression storage areas and the amount of antecedent rainfall will also affect the inlet time, since the rainfall must first overcome these losses before a steady state runoff condition will be achieved. Thus, the time of concentration can be calculated using the following equation:

$$T_c = T_o + T_f$$

Where: T_c = time of concentration (minutes)

T_o = initial, or overland flow time (minutes)

T_f = travel time in the ditch, channel, gutter, storm sewer, etc. (minutes)

Minimum time of concentration, T_c, shall be 5 minutes.

(4) The overland flow time, T_o, in non-urbanized watersheds may be calculated as follows:

$$T_o = 1.8\ (1.1\text{-}C)(L_o^{0.5})/(S_o^{0.333})$$

Where:

C = runoff coefficient

L_o = length of overland flow, (feet, 2000-feet maximum)

S_o = average basin slope (percent)

(5) The equation for overland flow time, T_o, is generally adequate for distances up to 2000 feet. For longer basin lengths, the runoff will combine and the sheet flow assumption is no longer valid. The time of concentration would then be overland flow in combination with the travel time, T_f, which is calculated using the hydraulic properties of the swale, ditch, or channel. The time of concentration is then the sum of the initial flow time, T_o, and the travel time, T_f.

(6) Runoff Coefficient: The runoff coefficient, C, represents the integrated effects of infiltration, evaporation, retention, flow routing, and interception, all of which affect the time distribution and peak rate of runoff. Determination of the runoff coefficient requires judgement and understanding on the part of the engineer. Table 9.3 presents the recommended range of C values for different surface characteristics as well as for different aggregate land uses. Coefficient values selected from the range available shall be consistent with the urbanized percent imperviousness (i.e. minimum percent imperviousness requires minimum runoff coefficient value). Also, for flat slopes and permeable soils, use the lower values. For steep slopes and impermeable soils use the higher values.

(7) Intensity: The intensity, I, is the average rainfall rate in inches per hour for the period of maximum rainfall of a given frequency having a duration equal to the time of concentration. For a given time of concentration, T_c, and a given design storm frequency, the rainfall intensity, I, can be obtained using the following equation:

$$I - d/(T_c + e)^f$$

Where I = Rainfall Intensity, inches per hour

T_c = Time of Concentration, minutes

d, e, f = Parameters defined in Table 9.4

TABLE 9.3
RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUSNESS

Land Use or Surface Characteristic	Percent Imperviousness	Runoff Coefficients
BUSINESS:		
Commercial Areas	70 to 95	0.70 to 0.95
Neighborhood Areas	60 to 80	0.50 to 0.70
RESIDENTIAL:		
Single Family	35 to 50	0.30 to 0.50
Multi-unit (detached)	45 to 55	0.40 to 0.60
Multi-unit (attached)	65 to 75	0.60 to 0.75
½ acre lot or larger	30 to 45	0.25 to 0.40
Apartments	65 to 75	0.50 to 0.70
INDUSTRIAL		
Light uses	70 to 80	0.50 to 0.80
Heavy uses	80 to 90	0.60 to 0.90
PARKS, CEMETERIES	4 to 8	0.10 to 0.25
PLAYGROUNDS	40 to 60	0.50 to 0.60
RAILROAD YARDS	35 to 45	0.20 to 0.35
UNDEVELOPED AREAS		
Cultivated	30 to 70	0.35 to 0.60
Pasture	20 to 60	0.25 to 0.50
Woodland	5 to 40	0.10 to 0.40
Offsite flow analysis (land use not defined)	35 to 55	0.45 to 0.65
STREETS		
Paved	90 to 100	0.80 to 0.90
Gravel	50 to 70	0.55 to 0.65
DRIVES AND WALKS	90 to 100	0.80 to 0.90
ROOFS	85 to 95	0.80 to 0.90
LAWNS		
Sandy Soils	5 to 10	0.10 to 0.20
Clayey soils	10 to 30	0.13 to 0.35

TABLE 9.4
RAINFALL INTENSITY PARAMETERS

Design Storm	Parameter		
	d	e	f
2 Year	56.43	11.5	0.81
5 Year	72	15	0.80
10 Year	82	15	0.80
25 Year	95	15	0.80
50 Year	108	15	0.80
100 Year	120	15	0.80

Source: Drainage Design Manual, ODOT, February, 1988

c. Modified Rational Unit Hydrograph Method

(1) Introduction: A hydrograph method must be used to determine peak runoff rates from watersheds larger than 200 acres, which is the upper limit of the Modified Rational Method and for all detention pond analyses.

(2) Design Storm Precipitation:

(a) For detention storage basin design, a 24 hour storm shall be used.

(b) For storm sewer design, the unit duration incremented shall be in multiples of one, two or five minutes (e.g., 1, 2, 5, 10, or 15-minutes) with the maximum unit duration to be 15 minutes under most circumstances. An acceptable unit storm duration should not exceed one-fifth of the time to peak of the watershed, t_p. As an example, if the watershed has a t_p of 35 minutes, then an appropriate unit storm duration would be five minutes.

d. SCS Unit Hydrograph Method: The Soil Conservation Service (SCS) method is presented in detail in Section 4 of the U.S. Department of Agriculture Soil Conservation Service Engineering Handbook and Model Drainage Manual, American Association of State Highway and Transportation Officials, 1991. The SC computer program TR20 or the U.S. Army Corps of Engineers computer program HEC-1 is acceptable ways of utilizing the SCS methodology. The SCS publication TR55 may be used for areas up to 2,000 acres.

e. USGS Regression Equations: The United States Geological Survey (USGS) regression equations for ungaged streams can be found in the USGS publication, "Techniques for Estimating Flood Discharges for Oklahoma Streams", Water Resources Investigation 77-54, U.S. Geological Survey, Water Resources Division, latest revision or FEMA 265, latest revision.

4. Street Drainage Design

a. Depth in Streets: Use of streets for conveyance of stormwater runoff shall be within the following limitations:

(1) For the 100-year event, when runoff is designed to flow in the street right-of-way, inlets shall be located so runoff is contained within the street right-of-way, and shall not be deeper than one (1) foot above the curb. For the 5-year event when runoff is designed to flow in the street right-of-way, the distance between inlets, as well as the distance to the first inlet, shall be determined by the following: whichever is less:

(a) Local, Minor. No curb overtopping. Flow may spread to crown of street.

(b) Collector, Commercial, Industrial, Central Business District. No curb overtopping. Flow spread must leave the equivalent of one 10-foot driving lane clear of water.

(c) Arterials. No curb overtopping. Flow spread must leave the equivalent of two 10-foot driving lanes clear of water. One lane in each direction.

(d) All Streets: Maximum distance between inlets allowed is 600 feet.

(2) Where sump collection systems are used, an overflow route shall be established in the event of complete blockage of the sump

b. Curb and Gutter Capacity:

(1) The allowable storm capacity of each street section with curb and gutter shall be calculated using the modified Manning's formula:

$$Q = 0.56(Z/N)S^{1/2}Y_T^{8/3}$$

Where:

Q = discharge is cfs
Z = reciprocal of the street cross slopes (S_x,ft/ft)
Y_T= depth of flow at the gutter (feet)
S = longitudinal grade of street (ft/ft)
N = Manning's roughness coefficient

(2) Manning's roughness coefficient, N, shall be used according to the applicable construction condition from Table 9.5.

TABLE 9.5
MANNING'S N-VALUES FOR STREET GUTTERS

Construction Type	N
Concrete gutter troweled finish	0.012
Asphalt Pavement	
Smooth texture	0.013
Rough texture	0.015
Concrete gutter with asphalt pavement	
Smooth	0.013
Rough	0.015
Concrete pavement	
Float finish	0.014
Broom finish	0.016
Brick	0.016

Note: For gutters on flat grade where sediment may accumulate, increase all above values of N by 0.002.

Source: Drainage Design Manual, ODOT, February, 1988

(3) When the street cross section has different cross slopes, capacity computation shall take into account the various cross slopes.

(4) Calculations for inlets, pipes and gutter flow shall be summarized and tabulated on the plans.

5. Stormwater Drainage Design

a. General:

(1) Definitions

(a) Stormwater Drainage System: A stormwater drainage system is defined as a combination of underground conveyance, street curb flow and over land flow within the street right-of-way.

(b) Under Ground Storm Sewer System: An underground storm sewer system is a system of curb inlets, grated inlets, sumps, pipe, boxes and arches designed to collect and convey storm water flow underground

(2) Capacity: Stormwater drainage systems shall be designed to receive and pass the runoff from the post-development 100-year frequency rainfall. The collector system shall be designed to either:

(a) Pass a minimum of the runoff from the 5-year frequency rainfall in a pipe network with overland flow capacities so that the combination of the two shall pass the runoff from a 100-year frequency rainfall under post-development conditions; or,

(b) Pass the entire runoff from the 100-year frequency rainfall in the pipe network. Should the entire runoff from the 100-year frequency rainfall be conveyed in a pipe network, an overland system shall be designed to convey a 5-year frequency runoff in the event of inlet blockage or bypass. (The overland flow portion of the stormwater drainageway system shall be confined in dedicated rights-of-way and/or restricted drainage easements).

(3) All underground storm sewer systems shall be shown in profile, showing flow-line, size, type and grade. Profiles shall show the natural and proposed ground line at the centerline of the storm sewer. Stationing shall be continuous through manholes, along the main (longest) line, to the top of the system. Branch lines shall be stationed, starting from 0+00, from their connection with the main line. Lines shall be stationed on the profile drawing from left to right, increasing upstream. The 5-year flow rate and the 100-year flow rate shall be labeled at all inlets, outlets, and junction boxes.

(4) Runoff from drainage areas greater than one half (1/2) acre flowing toward a street right-of-way shall be collected and taken underground before it reaches the right-of-way. Parking lots shall have internal drainage systems so as to reduce concentrated flow into streets. This requirement does not apply to single-family residential lots.

(5) The following items shall by summarized and tabulated on the plans:

(a) Drainage areas;

(b) Runoff from 5-year and 100-year frequency rainstorms;

(c) Time of concentration;

(d) Inlet design for each; and,

(e) The flows and velocities for each pipe and open channel

This summary table shall also be a part of the drainage calculations.

(6) If a tract of land under development has a floodplain area within its boundary, then a hydraulic (backwater) analysis of the existing and proposed drainage system shall be provided to show any impact the proposed development has on the floodplain area and elevation. This analysis shall be done when the flow in the floodplain is proposed to be increased, or when the ground in the floodplain is proposed to be altered. Any development encroaching into a floodplain area must comply with the governing authority's flood damage prevention ordinance.

b. Drainage Pipe/Boxes

(1) Materials

(a) Pipe

i. Reinforced Concrete Pipe: Concrete pipe shall not be less than ASTM C-76 Class III.

ii. Reinforced Concrete Arch Pipe: pipe shall not be less than ASTM C-506

iii. Reinforced Concrete Elliptical Pipe - shall not be less than ASTM C-507

iv. Corrugated metal pipe shall not be used unless special circumstances are approved by the City Engineer during design review. Under no circumstances shall corrugated metal pipe be used under pavement.

v. Polyvinyl chloride (PVC) may be allowed in sizes from 15-inch to 36-inch diameter storm drainage systems. Pipe shall be rated for gravity sewer usage. PVC shall not be used under pavement.

vi. High Density Polyethylene (HDPE) pipe may be allowed in sizes from 15-inch to 36-inch diameter storm drainage systems. Pipe shall comply with ODOT specifications. HDPE shall not be used under pavement.

(b) Pre-Cast Concrete Box: ASTM C-789/C-850, AASHTO M-259/273

(2) Parameters

(a) The storm sewer system shall commence at the point where the maximum allowable encroachment occurs. Where no curbing exists, runoff must be conveyed within the right-of-way or dedicated drainage easement.

(b) No pipe shall be installed downstream having a diameter smaller than the pipe from which it is receiving water.

(c) Junctions between different pipe sizes shall be made with the top inside of the downstream pipe no higher than the top inside of the upstream pipe.

(d) The horizontal distance between pipes being placed in the same trench, shall be a minimum of two (2) feet or one-third the diameter of the larger pipe, whichever is greater. This would include multiple pipe crossings for culvert purposes.

(e) The minimum storm sewer pipe size shall be 15-inch diameter pipe.

(f) Radius pipes shall not be used on storm sewers having a diameter of 36 inches or less. Radius pipes may be used on storm sewers larger than 36 inches. The degree of deflection shall not exceed the pipe manufacturer's recommendation.

The City is allowed to require radius pipe, should the energy loss be excessive and detrimental to the system.

(g) A minimum of 6 inches cover shall be provided over pipes and box culverts to the bottom of the subgrade in paved areas except when the box culverts are built with the top at grade.

(h) The radius of curve for a box structure shall be a minimum of three (3) times the maximum width of the box structure, but not less than 50 feet.

(i) When storm sewers are constructed in fill areas, all materials in fill areas shall be compacted to a 95 percent standard proctor density (SPD) prior to the trenching and laying of the pipe.

(j) The minimum velocity in any drainage system shall be 2.5 feet per second for all events of 5-year frequency and greater. The maximum velocity in a pipe shall be 30 feet per second and the maximum velocity in an unlined channel shall be six (6) feet per second.

(k) Location of Storm Sewers: Storm sewer shall not be placed within the wheel path of any driving lane of the pavement. The traffic lane is defined as the normal width provided for each lane and delineated by pavement stripes. The preferred location of the storm sewer is according to the following priority:

i. Behind the Curb

ii. Down the Center of the Traffic Lane

iii. On Centerline – This one has to be approved by City Engineer during design.

(l) Cul-de-sacs: Curb inlets and under ground storm drainage pipe shall be used to evacuate cul-de-sac when they are at the low end of the street. Above ground ditches and flumes shall not be allowed.

(m) Drainage between lots: Drainage between lots in subdivisions shall be piped in lieu of ditches or flumes.

c. Inlets

(1) Inlets shall be located at intersections to collect the flow from crossing the intersection. Inlets at intersections shall be located so that they do not encroach upon the curb return. No drainage structure shall be permitted at a wheelchair ramp.

(2) Grated inlets without curb opening are not permitted within the City of Claremore streets.

(3) The bicycle safe grates (in combination with a curb opening) are the only grates approved by the City of Claremore within the street right-of-way.

(4) When a grate is used in conjunction with a curb opening directly behind the grate, only the hydraulic capacity of the grate shall be utilized to estimate the flow that is intercepted, since the curb opening portion is reserved to collect debris. IN CASES where multiple opening and grates are used, only the first curb opening shall be neglected during drainage calculation.

(5) Grate interception capacities shall be determined for the specific grate to be used in the project. For example, if the grate inlet is manufactured by Neenah Foundry use Neenah's method of computing the capacity.

(6) Curb opening inlets shall be cast-iron and be in accordance with the City's Standard Drawings.

(7) Three types of inlets are used in the City of Claremore:

(a) Curb opening inlets,

(b) Combination grated and curb opening inlets and

(c) Median inlets.

(d) Multiple Inlets Multiple inlets occur when more than one inlet (of the same type) is used in a continuous series, resulting in greater flow interception capacity.

(e) All inlets shall have a minimum of two (2) grates.

(8) Time of Concentration: A maximum T_c of 5 minutes to the first inlet shall be used for commercial and industrial areas.

(9) Spacing Between Inlets: The spacing between inlets shall be such that depths of flow and widths of spread requirements are not violated. A maximum of 600 feet separation is required.

(10) Inlets shall be located at all low points in the gutter grade, on side streets at intersections where runoff would flow onto an arterial street or highway and upgrade of bridges to prevent runoff from flowing onto the bridge deck. Inlets are also required when the allowable depth of flow in the gutter is exceeded.

(11) Inlets at intersections shall be located in such a manner that no part of the inlet will encroach upon the curb return. Inlets on a continuous grade in the interior of a block should be placed upstream of a nearby driveway, if possible. The flowline and top of curb elevations shall be shown on all inlets.

(12) Where possible, runoff from large areas outside the roadway shall be collected before it reaches the roadway.

d. Sumps

(1) At sump locations, the stormwater shall not pond outside the right-of-way or dedicated drainage easement, and the ponding depth shall not exceed 12 inches above the top of the curb, for the 100-year frequency rainstorm.

(2) An overflow drainage easement shall be established along the overflow path in the event of blockage of the sump.

e. Manholes/Junction Boxes

(1) Pre-Cast Concrete Boxes shall meet the following: ASTM C-789/C-850, AASHTO M-259/273 or ODOT

(2) A manhole or junction box shall be required at all changes of grade, changes in alignment, and junctions between two (2) or more different size pipes.

(3) The maximum spacing between manholes or junction boxes shall not exceed 400 feet for pipes of 15-inch diameter, and 500 feet for pipes greater than 15-inch diameter.

(4) All junction boxes and manholes shall be built with the Standard Manhole Ring and Cover at grade, unless special circumstances warrants a grated lid.

(5) A manhole or junction box shall be constructed at the PC or PT of all curves in sewers.

6. Hydraulic Structures

a. Definitions

(1) Culverts: A culvert is defined as a closed conduit for the passage of water under an embankment, such as a road, railroad, or driveway. The distinction between a culvert and a sewer is the means by which flow enters the conduit. Flow normally enters a culvert by an open channel, generally at a similar elevation and a culvert usually crosses a street.

(2) Bridge: A bridge is constructed with abutments and superstructures, which are typically concrete, steel, or other materials. Since the superstructures are generally not an integral structural part of the abutments, and are therefore free to move, the hydraulic criteria for bridges is different than for culverts. Bridges are also usually constructed with earth or rock inverts, whereas culverts are typically the same materials throughout the waterway opening.

(a) Freeboard: Freeboard is defined as the vertical clearance of the lowest structural member of the bridge superstructure above the water surface elevation of the design frequency flood. The minimum freeboard shall be 1 foot for the 100-year frequency flood, unless accepted by the City Engineer.

(b) Backwater: Backwater is defined as the rise in the flood water surface due to the restrictions created by the construction of the bridge. The maximum backwater shall be 1 foot.

b. Culverts

(1) Construction Materials:

(a) Reinforced Concrete Pipe: Concrete pipe shall not be less than ASTM C-76 Class III.

(b) Reinforced Concrete Arch Pipe: pipe shall not be less than ASTM C-506

(c) Reinforced Concrete Elliptical Pipe - shall not be less than ASTM C-507

(d) Corrugated metal pipe shall meet the following information: AASHTO M-196, AASHTO M-190, AASHTO M-245, AASHTO M-167

(e) Polyvinyl chloride (PVC) may be allowed in sizes from 15-inch to 36-inch diameter storm drainage systems. Pipe shall be rated for gravity sewer usage. PVC shall _not be used under pavement.

(f) High Density Polyethylene (HDPE) pipe may be allowed in sizes from 15-inch to 36-inch diameter storm drainage systems. Pipe shall comply with ODOT specifications. HDPE shall not be used under pavement.

(g) Pre-Cast Concrete Box: ASTM C-789/C-850, AASHTO M-259/273

(h) Alternate materials: Alternate materials for culverts pipe shall be reviewed on a case-by-case basis.

(2) Sizing Method: Culverts shall be sized using either Kutters or Mannings charts or the methodology presented in Hydraulic Design of Highway Culverts, Hydraulic Design Series HDS No. 5, FHWA< U.S. Department of Transportation and Drainage Manual, Oklahoma Department of Transportation, 1992.

(3) Design Frequency: Minimum design frequency for culverts shall be 5-year. Impact for 100-year shall be calculated and shown.

(4) Minimum Size:

(a) Pipe Culverts: 18 inches diameter equivalent.
(b) Box Culverts: 3 feet wide, 3 feet in height.

(5) End treatments are required on all culverts, including culverts under driveways.

(6) The diameter of the driveway culvert for each lot in the addition must be shown on the plat.

(7) The schedule of driveway culverts must also include acceptable pipe material and class of material:

c. Bridges

(1) Bridges shall have adequate capacity to pass the 100-year post-development flow with one (1) foot of free board under the low

chord. A backwater analysis shall be provided to illustrate compliance with this requirement. Ponding at the inlets of pipe culverts and box culverts shall not overtop the roads under the 500-year event. The 500-year ponding elevations must be shown to document compliance with these criteria.

(2) All bridge outlets shall be designed to reduce the discharge velocity to non-erosive velocities.

(3) Velocity Limitations: The velocity limitations through the bridge opening are controlled by the potential abutment scour and subsequent erosion protection provided. Using riprap for the channel lining and/or protection of the abutments and wingwalls, the maximum channel velocity is limited to 4.5 meters/ sec (15 feet/ sec).

(4) Hydraulic Analysis: The hydraulic design of bridge crossings shall be in accordance with Drainage Manual, Oklahoma Department of Transportation, latest revision.

(5) Inlet and Outlet Configuration: The design of bridges shall include adequate wingwalls of sufficient length to prevent abutment erosion and to provide slope stabilization from the embankment to the channel. Erosion protection on the inlet and outlet transition slopes shall be provided to protect from the erosive forces of eddy current.

(6) ODOT Standards: Bridges shall be designed in accordance with AASHTO/ODOT criteria. Rails shall comply with ODOT Standard Details.

7. Channels

a. At all bends in improved channels, the amount of freeboard shall be increased by the following equation:

$$H = \frac{V^2 * b}{64.4 * r}$$

Where: H = Height of freeboard in feet.
V = Average Velocity in feet per second.
b = Width of the channel at the design water surface in feet.
r = Radius of curvature of the channel centerline in feet.

b. The increased freeboard height shall be maintained a minimum of one (1) channel width upstream and downstream of the bend.

c. Trapezoidal channels shall be designed with a hard-lined low flow channel, such as concrete. The low flow channel shall branch off to pick up any storm sewers discharging into the channel. The top of the sides of the low flow channel shall be a minimum of 6 inches lower than the adjacent main channel bottom to insure that the drainage runs over and into the low flow channel and not erodes around it. The minimum cross slope on the bottom of the trapezoidal channel shall be 2 percent. The side slopes of the channel shall be not steeper than 4:1, unless the side slopes are concrete lined. The easement for the trapezoidal channel shall include 10 feet additional width along the top of the bank for an access road.

d. All open channels shall be provided with a minimum of one (1) foot of freeboard above normal depth from a 100-year frequency rainstorm.

e. Trapezoidal channels shall be designed with a hard-lined low flow channel, such as concrete. The low flow channel shall branch off to pick up any storm sewers discharging into the channel. The top of the sides of the low flow channel shall be a minimum of 6 inches lower than the adjacent main channel bottom to insure that the drainage runs over and into the low flow channel and not erodes around it. The minimum cross slope on the bottom of the trapezoidal channel shall be 2 percent. The side slopes of the channel shall be not steeper than 4:1, unless the side slopes are concrete lined. The easement for the trapezoidal channel shall include 10 feet additional width along the top of the bank for an access road.

f. The centerline radius of a curve on an open channel shall be a minimum of three (3) times the top width at the design flow or 100 feet, whichever is greater.

8. Borrow Ditches

a. Maximum Depth: Borrow ditches, when allowed, shall not exceed 4 feet in depth.

b. Borrow ditches shall be sized to handle the 5-year or larger storm and shall not be less than 15 inches deep. The side slopes on the bank next to the road shall be 4 feet horizontal to 1 foot vertical (4:1), or flatter. The side slope on the opposite bank shall be maintainable. Ditches must be sodded or hydromulched. Roadside Ditch Capacity: The capacity of a roadside ditch shall be computed using Manning's equation.

SECTION 10 - STORMWATER DETENTION FACILITIES

1. The runoff from any development shall not exceed the pre-development condition which shall be demonstrated by analyzing the runoff from the 2-year, 5-year, and the 100-year rainfall frequency events. The pre-development condition is the runoff pattern, rate, and velocity prior to the construction of the development. The post-development condition with detention is the runoff pattern, rate, and velocity after construction of the development, which includes incorporating any stormwater detention facilities into the development.

2. A storm water detention report shall be submitted to the City to explain and support how each item in these Criteria are met. The report shall be formatted to sequentially answer each Criteria item. Any deviation from the Criteria shall be noted on the plans and explained in the report.

3. For all locations where storm water runs off of the development, the following information is required, and at each location, the pre-development condition shall not be exceeded.

    a. Pre-development discharge rate for all frequency events;

    b. Pre-development discharge velocity for all frequency events;

    c. Post-development discharge rate with detention for all frequency events; and,

    d. Post-development discharge velocity with detention for all frequency events.

4. A map showing the locations of these run off points shall be included in the submittal. A map shall also be submitted that shows the drainage area tributary to each proposed detention facility, both in the pre-development and post-development condition.

5. For the design of storm water detention facilities that serve drainage areas less than 10 acres, the rational method may be used. For the design of storm water detention facilities that serve drainage areas greater than 10 acres, a computer aided hydrograph method (for example, HEC-1 SCS method) shall be used, and may be used for drainage areas less than 10 acres.

6. U.S. Weather Bureau Technical Paper No. 40 and National Weather Service HYDRO-35 shall be used for rainfall information.

7. For computer aided hydrograph methods, 24-hour storm duration shall be used, and the rainfall shall be critically arranged in such a way that the largest increment is located one (1) time interval past the center of the duration of the

rainfall. For other methods, the rainfall pattern shall be used in accordance with the modeling technique selected.

8. The loss rates in determining the runoff hydrograph shall be an initial loss of 0.5 inches and a uniform loss of 0.08 inches/hour for the subsequent hours once the initial losses are satisfied.

9. All calculations for detention facilities shall be submitted for review by the City. Submittals shall include hydrographs, outflow rate and velocity, and stage-discharge relationship through the facility.

10. Detention facilities may be located in the regulatory floodplain outside of the floodway. Storm water storage volume in the detention facility shall be that volume above the base flood elevation.

11. Any construction in the floodplain, including the detention facility, shall not increase the base flood elevation in the regulatory floodplain. A HEC-2 analysis shall be submitted to document that the floodplain's base flood elevations have not increased.

12. Additional detention storage, in excess of the required storage for the development, can be provided to satisfy the detention requirements for a tract of land downstream of the detention facility, providing the detention facility is constructed prior to the development of the downstream tract. A map showing the specified tract of land included in the detention facility volume shall be submitted.

13. The maintenance requirements for all detention facilities shall be spelled out in the covenants. For example, frequency of mowing, dredging of ponds, sediment clearing.

14. All dikes and spillways on detention facilities shall show typical cross sections in the plans.

15. An access way, a minimum of 20 feet wide, shall be provided to and into all detention facilities from a public right-of-way. Access may be provided by frontage on a right-of-way or by an access easement to the detention facility. The access road shall have a maximum grade of 10%. The access road shall be paved, a minimum of 12 feet wide, extending from the top of bank to the bottom of the detention facility and to locations of high maintenance.

16. Side slopes on detention facilities shall not be steeper than 4:1 (horizontal run to vertical rise). The bottom of a dry detention facility shall have a minimum slope of 2% across grass surfaces and a minimum slope of 0.5% across paved surfaces. The standing water depth of the permanent pool of a wet detention facility shall be a minimum of 8 feet deep.

17. Detention facilities shall be provided with a trickle channel from the inlet to the outlet structure. The channel shall be concrete lined and be of sufficient width and geometry to allow for proper maintenance.

18. Energy dissipation devices shall be installed at the outlet of the detention facility, and shall be detailed in the plans.

19. All disturbed earth surfaces, including the detention facility, shall be protected from erosion.

20. Maintenance of the detention facility shall remain with the owner of the property. Only if the detention facility is dedicated to the public and accepted by the City will the City maintain the facility.

21. All detention facilities shall have a defined spillway. The spillway shall be designed to pass the 500-year flood event with a minimum of one-foot of freeboard. The plan shall show the 500-year flow rate, the spillway elevation, the 500-year flow rate's water surface elevation through the spillway, and the top of bank elevation that documents compliance of the item.

SECTION 11 - SOIL EROSION AND SEDIMENTATION CONTROL

1. Permits

   a. Purpose: The primary concern of the City is minimizing erosion and sedimentation damage during the period of site construction activities until final landscaping and erosion control measures are effectively in place.

   b. City of Claremore Earth Change Permit: In order to meet the Phase II permitting requirements, construction areas 1 acre and larger in size will require a City of Claremore Earth Change Permit completed and filed with the City Clerk's Office.

   c. EPA NPDES Permit - For construction areas 1-acres and larger in size, An Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) Permit shall be approved by EPA and filed with the City Clerk before construction shall begin.