CITY OF KAUFMAN

Standards of Design and Construction

Appendix 1

City of Kaufman, Texas

Adopted April 22, 2024

Ordinance O-05-24

Ratcliff Planning Consultants

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CHAPTER 02.031
STANDARDS OF DESIGN AND CONSTRUCTION
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ARTICLE 02.031.000..... GENERAL REQUIREMENTS

SEC. 02.031.001..... INTRODUCTION.

(a) Applicability. The Appendix 1 "*Standards of Design and Construction*" are generated to implement the provisions of the Subdivision Ordinance and to provide for the orderly safe, healthy, and uniform development of the area within the corporate city limits and within the surrounding City extraterritorial jurisdiction (ETJ)

(b) Supplemental Applicability. The *5th Edition of the North Central Texas Council of Government (NCTCOG) Standard Specifications for Public Works Construction* dated November 2017 as amended by the City of Kaufman Special Provisions are supplemental and are made a part of the Standards of Design and Construction. These documents are to be considered as the minimum requirements of engineering design. The adherence to the requirements of these documents and/or the approval by the City of Kaufman and its agents in no way relieves the developer or their engineer of the responsibility or adequacy of design, which may require more stringent stands than these, the completeness of plans and specifications or the suitability of the completed facilities. In unusual circumstances, the City of Kaufman may determine that designs other than those of the Standards are necessary and will inform the developer of such requirements before final engineering review.

(c) Deviations. The developer and/or their representative shall obtain authorization from the City of Kaufman, in writing, for any deviations from the requirements set forth in the Standards of Design and Construction, Standard Specification for Public Works Construction.

SEC. 02.031.002..... STANDARDS OF DESIGN AND CONSTRUCTION.

(a) Authority. The "Standards of Design and Construction", as adopted by the City of Kaufman, are set forth herein. These standards shall be considered as the minimum requirements, and it shall be the responsibility of the developer to determine if more stringent requirements are necessary for a particular development. It is not intended that the "Standards of Design and Construction" cover all aspects of a development.

(1) For those elements omitted, the developer will be expected to provide designs and facilities in accordance with good engineering practice and to cause the facilities to be constructed utilizing first class workmanship and materials.

(2) The Director of Public Works and/or the City Engineer reserves the right to request additional information not covered within the "Standards of Design and Construction" to be included in the design plans by the developer/design engineer in order to validate the intent, safety, constructability, readability, and competence of the design plans.

(3) The developer/engineer must ensure that all design and construction is in accordance with all Federal, State, and local regulations, and must provide certification on the final plans. A copy of all determinations, permits, and approvals received from Federal, State, and local agencies must be provided to the Development Services Department in conjunction with the submission of the initial construction plans.

(4) All engineering design and Construction Plans submitted to the Development Services Department by the developer/design engineer shall be in conformance with he adopted "Standard of Design and Construction" that are in affect when the first submittal is received by the Development Services Department.

i. If subsequent submittals have not been received within one (1) year of the previous submittal, any subsequent submittals must conform to the current adopted "Standards of Design and Construction". Approved construction plans will expire within one (1) year of approval date and must be reviewed and revised to meet the current adopted "Standards of Design and Construction".

SEC. 02.031.003..... STANDARD OF SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION.

(a) The City of Kaufman Special Provision to the NCTCOG Standard Specifications for Public Works Construction, 5th Edition, November 2017, as adopted by the City of Kaufman is referenced in this document. The Standard Specifications for construction set forth the minimum requirements for materials and workmanship for streets, parking lots, sidewalks, drainage, water, and wastewater systems.

(b) In an effort to have uniformity and to facilitate maintenance, the City has adopted the North Central Texas Council of Governments (NCTCOG) Standard Drawings as modified by the City of Kaufman Special Provisions for certain facilities such as manholes, street sections, sidewalks, water, wastewater, storm water, curb inlets, barrier free ramps, etc. The City of Kaufman Special Provisions can be obtained from the Public Works Department. The NCTCOG Standard Specifications can be obtained from the North Central Texas Council of Governments web page (www.NCTCOG.org).

SEC. 02.031.004..... INSPECTION OF CONSTRUCTION BY CITY PERSONNEL.

(a) Inspection of construction and verification of compliance to the plans and specifications shall be conducted by the City of Kaufman staff under the direction of the Director of Public Works and/or the City Engineer. The facilities included in this inspection requirement are streets, sidewalks, parking lots, alleys, storm drainage facilities, water distribution systems, wastewater collection system, etc. The developer shall advise all of his construction contractors of this requirement.

(b) No development will be accepted by the City until all construction has been approved by the City of Kaufman's staff. The developer shall be responsible for any additional expense to the City at a rate established by the City at that time when inspection is done after normal business hours of the City. The date of acceptance will be when all items have been accepted by the City Council. Twenty (20) months from the date of acceptance the City will determine any failures or defects and repairs will be made by the contractor.

(c) The accepted method of inspection for underground utilities shall be videoed and the City will require a copy of such inspection. The Developer or contractor shall be responsible for the cost of the videoed inspection.

SEC. 02.031.005..... FRANCHISE AND PUBLIC UTILITES TO BE UNDERGROUND.

(a) All franchise and public utilities within a residential and commercial development shall be placed underground. Utilities are defined for this purpose as water pipelines, wastewater pipelines, storm water pipelines, natural gas pipelines, telephone wires, cable TV wires and electric wires.

(b) In case of special or unique circumstances, the City may grant exceptions to this requirement (See Subdivision Regulations, Article 02.03.086 Exceptions and Minor Modifications). Any request for an exception should be submitted in writing to the City of Kaufman setting forth the justification for an exception. The granting of an exception by the City Council will be in writing. No work will be accepted without written approval from the Director of Public Works and/or the City Engineer.

SEC. 02.031.006..... SUBMITTAL TO UTILITY COMPANIES.

(a) The developer shall be responsible for submittal of information needed to design private utilities for the development. This information shall be submitted to the franchise (gas, electric, phone, and cable) companies. Written confirmation from the franchise companies shall be submitted to the Public Works and Development Services Department, verifying that the affected utility companies have installed their respective utilities prior to engineering acceptance of project.

SEC. 02.031.007..... REQUIREMENTS OF THE FINAL CONSTRUCTION PLAN DRAWINGS.

(a) The final construction plan drawings shall conform to the established “Construction Plan Drawings Requirements” and these Standards of Design. A general checklist for Construction Plan Drawings Requirements is outlined in Appendix A.

(b) The final construction plan drawings will consist of drawings showing all information necessary to completely review the engineering design of improvements proposed for or affected by the site and sealed a Registered Professional Engineer within the State of Texas.

SEC. 02.031.008..... CONSTRUCTION PLAN APPROVAL/CONSTRUCTION PERMIT RELEASE.

(a) All review fees (plan, flood study, TIA, Lift station, etc.) shall be paid in accordance with the any approved associated Development Agreement, Facilities Agreement, Professional Service Agreements and/or prior to and approval of a building permit and commencement of vertical construction.

SEC. 02.031.009..... EASEMENTS AND RIGHT-OF-WAY.

(a) All easements and right-of-way required for construction of a proposed project must be approved and accepted for filing prior to the approval or release of the final design/construction drawings.

(b) Requirements for On-Site Easements and Right-of-Way Dedication to the City:

(1) All easements and right-of-way shall be dedicated on a plat. No separate instruments will be allowed.

(2) No structures (buildings, walls, fences, decks, swimming pools, signage/monuments, etc.) are allowed in or over any easements, or rights-of-ways. No trees shall be planted within ten (10) feet of any public water or wastewater line ten (10) inches in diameter or larger. No trees shall be planted within five (5) feet of any public water and wastewater line less than ten (10) inches in diameter. No trees shall be planted within five (5) feet of any public storm system.

(3) All drainage and detention easements shall be maintained, repaired, and replaced by the property owner. This statement is to be noted on the plat.

(4) No public utilities allowed in detention easements.

(5) All rights-of-ways shall have a minimum five (5) foot utility easement dedicated adjacent to them.

(6) Easement dimensions and other special requirements can be found in the utility's respective section of these Standards.

(c) Requirements for Off-Site Easements Dedicated to the City:

(1) All easement and right-of-way documents shall be on forms provided by the City.

(2) Owner/Developer shall furnish the City a current title report and, metes and bounds description, and exhibit that is signed and sealed by a Texas Registered Professional Land Surveyor that shows the easements' and/or right-of-way, location, and current ownership information.

(3) All easements shall be reviewed and approved by the Director of Public Works and/or the City Engineer prior to releasing the documents for signatures by the property owners.

(4) The individual or entity requesting the easement shall pay all fees, plus filing fees required by the City of Kaufman and Kaufman County.

(5) The individual or entity shall return, to the Development Services Department, all originally signed documents, pay all outstanding fees plus a check for filing fees made out to Kaufman County for filing.

(6) All filing information for all easements must be shown on all plats.

(7) After recordation, a copy of the filed document will be forwarded to the property owner.

SEC. 02.031.010..... FINAL ACCEPTANCE OF CONSTRUCTION PLANS.

(a) Final Acceptance shall occur when all the items on the General Checklist for Final Acceptance as outlined in Appendix B or C, as applicable and any other more specific comments as provided by the City Engineer and/or the Director of Public Works. Items on the checklist for final acceptance will vary per project and additional items not shown on the check list may be required.

(b) After improvements have been constructed, the developer shall be responsible for providing to the City "As Built" or "Record Drawings". The design engineer shall furnish all digital files of the project formatted in Auto Cad 2020, or any other format required by the City or newer, and Adobe Acrobat (.pdf) format with a flash drive. The drive shall include a full set of plans along with any landscaping for residential subdivisions, wall plans, and details sheets.

(c) Submit one (1)-set of printed drawings of the "Record Drawings" containing copies of all sheets. The printed sheets will be reviewed by the construction inspector **PRIOR** to producing the "Record Drawing" digital files on disk or flash drive. This will allow any revisions to be addressed prior to producing the digital files.

(d) Record Drawing Disk drawings shall have the design engineer's seal, signature and must be stamped and dated as "Record Drawings" or "As Built Drawings" on all sheets.

(e) The City of Kaufman will not accept any "Record Drawing", or "As Built Drawings" on paper, or digital drawings which include a disclaimer with the like or similar verbiage. A disclaimer shall not directly or indirectly state or indicate that the design engineer or the design engineer's surveyor/surveyors did not verify grades after construction, or that the Record Drawings were based solely on information provided by the construction contractor/contractors. Any Record Drawings which include like, or similar disclaimer verbiage will not be accepted by the City of Kaufman. Below is acceptable disclaimer language.

> **Example of Acceptable Disclaimer:** To the best of our knowledge ABC Engineering, Inc., hereby states that this plan is As-Built. This information provided is based on surveying at the site and information provided by the contractor.

SEC. 02.031.011 ..... CHANGES IN *STANDARDS OF DESIGN AND CONSTRUCTION*.

(a) These Standards of Design and Construction can be modified by City Council through an ordinance. This document can also be updated from time to time to reflect changes in City requirements. It is the responsibility of the user to obtain the latest revisions of the City's *Subdivision Ordinance* and this Chapter.

SEC. 02.031.012 to SEC. 02.031.019 RESERVED.

ARTICLE 02.031.0200 ..... STREETS

SEC. 02.031.0211..... GENERAL.

(a) The street system, including the street layout, shall be in accordance with generally accepted engineering practices and in compliance with the City of Kaufman's Comprehensive Plan, *Thoroughfare Plan, Zoning Ordinance*, *Subdivision Regulations* and the Kaufman County *Thoroughfare Plan*, and other applicable regulations, as amended.

(b) The drainage system, as incorporated into the street system, shall comply with Section 300 of this Chapter. The plans and specifications, design computations, if required, and other applicable data shall be submitted to the City for review.

(c) Construction shall not commence prior to approval of the plans and specifications by the City. All changes during construction shall be submitted to the Director of Public Works and/or the City Engineer for approval prior to any construction modifications.

SEC. 02.031.0212 ..... STREET ARRANGEMENT.

(a) Unless otherwise approved by the City, provisions shall be made for the extension of existing major arterials, collector streets and local streets in accordance with the City and Kaufman County Master Thoroughfare Plan and any specific street alignments as adopted by the City Council.

(b) Off-center intersections will be considered for approval only for minor collectors and local streets and only when there is a minimum property line separation of one-hundred-twenty-five feet (125') unless otherwise approved by the Director of Public Works and/or the City Engineer.

(c) Within residential areas, the following design elements are encouraged:

(1) Developing only a limited number of access points to arterial streets bordering the subdivision;

i. More than one point of access;

ii. Incorporate curvilinear streets into the plan; and

iii. Incorporating a discontinuous residential street network, which utilizes three-way intersections in lieu of four-way intersections. When these factors are incorporated into a residential street plan, the result is enhanced character and traffic safety.

SEC. 02.031.0213 ..... THOROUGHFARE AND STREET GEOMETRY.

(a) Geometric Design Standards. Geometric design standards are presented in two (2) formats within this section, **Table 2.1 Thoroughfare Geometric Design Standards** identifies specific design criteria for each standard roadway type. **Figure 2.1A and 2.1B** shows the typical cross-section for each standard roadway type. It is noted that dimensions shown are to the face of curb, unless specifically identified otherwise. **Figure 2.1C** shows the typical radii of a cul-de-sac, and an eyebrow.

(b) Each roadway type is keyed to the City Master Thoroughfare Plan, with the exception of local streets. The reader is referred to this document for information as to the locations where these roadways are to be used.

Table 2.1 Thoroughfare Geometric Design Standards

Thoroughfare Designation	Type "A"		Type "B"		Type "C"		Type "D"			
Thoroughfare Type	**Major Arterial Divided 6-Lane**		**Minor Arterial Divided 4-Lane**		**Major Collector Undivided 4-Lane**		**Minor Collector/ Local Commercial Undivided**		**Local (Residential) *****	
Number Traffic Lanes	6		4		4		2		2	
Minimum Lane Width (feet)	12		12		12		12 +2 Parking		14	
***Minimum R.O.W. Width (feet)**	120		100		80		60		*50	
Design speed (m.p.h.)	45		40		35		30		30	
Posted Speed (m.p.h.)	40		35		30		30		30	
Stopping sight distance (feet)	400		325		275		200		200	
****Median Width (feet)**	**12		**14		—		—		—	
Minimum Lateral Clearance (feet)	6		6		6		6		—	
Parking Permitted	NO		NO		NO		COM.-SOME RES.-YES		RES.YES	
Minimum Horizontal Centerline Curvature (feet)	1200		850		Com.-700 Res.-600		Com.-500 Res.-350		Res.-250 Elbow -50'	
Crest Vertical Curve Minimum K Value	120		80		50		30		30	
Sag Vertical Curve Minimum K Value	90		70		50		40		40	
Maximum Grade (%)	7.5 (For max length of 200')		7.5 (For max length of 200')		7.5		7.5		10.0	
Minimum Grade (%)	0.7		0.7		0.7		0.7		0.7	

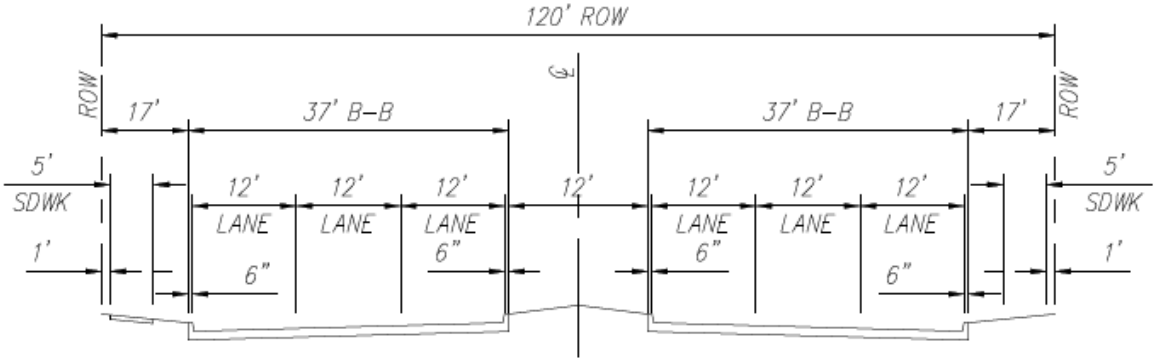
***RIGHT-OF-WAY REQUIREMENTS FOR STATE HIGHWAYS AND/OR THE PROVISION OF RIGHT TURN LANES OR OTHER INTERSECTION IMPROVEMENTS MAY EXCEED THIS MINIMUM R.O.W. STANDARD.**

****LARGER MEDIANS MAY BE REQUIRED TO PROVIDE FOR MULTIPLE TURN LANES.**

*****LOCAL RESIDENTIAL CUL-DE-SACS SHALL HAVE A MINIMUM R.O.W. RADIUS OF FIFTY-SEVEN AND HALF FEET (57.5').**

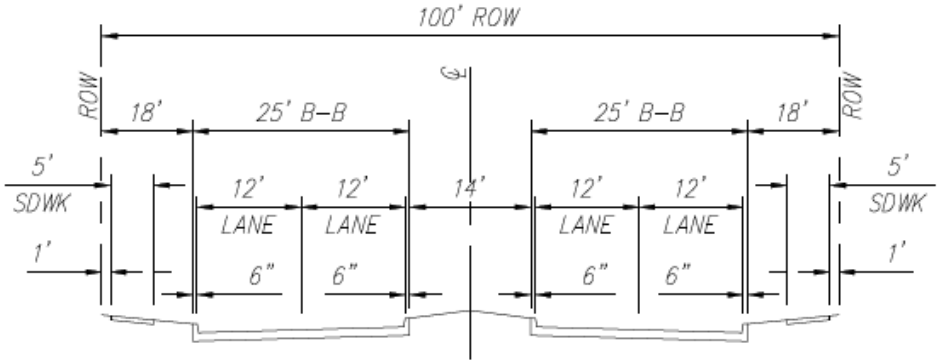
CROSS-SLOPE EXCEPTIONS NEED APPROVAL FROM CITY ENGINEER AND/OR P.W. DIR.

Figure 2.1A. Typical Thoroughfare Cross Sections



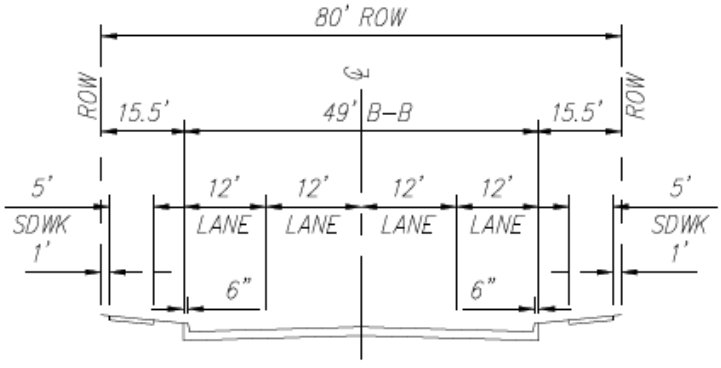
TYPE "A" - MAJOR ARTERIAL

N.T.S.



TYPE "B' - MINOR ARTERIAL

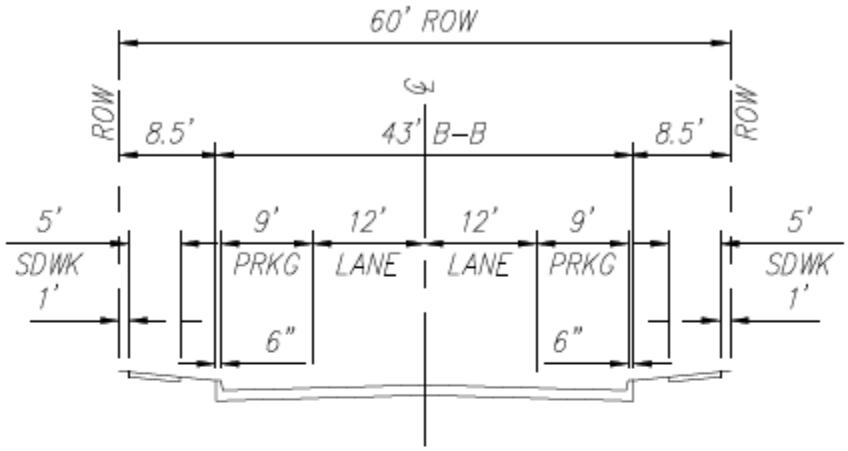
N.T.S.



TYPE 'C' - MAJOR COLLECTOR (WITHOUT MEDIAN)

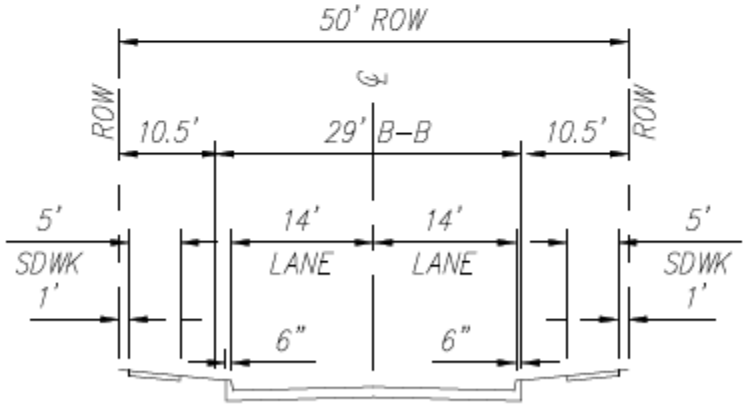
N.T.S.

Figure 2.1B: Typical Thoroughfare Section



TYPE 'D' - MINOR COLLECTOR

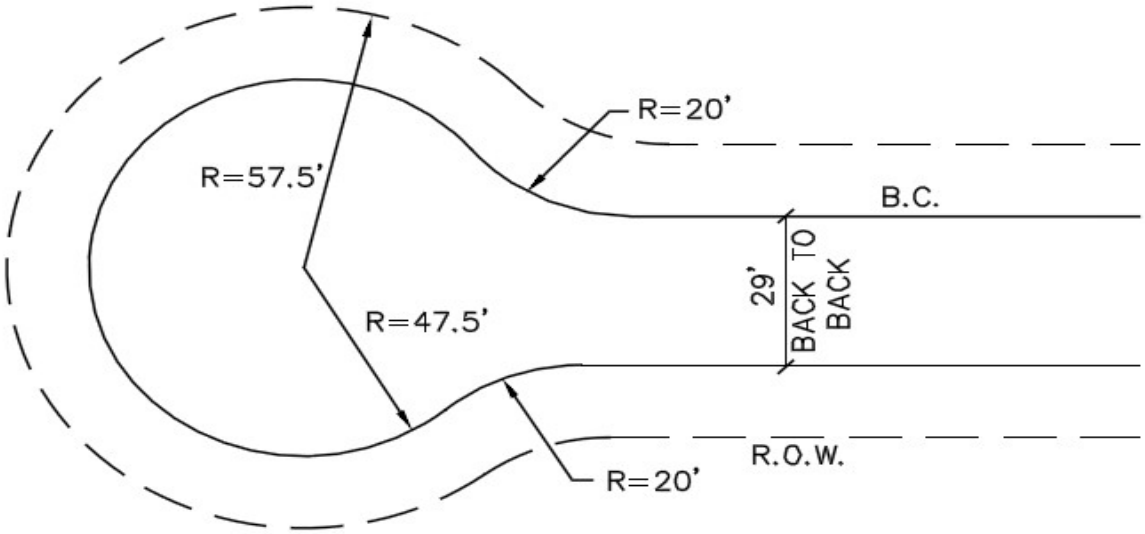
N.T.S.



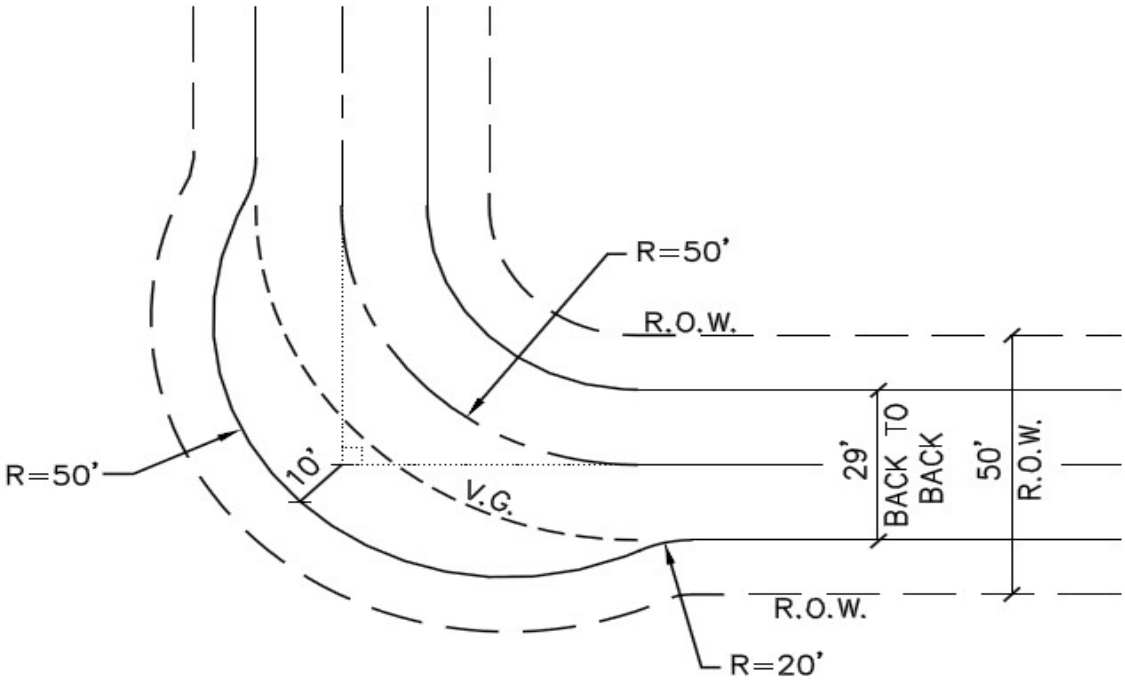
LOCAL (RESIDENTIAL STREET)

N.T.S.

Figure 2.1C: Typical Thoroughfare Cross Sections



TYPICAL CUL-DE-SAC



TYPICAL EYEBROW

SEC. 02.031.0214 ..... Turn Lanes.

(a) All left turn storage areas shall be eleven (11) feet wide with minimum storage requirements for left-turn lanes as in **Figure 2.2 Median Design Standards** .

(b) The transition curves used in left-turn lanes shall be two (2), two hundred-fifty (250)-foot radius reverse curves with a total transition length of one-hundred -feet (100').

(c) Medians less than seven (7) feet wide (face to face) are required to be constructed of reinforced integral stained and stamped color concrete a minimum of six (6) inch thick median pavement.

(d) All median noses are to be constructed of City approved integral stained and stamped color concrete. The color and pattern to be approved by the City.

(e) The paver system shall be installed a distance of ten (10) feet from the end of the nose.

SEC. 02.031.0215 ..... MEDIAN OPENINGS, WIDTH, LOCATION AND SPACING.

(a) Arterial thoroughfares in Kaufman have raised medians. Arterials having continuous two-way left turn lanes are discouraged and may be utilized only in special circumstances with the approval of the City Council.

(b) Median openings at intersections shall be from right-of-way to right-of-way of the intersecting street, unless otherwise approved by the Director of Public Works and/or the City Engineer.

(c) The width of mid-block median openings shall not be less than sixty (60) feet, but no greater than seventy (70) feet.

(d) Using the above requirements, examples of the minimum distance between median openings on a divided street where left-turn storage is provided in both directions are:

(1) Three hundred ten (310) feet from nose to nose of the median from the intersection of two major thoroughfares to a street or drive (see **Figure 2.2 Median Design Standards**);

(2) Two-hundred sixty (260) feet from nose to nose of the median from the intersection of two secondary thoroughfares or a secondary thoroughfare and a major thoroughfare to a residential street or a drive (see **Figure 2.2 Median Design Standards**), and;

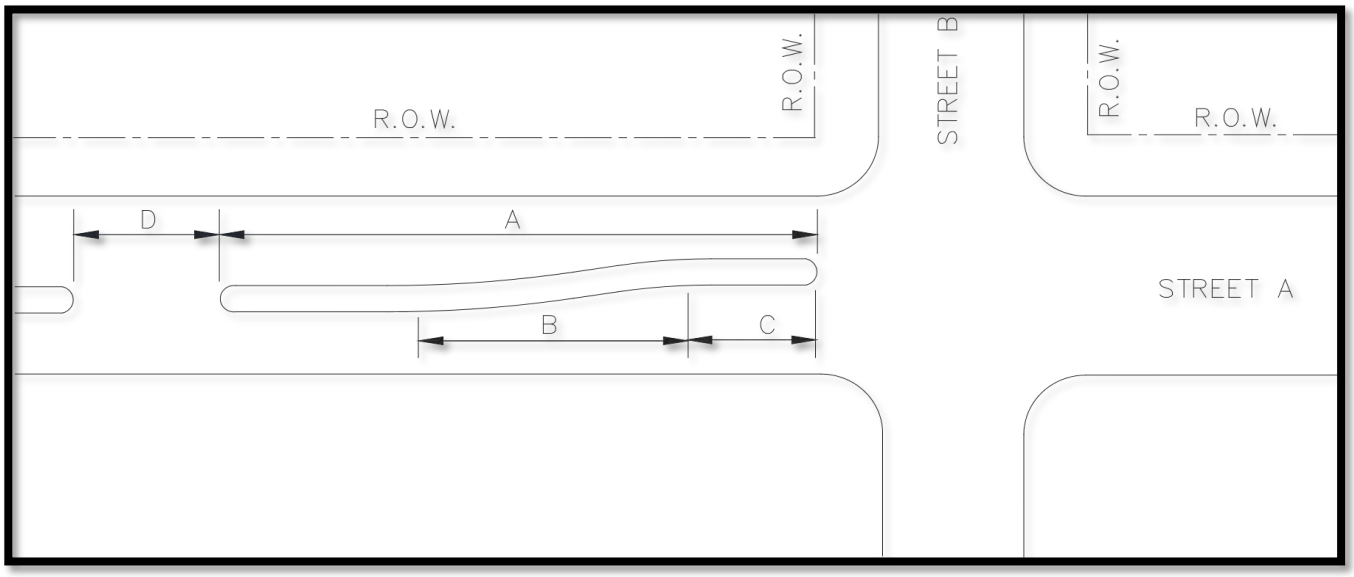
(3) Two-hundred twenty (220) feet from nose to nose of the median for intersection combinations of drives and/or residential streets (see **Figure 2.2 Median Design Standards**).

(d) Medians less than seven (7) feet wide are required to be constructed of a City approved paver or stamped concrete system. All median noses are to be constructed of City approved paver or stamped concrete system, a distance of ten (10) feet from the end of the nose.

(e) Any median that has landscaping requires a mow ramp to be installed for access.

(f) Noses shall be a solid poured steel reinforced concrete bullet nose.

Figure 2.2: Median Design Standards



INTERSECTING STREET TYPE		MINIMUM LENGTH (FEET)			
STREET A	STREET B	A	B	C*	D**
Major Arterial (6 Lanes)	Major Arterial (6 Lanes)	310	100	150	60
Major Arterial (6 Lanes)	Minor Arterial (4 Lanes)	260	100	100	60
Major Arterial (6 Lanes)	Major Collector (4 Lanes) Minor Collector (2 Lanes)	260	100	100	60
Major Arterial (6 Lanes)	Local/Private (2 Lanes)	260	100	60	60
Minor Arterial (4 Lanes)	Major Arterial (6 Lanes)	310	100	150	60
Minor Arterial (4 Lanes)	Minor Arterial (4 Lanes)	260	100	100	60
Minor Arterial (4 Lanes)	Major Collector (4 Lanes) Minor Collector (2 Lanes)	260	100	100	60
Minor Arterial (4 Lanes)	Local/Private	220	100	60	60

LEFT-TURN STORAGE AREA WIDTH 11' MINIMUM

MEDIAN WIDTH (See Table 2.1 Geometric Design Standard For Principal And Minor Arterial).

***MINIMUM LENGTH – ACTUAL LENGTH DEPENDENT UPON ANTICIPATED TURN VOLUME**

****OR STREET WIDTH + 8 FEET – WHICHEVER IS GREATER. AN EXCEPTION MAYBE GRANTED BY CITY COUNCIL ON A CASE-BY-CASE BASIS.**

SEC.02.031.0216 ..... DRIVEWAY SEPARATIONS.

(a) Minimum standards for driveway separation accessing the same site are shown in **Figure 2.3 Minimum Driveway Spacing and Corner Clearance**. This standard applies to all non-residential uses.

(b) There is a minimum distance upstream and downstream from adjacent intersections within which driveways should not be located. This separation distance varies with the classification of street and is shown in **Figure 2.3 Minimum Driveway Spacing and Corner Clearance**. This standard applies to all non-residential users.

(c) At mid-block access points, there is a minimum distance from a median nose, within which driveways should not be located. This is shown in **Figure 2.3 Minimum Driveway Spacing and Corner Clearance** and is equally applicable along both major and minor arterials for non-residential uses. All proposed paving connections to existing paving require a longitudinal butt joint connection.

(d) Minor Exceptions to these minimum standards may be approved by the Director of Public Works and/or the City Engineer based on visibility issues such as, but not limited to; the existing topography, physical constraints, and traffic safety related to the site.

SEC. 02.031.0217 ..... DRIVEWAYS ON TXDOT FACILITIES.

(a) Driveways on TxDOT facilities shall be placed in accordance to City Standards set forth in this section and the requirements of the current TxDOT's Access Management Manual and require TxDOT Driveway Permit approval.

(b) TxDOT Driveway Permits shall be processed through the Development Services Department.

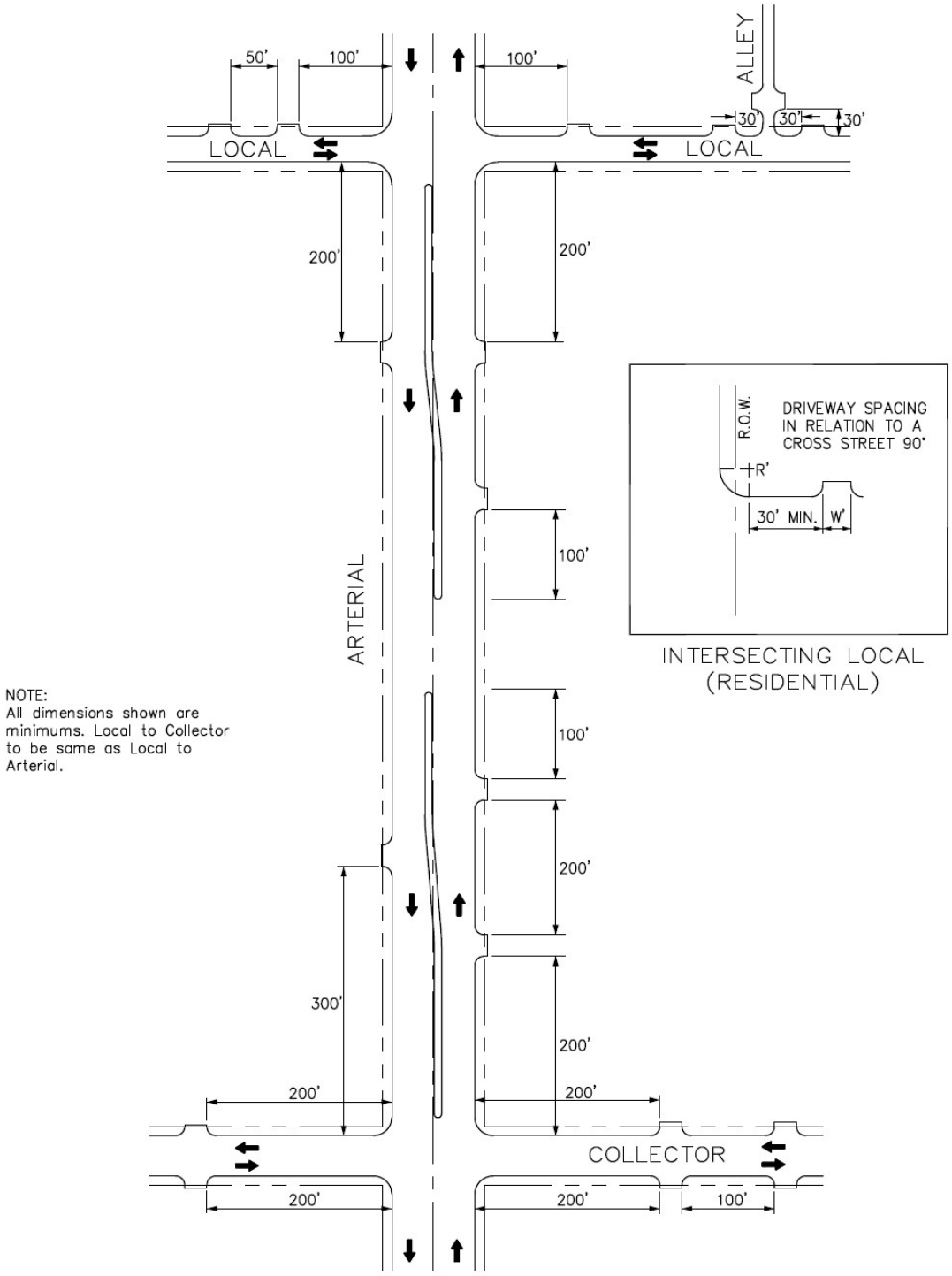
(1) TxDOT Permit Plan sets shall be 11"x17" in size and signed and sealed by a licensed professional engineer with the State of Texas. The number of printed permit plan sets required shall be set by the Development Services Department. A digital permit plan set signed and sealed set shall also be required.

(2) Permit plan sets shall include: typical sections, paving plan, and profile, all applicable TxDOT standard details, traffic control plans sheets, striping plans, demo plans, drainage plans (drainage area map, storm sewer plans and profiles, culvert plans and profiles), and any other items required by TxDOT, or the Director of Public Works and/or the City Engineer to construct the driveway.

SEC. 02.031.0218 ..... BLOCK LENGTHS.

(a) In general, streets shall be provided at such intervals as to serve cross traffic adequately and to intersect with existing streets. Where no existing plats control, the blocks shall be not more than twelve hundred (1,200) feet in length. Block arrangements must provide access to all lots, and in no case shall a block interfere with traffic circulation.

Figure 2.3 Minimum Driveway Spacing and Corner Clearance



SEC.02.031.0219 ..... STREET INTERSECTIONS.

(a) More than two streets intersecting at one point shall be avoided. All streets and thoroughfares should intersect other streets and thoroughfares at an angle of ninety (90) degrees unless otherwise approved by the Director of Public Works and/or the City Engineer.

(b) Arterial and collector street intersections shall have property line right-of-way corner clips with a minimum tangent distance of thirty (30) feet. Residential streets shall have a right-of-way corner clip at their intersection with other streets or thoroughfares consisting of a ten (10) foot by ten (10) foot right-of-way.

(c) Right-of-way corner clips will be required for all ninety-degree (90°) angle intersections. For all intersections that are **not** ninety-degree (90°) angles, a right-of-way corner clip is required as shown below:

(1) Arterial/Collector street intersection – thirty (30) foot by thirty (30) foot;

(2) Residential street intersections – twenty (20) foot by twenty (20) foot;

(3) Alley to street intersections – ten (10) foot by ten (10) foot

(d) Curb radii at intersections shall have a minimum radius of thirty (30) feet along arterials, twenty-five (25) feet along collectors and residential streets.

(e) In any case where streets intersect at an angle of other than ninety (90) degrees, the City may require non-standard right-of-way corner clips and curb return radii. (

(f) All proposed paving connections to existing paving require a longitudinal butt joint connection.

SEC.02.031.0220 ..... RELATION TO ADJOINING STREETS.

(a) The system of streets designed for the development, except in unusual cases, must connect with streets already dedicated in adjacent developments. Where no adjacent connections are platted, the streets must be the reasonable projection of streets in the nearest subdivided tracts and must be continued to the boundaries of the tract development, so that other developments may eventually connect with the proposed development.

(b) Strips of land controlling access to or egress from other property or any street or alley or having the effect of restricting or damaging the adjoining property for development or subdivision purposes or which will not be taxable or accessible for special improvements shall not be permitted in any development unless such reserve strips are conveyed to the City on fee simple.

(1) This determination is made by the Director of Development Services, or the Director of Public Works and/or the City Engineer. When such access is needed to maintain permanent City owned utilities, the street will be an improved right-of-way. If the utilities are temporary, an improved easement may be approved.

SEC. 02.031.0221 ..... DEAD-END STREETS, CUL-DE-SACS, AND COURTS.

(a) Cul-de-sacs are permitted within residential subdivisions. Use of this design shall provide proper access to all lots and shall not exceed six hundred (600) feet in length, measured from the center of the cul-de-sac to the center of the intersecting street (not a dead-end street).

(b) Cul-de-sac shall have a minimum paving radius of forty-seven and half (47 ½) feet and a minimum right-of-way radius of fifty-seven and half (57 ½) feet. Specific aspects of the standard cul-de-sac design are given in **Figure 2.1C Typical Thoroughfare Cross Sections**. In lieu of the typical design shown, the City may approve alternative concepts for a specific application.

SEC. 02.031.0222 ..... ALLEYS AND ALLEY WIDTHS.

(a) Alleys may be provided in all residential areas and shall be paved with steel reinforced concrete. No alley may be over twelve hundred (1,200) feet long.

(b) The minimum width of an alley shall be twenty (20) feet. All alleys shall be privately maintained as a common area lot. Dead-end alleys shall not be permitted. The City may waive this requirement where such dead-end alleys are unavoidable and where adequate turnaround facilities have been provided.

(c) Adequate provisions shall be made at all intersections in order that equipment, such as garbage collection vehicles and maintenance vehicles, can maneuver the corners.

(d) The interior edge of the pavement, at the corners, shall have a minimum radius of thirty (30) feet.

(e) The exterior edge of the pavement, at the corners, shall have a minimum radius of twenty (20) feet.

(f) The alley paving is to be flared at the street intersection.

(g) The alley width limits specified in these regulations shall be expanded, if necessary, beyond the minimum requirement in order to include all of the paved sections and utilities within the alley.

(h) Alley turnouts shall be paved to the property line and shall be fifteen (15) feet wide at that point.

(i) All alleys shall have a minimum of fourteen (14) feet of steel reinforced paved concrete roadway.

(j) Alley shall have a minimum thickness of seven (7) inches on the exterior edges and five (5) inches in the center sections.

SEC.02.031.0223 ..... STREET GRADES.

(a) Arterial streets may have a maximum grade of seven and one-half (7 ½) percent, for a maximum continuous distance of two-hundred(200) feet.

(b) Collector streets may have a maximum grade of seven and one-half (7 ½) percent.

(c) Residential streets may have a maximum grade of ten (10) percent, unless otherwise approved by the Director of Public Works and/or the City Engineer, where the natural topography is such as to require steeper grades.

(d) All streets must have a minimum grade of at least seven-tenths (0.7) of one (1) percent.

(e) Centerline grade changes with an algebraic difference of more than one (1) percent shall be connected with vertical curves in compliance with the minimum length requirements set forth in **Table 2.2A Crest Vertical Curves and Table 2.2B Sag Vertical Curves**

Table 2.2A: Crest Vertical Curves

Design Speed (MPH)	Coeff. of Friction (a)	Stopping Sight Dist. (Ft.)	Stopping Sight Dist. Rounded for Design (Ft.)	K	K Rounded for Design
15	0.42	72.98	75	4.01	5
20	0.40	106.83	125	8.59	10
25	0.38	146.70	150	16.19	20
30	0.36	193.58	200	28.20	30
35	0.34	248.72	250	46.55	50
40	0.32	313.67	325	74.03	80
45	0.31	383.12	400	110.44	120

(a) AASHTO, p. 316

ROUNDED
MINIMUM LENGTH OF VERTICAL CURVE IN FEET (L = KA)
For Speeds and K Values Shown Below

Algebraic Grade Diff. (%) (A)	MPH	15	20	25	30	35	40	45
	K	5	10	20	30	50	80	120
1		5	10	20	30	50	80	120
2		10	20	40	60	100	160	240
3		15	30	60	90	150	240	360
4		20	40	80	120	200	320	480
5		25	50	100	150	250	400	600
6		30	60	120	180	300	480	720
7		35	70	140	210	350	560	840
8		40	80	160	240	400	640	960
9		45	90	180	270	450	720	1080
10		50	100	200	300	500	800	1200
11		55	110	220	330	550	880	1320
12		60	120	240	360	600	960	1440
13		65	130	260	390	650	1040	1560
14		70	140	280	420	700	1120	1680
15		75	150	300	450	750	1200	1800

Table 2.2B: Sag Vertical Curves

Design Speed (MPH)	Coeff. of Friction (a)	Stopping Sight Dist. (Ft.)	Stopping Sight Dist. Rounded for Design (Ft.)	K	K Rounded for Design
15	0.42	72.98	75	8.13	10
20	0.40	106.83	125	14.75	20
25	0.38	146.70	150	23.56	30
30	0.36	193.58	200	34.78	40
35	0.34	248.72	250	48.69	50
40	0.32	313.67	325	65.69	70
45	0.31	383.12	400	84.31	90

(a) AASHTO, p. 316

ROUNDED
MINIMUM LENGTH OF VERTICAL CURVE IN FEET
For Speeds and K Values Shown Below (L = KA)

Algebraic Grade Diff. (%) (A)	MPH	15	20	25	30	35	40	45
	K	10	20	30	40	50	70	90
1		10	20	30	40	50	70	90
2		20	40	60	80	100	140	180
3		30	60	90	120	150	210	270
4		40	80	120	160	200	280	360
5		50	100	150	200	250	350	450
6		60	120	180	240	300	420	540
7		70	140	210	280	350	490	630
8		80	160	240	320	400	560	720
9		90	180	270	360	450	630	810
10		100	200	300	400	500	700	900
11		110	220	330	440	550	770	990
12		120	240	360	480	600	840	1080
13		130	260	390	520	650	910	1170
14		140	280	420	560	700	980	1260
15		150	300	450	600	750	1050	1350

SEC. 02.031.0224 ..... PAVEMENT DESIGN.

(a) Traffic projections for next thirty (30) years, engineered paving designs, and subgrade conditions are required for the pavement design section determinations of all collector and arterial streets.

SEC. 02.031.0225 ..... SUBGRADE.

(a) Subgrades shall be compacted and finished to a smooth uniform surface. Subgrades of native material which have a Plasticity Index (P.I.) of fifteen (15) or more shall be lime stabilized to a minimum depth of six (6) inches. The lime stabilization shall be used for the full width of the street, back of curb to back of curb, plus twelve (12) inches on outside of the curb. The minimum lime content shall be six (6) percent of the dry weight of the material (at least 27 lbs. per square yard).

(b) Lime stabilization or concrete stabilization may be required for soils showing a P.I. of 15 or less. Type of stabilization and paving design will be determined prior to pavement construction by a certified geotechnical testing lab. The subgrade materials will be tested in accordance with the Standard Specifications for Construction, unless otherwise approved by the City.

(c) In general, the soils testing will include the testing of Atterburg limits and testing of sulfates to determine if lime stabilization is infeasible. Laboratory tests must be submitted to the Director of Public Works and/or the City Engineer for approval to determine amount of lime required.

(d) Subgrades should be compacted to ninety-five (95) percent standard densities.

(e) No sand is allowed under any paving.

SEC.02.031.0226 ..... STEEL REINFORCED CONCRETE PAVEMENT.

(a) All concrete pavement shall be steel reinforced. The size and spacing shall conform to the design standards in **Table 2.3 Steel Reinforced Concrete Pavement Design** below. All non-structural cracks in paving shall be routed and sealed as determined by the City. All reinforcing steel placed within the public right-of-way shall be grade sixty (60) steel and comply with Texas Department of Transportation.

(b) Fly ash may be used in concrete pavement locations provided that the maximum cement reduction does not exceed twenty percent (20%) by weight per cubic yard of concrete. The fly ash replacement shall be one and a quarter (1.25) pounds per one (1.0) pound of cement reduction.

(c) At a minimum, all concrete pavement shall conform to the design standards in **Table 2.3 Steel Reinforced Concrete Pavement Design** below.

(d) Concrete batch designs for all paving, sidewalks, and sewer/storm structures are to be reviewed and approved by the Director of Public Works and/or the City Engineer.

(1) All batch designs shall be submitted with history of recent cylinder breaks for each separate strength requirement (machine placement and hand placed).

(2) All batch designs shall have the current date, project name, and use labeled on each design.

(3) Submit batch designs to the Director of Public Works and/or the City Engineer a minimum of ten (10) days prior to the projected placement date for review and approval.

(4) Submit concrete batch plant permit to the Development Services Department for location approval.

(e) During construction, the contractor shall furnish the following at his own expense:

(1) Batch plant control from a qualified commercial laboratory. Laboratory personnel shall be competent to determine free moisture in aggregates and make needed adjustments in control of the mix and slump.

(2) Prepare a minimum four (4) compression cylinders for each one-hundred fifty (150) cubic yards of concrete or fraction thereof, with one (1) cylinder break at seven (7) days, one at fourteen (14) days, and a minimum of two (2) cylinders broken at twenty-eight (28) days. **Note* No averaging on cylinder breaks.**

(3) Testing labs are to submit copies of any and all concrete cylinder breaks that do not meet the twenty-eight (28) day break specifications. Cores are to be taken within ten (10) days of any twenty-eight (28) day cylinder break failures.

(4) Test data and copies of all laboratory reports for site work are to be directed to the attention of the designated engineering construction inspector that is assigned to the project.

Table 2.3: Steel Reinforced Concrete Pavement Design

Street/Pavement Type	Minimum Thickness (inches)	Strength 28-Day (psi)	Minimum Cement (sacks / CY)		Steel Reinforcement	
			Machine placed	Hand Placed	Bar #	Spacing (O.C.E.W.)
Arterial *	10”	4,000	6.0	6.5	#3 bars”	18”
Collector *	8”	4,000	6.0	6.5	#3 bars	18”
Residential	6”	4,000	6.0	6.5	#3 bars	18”
Fire Lane	6”	4,000	6.0	6.5	#3 bars	18”
Driveways	6”	4,000	6.0	6.5	#3 bars	18”
Barrier Free Ramps	6”	3,600	N/A	6.5	#3 bars	18”
Sidewalks	4”	3,000	N/A	5.5	#3 bars	18”
Parking Lot/Drive Aisles	5”	3,600	5.0	5.5	#3 bars	18”
Dumpster Pads	7”	4,000	6.0	6.5	#3 bars	18”

* Paving section designs for arterials and collectors shall be based off thirty (30) year projected traffic volumes and geotechnical analysis/report. (Paving section design shall include but not limited to the following: pavement thickness, reinforcing size and spacing, pavement strength, subgrade thickness, subgrade treatment type (lime or cement))

(f) The City of Kaufman may suspend concreting operations if the quality of the concrete being placed is not acceptable or due to adverse climate conditions. Concrete placement shall cease if the concrete temperature meets or exceeds ninety-five (95) degrees Fahrenheit. If in the opinion of the owner or the City of Kaufman concrete placement operations shall cease if a combination of temperature, wind, and humidity create conditions which are adversely affecting the condition of the concrete.

(g) Concrete placement shall also cease if concrete temperature is below forty (40) degrees Fahrenheit and falling. Except by specific written authorization of the owner, or the City of Kaufman, no concrete shall be placed when the air temperature is less than forty (40) degrees Fahrenheit and falling but may be placed when the air temperature is above thirty-five (35) degrees Fahrenheit and rising, "Pending No Freezing Weather is Imminent" with the temperature being taken in the shade away from artificial heat.

(1) When and if such permission is granted, the contractor shall furnish sufficient protective material and devices to enclose and protect the fresh concrete in such a way as to maintain the temperature of fifty (50) degrees Fahrenheit for a period of at least five (5) days.

(2) No concrete shall be placed on frozen subgrades. If in the opinion of the owner or the City of Kaufman concrete operations shall cease if a combination of temperature, wind, and humidity create conditions which are adversely affecting the condition of the concrete, then concrete placement shall cease. It is to be distinctly understood that the contractor is responsible for the quality and strength of the concrete placed under any weather conditions.

(h) Maximum time intervals between the addition of mixing water and/or cement to the batch, and the placing of concrete in the forms shall not exceed standards in **Table 2.4 Maximum Time Interval for Concrete Mixing and Placement** below. The use of an approved set-retarding admixture will permit the extension of the below time maximums, by thirty (30) minutes for agitated concrete only.

Table 2.4: Maximum Time Intervals for Concrete Mixing and Placement

Air or Concrete Temperature of Water to Placement	Maximum Time from Addition Whichever is Higher
Non-Agitated Concrete	
Up to 80 degrees Fahrenheit	30 Minutes
Above 80 degrees Fahrenheit	15 Minutes
Agitated Concrete	
Up to 75 degrees Fahrenheit	90 Minutes
75 degrees to 89 degrees Fahrenheit	60 Minutes
Over 89 degrees Fahrenheit	45 Minutes

SEC. 02.031.0227 ..... PARKWAYS, GRADES AND SIDEWALKS.

(a) All parkways shall be constructed to conform to top of curb grades with a standard transverse slope of one-quarter (1/4) inch per foot rise from top of curb to right-of-way. All City rights-of-way shall be sodded if disturbed.

(b) Where the natural topography is such as to require steeper grades, transverse slopes (except for sidewalk) up to three-quarter (¾) inch per foot may be used with approval of the City of Kaufman.

(c) Sidewalks shall be required adjacent to all public streets and on all streets designated on the adopted City and County Thoroughfare Plans, and shall stub out to the adjacent property. Barrier free ramps and sidewalks along screening walls, landscaped areas, trails, parks, open space, greenbelts, and/or drainage ways, shall be installed by the Developer with street construction and the sidewalks in front of residential lots shall be installed by the home builder. The City may require sidewalks in other locations.

(1) Sidewalks shall be five (5) feet in width and shall have one (1) foot of green space between the Right of Way line and the outside edge of sidewalk. Sidewalks shall be located wholly within the street Right of Way, sidewalk corner clip easement, or road easement.

i. If a fire hydrant is too close to the sidewalk, swerve sidewalk toward the right-of-way line to maintain five (5) feet clear path.

(2) Sidewalks placed adjacent to the back of the curb must be six (6) feet wide and lugged into the curb. Sidewalks to be placed against the back of curb shall be approved by the Director of Public Works and/or the City Engineer.

(d) If sidewalk has to be built outside the right-of-way, a sidewalk easement shall be required.

(e) Sidewalks/Trails wider than 5' will be required to have engineered details.

SEC. 02.031.0228 .. ROAD RECONSTRUCTION.

(a) During a roadway City initiated reconstruction project if a block of a street to be reconstructed does not currently have sidewalks in place, a five (5) foot sidewalk against/adjacent to the curb shall be required on both sides of the roadway within that street block if the following criteria are met:

(1) The roadway is above a residential/local classification or on the currently adopted Thoroughfare Plan. (i.e., Minor Collector, Major Collector, Minor Arterial and Major Arterial) and has an Average Daily Traffic (ADT) of 750 vehicles or more per day; or

(2) Any portion of the street block is located within one-thousand (1,000) feet of a school, city park, or church. In cases where the street block is located within this one-thousand (1,000) foot buffer the street block shall have a direct connection to another street block or sidewalk system that is also located within the one-thousand (1,000) foot buffer. Any street block or sidewalk system that is inhibited from connecting to an existing street block or sidewalk system by a physical barrier (e.g. bridges) may be exempted from this requirement at the discretion of the City Engineer and/or Public Works Director.

(3) For the purpose of this section a street block shall be defined as the section of the road that extends from one (1) street intersection to another, or from a street intersection to the end of a cul-de-sac or dead-end.

SEC. 02.031.0229 ..... Driveways/Drive Aisles.

(a) Residential.

(1) Steel reinforced concrete residential driveways to serve single car garages shall not be less than twelve (12) feet in width. Two car garages, carports and/or storage areas shall not be less than eighteen (18) feet and no more than twenty-four (24) feet in width at the property line. The width of the driveway for a three-car garage shall be twenty-eight (28) feet or larger on a case-by-case basis.

(2) Residential driveways shall be separated from one another by a distance of at least ten (10) feet. The radii of all residential driveway returns shall be a minimum of five (5) feet and shall not extend past the adjoining property line. The driveway approaches devoted to one use shall not occupy more than sixty percent (60%) of the frontage abutting the roadway or alley.

(b) Non-Residential.

(1) Steel reinforced concrete driveways providing access to multi-family or nonresidential uses shall have a minimum width of twenty-four (24) feet and a maximum width of forty-five (45) feet when measured at their narrowest point near, or at, the property line.

(2) The minimum radius for these uses shall be twenty-five (25) feet. Larger radii are encouraged. Driveway radii returns shall not extend across abutting property lines.

(3) The drive aisles shall have a minimum width of twenty-four (24) feet

(4) Limitations on permissible locations for these driveways are addressed in **Section 02.03.0216 Driveway Separations**.

SEC. 02.031.0230 ..... GRADES.

(a) The change in grade between the roadway cross slope and the slope of the driveway apron is important to ensure a smooth, low speed turning maneuver. The maximum algebraic change in grade is shown in **Table 2.4 Driveway Grades and Grade Change**. An abrupt change in grade will cause the front bumper to drag on the surface of the street and driveway.

Table 2.5: Driveway Grades and Grade Change

Type	Max Grade	Max Algebraic Change in Grade
Residential	14%	12%
Non-Residential	8%	8%

(b) When an algebraic change in grade occurs within a driveway of more than 4% vertical curve will be required. The minimum recommended lengths of vertical curve for the corresponding change in grade for driveway profiles are shown in **Table 2.5 Vertical Curve Lengths for Driveways**. It is recommended to put a two (2) foot vertical curve wherever the algebraic change in grade is less than four percent (4%).

Table 2.6: Vertical Curve Lengths for Driveways

Algebraic Change in Grade	Minimum Length (ft)	
	Crest Curve	Sag Curve
< 4%	2	2
4% - 5%	5	6
6% - 8%	5	7
9% – 12%	6	8

(c) All driveway profiles should be designed to accommodate a sidewalk crossing at a maximum allowable cross-slope of two percent in order to meet ADA requirements. A sidewalk crossing grade of two percent (2%) shall be incorporated into the driveway even if a sidewalk is not to be constructed at the same time.

(d) Reference driveway profiles **Figure 2.4 Driveway Profiles on an Upgrade** and **Figure 2.5, Driveway Profiles on a Downgrade**. No downgrade driveways will be allowed for new development or construction. If an existing driveway with a downgrade already exists it shall be reconstructed to conform to **Figure 2.5 Driveway Profiles on a Downgrade**. All down grade driveways shall have a raise that must be equal to or above the top of curb elevation.

SEC. 02.031.0231 ..... TRAFFIC INFORMATION AND CONTROL DEVICES.

(a) Any work disturbing traffic on City streets shall require a signed and sealed traffic control plan by a Registered Professional Engineer in the State of Texas. All signage in City right-of-way shall conform to the Texas Manual of Uniform Traffic Control Devices.

(b) The developer shall be responsible for and arrange for the installation of all pavement striping, regulatory, warning, guide, and school zone signs including posts, as shown on the plans, or as directed by the City. Street name signs shall be installed at each intersection. Examples of regulatory, warning, information and guide signs are as follows:

(1) Regulatory signs shall include, but are not limited to, STOP, 4-WAY, YIELD, KEEP RIGHT and speed limit signs.

(2) Warning signs shall include, but are not limited to, DEAD END, NO OUTLET, DIVIDED ROAD, DIP, and PAVEMENT ENDS.

(3) Guide signals shall include, but are not limited to, street name signs, DETOUR, direction arrow and advance arrow. Traffic striping and buttons shall be provided by the developer as shown on plans or as directed by the City.

(4) All signage within medians shall be break away pole bases

Figure 2.4: Driveway Profiles on an Upgrade

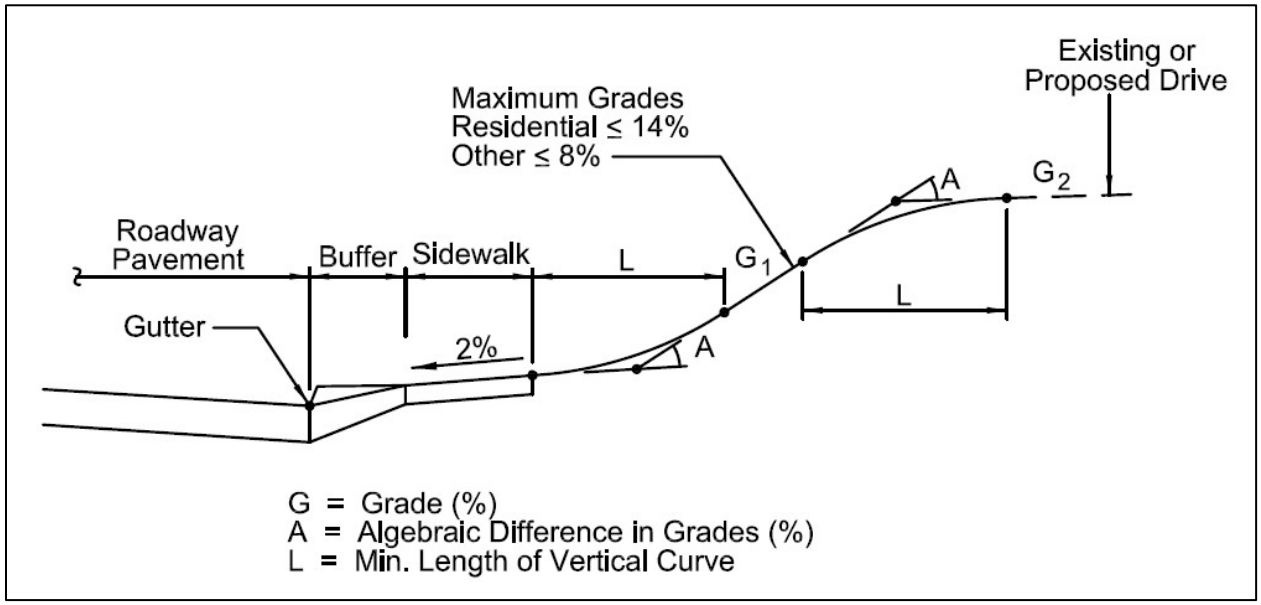
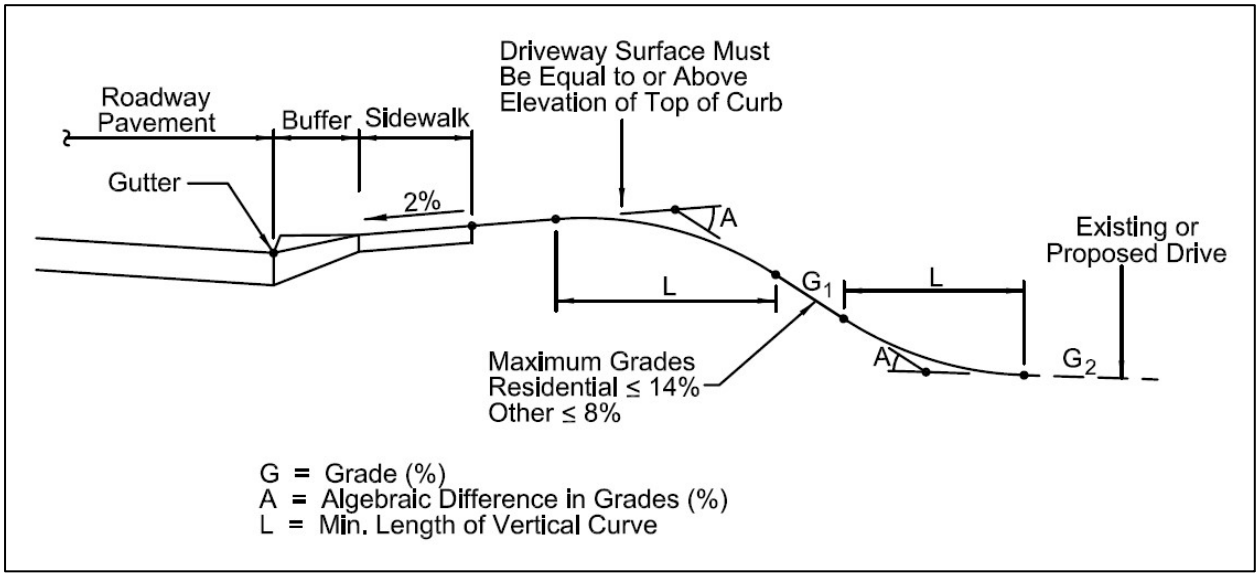


Figure 2.5: Driveway Profiles on a Downgrade



SEC.02.031.0232 ..REGULATORY SIGNAGE.

(a) Regulatory signs should be used only where justified by engineering judgment. All signage plans shall be reviewed and approved by the City of Kaufman Public Works Department and be designed in accordance with the principles described in the current Texas Manual on Uniform Traffic Control Devices (TMUTCD).

(b) All street and regulatory signage shall be installed, inspected, and approved, prior to final acceptance of the project. This inspection typically takes place as part of the Public Works Department's final walkthrough. Any sign related issue/issues will be noted on the projects final punch list.

(1) A detailed street and regulatory signage plan is to be submitted to the City of Kaufman Public Works Department. All signs shall be shown in the construction plans for review and approval. The signage plan shall be shown on a separate signage & pavement marking layout sheet, or as a part of the plan, and profile sheet. The plan shall identify the specific sign designation, size, height, and location for each sign. Sign standards shall also be included in the construction plans.

(2) All signage installed shall comply with the current "Texas Manual on Uniform Traffic Control Devices" and the "Standard Highway Sign Designs for Texas." The sign layout drawings shall show the color and dimensions of all sign face legend components, including background color, legend color, borders, symbols, letter size and style.

(3) The developer shall be responsible for furnishing and installing all regulatory signage, warning signage and street name signage along with all necessary sign mounts in accordance with the approved construction plans..

i. A sample production sign shall be submitted to the Public Works Department for review, and approval. The sample shall be directed to the City of Kaufman Public Works Department located at 1003 W. Grove Street, Kaufman Texas 75142. The sample sign must be submitted at least 10 days prior to the scheduled installation date.

(4) For a street with a cul-de-sac end, a standard W 14-2a shall be mounted over the street name blade, if the cul-de-sac is not clearly visible from the adjoining roadway, or is located in excess of four-hundred (400) linear feet from the adjoining roadway.

(c) Street Name Blades.

(1) Street name sign blades shall be double-sided with rounded corners.

(2) Street Name Blades shall be nine-inch (9") tall flat aluminum. The blades shall be eight hundredths of an inch (0.080") thick and be a minimum of thirty-six inches (36") long.

(3) The lettering for the street signs shall be 3M 3930 high Intensity prismatic material sheeting for street, regulatory and warning signs and shall be high intensity diamond grade type III prismatic. The street sign background shall be green, and the legend shall be white.

(4) The street sign blade must incorporate the current City of Kaufman logo. The logo shall consist of white Scotchlite Series 3930 high intensity prismatic material. (Product Code 3930)

(5) Block Numbers are required on all street name blades and shall be located on the top right corner of the street blade.

(6) The lettering for the street blades shall be composed of a combination of lower-case letters with initial upper-case letters. The Clearview FHWA font shall be used. The lettering shall be composed of initial upper-case letters of at least six (6) inches in height. For supplementary lettering to indicate the type of street (such as Street, Avenue or Road) shall be composed of initial upper-case letters at least three (3) inches in height. Abbreviations may be used (for example St., Ave., or Rd) except the street name itself. The supplementary lettering shall be located at the lower right corner of the street blade, under the block number. (See Standard Drawing 2300)

(7) The street blade sign shall consist of white Scotchlite 3930 high intensity prismatic material background and white Scotchlite 3930 high intensity prismatic material for the lettering (product code – 3930). The background sheeting shall be white 3M 3930 high intensity prismatic material. The colors shall be traffic blue and traffic red (See Standard Drawing 2300). The background material shall be applied to the full width and height of the sign blank leaving no metal exposed. The background material shall be one continuous piece of material. Patching of background material is not allowed and any sign with patching material of any type will be rejected by the City.

i. Alternative Option.- As an alternative, the foreground color may be white transparent Scotchlite ElectroCut1177 film (E.C. film). Lettering shall be cut out and removed producing a single continuous piece of white transparent film material.

SEC.02.031.0233 ..... STANDARD SIGN POLE AND FIXTURES.

(a) **Standard Street Sign Post** – shall be twelve feet (12') long - minimum two and three-eighths of an inch (2-3/8") galvanized steel - round post with a minimum of sixty (60) mil wall thickness.

(b) **Standard Post Installation Depth** – sign post shall be installed into solid ground to a minimum depth of twenty-four (24) inches and anchored with a minimum of sixty (60) pounds of concrete.

(c) **Standard Post Bracket** – shall be eighteen inches (18") cast aluminum - round post bracket street sign mount for bottom street blade.

(d) **Standard Top Crossing Bracket** – shall be twelves inches (12") cast aluminum top crossing street sign bracket mount for top street blade.

(e) **Standard Mounting Bracket Assemblies** – shall be two and two eighths' inches (2-2/8") diameter aluminum - round post interlocking bracket times tow (x 2) per pole.

SEC.02.031.0234 ..... DECORATIVE SIGNS AND POSTS.

(a) The City of Kaufman will allow the installation of decorative signs and posts or other non-standard items by Developers/Homeowners Associations on a case-by-case basis provided that their installation does not result in an adverse impact to the public safety and that there is no cost to the City for installation or maintenance. The Developer requesting such installations will be required to give the recorded documentation of an incorporated Homeowner's Association (HOA) or Property Owner's Association (POA) to the City. The City of Kaufman maintains only standard street and regulatory signs/post installed on public streets within its designated rights-of-way. The City of Kaufman does not maintain decorative sign poles and fixtures installed by a Developer, a HOA or a POA.

(b) If the Developer elects to install non-standard decorative signs, sign poles and fixtures, the designated HOA or POA must enter into a maintenance agreement with the City covering the hold harmless provisions. These provisions shall be noted on the approved final plat for the subdivision. The platted maintenance provisions will serve as the agreement and applies to all non-standard decorative signs, poles/post, hardware, or any other attachments. The City of Kaufman has no maintenance or other responsibility to these items. The ownership and maintenance of all such signs, poles and fixtures become the maintenance responsibility of the designated HOA.

(c) Decorative Sign Pole/Fixture Submittals: A detail of the decorative sign poles, pole fixtures and base mounting shall be included with the submittal of the construction plans. The submittal shall also include a street/site plan indicating the location and identification of all proposed signage and post to scale.

(1) The HOA or POA is responsible for maintaining all non-standard decorative signs, poles/post, hardware, attachments, or other approved nonstandard items under this agreement. The City of Kaufman has no maintenance or other responsibility to these items. The City of Kaufman, the HOA or the POA agree the Association will bear any and all maintenance cost related to the said improvements. The City has the statutory authority to install and maintain traffic control devices for vehicular traffic on public streets/roads within the city limits of the City of Kaufman, Texas. This agreement in no way constitutes a change in that authority and does not constitute any delegation of this authority to the Association.

(2) The City of Kaufman reserves the right to install temporary replacement signs using standard sign post mounting or alternate temporary mounting when decorative sign posts and signs are damaged. Routine maintenance/replacement of damaged signs, posts and

any sign mounting backboard/trim/hardware or other fixtures is the sole responsibility of the HOA or POA and must be repaired within 4 weeks of reporting to the applicable HOA or POA.

(3) The City of Kaufman will not handle, store or be responsible for any decorative non-standard sign, post or associated fixtures installed under this agreement.

(4) All signs (regulatory and warning) shall be in conformance with the "Texas Manual on Uniform Traffic Control Devices" (Texas MUTCD) and the "Standard Highway Sign Designs for Texas."

(5) Sign posts must be of sufficient height to mount the sign in conformance with the current (Texas MUTCD) requirements. Most typical installations require a vertical clearance of seven (7) feet from the bottom edge of the sign to the ground surface. Overhead signs must conform to all required standards.

(6) Sign/posts must be installed in locations as provided in the approved construction plans or as otherwise approved by the City of Kaufman. On occasion, it may be necessary to re-locate signage/poles-based engineering judgment, study or when otherwise deemed necessary by the City.

(7) The City of Kaufman reserves the right to approve or disapprove any sign/pole design and/or location. The City of Kaufman must approve the color of signposts and any requested sign mounting/trim.

SEC.02.031.0235 ..... MISCELLANEOUS.

(a) All private signage for multifamily, commercial, retail, and industrial developments are required to have a separate sign permit from the Development Services Department. Signs, including any overhangs, are not allowed in any rights-of-ways and/or easements. The location and permitting of any private signage is not approved on construction plans.

SEC.02.031.0236 ..TEMPORARY TRAFFIC CONTROL.

(a) When the normal function of the roadway is suspended through closure of any portion of the right-of-way, temporary construction work zone traffic control devices shall be installed to effectively guide the motoring public through the area. Consideration for road user safety, worker safety, and the efficiency of road user flow is an integral element of every traffic control zone.

(b) All traffic control plans shall be prepared and submitted to the Public Works Department in accordance with the standards identified in Part VI of the most recent edition of the TMUTCD. When the normal function of the roadway is suspended through closure of any portion of the right-of-way, a temporary construction work zone with traffic control devices shall be installed to effectively guide the motoring public through the area. Consideration for road user safety, worker safety, and the efficiency of road user flow is an integral element of every traffic control zone. Lane closures will not occur on roadways without an approved traffic control plan. Traffic control plans shall be required on all roadways as determined by the Director of Public Works and/or the City Engineer.

(c) All traffic control plans must be prepared, signed, and sealed by an individual that is licensed as a professional engineer in the State of Texas. All traffic control plans and copies of work zone certification must be submitted to the Director of Public Works and/or the City Engineer for review and approval a minimum of three (3) weeks prior to the anticipated temporary traffic control.

(d) The contractor executing the traffic control plan shall notify all affected property owners two (2) weeks prior to any the closures.

(e) Any deviation from an approved traffic control plan must be reviewed by the Director of Public Works and/or the City Engineer. If an approved traffic control plan is not adhered to, the contractor will first receive a verbal warning and be required to correct the problem immediately. If the deviation is not corrected, all construction work will be suspended, the lane closure will be removed, and the roadway opened to traffic.

(f) All temporary traffic control devices shall be removed as soon as practical when they are no longer needed. When work is suspended for short periods of time at the end of the workday, temporary traffic control devices that are no longer appropriate shall be removed or covered. The first violation of this provision will result in a verbal warning to the construction foreman. Subsequent violations will result in suspension of all work at the job site for a minimum of forty-eight (48) hours.

(g) Lane Closures.

(1) Lane closures on any major or minor arterial will not be permitted between the hours of 6:00 am to 9:00 am and 4:00 pm to 7:00 pm.

(2) Where lane closures are needed in a school area, they will not be permitted during peak hours of 7:00 am – 9:00 am and 3:00 pm to 5:00 pm. Closures may be adjusted according to the actual start-finish times of the actual school with approval by the Director of Public Works and/or the City Engineer.

(3) The first violation of this provision will result in a verbal warning to the construction foreman. Subsequent violations will result in suspension of all work at the job site for a minimum of forty-eight (48) hours.

SEC.02.031.0237 ..STREET LIGHTING.

(a) Street Lighting. All developments shall provide streetlights. In general, lights should be located at street intersections and at intervals no greater than four hundred (400) feet apart. Street lights shall be centered one and half (1 ½) feet off the back of curb.

(1) Street lighting shall be installed to provide an average of 0.4 foot-candle per square foot on the roadway between curbs. The lowest intensity at any point shall not be less than 0.1 foot-candle per square foot. Street lighting materials shall be approved by the City Manager, or his designee. Any costs associated with upgrading street lighting fixtures shall be borne by the developer/property owner.

SEC.02.031.0238 ..... BARRIER FREE RAMPS.

(a) Barrier free ramps shall be required within all areas with sidewalks and trails. Ramps shall be located to provide access in accordance with the standards set by the Texas Department of Licensing and Regulation (TDLR) to all pedestrian sidewalks and trails.

(b) Laydown curbs and ramps shall be constructed at all street intersections, and driveways whether or not sidewalks are being installed. Laydown curbs and ramps shall be constructed by the developer. Barrier free ramps shall have truncated dome plates in the color approved by the City. No truncated dome pavers or ridges allowed.

SEC.02.031.0239 ..... OFF-STREET PARKING.

(a) All parking areas and spaces shall be designed and constructed of steel reinforced concrete in accordance with the following requirements:

(1) All parking areas and spaces shall be designed and constructed of steel reinforced concrete so as to have free ingress and egress at all times.

(2) No parking space or parking area shall be designed so as to require a vehicle to back into a public street or across a public sidewalk, except in the case of development in the Central Business District and one- and two-family dwelling units, except as otherwise allowed in a Planned Development District, or as approved as a City park project.

(3) Minimum Dimensions for Off-Street Parking:

i. Ninety-degree angle-parking (**Figures 2.6a and 2.6b**) – All parking spaces shall be a minimum of nine (9) feet in width. Each parking space adjacent to a building shall not be less than twenty (20) feet in length. Dual head in parking spaces should be a minimum of eighteen (18) feet in length. Parking spaces not adjacent to a building or dual head may be eighteen (18) feet in length with two (2) feet of clear (no obstruction including landscaping, lighting, wheel stops, and/or signage) over hang between curb and sidewalk or property line. Maneuvering space shall not be less than twenty-four (24) feet.

ii. Sixty-degree-angle parking (**Figures 2.7a and 2.7b**) – Each parking space shall be not less than nine (9) feet wide perpendicular to the parking angle nor less than twenty and one tenth (20.1) feet in length when measured at right angles to the building or parking line. Maneuvering space shall not be less that fourteen and on-half (14 ½) feet for one-way traffic or twenty-two (22) feet for two-way traffic perpendicular to the building or parking line.

iii. Forty-five-degree angle parking (**Figures 2.8a and 2.8b**) – Each parking space shall not be less than nine (9) feet wide perpendicular to the parking angle nor less than nineteen (19) feet in length when measured at right angles to the building or parking line. Maneuvering space shall be not less than twelve (12) feet for one-way traffic or twenty-one (21) feet for two-way traffic perpendicular to the building or parking line.

iv. Parallel Parking – Each parking space shall not be less than nine (9) feet in width and twenty-two (22) feet in length. Maneuvering space will not be less than twenty (20) feet.

v. Handicap Space Parking – Where handicapped parking is required or installed, the design shall be as in **Figure 2.9.**

vi. Excess Parking – When off-street parking facilities are provided in excess of minimum amounts herein specified, or when off-street parking facilities are provided, but not required by this chapter, said off-street parking facilities shall comply with the minimum requirements for parking and maneuvering space herein specified.

vii. Stripping - Each parking space/stall shall be striped to the minimum dimension detailed out above in this section.

viii. Dead-End Parking – No dead-end parking shall be allowed for more than six (6) parking spaces without a minimum turnaround of a 15 feet wide by 64 feet long or a cul-de-sac shall be provided and striped off as “No Parking”. If there are less than six (6) parking spaces a 24 feet by 15 feet would be allowed and would need to be signed as “No Parking”.

(4) Paving Standards.

i. Unless otherwise approved by the City Council or as specified in these standards, all parking lots shall be paved with steel reinforced concrete and designed

according to City standards and specifications. The parking lanes must be clearly marked by approved paint, buttons, or other material.

ii. All driveway approaches shall be constructed of steel reinforced concrete in the same strength, thickness, and reinforcing as the adjacent street and shall be curbed per City standards.

iii. All parking lot pavement and drive aisles shall be steel reinforced concrete except for existing asphalt parking lots being rehabilitated. A steel reinforced concrete or asphalt pavement (rehabilitated parking lots) design shall be provided to the City Engineer for review and approval.

iv. Industrial and commercial parking lot pavement shall be steel reinforced concrete and designed by a Professional Engineer. Pavement design shall be submitted to the City for approval

v. The pavement within a designated loading area shall be designed and constructed to carry the additional loading of merchandise, goods, sanitation pick-up, etc., in order to prevent any unnecessary failure in the pavement itself. The pavement design shall be included in the construction plans and specifications and submitted to the Development Services Department for the Director of Public Works and/or the City Engineer for review and approval. The pavement design shall be designed by a Geotechnical Engineer.

vi. The fire lane shall have a maximum running slope of ten (10) percent and a cross slope of five (5) percent. A vertical curve is required for grade breaks greater than one (1) percent.

(5) Dead-end parking shall be designed and constructed with a minimum length of fifteen (15) feet and width of sixty-four (64) feet turnaround space provided at the end of the dead-end parking area.

(6) If a portion of an existing street is removed for construction, the entire concrete panel must be removed and replaced with the same strength steel reinforced concrete and one (1”) inch thicker than the existing thickness.

Figure 2.6a: 90° Parking Single Row

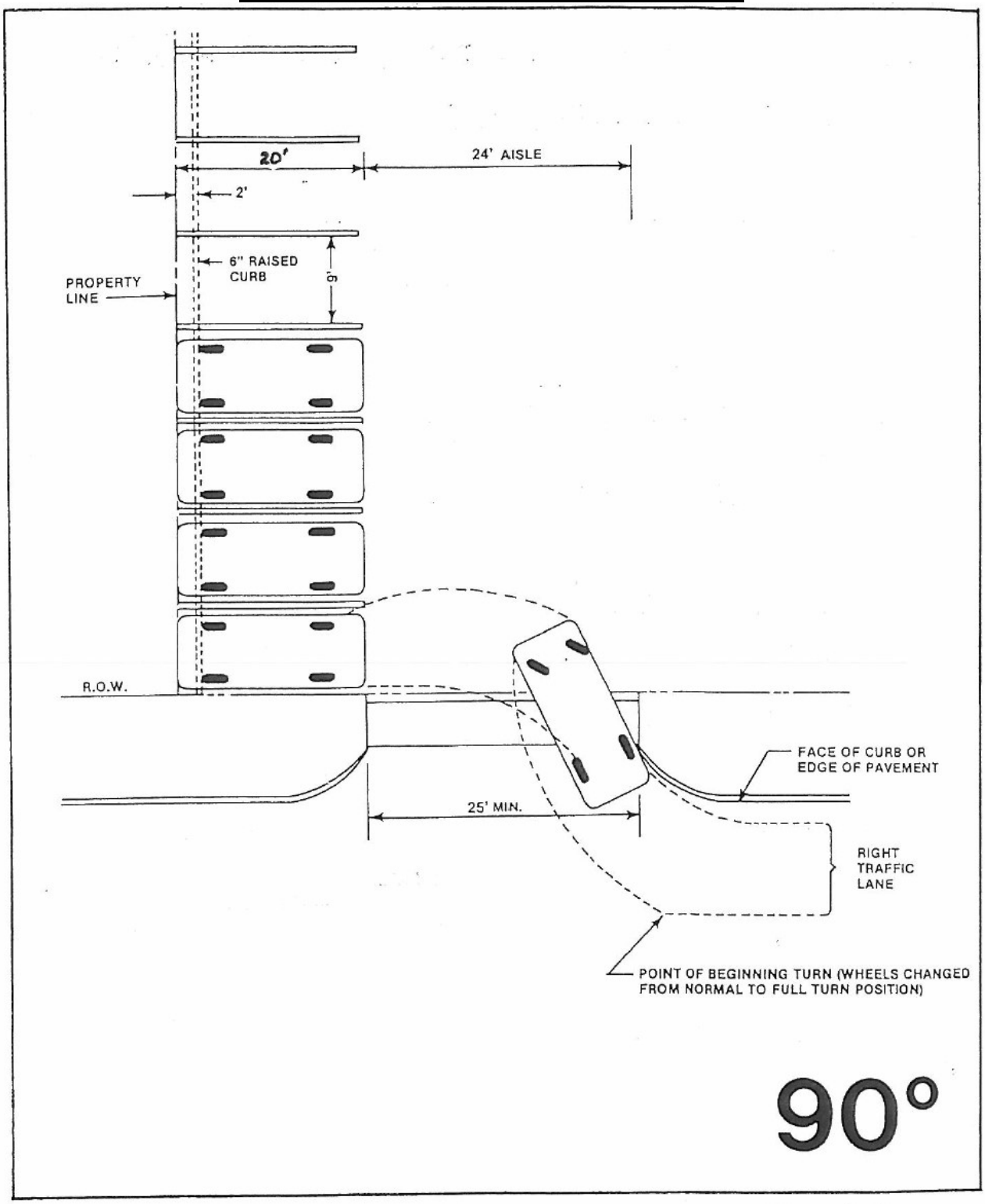


Figure 2.6b: 90° Parking – Double Row

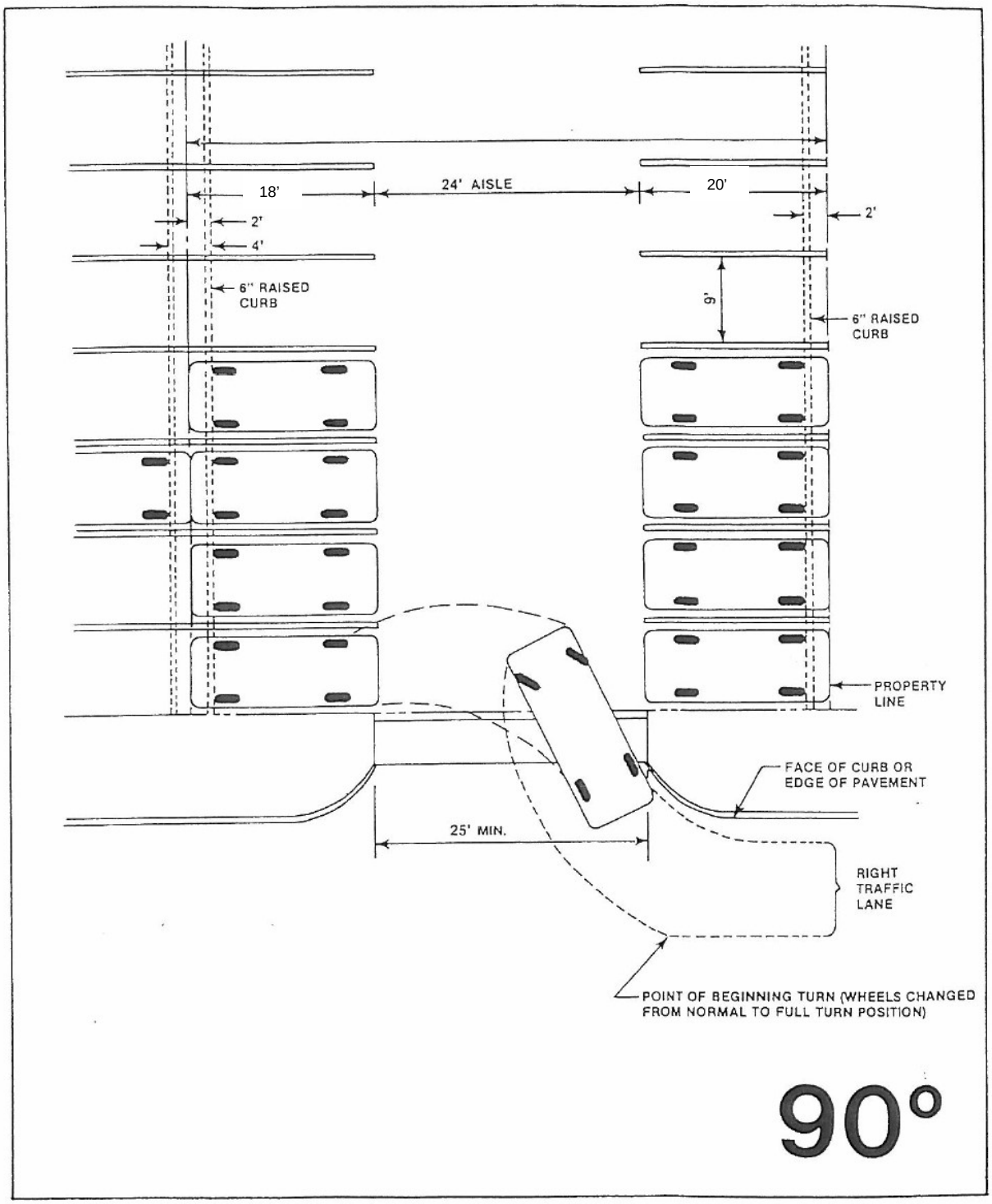


Figure 2.7a: 60° Parking – Single Row

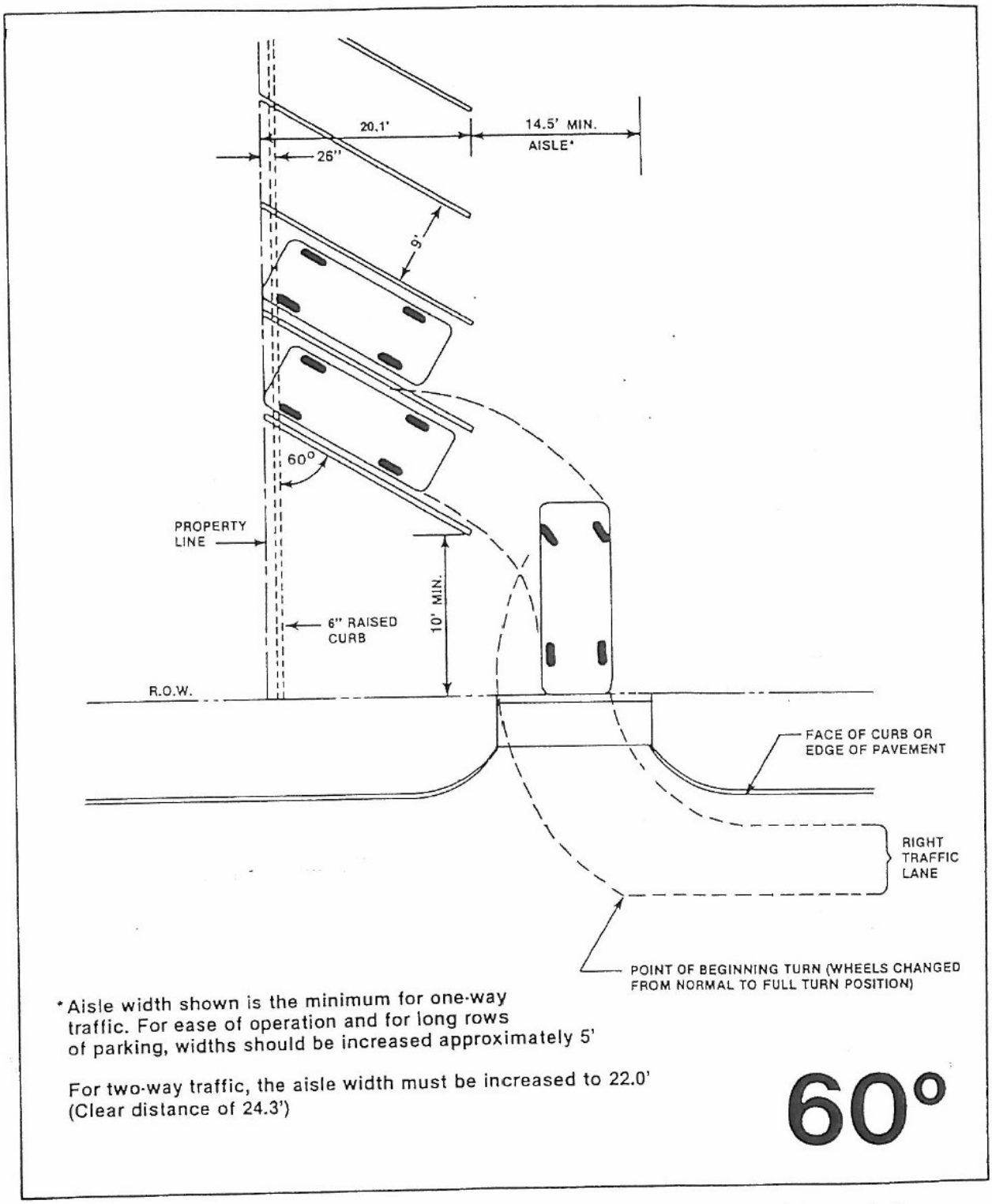


Figure 2.7b: 60° Parking – Double Row

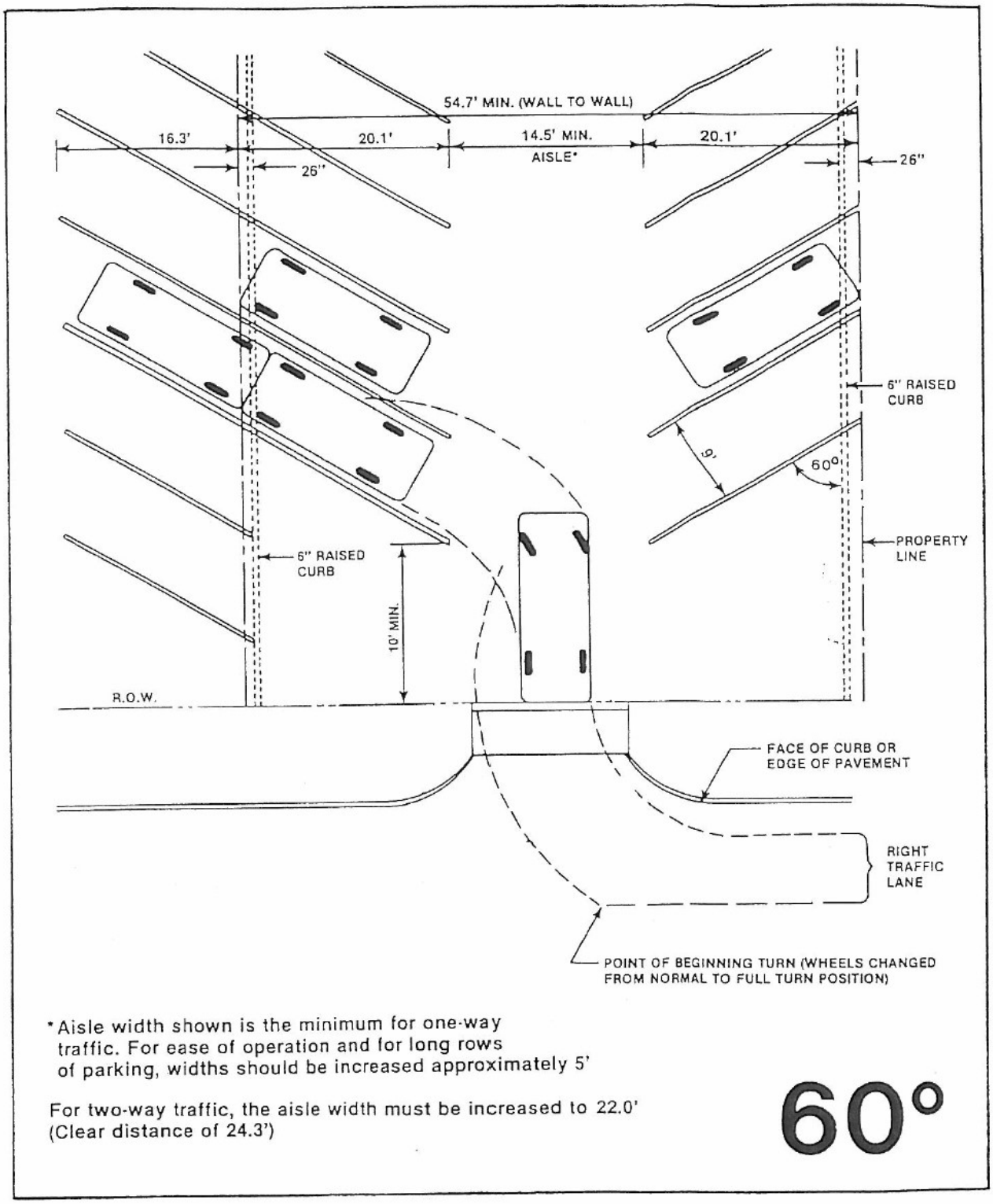


Figure 2.8a: 45° Parking – Single Row

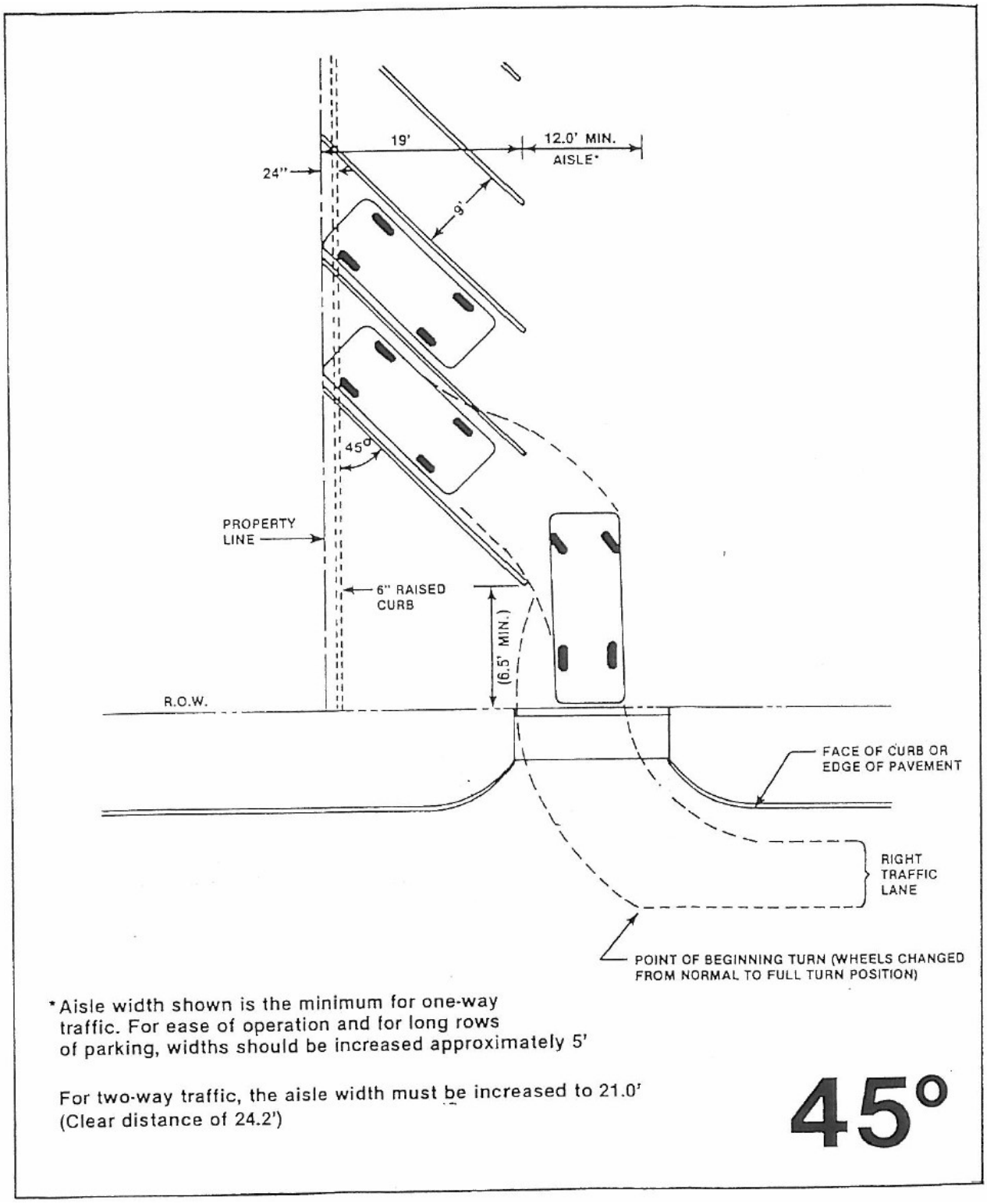


Figure 2.8b: 45° Parking – Double Row

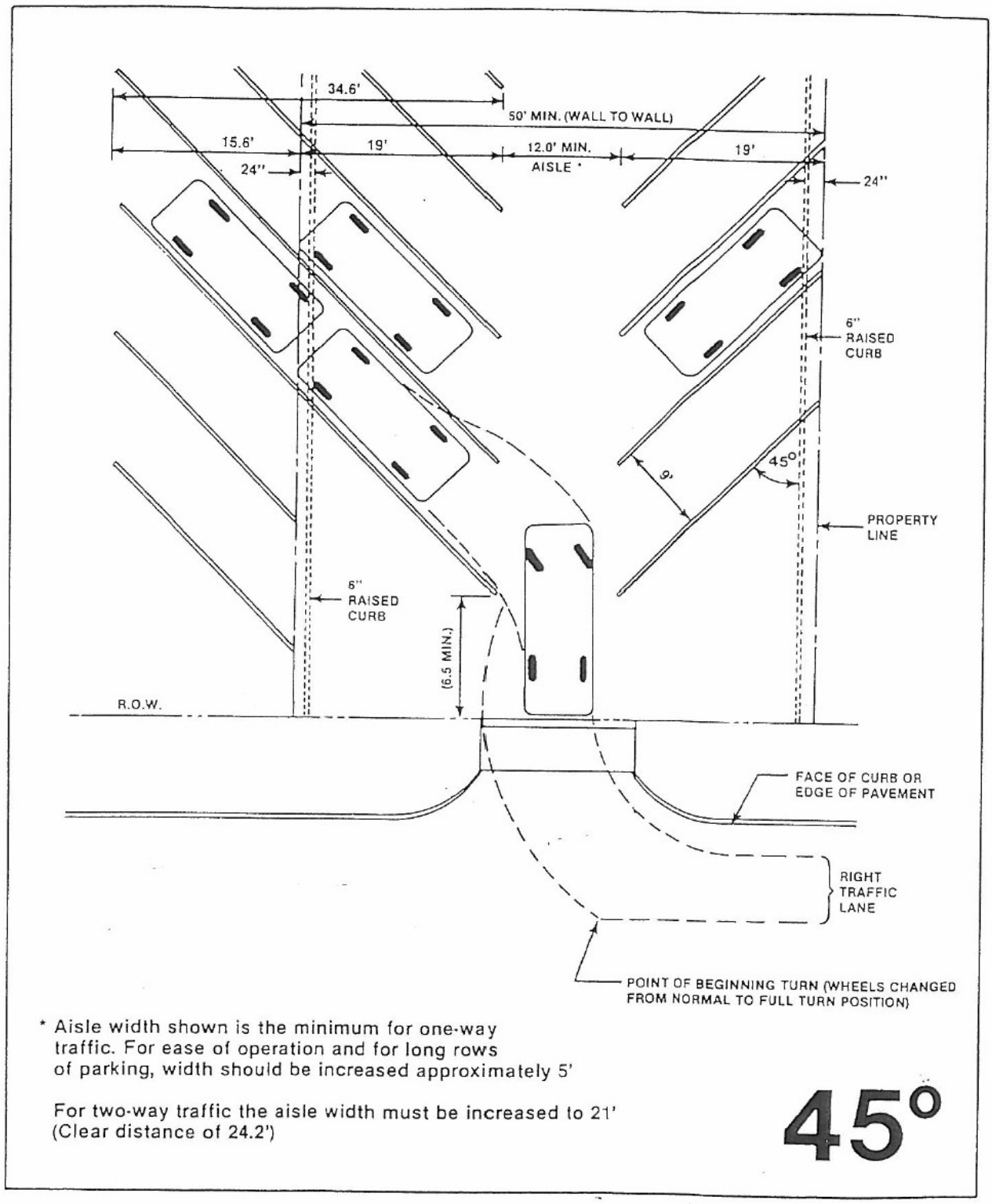
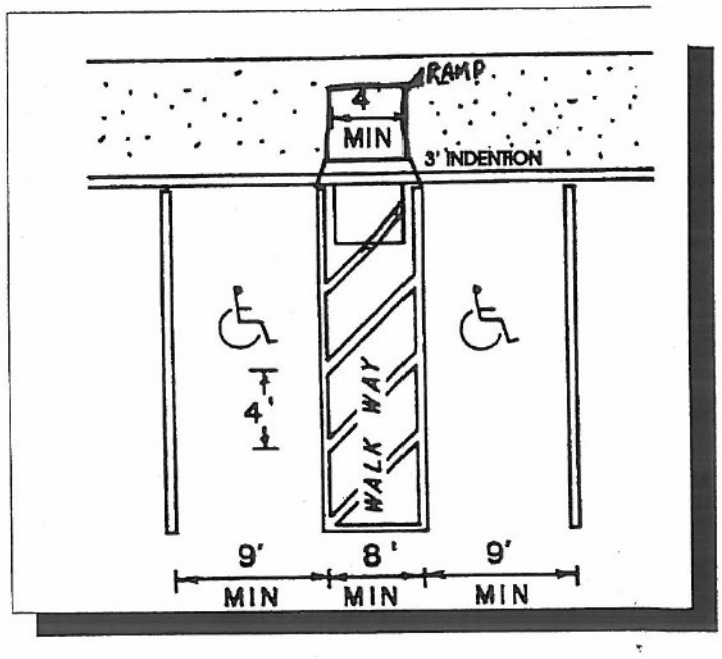
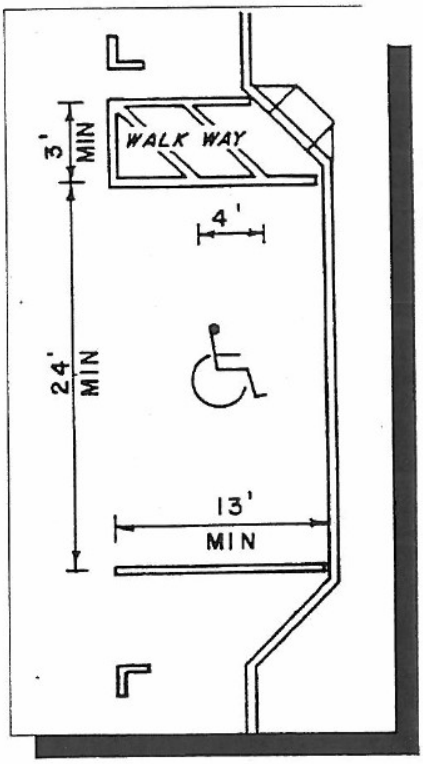


Figure 2.9: Handicap Space Parking



HANDICAPPED PARKING STANDARDS
Head-in or Angle parking Dimensions



HANDICAPPED PARKING STANDARDS
Parallel parking Dimensions

(7) All entrances or exits in a parking lot shall be a minimum of thirty (30) feet from the beginning point of any corner radius

(8) All entrances or exits in a parking lot shall be a minimum of twenty-four (24) feet and a maximum of forty-five (45) feet in width, unless one-way, in which case they shall both be a minimum of twelve (12) feet, or as approved by the City Council.

(9) No parking areas or parking spaces shall be allowed to pave over or utilize public right-of-way, with the exception of approved entrances and exits, unless the City Council grants an exception and/or a facilities agreement.

(10) All multi-family and commercial parking areas and parking spaces shall be designed and constructed to protect adjacent residences from the direct glare of headlights of vehicles using the parking area.

(11) No City street curb, alley or street pavement may be cut without a permit from the City.

(12) If required, the contractor shall submit a traffic control design to the City of Kaufman Public Works Department prepared by a registered professional engineer prior to beginning of construction.

i. The contractor shall provide signs and barricades in construction areas and comply with the Texas Department of Transportation standard of work zone traffic control.

ii. Employees exposed to public vehicular traffic, shall be provided with and wear warning vest or other suitable garments marked with or made of reflective or high visibility material.

iii. The contractor shall provide flagman when working inside an active street rights-of-way where necessary.

SEC.02.031.0240 ..... TRAFFIC IMPACT ANALYSIS AND MITIGATION.

(a) **Purpose.** The purpose of a Traffic Impact Analysis (TIA) is to assess the effects of specific development activity on the existing and planned thoroughfare system. Development activity may include but is not limited to rezoning, preliminary site plans, site plans, Preliminary Plats, driveway permits, certificates of occupancy and Thoroughfare Plan amendments.

(b) **Pre-submission Meeting**. Prior to the commencement of a TIA, an initial or pre-submission meeting with the Development Review Committee (DRC) is required to establish a base of communication between the City and the Developer. This meeting will define the requirements and scope relative to conducting a TIA and ensure that any questions by the Developer are addressed.

(c) **Applicability of TIA Requirements.**

(1) **Zoning.** These TIA requirements shall apply to all zoning requests for land uses which will generate two-thousand five hundred (2,500) or more vehicle trips per day or contain a density of 0.75 Floor Area Ratio (FAR) or greater. Applicable requests include zoning requests and Thoroughfare Plan amendments if no previous traffic assessment was performed.

i. Special circumstances, including but not limited to development with no case history, which does not meet the daily trip generation threshold, may also require a TIA. Such circumstances, as determined by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer may include, but not be limited to:

a. Impacts to residential neighborhoods from non-residential development;

b. Inadequate site accessibility;

c. Implementation of the surrounding Thoroughfare Plans is not anticipated during the estimated time period of the proposed development;

d. Proposed land use differs significantly from that contemplated in the Comprehensive Plan; and/or

e. The internal street or access is not anticipated to accommodate the expected traffic generation.

(2) **Development.** These TIA requirements shall apply to all development requests for land uses which will generate over one-hundred (100) total trips during the weekday AM or PM peak hour or the weekend peak hour. Applicable development requests include concept plans, preliminary site plans, site plans and Preliminary Plats.

i. Special cases, in which site generated peak hour trip activity is different from that of the adjacent street (weekdays 7:00-9:00 am and 4:00-6:00 pm), may require an additional separate analysis as determined by the by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer. Such circumstances may include, but are not limited to, commercial/retail, entertainment, or institutional activity.

ii. The Director of Development Services, and/or Director of Public Works, and/or the City Engineer may waive the TIA for a development request if a TIA was performed previously with the Zoning request and conditions listed in the report are still current.

(3) **Single-Family Residential Exception**. A TIA for single-family residential development will not be required if the development contains fewer than six (6) dwelling units unless special circumstances exist, as determined by the Director of Development Services, and/or the Director of Public Works and/or the City Engineer.

i. These special circumstances may include, but are not limited to:

a. Impacts to other residential development from cut-through traffic;

b. Inadequate site accessibility;

c. Implementation of the surrounding Thoroughfare Plans is not anticipated during the estimated time period of the proposed development;

d. The internal street or access system is not anticipated to accommodate the expected traffic generation; and/or

e. The development is outside the urban core of the community.

(4) **Daycares and Schools**. All development requests and/or specific use permit requests for a daycare, Montessori school, private school, charter school, or public school shall include, at a minimum, a traffic circulation study.

i. This study shall include the estimated maximum peak hour trip generation of the facility,

the planned circulation of inbound and outbound traffic during drop-off and pick-up operations, and the estimated length of the queue of cars waiting to pick up students at the peak periods. The design of the site and the circulation plan shall ensure that school traffic does not back up onto any public street at any time.

ii. The traffic circulation study shall include a statement that the owner and/or operator of the daycare or school agree to operate the facility in accordance with the approved circulation plan. The circulation plan must be approved by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer before the development request, or the specific use permit can be approved. The traffic circulation study must remain current and filed onsite and with the City.

(5) **Carwashes and Other Commercial Uses that may fall below a TIA threshold**. At the discretion of the Director of Development Services and/or the Director of Public Works and/or the City Engineer, a traffic circulation study may be required.

i. This study shall include the estimated maximum peak hour trip generation of the facility, the planned circulation of inbound and outbound traffic during drop-off and pick-up operation, and the estimated length of the queue of cars waiting for services. The design of the site and the circulation plan shall ensure that traffic does not back up onto any public street at any time.

ii. The traffic circulation study shall include a statement that the owner and/or operator of the site agree to operate the facility in accordance with he approved circulation plan. The circulation plan must be approved by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer or designee before the development request, or the specific use permit can be approved.

(6) **Determination of Applicability**. The need for a TIA shall be determined by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer based upon the results and recommendation from a pre-submission meeting. It shall be the responsibility of the Developer to demonstrate that a TIA should not be required. If a TIA is required, the level of effort for a TIA submission shall be determined based on the criteria set forth in **Table 2.7 Criteria for Determining TIA Study Requirements**. Depending upon the specific site characteristics of the proposed development, one or more of the following elements may also be required as part of the TIA: an accident analysis, sight distance survey, traffic simulation, traffic signal warrant analysis, queuing analysis, turn lane analysis, and/or traffic circulation plan.

Table 2.7 Criteria for Determining TIA Study Requirements

Analysis Category	Site Trips Generated at Full Build-Out	TIA Analysis Periods[1]	Minimum Study Area[3]
I	>50 peak hour driveway trips; or 100-500 total peak hour trips	1. Existing year 2. Opening year[2] 3. Five (5) years after opening	1. All site access drives 2. All signalized intersections and/or major un-signalized intersections within 0.5 mile to 1 mile of site boundary
II	>500 total peak hour trips	1. Existing year 2. Opening year of each phase 3. Five (5) years after initial opening 4. Ten (10) years after final opening with full build-out	1. All site access drives 2. All signalized intersections and/or major un-signalized intersection within 1.5 miles of site boundary

[1]Analysis periods shall include build and no-build scenarios. Assume full occupancy when each phase opens.
[2]Assume full build-out.
[3]For certain projects, the City may require an enlarged study area. Land Uses within the study area should include recently approved or pending development adjacent to the site

(d) **Requirements for TIA Updates**. A TIA shall be updated when time or circumstances of the original study fall within the parameters presented in **Table 2.8 Criteria for Determining TIA Update Requirements.** The Developer is responsible for preparation and submittal of appropriate documentation for City staff to process the zoning or development application. A TIA for site development request must be updated if two years have passed since the original submittal, or if existing or assumed conditions have changed within the defined study area. The Director of Development Services, and/or the Director of Public Works and/or the City Engineer shall make the final determination as to the extent of a TIA update.

Table 2.8: Criteria for Determining TIA Update Requirements

Original TIA Report was based on:	Changes to the Originally Proposed Development:	
	Access Changed [1] or Trip Generation Increased by more than 10%	Access Not Changed and Trip Generation Increased by less than 10%
Zoning; or Preliminary Site Plan or Site Plan that is less than 2 years old	Prepare New Study. Must meet all current TIA requirements	Letter Documenting No Change (No analysis is required)
Preliminary Site Plan or Site Plan that is more than 2 years old	Prepare New Study. Must meet all TIA requirements	Prepare New Study. Must meet all current TIA requirements.

(e) **Responsibility of TIA Preparation and Review.**

(1) A TIA shall be prepared in accordance with all the guidelines in this section and submitted in accordance with the Development Review Schedule set by the City. The responsibility for TIA preparation shall rest with the Developer and must be performed by a Professional Engineer (P.E.) licensed in the State of Texas with experience in traffic and transportation engineering. The final TIA report must be signed, and sealed by the professional engineer responsible for the analysis to be considered for review by the City. Application review fees are due at the time of each submittal. City staff shall serve primarily in a review and advisory capacity and will only provide data to the Developer when available.

(2) It shall be the responsibility of the Developer to submit an electronic copy of the TIA report and executive summary with the zoning and/or development request submission. The report, the timing for submission, and the review of this report shall be based on standard City development review procedures. Incomplete TIA's or failure to submit a TIA with the submission shall delay consideration of zoning and development requests. Should it be determined during the review of any zoning and/or development plans that a TIA is required, consideration shall be deferred until the Developer submits a completed TIA and the City has reviewed the assessment.

(3) The City shall review the TIA and provide comments to the Developer. It shall be the responsibility of the Developer to submit a finalized TIA report and executive summary once all review comments have been addressed.

(f) **TIA Standards**.

(1) **Design Level of Service** – The minimum acceptable level of service (LOS) within the City shall be defined as LOS "D" in the peak hour for all critical movements and links. All development impacts on both thoroughfare and intersection operations must be measured against this standard or not worsen in the case of an existing road that is already performing less than LOS D

(2) **Trip Generation Resources** – The City's standard for trip generation rates for various land use categories shall be those found in the latest edition of Trip Generation published by the Institute of Transportation Engineers (ITE) or other published or recognized sources applicable to the region. Alternate trip generation rates may be accepted on a case-by-case basis if the Developer can provide current supporting data substantiating that their development trip generation rates are significantly different from the ITE rates. The Director of Development Services, and/or the Director of Public Works, and/or the City Engineer must approve alternative trip generation rates in writing in advance of the TIA submission.

(3) **Trip Reductions** – Trip reductions for passer-by trips and internal capture for mixed-use developments will be permitted, subject to analytical support provided by the Developer and approval by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer on a case-by-case basis. The number of pass-by-trips calculated for any movement of a study intersection should not exceed twenty-five percent (25%) of the existing traffic volume for the movement. Any trip generation above twenty-five percent (25%) of existing traffic must be counted as a new trip. Assumptions relative to automobile occupancy, transit mode share, or percentage of daily traffic to occur in the peak hour must be documented and will be considered subject analytical support provided by the Developer.

(4) **Study Horizon Years** – The TIA must evaluate the impact of the proposed development on both existing traffic conditions and future traffic conditions for the horizon year(s) as specified **in Table 2.8 Criteria for Determining TIA Update Requirements** Horizon year(s) are defined as any analysis year beyond the existing year. These applications should take into account the City and County's Thoroughfare Plan..

(g) **TIA Methodology**.

(1) **Site Location/Study Area** – A brief description of the size, general features, and location of the site, including a map of the site in relation to the study area and surrounding vicinity;

(2) **Existing Zoning** – A description of the existing zoning for the site and adjacent property, including land area by zoning classification and density by FAR, square footage, number of hotel rooms, and dwelling units (as appropriate).Existing Development – A description of any existing development on the site and adjacent to the site and how it would be affected by the development proposal;

(3) **Existing Development** – A description of any existing development on the site and adjacent to the site and how it would be affected by the development proposal;

(4) **Proposed Zoning / Site Development** – A description of the proposed zoning/development for the site, including land area by zoning classification and density by FAR, square footage, number of hotel rooms, and dwelling units (as appropriate); identify other adjacent land uses that have similar peaking characteristics as the proposed land use; identify recently approved or pending land uses within the area;

(5) **Thoroughfare System** – A description and map of existing planned or proposed thoroughfares and traffic signals for horizon year (s) within the study area;

(6) **Existing Traffic Volumes** – Recent traffic counts for existing thoroughfares and major intersections within the study area. Counts shall be performed while schools are in session unless approved by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer;

(7) **Projected Traffic Volumes** – Background traffic projections for the planned thoroughfare system within the study area for the horizon year (s). Growth rates for projections shall be based on the most recent five (5) years historical growth in the area unless approved by the Directo of Development Services, and/or the Director of Public Works, and/or the City Engineer. The minimum growth rate for projections shall be two percent (2%);

(8) **Density of Development** – A table displaying the amount of development assumed for existing zoning and/or the proposed development (using gross floor area, dwelling units, occupied beds, etc., as required by the trip generation methodology;

(9) **Existing Site Trip Generation** (for redevelopment or changes to a prior TIA) – A table displaying trip generation rates and total trips generated by land use category for the AM and PM peak hours, or weekend peak hour if applicable, and on a daily basis, assuming full development and occupancy based on existing zoning (if applicable) and including all appropriate trip reductions (as approved by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer.

(10) **Proposed Site Trip Generation** – A Table displaying trip generation rates and total trips generated by land use category for the AM and PM peak hours, or weekend peak hour if applicable, and on a daily basis, for each phase of multi-phase developments and for full build-out, assuming full development and occupancy for the proposed development, and including all appropriate trip reductions (as approved by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer);

(11) **Net Change in Trip Generation (for rezoning cases)** – Proposed trip generation minus existing trip generation (if applicable); the net increase in trips to be added to base volumes for the design year;

(12) **Trip Distribution and Traffic Assignment** – Tables and figures of trips generated by the proposed development (or net change in trips, if applicable) added to the existing and projected volumes, as appropriate, with distribution and assignment assumptions, unless computer modeling has been performed. Each step of the procedure should be clearly shown in enough detail so that all calculations can be verified;

(13) **Level of Service Evaluations** – Capacity analyses for weekday AM and PM peak hours, or weekend peak hour if applicable, of the roadway and peak hour of the site, if different from the roadway, for existing conditions, at the completion of each phase of multi-phase developments, and for the horizon year(s). For each phase and horizon year, separate analyses shall be performed for background traffic and background plus site traffic. Capacity analyses shall be provided for intersections, thoroughfare links, median openings and turn lanes associated with the site, as applicable;

(14) **Access Connection Spacing** – Access connection spacing shall be evaluated per City criteria (TxDOT criteria for connections to TxDOT roadways);

(15) **Auxiliary Lane Evaluations** – The need for right and left-turn acceleration and deceleration lanes at proposed development access locations shall be evaluated;

(16) **Sight Distance Evaluations** – Sight distance at each proposed development access location shall be evaluated. Photographs of views in each direction from each proposed access location shall be included in an appendix;

(17) **Traffic Signal Evaluations** – The need for new intersection controls (i.e. traffic signals, all-way stop control) shall be based on warrants and include their impact on the performance of the transportation system;

(18) **Evaluation of Proposed/Necessary Mitigation** – Capacity analyses for weekday AM and PM peak hours of the roadway and peak hours of the roadway, for intersections, thoroughfare links, median openings and turn lanes associated with the site under proposed/necessary traffic mitigation measures;

(19) **Conclusions**- Identification of all thoroughfares, driveways, intersections, and individual movements that exceed LOS D or degrade by one or more LOS, the percentage of roadway volume change produced by the proposed development, and any operational problems likely to occur;

(20) **Recommendations** – Proposed impact mitigation measures consistent with Subsection I below; and

(21) **Other information required for proper review** – As requested by the Director of Development Services, and/or the Director of Public Works, and/or the City Engineer.

(h) **TIA Report Format.**

(1) The TIA report must be prepared as 8.5" x 11" sheets. However, it may contain figures on larger sheets, provided hard copies can be folded to this size. All text and map products shall be computer-based and provided in both published format and computer file format (PDF). In addition, all electronic files used as part of the traffic analysis (i.e. Synchro, HCS, Passer II/III, CORSIM, VISSIM, etc.) shall be provided.

(2) The sections of the TIA report should be categorized according to the outline shown below:

Executive Summary;
- I. Introduction;
  - a) Purpose;
  - b) Methodology;
- II. Existing and Proposed Land Use;
  - a) Site Location/Study Area;
  - b) Existing Zoning;
  - c) Existing Development;
  - d) Proposed Zoning (if applicable);
- III. Existing and Proposed Transportation System;
  - a. Thoroughfare System;
  - b. Existing Traffic Volumes;
  - c. Projected Traffic Volumes;
- IV. Site Traffic Characteristics;
  - a) Existing Site Trip Generation (if applicable);
  - b) Proposed Site Trip Generation;
  - c) Net Change in Trip Generation (if applicable);
  - d) Trip Distribution and Traffic Assignment;
- V. Traffic Analysis;
  - a) Level of Service Evaluations;
  - b) Traffic Signal Evaluations (if applicable);
- VI. Access Connection Spacing;
- VII. Auxiliary Lane Evaluations;
- VIII. Sight Distance Evaluations;
- IX. Mitigation;
- X. Conclusions;
- XI. Recommendations;

Appendices.

(3) One (1) hard copy and one (1) digital copy of the accepted report shall be provided to the City for filing

(i) **Traffic Impact Mitigation.**

(1) Mitigation of traffic impacts shall be required if the analyses indicate the proposed development would cause a facility or traffic movement to exceed LOS D, or where it already exceeds LOS D, and the development would contribute five percent (5%) or more of that movement's total traffic during any projected horizon year. If mitigation is required, the applicant must only mitigate the impact of the proposed development and would not be responsible for alleviating any deficiencies in the thoroughfare system that may occur without the proposed development.

(2) Acceptable mitigation measures shall include:

i. Staging of development in order to relate site development to the construction of the required thoroughfare system;

ii. Staging of development so that the site contributes less than five percent (5%) of the total traffic to the affected facility or traffic movement during the projected horizon year;

iii. Off-site improvements, including the provision of ROW and/or the participation in funding for needed thoroughfare and intersection improvement projects (including, but not limited to, through lanes turn lanes and traffic signals); and

iv. On-site improvements, including access controls and site circulation adjustments.

(j) **Administration of the TIA** – Based on the results of the TIA and actions recommended by the City Engineer and/or the Public Works Director, the Planning and Zoning Commission shall recommend, and City Council shall take, one or more of the following actions:

(1) Approve the zoning or development request, if the project has been determined to have no significant impact or where the impacts can be adequately mitigated;

(2) Approve the development request, subject to a phasing plan;

(3) Recommend study of the City and/or County Thoroughfare Plan to determine amendments required to increase capacity;

(4) Recommend amendment of the Capital Improvement Program (CIP) to expedite construction of needed improvements; or

(5) Deny the zoning or development request, where the impacts cannot be adequately mitigated.

(k) The Developer, engineer, or property owner requesting the proposed change in land use shall enter into a Professional Services Agreement with the City to retain consultants to provide a wide variety of professional services including, but not limited to engineering, financial and legal services as needed in accordance with the Subdivision Regulations Section 02.03.045, *Facilities and Professional Services Agreements, Financial Assurances and Construction Contracts for Public Improvements* agreeing to an estimated specified retainer to assist City staff in the analyzation and review of the Traffic Impact Analysis studies.

Article 02.031.0300 DRAINAGE

Sec. 02.031.0311 ..... GENERAL STANDARDS

(a) Drainage systems shall be designed and constructed at such locations and of such size and dimensions to adequately serve the development and the contributing drainage area upstream of the development. The developer shall provide all the necessary easements and rights-of-ways required for drainage systems including, but not limited to, storm drains and open channels, (lined or unlined), flood detention facilities, and stormwater diversion or containment facilities (such as levees, dams, berms, and stream diversions).

(b) The design flows for the drainage system shall be calculated by the Rational Method in accordance with the requirements set forth in this document unless otherwise noted within these Standards (such as where the unit hydrograph methods are required). Curbs, inlets, manholes, etc. shall be designed and constructed in accordance with the *Standard Details*. Materials and construction procedures shall conform to the requirements of the *North Central Texas Council of Government (NCTCOG) Standard Specifications for Construction*.

(c) The developer shall provide plans, specifications, and design calculations for all drainage structures. All open channels that are not concrete lined shall be designed to prevent erosion (**Table 3.11 Roughness Coefficients for Open Channels and Maximum Velocity**). If an existing open channel is experiencing erosion or velocities that are calculated to be erosive, the channel shall be modified to prevent erosion. The Director of Public Works and/or the City Engineer shall specifically approve the type of methods used for prevention of erosion.

(d) The design, size, type, and location of all storm drainage facilities shall be subject to the approval of the Director of Public Works and/or the City Engineer. The requirements set forth herein are considered minimum requirements. **The developer and their engineers shall bear the total responsibility for the adequacy of design. The acceptance of the facilities by the City in no way relieves the Developer and their engineer of this responsibility.**

(e) The design factors, formulas, graphs, and procedures described shall serve as means to prove that adequate conveyance of storm water and adequate flood prevention within the City is being provided. Responsibility for the actual design remains with the developers and design engineer of record. Deviation from the requirements of these standards shall require the approval of the Director of Public Works and/or the City Engineer.

(f) The City, as a participant in the National Flood Insurance Program (NFIP), must enforce all parts of its adopted Flood Damage Prevention Ordinance, as approved by the Federal Emergency Management Agency (FEMA). Therefore, the requirements of that ordinance are adopted and included as a part of the City's *Standards of Design and Construction*.

(g) The developer shall be responsible for the necessary facilities to provide drainage patterns and drainage controls such that properties within the overall watershed, whether upstream or downstream of the development, are not adversely affected by storm drainage from facilities on the development. These are outlined in **Section 02.031.0322 Storm Drainage Management Plan**.

(h) The storm drainage management plan provided as part of the final Construction Plans shall address how storm water on the proposed development and affected adjoining properties will be controlled during phased and completed development. Off-site improvements may be required to carry the additional flows caused by the proposed development. If the downstream system is insufficient to carry the proposed flow from the fully developed drainage area without causing

potentially increased flood damages, detention will be required to release only the proportionate flow amount capable of being carried in the existing system for the drainage area. One site may not utilize all remaining capacity if undeveloped property is part of the drainage area.

(i) Storm drainage released from the site will be discharged to a natural water course or storm sewer system of an adequate size to convey the one hundred--year (100-year) storm runoff expected after development.

(j) All storm drainage structures shall be constructed with a minimum of four thousand two-hundred pounds per square inch (4,200 psi) concrete in twenty-eight (28) days with a cement content of not less than seven (7) sacks per cubic yard. Fly ash shall not be allowed. All batch designs shall be reviewed and approved by the Director of Public Works and/or the City Engineer.

(k) All batch designs shall have the current date, project name, and use labeled on each design. Submit batch designs to the Director of Public Works and/or the City Engineer a minimum of ten (10) days prior to the projected placement date for review and approval. If pre-cast structures are being utilized, shop drawings must be submitted to the Director of Public Works and/or the City Engineer for approval along with the batch design which is provided by the manufacturer. All drainage structures shall be double formed. No earth forms will be allowed.

Sec. 0.03.0312.....MINIMUM EASEMENT STANDARDS

(a) The minimum easement widths for drainage facilities shall be per **Table 3.1. Drainage Easements – Minimum Width**. Wider easements may be required by the Director of Public Works and/or the City Engineer. For detention pond easements, water lines and wastewater lines shall not be allowed in the easement.

(b) For new single-family residential subdivisions storm sewer infrastructure, detention ponds, floodplain, open channel setback, and drainage easements shall not be located on a residential lot and must be fully within a Homeowners' Association (HOA) maintained lot.

Table 3.1: Drainage Easements – Minimum Width

		Minimum Easement Width (ft)
Conduit Size	18" – 48" RCP	20'
	48" – 72" RCP	25'
	Box 3' – 4' span, RCB	20'
	Box 5' – 8' span, RCB	25'
	Box 9' – 12' span, RCB	30'
Depth of Conduit	< 14'	20'
	14' - 16'	25'
	17' – 20'	30'
	21' – 23'	35'
	> 23'	40'
Open Channel		15' wider than top width of channel
Emergency Overflow Flume		20'
Creeks/Stream/Floodplains		See Section 3.27 Open Channel Setbacks
Detention Ponds		10' beyond the top of the pond berm or at the toe of the berm whichever is greater

(a) **Rational Method.** For all drainage areas less than one-hundred(100) acres, the Rational Method of computing runoff may be used for design of small drainage facilities (such as storm sewer systems, inlets, street gutter, and small detention facilities). The Rational Method is shown by **Equation 3.1** below:

$$\mathbf{Q = C \times I \times A}$$

Equation 3.1 where:

Q = The storm flow rate at a given point (cfs)

C = runoff coefficient (the ratio of rainfall to peak runoff) as indicated in **Table 3.2 Runoff Coefficient for Types of Land Use**

I = The average intensity of rainfall, for a period equal to the time of flow from the most hydraulically remote point of the drainage area to the point of design (i.e., point with longest flow time to the design point) and is obtained from **Table 3.5 AMS-Based Precipitation Frequency Estimates for Kaufman County** (inches/hr.)

A = The area that is contributing to the point of design (acres)

(1) Runoff Coefficient (C) - For design of proposed drainage facilities using the Rational Method, runoff coefficients shall be based on the future land use. The runoff coefficients for different land uses should be taken from **Table 3.2. Runoff Coefficient for Types of Land Use**. A weighted runoff coefficient shall be used if different land uses are contributing to a discharge design point.

Table 3.2: Runoff Coefficient for Types of Land Use

TYPE OF AREA OR LAND USE	ADOPTED RUNOFF COEFFICIENT
Parks or Open Areas	0.35
Single Family Zoning Categories	
SF-20	0.50
SF-8 or SF-10	0.58
SF-6	0.62
TH (PH, SFA, 2F)	0.80
School	0.70
Multi-Family or Apartments	0.75
Churches	0.80
Industrial	0.90
Commercial Business	0.90
Central Business District	0.90
Retail	0.90
Parking Lot	0.90
Major and Minor Arterials – R.O.W.	0.90

(2) Time of Concentration - The time of concentration is defined as the longest time, without unreasonable delay, that will be required for water to flow from the upper limit of a drainage area to the point of concentration. The time of concentration to any point in a storm drainage system is a combination of the "inlet time" and the time of flow in the storm drain. The inlet time is the period of time required for water to flow over the surface of the ground to the storm drain inlet.

i. Using the Rational Method for small drainage areas under average conditions, the minimum time of concentration from the upstream end of a drainage system will coincide below with **Table 3.3 Minimum Inlet Time of Concentration**.

Table 3.3: Minimum Inlet Time of Concentration

TYPE OF AREA OR LAND USE	MINIMUM INLET TIME (minutes)
Parks or Open Areas	15
Single Family Residential or Duplex	10
School	10
Apartments	10
Townhouse	10
Churches	10
Industrial	10
Commercial Business	10
Central Business District	10
Retail	10
Parking Lot	10
Major and Minor Arterials – R.O.W.	10

ii. Under circumstances which will produce times of concentration in excess of those shown in **Table 3.3. Minimum Inlet Time of Concentration** the following National Resources Conservation Service (NRCS) TR55 methodology shall be used to determine the time of concentration (Tc). This method separates the flow through the drainage area into sheet flow, shallow concentrated flow, and open channel flow. The Tc is the sum of travel times for sheet flow, concentrated shallow flow and open channel flow. The time of concentration flow path and sheet flow path and following calculations shall be shown in the plans.

a. Sheet Flow: The maximum allowable length for sheet flow shall be no more than one-hundred-feet (100'), if not prior to one hundred-feet (100'). Guidelines for determining the maximum allowable sheet flow length are provided in the Unit Hydrograph Method Section 02.031.0313(b). The T_t in minutes for sheet flow is determined **Equation 3.2** below:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} S^{0.4}}$$

Equation 3.2 where
T_t = travel time, (hr.)
n = Manning's roughness coefficient, (**Table 3.4 Sheet Flow 'n' Values**)
L = flow length
P_2 = 2-year, 24-hour rainfall, (**Table 3.5 Precipitation Frequency Estimates for Kaufman, TX)**
S = land slope of hydraulic grade line (ft/ft)

Table 3.4: Sheet Flow 'n' Values

Surface Description	n (1)
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.050
Cultivated soils:	
Residue cover less than 20%	0.060
Residue cover greater than 20%	0.170
Grass:	
Short Prairie Grass	0.150
Dense grasses	0.240
Bermuda grass	0.410
Range (natural)	0.130
Woods:	
Light underbrush	0.40
Dense underbrush	0.80

[1]These "n" values are only applicable for flow depths of approximately one hundredth foot (0.1') or less where sheet flow occurs. For greater flow depths, typically concentrated shallow overland flow or channel flow occurs, with lower "n" values typical of those generally used in open-channel flow.

b. Shallow concentrated flow travel time is computed as shown in **Equation 3.3**

$$t_{SC} = \frac{L_{SC}}{3600 K S_{SC}^{0.5}}$$

Equation 3.3 where:
t_{sc} = shallow concentrated flow time, (hr.)
L_{sc} = shallow concentrated flow length, (ft)
K = 16.13 for unpaved surface, 20.32 for paved surface
S_{sc} = shallow concentrated flow slope, (ft/ft

c. Channel Flow travel time shall be computed by dividing the channel length by the flow rate obtained from Manning's Equation as shown by **Equation 3.4:**

$$t_{sc} = \frac{n L^{ch}}{3600(1.49) R^{2/3} S_{ch}^{1/2}}$$

Equation 3.4 where:
t_{ch} = channel flow time, (hr.)
L_{ch} = channel flow length, (ft)
S_{ch} = channel flow slope, (ft/ft)
n = Manning's roughness coefficient (**Table 3.11 Roughness Coefficients for Open Channels and Maximum Velocity**)

R = channel hydraulic radius (ft), R = a/p_w

where: a = cross sectional area (ft^2)

p_w = wetted perimeter (ft)

d. Since urbanization is anticipated on all drainage areas, all drainage improvements shall be designed for the case of fully developed watersheds. It is generally not practical to design improvements to gravity drainage systems in stages to match development, except in the case of unlined ditches, and then, it is essential that ultimate rights-of-way be obtained at the outset. When the watershed in question is basically undeveloped, the developer shall attempt to anticipate future fully developed conditions and storm water drainage patterns and flow characteristics when determining the time of concentration.

(3) Rainfall Intensity (I) - The Rainfall intensity shall be taken from **Table 3.5 AMS-Based Precipitation Frequency Estimates for Kaufman County** below for the minimum inlet time in **Equation 3.1** above.

Table 3.5: AMS Based Precipitation Frequency Estimates for Kaufman County

Hours	Duration	Average Recurrence Interval (Years)							
		1	2	5	10	25	50	100	500
		Intensity (inches per hour)							
0.083	**5-min**	**5.24**	**5.65**	**7.24**	**8.41**	**9.95**	**11.08**	**12.20**	**14.89**
	6	5.03	5.42	6.95	8.08	9.55	10.64	11.72	14.28
	7	4.82	5.19	6.66	7.74	9.16	10.20	11.24	13.66
	8	4.61	4.96	6.36	7.40	8.76	9.77	10.75	13.04
	9	4.40	4.74	6.07	7.07	8.36	9.33	10.27	12.42
0.167	**10-min**	**4.19**	**4.51**	**5.78**	**6.73**	**7.97**	**8.89**	**9.79**	**11.81**
	11	4.05	4.36	5.59	6.50	7.69	8.58	9.44	11.41
	12	3.91	4.21	5.40	6.28	7.42	8.27	9.10	11.01
	13	3.78	4.06	5.20	6.05	7.15	7.96	8.76	10.62
	14	3.64	3.92	5.01	5.82	6.87	7.65	8.42	10.22
0.250	**15-min**	**3.50**	**3.77**	**4.81**	**5.59**	**6.60**	**7.34**	**8.08**	**9.82**
	16	3.43	3.69	4.72	5.48	6.47	7.19	7.91	9.62
	17	3.36	3.62	4.62	5.37	6.33	7.04	7.74	9.42
	18	3.29	3.54	4.52	5.25	6.20	6.89	7.58	9.22
	19	3.22	3.47	4.43	5.14	6.06	6.74	7.41	9.02
	20	3.15	3.39	4.33	5.03	5.93	6.59	7.25	8.82
	21	3.08	3.32	4.23	4.91	5.80	6.44	7.08	8.62
	22	3.01	3.24	4.14	4.80	5.66	6.29	6.91	8.42
	23	2.94	3.17	4.04	4.69	5.53	6.14	6.75	8.23
	24	2.87	3.09	3.94	4.58	5.39	5.99	6.58	8.03
	25	2.81	3.02	3.85	4.46	5.26	5.84	6.42	7.83
	26	2.74	2.94	3.75	4.35	5.13	5.69	6.25	7.63

Table 3.5: AMS Based Precipitation Frequency Estimates for Kaufman County

Hours	Duration	Average Recurrence Interval (Years)							
		1	2	5	10	25	50	100	500
		Intensity (inches per hour)							
	27	2.67	2.87	3.65	4.24	4.99	5.54	6.09	7.43
	28	2.60	2.79	3.56	4.12	4.86	5.39	5.92	7.23
	29	2.53	2.72	3.46	4.01	4.72	5.24	5.75	7.03
0.500	**30-min**	**2.46**	**2.64**	**3.36**	**3.90**	**4.59**	**5.09**	**5.59**	**6.83**
	31	2.43	2.61	3.32	3.85	4.54	5.03	5.53	6.76
	32	2.40	2.58	3.29	3.81	4.49	4.97	5.46	6.68
	33	2.37	2.55	3.25	3.77	4.43	4.92	5.40	6.61
	34	2.34	2.52	3.21	3.72	4.38	4.86	5.34	6.53
	35	2.32	2.49	3.17	3.68	4.33	4.80	5.28	6.46
	36	2.29	2.46	3.13	3.63	4.28	4.75	5.22	6.39
	37	2.26	2.43	3.09	3.59	4.23	4.69	5.15	6.31
	38	2.23	2.40	3.05	3.54	4.18	4.63	5.09	6.24
	39	2.20	2.37	3.02	3.50	4.12	4.58	5.03	6.17
	40	2.17	2.34	2.98	3.46	4.07	4.52	4.97	6.09
	41	2.14	2.30	2.94	3.41	4.02	4.46	4.91	6.02
	42	2.12	2.27	2.90	3.37	3.97	4.40	4.84	5.94
	43	2.09	2.24	2.86	3.32	3.92	4.35	4.78	5.87
	44	2.06	2.21	2.82	3.28	3.87	4.29	4.72	5.80
0.750	**45-min**	**2.03**	**2.18**	**2.79**	**3.23**	**3.81**	**4.23**	**4.66**	**5.72**
	46	2.00	2.15	2.75	3.19	3.76	4.18	4.60	5.65
	47	1.97	2.12	2.71	3.15	3.71	4.12	4.53	5.58
	48	1.94	2.09	2.67	3.10	3.66	4.06	4.47	5.50
	49	1.92	2.06	2.63	3.06	3.61	4.01	4.41	5.43

Table 3.5: AMS Based Precipitation Frequency Estimates for Kaufman County

Hours	Duration	Average Recurrence Interval (Years)							
		1	2	5	10	25	50	100	500
		Intensity (inches per hour)							
	50	1.89	2.03	2.59	3.01	3.56	3.95	4.35	5.35
	51	1.86	2.00	2.55	2.97	3.50	3.89	4.29	5.28
	52	1.83	1.97	2.52	2.92	3.45	3.84	4.22	5.21
	53	1.80	1.94	2.48	2.88	3.40	3.78	4.16	5.13
	54	1.77	1.91	2.44	2.84	3.35	3.72	4.10	5.06
	55	1.74	1.88	2.40	2.79	3.30	3.66	4.04	4.99
	56	1.72	1.85	2.36	2.75	3.25	3.61	3.98	4.91
	57	1.69	1.82	2.32	2.70	3.19	3.55	3.91	4.84
	58	1.66	1.79	2.29	2.66	3.14	3.49	3.85	4.76
	59	1.63	1.76	2.25	2.61	3.09	3.44	3.79	4.69
1	**60-min**	**1.60**	**1.73**	**2.21**	**2.57**	**3.04**	**3.38**	**3.73**	**4.62**
2	2-hr	0.98	1.06	1.39	1.63	1.96	2.22	2.48	3.17
3	3-hr	0.72	0.79	1.04	1.23	1.50	1.71	1.93	2.52
6	6-hr	0.42	0.46	0.62	0.75	0.92	1.06	1.21	1.61
12	12-hr	0.24	0.27	0.37	0.44	0.55	0.64	0.73	0.99
24	24-hr	0.14	0.16	0.21	0.26	0.32	0.37	0.43	0.58
48	48-hr	0.08	0.09	0.12	0.15	0.18	0.21	0.24	0.32
72	3-days	0.061	0.067	0.090	0.108	0.133	0.152	0.172	0.229

(b) **Unit Hydrograph Method.** For contributing drainage areas greater than one hundred (100) acres, the unit hydrograph method shall be used to determine the peak storm discharge quantities. This method shall also be used for verification of adequacy of stormwater detention facilities with contributing drainages areas that are equal to or greater than twenty (20) acres.

(1) The use of a unit hydrograph method shall be based upon standard and accepted engineering principles used in the profession. Acceptable methods include the Natural Resources Conservation Service (NRCS) and the Snyder unit hydrograph methods. When the flood study involves a watershed that does not already have any available hydrology model, or in the case where conversion of an existing model to a later version hydrology model is desired, the City's preference is the latest version of HEC-HMS model available.

(2) When the unit hydrograph method is used, a flood study report shall be prepared and provided to the Director of Public Works and/or the City Engineer, documenting the methodology, assumptions, derivation of all data used, and results of the study. In order to maintain consistency of all hydrologic studies within the City, the following requirements/conditions shall be used when preforming the unit hydrograph method. These requirements/conditions shall be included in the plan set and the flood study report:

i. Use the NRCS 24-hour Type III Rainfall Distribution.

ii. Use wet antecedent soil moisture conditions (AMC-III).

a. Storm runoff/loss parameter calculations, such as NRCS runoff curve numbers (*CN*). *CN* values should first be computed based on average antecedent soil moisture conditions (AMC-II) to the nearest 0.1 value (*CN2*), based on hydrologic soil group, land cover and treatment practices. Then compute the *CN3* value for AMC-III conditions, to the nearest 0.1 value, using the NRCS conversion as shown in **Equation 3.4a** as follows:

$$CN_3 = \frac{23CN_2}{10 + 0.13CN_2}$$

iii. Compute both pre-construction conditions (based on existing off-site watershed conditions) and post-construction conditions and show comparison in summary table of results.

iv. In addition to No. 3 compute projected future fully developed conditions to determine design elevations and erosion protection.

v. 24-hour rainfall storm totals, (See **Table 3.5 AMS-Based Precipitation Frequency Estimates for Kaufman County**)

vi. Time of Concentration (*Tc*) and Lag Time Calculations, computed to the nearest one (1) minute: The lag time is generally considered to be six tenths (0.6) x *Tc*. The *Tc* calculations should include sheet flow travel time, shallow concentrated flow travel time, channel flow travel time, and travel time associated with any storm sewer system pipes, street gutter flow, and other travel times. Storm sewer pipe travel time may be derived based on design velocities and pipe flow lengths from available or proposed sewer pipe plans. General guidelines pertaining to NRCS TR-55 methodology for determining flow times for sheet flow, concentrated shallow flow, channel flow, and other flow types are included above in **Section 02.03.0313 (a) Storm Drainage Design Criteria**. The length of sheet flow used with the unit hydrograph method should be determined based on the following procedures to determine where sheet flow ends:

a. Field investigations, where possible, to detect overland drainage patterns and where sheet flow transitions to other types of overland or pipe flow (such as observation of beginning of overland flow rill erosion patterns or entrance to a storm water inlet).

b. Information from topographic maps, such as deflections in elevation contours indicating where sheet flow ends, and shallow concentrated flow or channel flow may begin.

c. For areas where previous construction has occurred, review of as-built drainage plans.

d. High-resolution photography, which may indicate locations where overland flow begins to form shallow concentrated flow as evidenced by erosion patterns.

e. If the length of sheet flow cannot be determined by the above procedures, or if it is determined by the above procedures to be greater than one hundred feet (100'), the maximum length to be used shall be the lesser of one hundred feet (100') or the length computed by in **Equation 3.4b** below [as taken from the NRCS National Engineering Handbook, Part 630 – Hydrology, Chapter 15]:

$$L = \frac{100S_{0.5}}{n}$$

Equation 3.4b where:
L = limiting sheet flow length, (ft)
S = land slope over length *L*, (ft/ft)
n = Manning's roughness coefficient over length *L*

vii. When using a unit hydrograph procedure, mixing the hydrology modeling data with data based on differing procedures is not acceptable:

a. The time of concentration should be calculated using actual travel time computations. [Do not assume a 10-minute inlet time as assumed in Rational Method].

b. Use total storm precipitations (inches) listed in **Table 3.5 AMS-Based Precipitation Frequency Estimates for Kaufman County**. [Do not use rainfall intensities (inches/hour) or derive total storm precipitation based on the Rational Method rainfall intensities].

c. For detention ponds with drainage areas greater than twenty (20) acres, if a proposed pond and dam is first designed based on Modified Rational Method but is found to be inadequate when checked with the unit hydrograph method, then it should be re-designed to safely pass the maximum required design storm using the unit hydrograph method, without flow passing over the top of the dam (and with required freeboard) and without increased discharges being passed downstream from the project site.

viii. Drainage areas shall be rounded to the nearest 0.01 acre (0.000001 sq. mi.) in hydrology models, as well as for areas of land use and soil categories when computing composite runoff curve numbers.

ix. Impervious areas of a drainage basin should be included within the computed composite runoff curve number calculations used in the hydrology models (instead of using a percentage of impervious area in combination with a weighted curve number in hydrology models that contain that option).

Table 3.6: NRCS Runoff Curve Numbers (AMC-II) for Various Land Use Classifications

Land Use Classification	Hydrologic Soil Group			
	A	B	C	D
Wooded (Wf)	36	60	73	79
Wooded (Wg)	30	55	70	77
Open Space/Range/Pasture (OSf)	49	69	79	84
Open Space/Range/Pasture (OSg)	39	61	74	80
Cultivated, Straight Row (Csr)	72	81	88	91
Cultivated, Contoured w/o Terracing (Cc)	70	79	84	88
Cultivated, Contoured and Terraced (Cct)	66	74	80	82
Residential (SF-20)	66	78	85	88
Residential (SF-8 & SF-10)	69	80	86	89
Residential (SF-6)	74	83	88	91
Residential (TH, PH, SFA, 2F)	80	87	91	93
Bare Soil	77	86	91	94
Commercial/Business/Multifamily (CBM)	89	92	94	95
Industrial	81	88	91	93
Dirt or Gravel Roads, R.O.W. (Rd)	76	85	89	91
Paved Roads, R.O.W. (Rp)	83	89	92	93
Inundated (W)	100	100	100	100
Urban High Runoff Equivalent *	83	89	92	94

*Urban high runoff equivalent is used only for projected fully-developed watershed conditions.

x. Stream reach hydrograph routing computations within hydrology models must be performed using a procedure that accounts for the effects of channel and floodplain storage (such as Modified Puls method), so that impacts on flood discharges due to loss of flood valley storage within the reach, whether caused by currently proposed construction or due to future development, can be determined.

xi. NRCS runoff curve numbers listed in NRCS's TR-55 for urban and residential districts are generally inappropriate for typical developments in the City of Kaufman, due to the indicated low percentage of impervious areas indicated with the values. Therefore, curve numbers typical of conditions in the City of Kaufman are included in **Table 3.6 NRCS. Runoff Curve Numbers (AMC-II) for Various Land Use Classifications.** These values should be used in most cases; however, other curve numbers for conditions not listed in **Table 3.6 NRCS. Runoff Curve Numbers (AMC-II) for Various Land Use Classifications** may be derived and used if reasonably justified and documented.

xii. Options available in hydrology models to automatically compute pond spillway discharges, based on spillway or outlet type or configuration, are sometimes limited and often do not adequately represent the designed spillway. In such cases, pond water surface elevations versus discharges may need to be computed by other methods and entered into the hydrology model as user defined paired data.

(c) **Design Storm Frequencies.**

(1) The design storm frequencies shall be the five (5) year, ten (10) year, twenty-five (25) year, fifty (50) year and one hundred (100)year storms.

(2) For the Rational Method the relationship between rainfall intensity, duration and frequency is set forth in **Table 3.5 AMS Based Precipitation Frequency Estimates for Kaufman County**.

(3) For the Unit Hydrograph Method the total rainfall for the 24-hour duration storm is used. See **Table 3.5** *AMS Based Precipitation Frequency Estimates for Kaufman County*..

(d) **Drainage Calculations Summary Tables.** The calculations of the storm water discharge shall be provided to the City. As a minimum, the engineering plans shall include:

(1) Existing and Proposed Drainage Area Calculations Table using **Form 3.1 Drainage Calculations Table***;*

(2) Inlet Calculations Table using **Form 3.2 Inlet Design Calculations Table**

(3) Storm Sewer Calculations Table using **Form 3.3 Storm Sewer Calculations Table**;

(4) Open Drainage Channel Calculations Table using **Form 3.4 Open Channel Drainage Calculations Table**; and

(5) Culvert Design Calculations Table using **Form 3.5 Culvert Design Calculations Table***.*

Form 3.1 Drainage Calculations Table

Areas Drained					Weighted Runoff Coeff. C	C*A
Area ID	Total Drainage Area	Parks or Open Area (C=0.35)	Residential (C=var.)	Comm. (C=0.9)		
	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**

Time of Concentration TC	Design Storm Frequency	Intensity I	Storm Runoff Q	Drains To/ Remarks
(min)	(yrs.)	(in/hr.)	(cfs)	
(8)	**(9)**	**(10)**	**(11)**	**(12)**

Instructions for Form 3.1: Drainage Area Calculation Table	
Column (1)	Drainage area identification number or designation
Column (2)	Total Drainage area in acres
Column (3 to 5)	Area drained for each land use type in acres (add additional columns for different land use areas as needed) Runoff Coefficient taken from **Table 3.2**
Column (6)	Weighted Runoff Coefficient calculated from Columns 2 to 5
Column (7)	Product of Column (2) and Column (6)
Column (8)	Minimum inlet time of concentration taken from **Table 3.3**
Column (9)	Design Storm Frequency, shall be 100-yr for all areas
Column (10)	Using the time of concentration and design storm frequency, the rainfall intensity is taken from or **Table 3.5 AMS Based Precipitation Frequency Estimates for Kaufman County**
Column (11)	Solution of the Rational Method **Equation 3.1** (see Section 02.03.0313(a)
Column (12)	A detailed description of where the drainage area drains to including but not limited to Inlet ID, Street Location, Creek Name, Detention Pond Designation, etc.

(e) **Flow in Streets.** Capacity of Arterials, Collectors and Residential streets shall be calculated using a straight crown: Storm water flow in streets having a straight crown shall be calculated as shown below in **Equation 3.5:**

$$Q = \frac{0.56}{n} S_x^{5/3} S^{1/2} T^{8/3}$$

Equation 3.5 where:
Q = gutter flow rate, (cfs)
n = Manning's roughness coefficient; value = 0.0175
S = the longitudinal slope of the street gutter, (ft/ft)
S_x = pavement cross slope, (ft/ft)
T = ponded width, (ft)

(f) **Flow in Alleys.** Capacity of alleys should be taken from Manning's Equation as shown below in **Equation 3.6:**

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Equation 3.6 where:
Q = alley flow rate, (cfs)
n = Manning's roughness coefficient; value = 0.0175
A = cross sectional area of flow, (ft^2)
R = hydraulic radius, (ft)
S = the longitudinal slope of the alley, (ft/ft)

(g) **Permissible Spread of Water (Ponding Width)**

(1) General. Spread of water refers to the amount of water that may be allowed to collect in streets during a storm of specific design frequency. The following **Equation 3.7**, a re-arranging of **Equation 3.5**, shall be used to determine the ponding width "T" for straight crowned streets. (Arterials, Collectors and Residential).

$$T = 1.24 \left(\frac{Q}{S_x^{5/3} S^{1/2}} \right)^{8/3}$$

Equation 3.7 where:
Q = gutter flow rate, (cfs)
n = Manning's roughness coefficient; value = 0.0175
S = the longitudinal slope of the street gutter, (ft/ft)
S_x = pavement cross slope, (ft/ft)
T = ponded width, (ft)

(2) In order that excess storm water will not collect in streets during a storm of the design frequency, the following spread of water values shall be used for the various types of streets.

i. Major and Minor Arterials (P6D & M4D) – Divided. Based on pavement cross-slope of two percent (2.0%), the one-hundred-year (100-yr) Design Frequency flow shall not exceed the elevation of the lowest top of curb. The design engineer shall verify that one lane of traffic in each direction shall remain free of ponding in the one-hundred-year (100-yr) storm event.

ii. Major Collector Streets – (M4U & M3U). Based on a straight cross-slope with a roof top crown of six-inches (6"), the one-hundred-year (100-yr) storm event flows shall not exceed the top of curb, six-inches (6").

iii. Minor Collector Streets - Based on a straight cross-slope with a roof top crown of six-inches (6"), the one-hundred-year (100-yr) storm event flows shall not exceed the right-of-way width.

iv. Residential Streets. Based on a straight cross-slope with a roof top crown of six (6) inches, the 100-year storm event flows shall not exceed the right-of-way.

v. Alleys. The one-hundred-year (100-yr) Design Frequency shall not exceed the capacity of the alley pavement, a depth of five-inches (5"). No ponding will be allowed beyond the pavement edge. Alley paving to be warped to drain the paving toward the inlet.

vi. Parking Lots. The one-hundred-year (100-yr) design frequency shall not exceed a depth of six-inches (6") except where on pavement detention is occurring where one-foot (1') in depth is permissible.

(h) **Inlet Design.** Determination of the required size of the storm drain inlets will be based on the calculations called out in this section and the instructions for **FORM 3.2**: **Inlet Design Calculations Table.**

(1) Types of Inlets. City requires the use of depressed curb inlets. A depressed curb inlet is more efficient than a non-depressed inlet because a depressed inlet induces a greater cross-flow toward the inlet allowing less water to flow past it. Also, the transition out of the depression causes a backwater effect, which further increases the capacity of the storm drain. A gutter depression for all curb inlets shall be six-inches (6"), as shown in the Standard Details. Inlets shall be sized in multiplier of ten feet (10'), fifteen-feet (15') and twenty-feet (20'). Construction of inlets shall be in accordance with the Standard Details. Use **Table 3.6 Storm Drain Inlets** for the selection of inlets to be used within the City. No grate inlets are allowed without approval from the Director of Public Works and/or the City Engineer.

TABLE 3.6: STORM DRAIN INLETS

INLET DESCRIPTION	AVAILABLE INLET SIZES	WHERE USED	DESIGN EQUATIONS
Standard Curb Opening Inlet on Grade	10' 15' 20'	Collectors) Local (Residential) Alley	Equation 3.8 through 3.16

TABLE 3.6: STORM DRAIN INLETS

INLET DESCRIPTION	AVAILABLE INLET SIZES	WHERE USED	DESIGN EQUATIONS
Standard Curb Opening Inlet at Low Point	10’ 15’ 20’	Collectors Local (Residential) Alley	Equation 3.17 & 3.18
Recessed Curb Opening Inlet on Grade	10’ 15’ 20’	Arterials Collectors	Equation 3.19 through 3.20
Combination Inlet at Low Grade	4’ 6’ 8’	Alleys **Director of Public Works and/or the City Engineer Approval Required**	
Grate Inlet	2 Grate 3 Grate 4 Grate 6 Grate	**No grate inlets are allowed without approval from the Director of Public Works and/or the City Engineer**	
Drop Inlet	2’x2’ 3’x3’ 4’x4’ 5’x5’	Open Channels/Area Drain	Equation 3.19 & 3.20

(2) Inlet Location. All inlets (edge of opening) shall be a minimum of ten feet (10’) feet from street or driveway curb return. Recessed inlets will be required to be installed at all inlet locations where the street grade is to be six percent (6%) or greater except on residential streets. At locations where depressed inlets are expected to interfere with pedestrian activity, usually at crosswalks or interior spans of the block used for parking, a depression of less than six inches (6”) may be required. These locations may require additional inlet width to compensate for the reduced depression. The City will consider all variances from a standard six-inch (6”) gutter on an individual basis.

i. Major and Minor Arterials (Divided): Inlets shall be located at street intersections, at low points of grade or where the gutter flow exceeds the permissible spread of water criteria. Inlets shall be located, when possible, on lesser traveled streets or alleys when grades permit. Inlets located on arterials shall be recessed in order to minimize interference of the gutter depression with travel lanes. In super-elevated sections, inlets placed against the center medians shall have no gutter depression and shall intercept gutter flow at the point of vertical curvatures to prevent flow from crossing the arterial. Unless expressly approved by the Director of Public Works and/or the City Engineer, storm waters will not be allowed to cross arterials on the surface in valley gutters or otherwise. All sag inlets will require a reinforced concrete emergency overflow flume. The capacity of the emergency overflow flume shall equal or exceed the one-hundred-year (100-yr) design storm flow coming to the sag point.

ii. Collector Streets: Inlets shall be located at street intersections, low points of grade or where the gutter flow exceeds the permissible spread of water criteria. Inlets

shall be located, when at all possible, on lesser traveled streets or alleys where grade permits. All sag inlets will require a reinforced concrete emergency overflow flume. The capacity of the emergency overflow flume shall equal or exceed the one-hundred-year (100-yr) design storm flow coming to the sag point.

iii. Residential Streets: Inlets shall be located at street intersections, low points of grade or where the gutter flow exceeds the permissible spread of water criteria. All sag inlets will require a reinforced concrete emergency overflow flume unless the design engineer calculates that the street will carry the overflow above the crest of the roadway without the water surface elevation exceeding the top of curb. The capacity of the emergency overflow flume shall equal or exceed the one-hundred-year (100-yr) design storm flow coming to the sag point.

iv. Alleys: Inlets shall be located before intersections with streets, alley to alley intersections, change in alley directions, low points of grade or where the gutter flow exceeds the permissible spread of water criteria. All sag inlets will require a reinforced concrete emergency overflow flume. The capacity of the emergency overflow flume shall equal or exceed the one-hundred-year (100-yr) design storm flow coming to the sag point.

v. Parking Lots: Inlets shall be located at all sag points and before ponding exceeds six inches (6") in depth except when on pavement detention is occurring.

(3) Curb Inlets On-Grade. Curb inlets on-grade shall be sized based on the following **Equations 3.8 through 3.16** and **Figure 3.1 Gutter Cross Section Diagram**. .

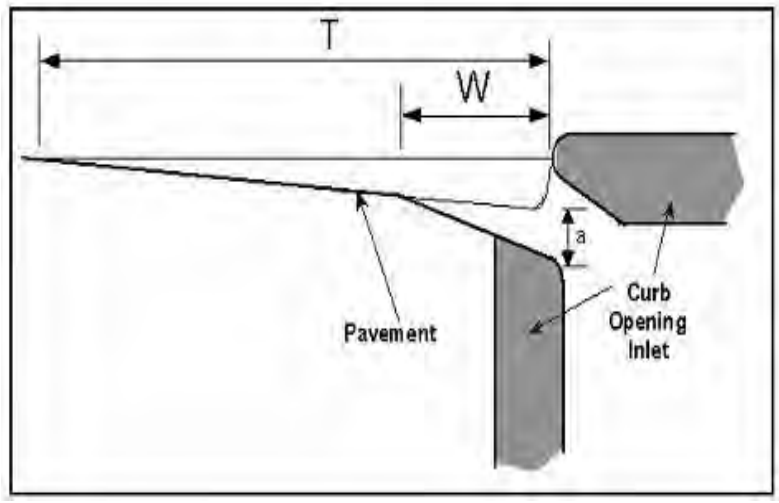
$$L_r = 0.6Q^{0.42}S^{0.3}\left(\frac{1}{nS_e}\right)^{0.6}$$

Equation 3.8 where:
Lr = length of curb inlet required (ft)
Q = flow rate in gutter (cfs)
S = longitudinal slope (ft./ft)
n = Manning's roughness coefficient, value = 0.0175
Se = equivalent cross slope (ft./ft.)

$$S_e = S_x + \frac{a}{W}E_0$$

Equation 3.9 where:
S_e = equivalent cross slope (ft/ft)
S_x = cross slope of the road (ft/ft)
a = gutter depression depth (ft), all inlet depressions shall be 0.50 feet (6 inches)
W = gutter depression width (ft) - standard inlets W = 2.0 ft, recessed inlets W = 3.0 ft
E_o = ratio of depression flow to total flow

Figure 3.1: Gutter Cross Section Diagram



$$E_0 = \frac{K_W}{K_W + K_0}$$

Equation 3.10 where:
E_0 = ratio of depression flow to total flow
K_W = conveyance of the depressed gutter section (cfs)
K_0 = conveyance of the gutter section beyond the depression (cfs)

$$K = \frac{1.486A^{5/3}}{nP^{2/3}}$$

Equation 3.11 where:
K = conveyance of cross section (cfs)
A = area of cross section (ft^2)
n = Manning's roughness coefficient, value = 0.0175
P = wetted perimeter (ft)

$$A_W = WS_x\left(T - \frac{W}{2}\right) + \frac{1}{2}aW$$

Equation 3.12 where:
A_W = area of depressed gutter section (ft^2)
W = gutter depression width (ft) - standard inlets W = 2.0 ft, recessed inlets W = 3.0 ft
S_X = cross slope (ft/ft)
T = calculated ponded width (ft)
a = gutter depression depth (ft), all inlet depressions shall be 0.50 feet (6 inches)

$$P_W = \sqrt{(WS_x + a)^2 + W^2}$$

Equation 3.13 where:
P_W = wetted perimeter of depressed gutter section (ft)
W = gutter depression width (ft) - standard inlets W = 2.0 ft, recessed inlets W = 3.0 ft
S_X = cross slope (ft./ft)
a = gutter depression depth (ft), all inlet depressions shall be 0.50 feet (6 inches)

$$A_0 = \frac{S_x}{2}(T - W)^2$$

Equation 3.14 where:
A_0 = area of gutter/road section beyond the depression width (ft^2)
S_X = cross slope (ft/ft)
W = gutter depression width (ft) - standard inlets W = 2.0 ft, recessed inlets W = 3.0 ft
T = calculated ponded width

$$P_0 = T - W$$

Equation 3.15 where
P_0 = wetted perimeter of the depressed gutter section (ft)
T = calculated ponded width (ft)
W = gutter depression width (ft) - standard inlets W = 2.0 ft, recessed inlets W = 3.0 ft

For determining the bypass of a curb inlet on grade use the following **Equation 3.16** which factors in the ratio of the actual length of curb inlet (L_a) to the length of inlet required (L_r)

$$Q_{bypass} = Q\left(1 - \frac{L_a}{L_r}\right)^{1.8}$$

Equation 3.16 where:
Q_{bypass} = carryover discharge (cfs)
Q = total discharge (cfs)
L_a = design length of the curb opening inlet (ft)
L_r = length of curb opening inlet required to intercept the total flow (ft)

(4) Curb Inlet at Sag/Low Point. Determining the capacity of curb inlets at sag/low point shall be taken from **Equation 3.17** while the inlet operates as a weir until the water depth approaches 1.4 times the curb opening height.

$$Q = 2.3(L + 1.8W)y^{1.5}$$

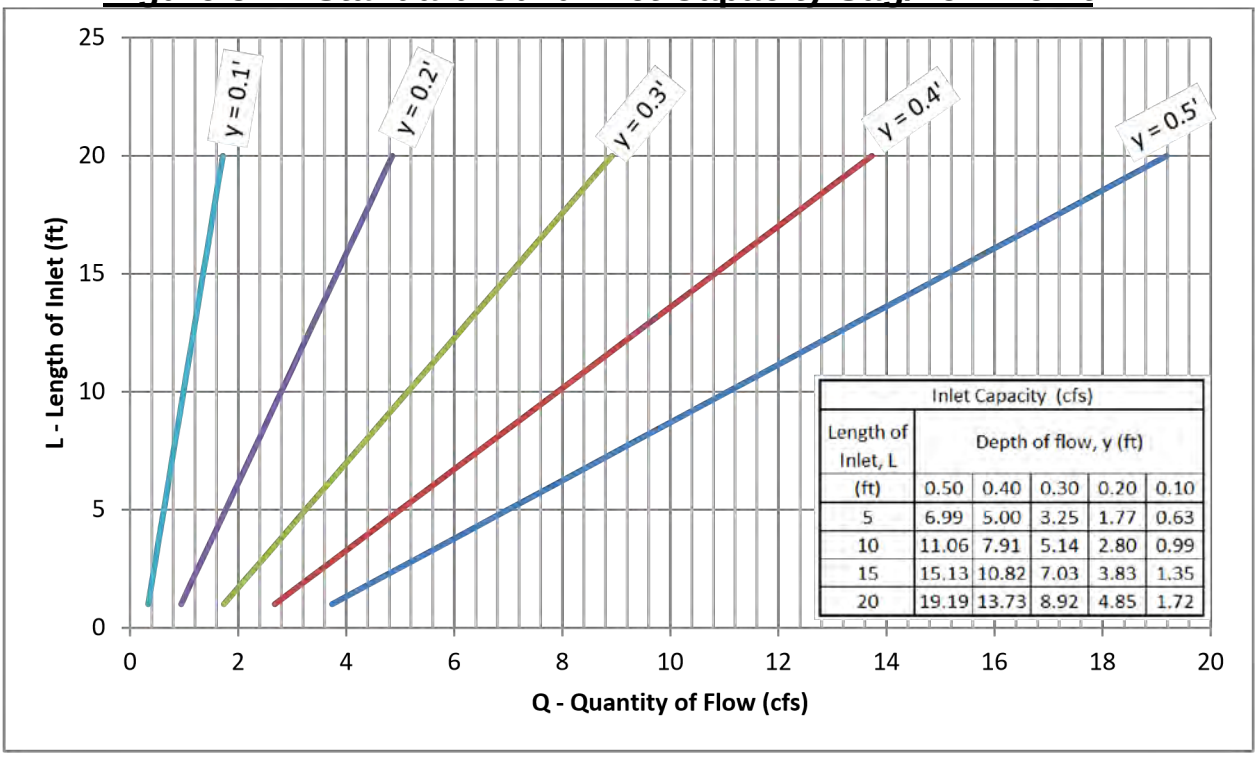
Equation 3.14 can be rearranged to find the required curb inlet length at a sag point as shown in **Equation 3.18**.

$$L = \frac{Q}{2.3y^{1.5}} - 1.8W$$

Equation 3.17 and **3.18** where:
Q = total flow reaching inlet (cfs) *y* = depth of flow (ft)
L = length of curb inlet opening (ft)
W = gutter depression width (ft) - standard inlets W = 2.0 ft, recessed inlets W = 3.0 ft

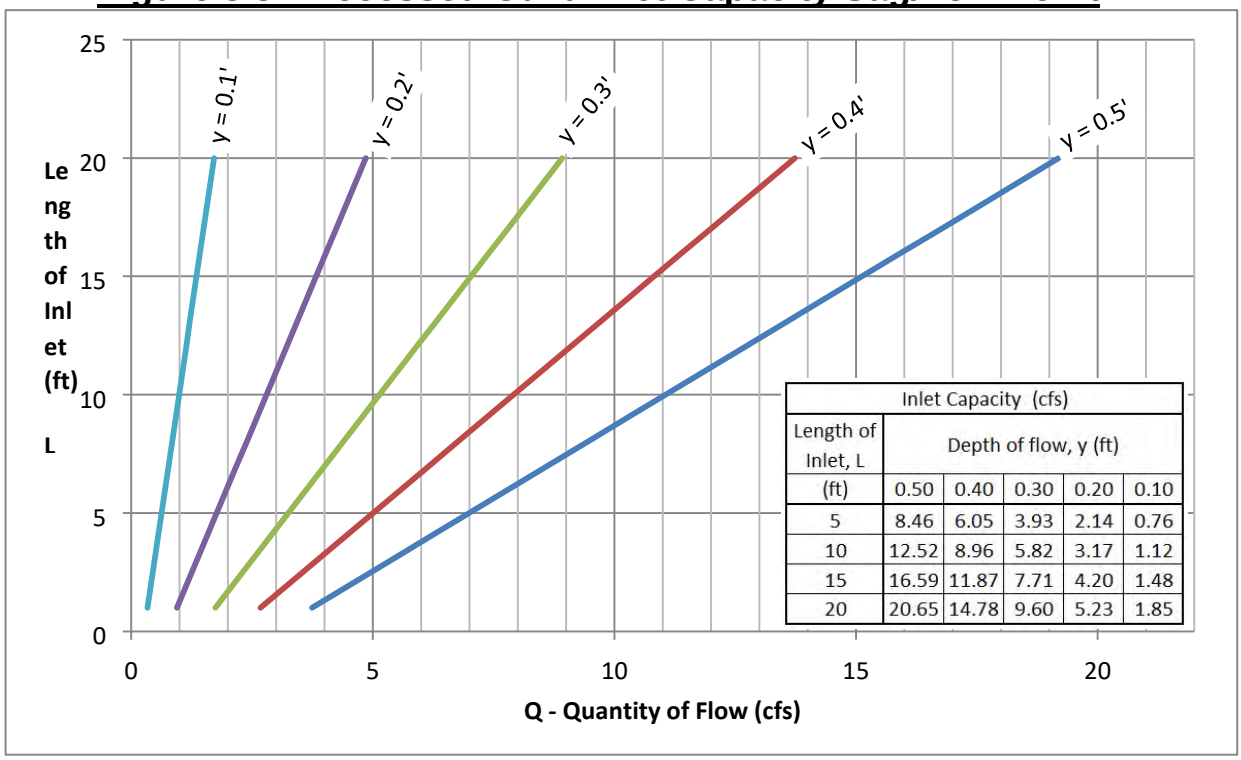
Figures 3.2 through **3.3** are provided as reference for **Standard and Recessed Sag Curb Inlet Capacities**.

Figure 3.2: Standard Curb Inlet Capacity Sag/Low Point



Inlet Capacity (cfs)					
Length of Inlet, L	Depth of flow, y (ft)				
(ft)	0.50	0.40	0.30	0.20	0.10
5	6.99	5.00	3.25	1.77	0.63
10	11.06	7.91	5.14	2.80	0.99
15	15.13	10.82	7.03	3.83	1.35
20	19.19	13.73	8.92	4.85	1.72

Figure 3.3: Recessed Curb Inlet Capacity Sag/Low Point



Inlet Capacity (cfs)					
Length of Inlet, L	Depth of flow, y (ft)				
(ft)	0.50	0.40	0.30	0.20	0.10
5	8.46	6.05	3.93	2.14	0.76
10	12.52	8.96	5.82	3.17	1.12
15	16.59	11.87	7.71	4.20	1.48
20	20.65	14.78	9.60	5.23	1.85

(5) Drop Inlets / 'Y' Inlet Design. The capacity of drop inlets shall be taken from the **Equation 3.19**. All drop inlets shall be sized to have a maximum allowable head (depth of water) on the inlet to be six (6) inches.

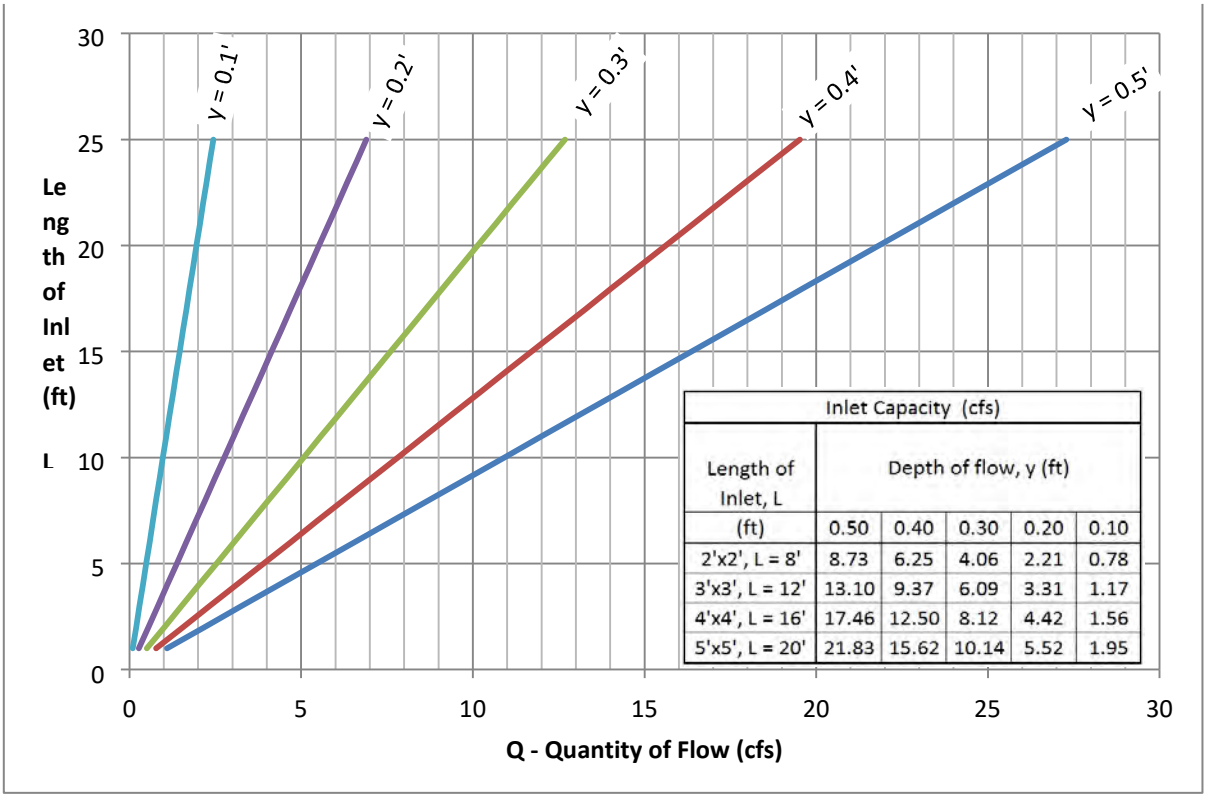
$$Q = 3.087Ly^{3/2}$$

The equation can be rearranged to find the length of Drop Inlet opening as shown in **Equation 3.20**.

Equation 3.20 where:
Q = flow to inlet (cfs)
L = length of inlet opening (ft)
y = depth of water (head) at inlet (ft)

Figure 3.4 is provided as reference for Drop/"Y" Inlet Capacities.

Figure 3.4: Drop/'Y' Inlet Capacity



Inlet Capacity (cfs)					
Length of Inlet, L	Depth of flow, y (ft)				
(ft)	0.50	0.40	0.30	0.20	0.10
2'x2', L = 8'	8.73	6.25	4.06	2.21	0.78
3'x3', L = 12'	13.10	9.37	6.09	3.31	1.17
4'x4', L = 16'	17.46	12.50	8.12	4.42	1.56
5'x5', L = 20'	21.83	15.62	10.14	5.52	1.95

(6) Combination and Grate Inlet Design. When allowed by the Director of Public Works and/or the City Engineer combination and grate Inlets shall be sized using standard engineering practices or manufacturer's recommendation.

Form 3.2: Inlet Design Calculations Table

Inlet ID	Location				Area Runoff					
	Align-ment	Station	Offset	Design Freq.	C	Area ID	Time of Concen-tration Tc	Intensity I	Area A	Runoff Q
				(yr.+++)			(min)	(in/hr.)	(acres)	(cfs)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

Upstream Bypass C*A	Total Gutter Flow Q_a	Gutter Flow							
		Thorough-fare Type	OnGrade/ Sag	Manning's n	Long Slope S	Crown Type	Cross Slope SX	Depression	
								Depth a	Width W
(cfs)	(cfs)				(ft/ft)		(ft/ft)	(ft)	(ft)
(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)

Gutter Flow					Inlets Capacity			
Ponding Width/ Spread		Depth of Gutter Flow		Max. Allowable Flow based on Max. Allowable Ponding Width Qallow gutter	Depressed Gutter Section		Section Beyond Depression	
					Area	Wetted Perimeter	Area	Wetted Perimeter
(allow) Tallow	(actual) Tactual	(allow) yallow	(actual) yactual		AW	PW	A_0	P_0
(ft)	(ft)	(ft)	(ft)	(cfs)	(ft^2)	(ft)	(ft^2)	(ft)
(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)

Inlets Capacity							Inlet By-pass			Remarks
Conveyance		Ratio of Depress. flow to Total Flow E_0	Equiv. Cross slope, S_e	Inlet Length		Inlet Capacity QC	Flow Qbypass	C* A	To Inlet ID	
Depression Section Kw	Section Beyond Depress. K_0			Required LReq'd	Actual Lactual					
(cfs)	(cfs)		(ft/ft)	(ft)	(ft)	(cfs)	(cfs)			
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)

Instructions for Form 3.2: Inlet Design Calculation Table	
Column (1)	Inlet number or designation, starting with the most upstream inlet.
Column (2)	Street Alignment/ Name in which the inlet is located.
Column (3)	Station along the alignment in which the inlet is located.
Column (4)	Offset distance and side (RT/LT) inlet is located.
Column (5)	Design Storm Frequency shall be 100-yr for all inlets.
Column (6)	Runoff coefficient taken from **Table 3.2**, **Runoff Coefficient for Types of Land Use**.
Column (7)	Contributing drainage area ID.
Column (8)	Minimum inlet time of concentration taken from **Table 3.3, Minimum Inlet Time of Concentration**.
Column (9)	Using the time of concentration and design storm frequency, the rainfall intensity is taken from **Table 3.5, AMS Based Precipitation Frequency Estimates for Kaufman County**
Column (10)	Runoff area to inlet in acres.
Column (11)	Solution of **Equation 3.1**.
Column (12)	Taken from Column (39) of the upstream inlet.
Column (13)	$= Column\ (9)\{Column\ (12) + \{Column\ (6) * Column\ (10)\}\}$
Column (14)	Thoroughfare Type Taken from **Article 02.031.0200 Streets**, (Type A, Type B, Type C, Type D, Local, Alley, Parking).
Column (15)	Determined by location of inlet (On-Grade or Sag).
Column (16)	Manning's n value.
Column (17)	Street longitudinal gutter slope of the street taken in (feet/feet).
Column (18)	Street crown type on which the inlet is located.
Column (19)	Street cross-slope in feet/feet .

Instructions for Form 3.2: Inlet Design Calculation Table	
Column (20)	Gutter depression depth, reference **Figure 3.1**.
Column (21)	Gutter depression width, reference **Figure 3.1**.
Column (22)	Determined by the type of thoroughfare in the permissible spread width section.
Column (23)	Solution of **Equation 3.7**.
Column (24)	The product of Column (22) and Column (19).
Column (25)	The product of Column (23) and Column (19).
Column (26)	Solution of **Equation 3.5.** using the maximum allowable pond width from Column (22).
Column (27)	Solution of **Equation 3.12**.
Column (28)	Solution of **Equation 3.13**.
Column (29)	Solution of **Equation 3.14**.
Column (30)	Solution of **Equation 3.15**.
Column (31)	Solution of **Equation 3.11** using Columns (27) and (28).
Column (32)	Solution of **Equation 3.11** using Columns (29) and (30).
Column (33)	Solution of **Equation 3.10**.
Column (34)	Solution of **Equation 3.9**.
Column (35)	Solution of **Equation 3.8** for on-grade curb inlets, **Equation 3.18** for sag curb inlet, or **Equation 3.20** for drop inlets.
Column (36)	Selected Inlet Size.
Column (37)	The capacity of the selected inlet size of Column (35), solution found by iteratively solving for capacity based on **Equation 3.8** for curb inlets, **Equation 3.17** for sag curb inlets, **Equation 3.19** for drop inlets.
Column (38)	For on-grade inlets the solution of **Equation 3.16**.
Column (39)	Equal Column (38) divided by Column (9).
Column (40)	Next downstream inlet to which by the by-pass is going.
Column (41)	Special design comments are entered here.

(i) **Flow in Storm Drain Conduits and Their Appurtenances**

(1) Hydraulic Gradient of Conduits.

i. A storm drainage conduit must have sufficient capacity to discharge a design storm with a minimum of interruption and inconvenience to the public using streets and thoroughfares. The size of the conduit is determined by accumulating runoff from contributing inlets and calculating the slope of a hydraulic gradient from Manning's Equation:

$$S_f = \frac{Qn^2}{1.49AR^{2/3}}$$

Equation 3.21 where:
Q = flow in conduit, (cfs)
n = Manning's roughness coefficient; value = 0.013 A = cross sectional area of flow, (ft^2)
R = hydraulic radius, (ft)
S_f = hydraulic friction slope, (ft/ft)

ii. Hydraulic gradient for the selected conduit size shall be 1.50' below gutter (2.0' below top of curb) for each contributing inlet to ensure that the selected conduit will carry the design flow at an elevation below the gutter profile. As the conduit size is selected and the hydraulic gradient is plotted between each inlet pickup point, a head loss due to a change in velocity and pipe size must be incorporated in the gradient profile.

iii. At an outfall/headwall the starting hydraulic grade line (HGL) for a conduit system shall be set to the greater of the following: the conduit soffit or the one-hundred-year (100-yr) water surface elevation for the receiving channel or detention pond. In situations where the drainage area for the receiving stream is significantly larger than the drainage area for the site, an evaluation may be performed to determine the water surface elevation and resulting HGL that is appropriate for the site.

iv. Concrete pipe conduit shall be used to carry the storm water, and flow chart, **FIGURE 3.5**, **Capacity of Circular Pipes Flowing Full** based on Manning's Equation may be used to determine the various hydraulic elements including the pipe size, the hydraulic gradient, and the velocity. Special hydraulic calculators are also available for solution of Manning's Equation. All public storm lines shall be sized to carry the 100-year flow or greater.

v. The roughness coefficient 'n' for storm sewer conduit shall be 0.013.

vi. With the hydraulic gradient established, considerable latitude is available for establishment of the conduit flow line. The hydraulic gradient at every inlet should be plotted directly on the construction plan profile worksheet and adjusted as necessary.

vii. All public storm sewer systems shall be reinforced concrete pipe. In order to facilitate pipe inspection, where pipe sizes change, the flowlines shall match. Storm sewer pipe with two-feet (2') feet or less of cover are required to be Class IV reinforced concrete pipe. All storm pipes and laterals are required to have a plan and profile on engineering plans. All flow data (Q100, Qcap, velocity, hydraulic slope) is required at every change in pipe size, slope and/or change in flow rate.

Figure 3.5 Capacity of Circular Pipes Flowing Full

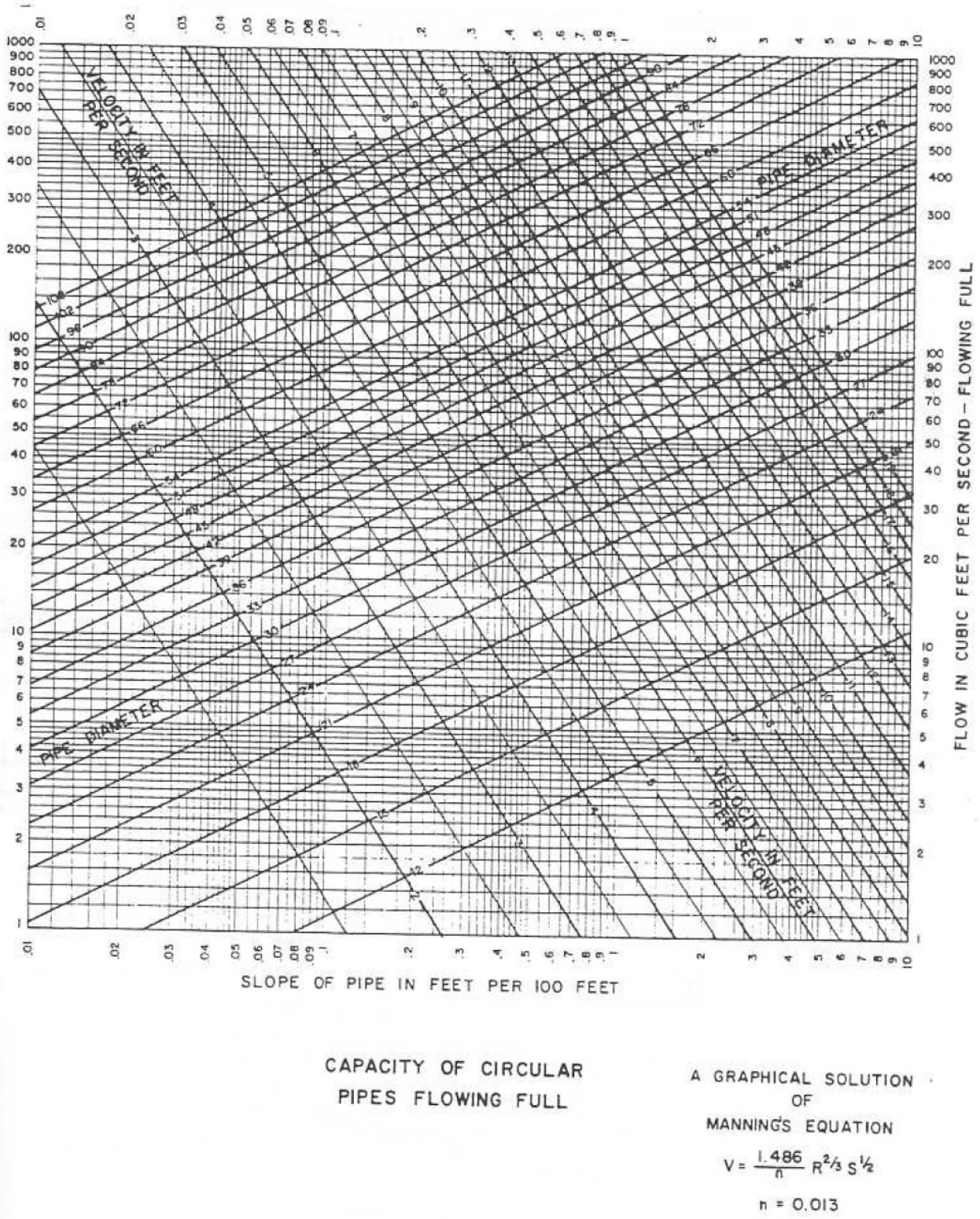


Table 3.7: Entrance Loss Coefficients

Type of Structure and Design of Entrance	Coeff. K_E
Pipe (Concrete)	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, square cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
End-section conforming to fill slope	0.5
Beveled edges, 33.7- or 45-degree bevels	0.2
Side- or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, (Corrugated Metal)	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
End-section conforming to fill slope	0.5
Beveled edges, 33.7- or 45-degree bevels	0.2
Side- or slope-tapered inlet	0.2
Box (Reinforced Concrete)	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension or beveled edges on 3 sides	0.2
Wingwalls at 30- to 75-degrees to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10- to 25-degrees to barrel	
Square-edged at crown	0.5
Wingwall parallel (extension of sides)	
Square-edged at crown	0.7
Side- or slope-tapered inlet	0.2

(2) Minor Head Losses. When establishing the hydraulic gradeline of a storm sewer, minor head losses at points of turbulence shall be calculated and included in the computation of the hydraulic gradeline.

i. Entrance Losses. Entrance losses to a closed storm sewer system from an open channel or lake shall be calculated using **Equation 3.22**.

$$H_L = K_E \frac{V_1^2}{2g}$$

Equation 3.22 where:
H_L = head loss (ft)
K_E = head loss coefficient (see **Table 3.7 Entrance Loss Coefficients)** .
V_1 = velocity in the downstream conduit (ft/s)
g = the acceleration of gravity (32.3 ft/s^2)

ii. Inlet Losses. Inlet losses shall be calculated using **Equation 3.23.**

$$H_L = 1.25 \frac{V_{LAT}^2}{2g}$$

Equation 3.23 where:
H_L = head loss (ft)
V_{LAT} = velocity in the lateral (ft/s)
g = the acceleration of gravity (32.2 ft/s^2

iii. Expansion Losses. For pipe size expansions, head loss shall be calculated using **Equation 3.24**.

$$H_L = \left(1 - \left(\frac{D_1}{D_2}\right)^2\right) \frac{V_1^2}{2g}$$

Equation 3.24 where:
H_L = head loss (ft)
V_1 = upstream velocity (ft/s)
D_1 = upstream conduit diameter (ft)
D_2 = downstream conduit diameter (ft)
g = the acceleration of gravity (32.2 ft/s^2

iv. Manhole and Bend Losses. Head losses associated with manholes for pipe direction changes and bends in pipes of equal diameter shall be calculated using **Equation 3.25.**

$$H_L = K_j \frac{V_2^2}{2g}$$

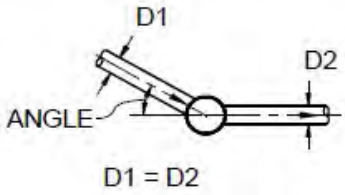
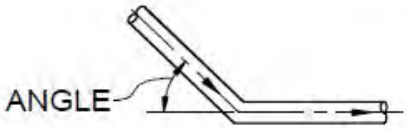
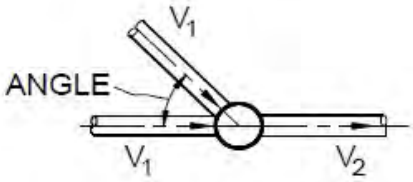
Equation 3.25 where:
H_L = Head loss (ft)
V_1 = Velocity in the upstream conduit (ft/s)
V_2 = Velocity in the downstream conduit (ft/s)
K_j = Head loss coefficient from **Table 3.8**. **Head Loss Coefficients for Closed Conduits**
g = the acceleration of gravity (32.2 ft/s^2)

v. Junction Losses. Head losses associated with wye connections or manholes branch laterals entering the main line shall be calculated by sing **Equation 3.26.**

$$H_L = \frac{V_2^2}{2g} - K_j \frac{V_1^2}{2g}$$

Equation 3.26 where:
H_L = Head loss (ft)
V_1 = Velocity in the upstream conduit (ft/s)
V_2 = Velocity in the downstream conduit (ft/s) K_j = Head loss coefficient from **Table 3.8 Head Loss Coefficients for Closed Conduits**
g = the acceleration of gravity (32.2 ft/s^2)

Table 3.8 Head Loss Coefficients for Closed Conduits

MANHOLE AT CHANGE IN PIPE DIRECTION		
DESCRIPTION	ANGLE	HEAD LOSS COEFFICIENT Kj
	90°	0.55
	60°	0.48
	45°	0.42
	30°	0.3
	0°	0.05
BENDS IN PIPES		
DESCRIPTION	ANGLE	HEAD LOSS COEFFICIENT Kj
	90°	0.5
	60°	0.43
	45°	0.37
	30°	0.25
JUNCTION		
DESCRIPTION	ANGLE	HEAD LOSS COEFFICIENT Kj
	0°	1
	22 1/2°	0.75
	45°	0.5
	60°	0.35
	90°	0.25

(3) Minimum Grades.

i. Storm drains should operate with flow velocities sufficient to prevent excessive deposits of solid materials; otherwise objectionable clogging may result. The controlling velocity with regard to sediment deposition is near the bottom of the conduit and considerably less than the mean velocity of the storm.

ii. Storm drains shall be designed to have a minimum mean velocity flowing full of 2.5 feet per second (f.p.s.). **Table 3.9 Minimum Grades for Storm Drain Pipelines** indicates the minimum grades for concrete pipe with "Manning's "n" = 0.013 and flowing at 2.5 f.p.s.

Table 3.9: Minimum Grades for Storm Drain Pipelines

Pipe Diameter. (Inches)	Slope (foot/foot)
18	0.0018
21	0.0015
24	0.0013
27	0.0011
30 -96	0.0010

(4) Maximum Velocities. The slope of a storm sewer should also be such that excessive velocities will not damage the pipeline or drainage structures. **Table 3.10 Maximum Velocities in Closed Conduits** delineates the maximum desirable velocities for storm sewer.

Table 3.10: Maximum Velocities in Closed Conduits

Type of Conduit	Maximum Velocity
Culverts	15 f.p.s.
Inlet Laterals	15 f.p.s.
Storm Sewer Pipe	12.5 f.p.s.

(5) Discharge of Storm Drain Pipe.

i. For discharging into retention ponds or other water features with a normal pool, the outfall must be at minimum the same level of the normal water surface elevation. Pipes may not be designed or discharged to retain water within the pipe longer than forty-eight (48) hours.

ii. Headwalls or sloped end treatments shall be constructed at the pipe ends of all storm drain systems. Sloped end treatments are required along streets when the drainage feature is adjacent and parallel to traffic flow. The sloped end treatment shall be a minimum of six horizontal to one vertical (6:1) end section. Storm drain systems that outfall to a stream, natural channel, or pond shall conform to the existing side slope of the channel, outfall to the stream flowline, and be connected to a headwall. Hard armor protection and energy dissipation shall be installed at the outfall structure to address potential erosion issues associated with the new storm drainage system. Refer to the iSWM Technical Manual Hydraulics Section for design of channel transitions and energy dissipation. Follow requirements for open channel transition materials when out-falling to a channel

(6) Manholes.

i. Storm drain manholes shall be located at intervals not to exceed five hundred feet (500') for all underground storm conduit systems.

ii. Manholes shall also be placed at locations where CCTV and Vac-con equipment can inspect/clean entire system without getting stuck or unable to make bends/wye connection turns. Therefore manholes shall also be placed where there is no more than one (1) bend or wye connection between manholes or inlets.

iii. Inlet and manhole lids shall be twenty-four inches (24") with locking lids.

(7) Underdrains/French Drains.

i. The use of French Drains shall be approved by the Director of Public Works and/or the City Engineer. The minimum size of underdrains/French drain shall be six-inches (6") in diameter. Piping shall be installed per standard detail R-6080 and connect to the nearest downstream inlet.

ii. Cleanout shall be placed at the most upstream point and at a maximum spacing of four-hundred-feet (400').

iii. Horizontal location shall be adjusted as needed in order to prevent conflict with other proposed or existing utilities within corridor.

iv. Ninety-degree (90°) bends in small lines are prohibited. Forty-five-degree (45°) bends or clean outs are recommended.

v. Any private underdrains/French drains that are discharging into City right-of-way or easements shall connect to the closest City underdrain, storm drain pipe or inlet. A clean out shall be placed at the right-of-way line to the private underdrain lateral.

vi. If a private underdrain is not in close proximity to a larger storm drain pipe or inlet system, a pop-up drain shall be installed in private property.

vii. No cutting or "punching" into City curb with pipes will be allowed.

(j) **One Hundred-Year (100-yr) Flood Zones**. Where the Federal Emergency Management Administration (FEMA) has defined a flood hazard area with regard to a drainage course as shown on the effective Flood Insurance Rate Maps (FIRMs), the flood hazard zone and the floodplain, floodway, cross-section lines and water surface elevations at each cross-section, if available, shall be shown on the plat and engineering plans.

(k) **Local One-Hundred-Year (100-yr) Flood Zones**. Where flood information has not been determined for streams, creeks, channels, or impoundments located within or adjacent to a proposed development, the one-hundred-year (100-yr) fully developed flood elevations and flood

boundaries shall be determined by the developers' engineers. The local floodplain, cross-section lines and water surface elevations at each cross-section shall be shown on the plat and engineering plans.

(l) **Inlet Markers**. The City will provide "No Dumping, Drains to Waterway" inlet markers to be installed on each inlet by the Developer.

(m) **Fueling Stations**. If there is a fueling station on the site, the storm line serving the fueling station drainage area shall have an oil/water separator installed before leaving the site. This private system shall discharge into a storm system and cannot discharge into a wastewater system.

(n) **Testing**. If there is a fueling station on the site, the storm line serving the fueling station drainage area shall have an oil/water separator installed before leaving the site. This private system shall discharge into a storm system and cannot discharge into a wastewater system.

SEC.02.03.0314 ..... STORM SEWER DESIGN – CLOSED CONDUIT

(a) **General.** To facilitate the design of closed conduit storm sewers, design will be based on the calculations called out in this section and the instructions for Form 3.3: Storm Sewer Calculations. **Form 3.3 Storm Sewer Calculations Table** in its entirety shall be included in the plans and calculations shall be provided for each system including laterals.

Form 3.3: Storm Sewer Calculations Table

SYSTEM ID	Conduit Properties									
	Collection Point Station		Length	# of Barrels	Pipe Size	Box		Type	Area	
	U/S	D/S				Span	Rise			
			(ft)		(inches)	(ft)	(ft)		(ft^2)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	

Conduit Properties						Incremental Drainage Area				
Wetted Perim-eter PW	Hydraulic Radius	Manning's n	Flowline Elevation		Slope	Inlet ID	Area	Runoff Coeff. C	Incre-mental C*A	
			Up-stream	Down-stream						
(ft)	(ft)				(ft/ft)		(acres)			
(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	

	Accum-ulated C*A	Upstream TC	Design Storm Freq.	Intensity I	Runoff Q	Conduit Capacity QC	Partial Flow	Velocity V	Time in Conduit	
		(min)	(yr)	(in/hr.)	(cfs)	(cfs)	(Yes/No)	(ft/s)	(min)	
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	

	Friction Slope S_f	Friction Head-loss	HGL		Headloss Calculations					Design HGL	Top of Curb Elev.	HGL Depth Below T/C	Remarks
			U/S	D/S	$\frac{V_1 2}{2g}$	$\frac{V_2 2}{2g}$	Jct. Type	Coeff. K_J	Head-loss H_L				
	(ft/ft)	(ft)			(ft)	(ft)			(ft)			(ft)	
	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)

Instructions for Form 3.3: Storm Sewer Calculation Table

Column (1)	System ID, if private label (ex. Line-A, Line-B, ….; Lat-A1, Lat-A2, ….)
Column (2)	Storm sewer line station at the upstream end of conduit section
Column (3)	Storm sewer line station at the downstream end of conduit section
Column (4)	Length of Conduit segment, equal to Column (2) minus Column (3)
Column (5)	Number of barrels of conduit
Column (6)	Size of Pipe in inches
Column (7)	Span of Box Conduit
Column (8)	Rise of Box Conduit
Column (9)	Conduit Type (ex. RCP, RCB, PVC, HDPE, ….)
Column (10)	Conduit area
Column (11)	Wetted Perimeter
Column (12)	Equal to Column (10) divided by Column (11)
Column (13)	Manning's Roughness Coefficient
Column (14)	Conduit flowline elevation at the upstream end of conduit section
Column (15)	Conduit flowline elevation at the downstream end of conduit section
Column (16)	Conduit slope in feet/feet
Column (17)	The incremental drainage area ID contributing to the conduit section
Column (18)	The incremental drainage area in acres contributing to the conduit section
Column (19)	The incremental drainage area runoff coefficient contributing to the conduit section

Instructions for Form 3.3: Storm Sewer Calculation Table

Column (20)	Equal to Column (18) multiplied by Column (19)
Column (21)	Equal to Column (20) plus Column (21) of the upstream conduit section
Column (22)	Equal to inlet Tc if most upstream conduit section, or the sum of previous conduit section Column (22) and Column (29)
Column (23)	Design Storm Frequency shall be 100-yr
Column (24)	Shall be taken from **Table 3.5 AMS Based Precipitation Frequency Estimates for Kaufman County** using Columns (22) and (23)
Column (25)	Solution of Equation 3.1 using Columns (21) and (24)
Column (26)	Solution of Manning's **Equation 3.6** where the conduit is flowing full (depth of flow is equal to height of conduit)
Column (27)	Yes, if Column (25) < Column (26). No, if Column (25) ≥ Column (26)
Column (28)	The actual velocity within the conduit
Column (29)	Equal to Column (4) divided by Column (28) divided by 60 sec/min
Column (30)	Solution of **Equation 3.21**
Column (31)	Equal to Column (4) multiplied by Column (30)
Column (32)	Upstream Hydraulic Grade Line. Equal to Column (33) plus Column (31)
Column (33)	This is the beginning hydraulic gradient of the line. It is equal to the Design HGL Column (38) for the next downstream segment, or the beginning HGL of the system.
Column (34)	Velocity Head of the incoming pipe at the wye, junction, inlet, or manhole.
Column (35)	Velocity Head of the outgoing pipe (the pipe segment being analyzed) at the wye, junction, inlet, or manhole.
Column (36)	Upstream junction type (ex. Inlet, 60° Wye, 30° Bend, Jct. Box, ….)
Column (37)	Taken from **Table 3.8.,Velocity Head Loss Coefficients for Closed Conduits**
Column (38)	Taken from **Equations 3.23** through **3.26** depending on Junction Type
Column (39)	Upstream Hydraulic Grade Line design point of the conduit segment. Column (24) plus Column (32)
Column (40)	The top of curb elevation at which the inlet is located
Column (41)	Equal to the Column (40) minus Column (39)
Column (42)	Special design comments are entered here.

SEC. 02.03.0315 ..... STORM SEWER DESIGN – OPEN CHANNELS

(a) **General.**

(1) All channels shall be designed to have a minimum bottom width of six feet (6'), a minimum flow line slope of one 0.5%, and shall be sized for the anticipated design.

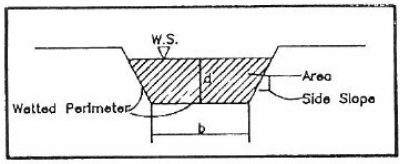
(2) Side slopes of channels shall not be steeper than one foot (1') rise to four feet (4') horizontal distance. Where slopes are steeper than four to one (4 to 1), the slopes shall be lined for slope protection with concrete, gabions, or another approved method.

(3) In unlined open channels, the side slopes and channel slopes shall be such that erosion is controlled and the channel is stable. Channels discharging into water courses shall have the same invert level as the water course.

(4) Open channel modeling and design should be done using HEC-RAS when the flow is greater than fifty cubic feet per second (50 cfs) or there are existing or proposed crossings of the channel.

(5) When flow is less than fifty cubic feet per second (50 cfs) and there are no existing or proposed crossings, calculation may be performed manually using **Form 3.4 Open Drainage Channel Calculations Table**. The instructions for **Form 3.4**: **Open Drainage Channel Calculations Table**, have been included in this section to facilitate the hydraulic design of an open channel.

Form 3.4: Open Drainage Channel Calculations Table



OPEN CHANNEL CALCULATIONS

PROJECT NAME ____________________ BY ____________

LINE NAME ____________________ DATE ____________

CHANNEL STATION		Channel Type	Flow "Q" (c.f.s.)	Roughness Coeff. "n"	Slope "S" (ft./ft.)	"$S^{1/2}$"	$\frac{Q \times n}{1.486 \times S^{1/2}}$	Width "b" (feet)	Depth "d" (feet)	Side Slope	Area "A" (sq.ft.)	Wetted Perimeter "WP" (feet)	Hydraulic Radius "$R = \frac{A}{WP}$"	$R^{2/3}$	$AxR^{2/3}$	Velocity $V = \frac{Q}{A}$	Velocity Head $\frac{V^2}{2g}$ (ft.)	REMARKS
From	To																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Instructions for Form 3.4 Open Drainage Channel Calculations

Column (1)	Downstream limit of the section of channel under consideration.
Column (2)	Upstream limit of the section of channel under consideration.
Column (3)	Type of channel as shown shall be either Type I natural unimproved channel, Type II unlined with maintenance section, (concrete pilot channel) or Type III, concrete lined channel.
Column (4)	Flow in the section of channel under consideration.
Column (5)	Roughness coefficient of the channel cross-section taken from **TABLE 3.11 Roughness Coefficients for Open Channels and Maximum Velocity**.
Column (6)	Slope of the channel which is most often parallel to slope of the hydraulic gradient.
Column (7)	Square root of Column (6).
Column (8)	Calculation is made using the values in Columns (4), (5) and (7).
Column (9)	Assumed width of the bottom width of the channel.
Column (10)	Assumed depth of flow.
Column (11)	Assumed slope of the sides of the channel.
Column (12)	Area of flow which is calculated based on Columns (9), (10) and (11).
Column (13)	Wetter perimeter calculated from Columns (9), (10) and (11).
Column (14)	Value is calculated from Columns (12) and (13).
Column (15)	Column (14) raised to 2/3 power.
Column (16)	Product of Column (13) times Column (15).
When the value of Column (16) equals the value of Column (8) the channel has been adequately sized. When the value of Column (16) exceeds the value of Column (8) by more than five percent, the channel width or depth should be decreased, and another trial section analyzed.	
Column (17)	Calculation is based on the values of Columns (4) and (12)
Column (18)	Calculation is based on Column (17)
Column (19)	Remarks concerning the channel section analyzed may be entered.

Table 3.11: Roughness Coefficients for Open Channels and Maximum Velocity

Channel Description	Manning's n	Max. Permissible Channel Velocity (ft/s)
Fairly Regular Section		
1. Some grass and weeks, little or no brush	0.030	6
2. Dense growth of weeds, depth of flow materially greater than week height	0.035	6
3. Some weeds, light brush on banks	0.035	6
4. Some weeds, heavy brush on banks	0.050	6
5. Some weeds, dense willows on banks	0.060	6
For trees within channels with branches submerged at high stage, increase above values by	0.010	6
Irregular section with pools, slight channel meander, increase above values by	0.010	6
Floodplain - Pasture		6
1. Short grass	0.030	6
2. Tall grass	0.035	6
Floodplain - Cultivated Areas		6
1. No crop	0.030	6
2. Mature row crops	0.035	6
3. Mature field crops	0.040	6
Floodplain - Uncleared		6
1. Heavy weeds/scattered brush	0.050	6
2. Wooded	0.12	6
MAJOR NATURAL STREAMS		
Roughness coefficient is usually less than for minor streams of similar description on account of less effective resistance offered by irregular banks or vegetation on banks. Values of "n" for larger streams of mostly regular sections, with no boulders or brush.	Range from 0.280 to 0.060	6
UNLINED VEGETATED CHANNELS		
Clays (Bermuda Grass)	0.035	6
Sandy and Silty Soils (Bermuda Grass)	0.035	5
UNLINED NON-VEGETATED CHANNELS		
Sandy Soils	0.030	2.50
Silts	0.030	1.50
Sandy Silts	0.030	3
Clays (Bermuda Grass)	0.030	5
Coarse Gravels	0.030	6
Shale	0.030	10

Table 3.11: Roughness Coefficients for Open Channels and Maximum Velocity

Channel Description	Manning's n	Max. Permissible Channel Velocity (ft/s)
Rock	0.025	15
LINED CHANNELS		
Grass Lined	0.035	6
Concrete Lined	0.015	15
Rock Riprap	0.040	12
Grouted Riprap	0.028	15

SEC.02.03.0316 ..... CULVERT DESIGN

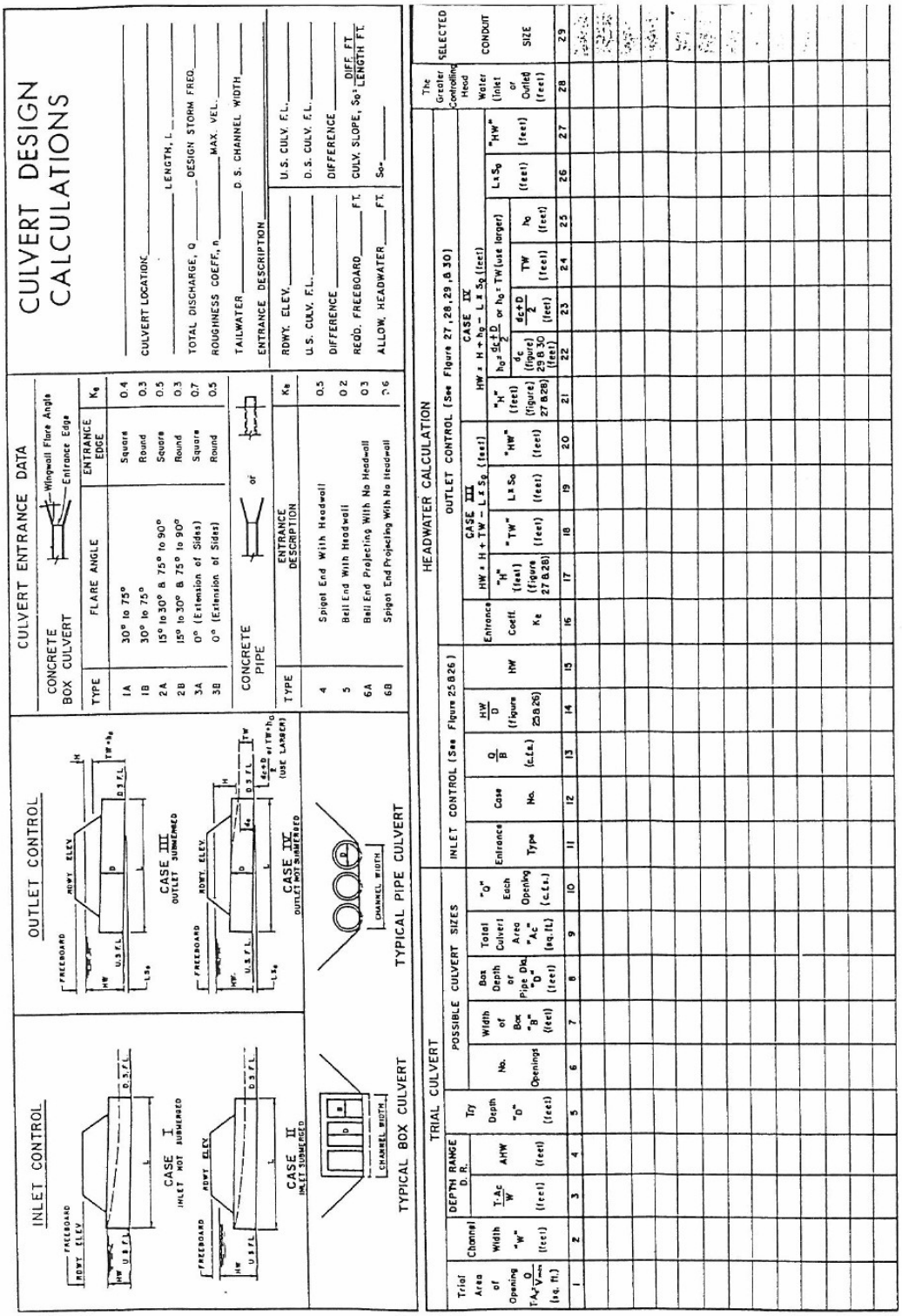
(a) General.

(1) The design of culverts shall be sized to convey the discharge of the design flood frequency of one-hundred-year (100-yr) fully-developed watershed. The hydraulic calculations shall be entered into Form 3.5 Culvert Design Calculations, which is further described herein. If computer modeling software is used in culvert design such as HY-8, HEC-RAS, etc. all input and output parameters shall be included in the plans, or in a certified report referenced in the plans.

(2) Where a parallel culvert is to be placed in a roadside ditch under a driveway or roadway, the culvert headwalls shall start at the end of the curb return and extend beyond the return.

(3) The instructions for **FORM 3.5**: **Culvert Design Calculations Table** have been included in this section to facilitate the hydraulic design of a culvert.

Form 3.5 Culvert Design Calculations Table



FORM 3.5: INSTRUCTION FOR INFORMATION IN THE UPPER RIGHT-HAND CORNER OF FORM

Culvert Location	This is a word description of the physical location.
Length	**The actual length of the culvert**
Total Discharge, Q	This is the flow computed on **Form 3.1: Drainage Calculations Table (Design Storm Frequency – 100-year storm)**
Roughness Coefficient	n-value = 0.013
Maximum Discharge Velocity	Obtained from **Table 3.12: Culvert Discharge Velocities**
Tailwater	This is the design depth of water in the downstream channel and is obtained in connection with the channel design performed on **Form 3.4**.:**Open Drainage Channel Calculations Table**
D.S. Channel Width	This is the bottom width of the downstream channel. The culvert should be sized to approximate this width whenever possible.
Entrance Description	This is a listing of the actual condition as shown in the "Culvert Entrance Data" shown on the calculation sheet.
Roadway Elevation	The elevation of the top of curb at the upstream end of culvert.
U.S. Culvert F.L.	The flow line of the culvert at the upstream end.
Difference	The difference in elevations of the roadway and the upstream flow line.
Required Freeboard	The vertical distance required for safety between the upstream design water surface and the roadway elevation or such other requirements, which may occur because of particular physical conditions.
Allowable Headwater	This is obtained by subtracting the freeboard from the difference shown immediately above.
D.S. Culvert F.L	The flow line elevation of the downstream end of the culvert
Culver Slope, S	This is the physical slope of the structure calculated as indicated.

Table 3.12: Culvert Discharge Velocities

Culvert Discharges On	Maximum Allowable Velocity (f.p.s.)
Earth (Sandy)	6
Earth (Clay)	6
Sodded Earth	6
Concrete	15
Shale	10
Rock	15

INSTRUCTIONS FOR FORM 3.5: CULVERT DESIGN CALCULATIONS

Columns 1 through 10 deal with selection of trial culvert size and are explained as follows:	
Column 1	Total design discharge, Q, passing through the culvert divided by the allowable maximum velocity gives trial total area of culvert opening.
Column 2	Culvert width should be reasonably close to the channel bottom width, W, downstream of the culvert.
Column 3	Lower range for choosing culvert depth is trial area of culvert opening, Column 1 divided by channel width, Column 2.
Column 4	Allowable headwater obtained from upper right of sheet.
Column 5	Trial depth, D, of culvert corresponding to available standard sized and between the numerical values of Columns 3 and 4.
Columns 6, 7 and 8 are solved simultaneously based on providing a total area equivalent to the trial area of opening in Column 1.	
Column 6	Number of culvert openings.
Column 7	Inside width of one opening.
Column 8	Inside depth of one opening if culvert is box structure or diameter if culvert is pipe.
Column 9	Column 6 multiplied by Column 7 and Column 8.
Column 10	Total discharge divided by number of openings shown in Column 6.
Columns 11 through 15 (Inlet Control) and 16 through 27 (Outlet Control) deal with headwater calculations which verify hydraulics of trial culvert selected and are explained as follows.	
Column 11	Obtained from upper right of sheet.
Column 12	When the allowable headwater is equal to or less than the value in Column 8, enter Case I. When the allowable headwater is more than the value in Column 8, enter Case II.
Column 13	Column 10 divided by Column 7.
Column 14	Obtained from **FIGURE 3.6** for box culverts or **FIGURE 3.7** for pipe culverts.
Column 15	Column 14 multiplied by Column 8.
Column 16	Obtained from upper part of sheet.
Column 17	Obtained from **FIGURE 3.8** for box culverts and **FIGURE 3.9** for pipe culverts.
Column 18	Tailwater depth from upper right of sheet.
Column 19	Culvert slope, S, multiplied by culvert length, both obtained from upper right of sheet.
Column 20	Sum of Columns 17 and 18, minus Column 19.
Column 21	Obtained from **FIGURE 3.8** for box culverts and **FIGURE 3.9** for pipe culverts.
Column 22	Critical depth obtained from **FIGURE 3.10** for box culverts and **FIGURE 3.11** for pipe culverts.
Column 23	Sum of Columns 22 and 8 divided by 2.
Column 24	Tailwater depth from upper right of sheet.
Column 25	Enter the larger of the two values shown in Column 23 or Column 24.
Column 26	Previously calculated in Column 19 and may be transposed.

INSTRUCTIONS FOR FORM 3.5: CULVERT DESIGN CALCULATIONS

Column 27	The sum of Columns 21 and 25 minus Column 26.
Column 28	Enter the larger of the values from either Column 15, Column 20, or Column 27. This determines the controlling hydraulic conditions of the particular size culvert investigated.
Column 29	When the Engineer is satisfied with the hydraulic investigations of various culverts and has determined which would be the most economical selection; the description should be entered.

Figure 3.6 Headwater Depth for Concrete Box Culvert with Inlet Control

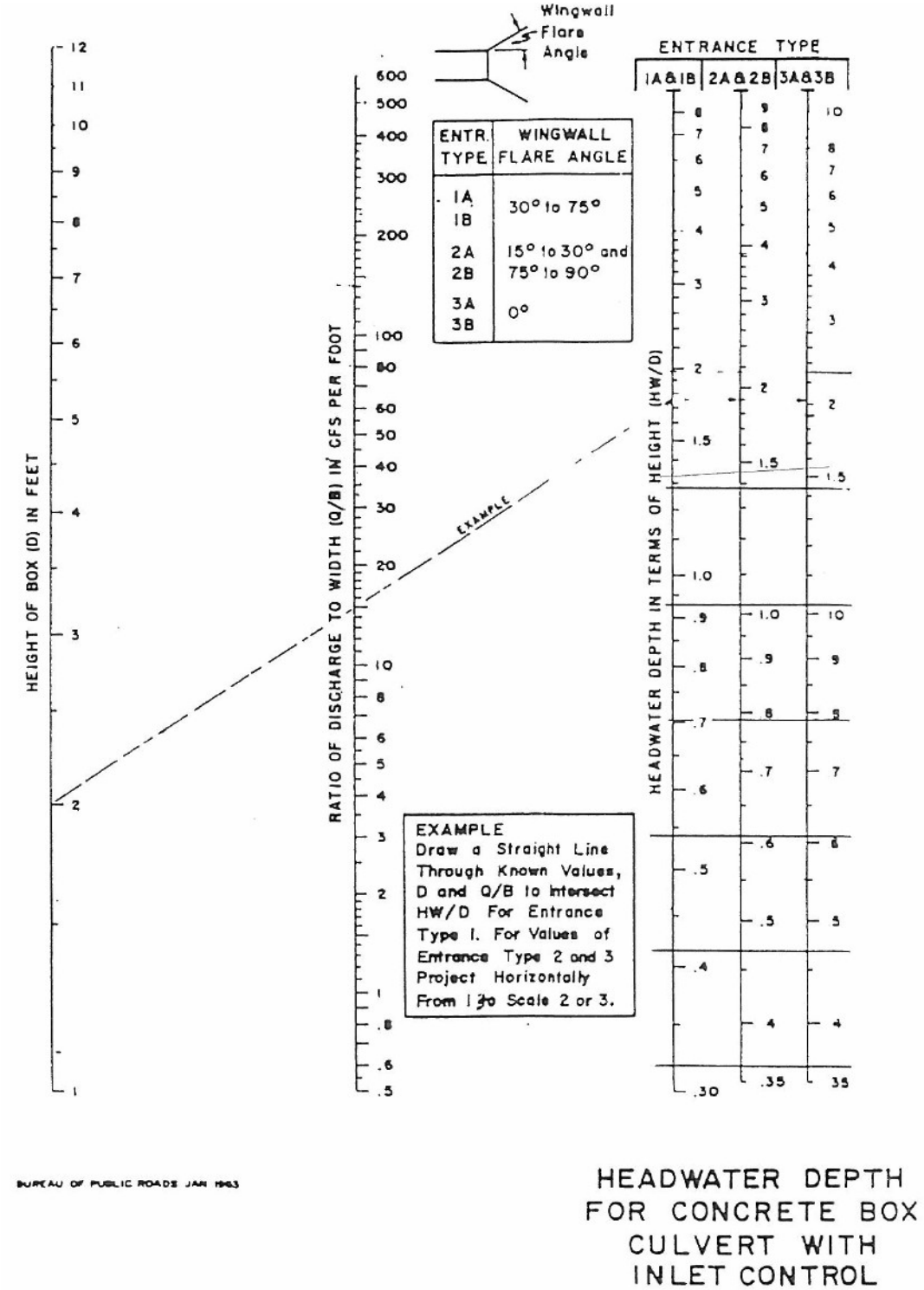


Figure 3.7: Headwater Depth for Concrete Pipe Culvert with Inlet Control

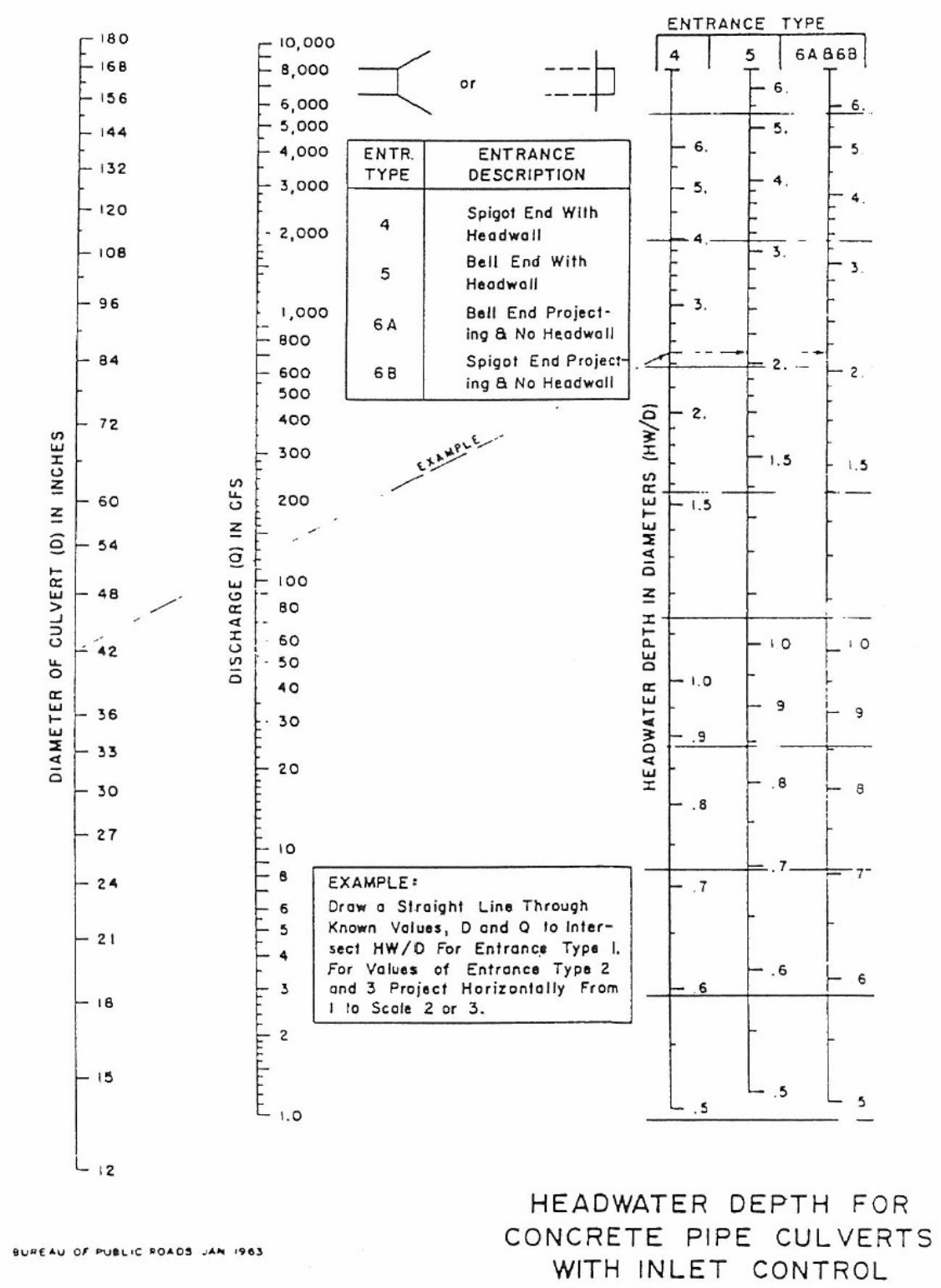


Figure 3.8: Head for Concrete Box Culvert Flowing Full

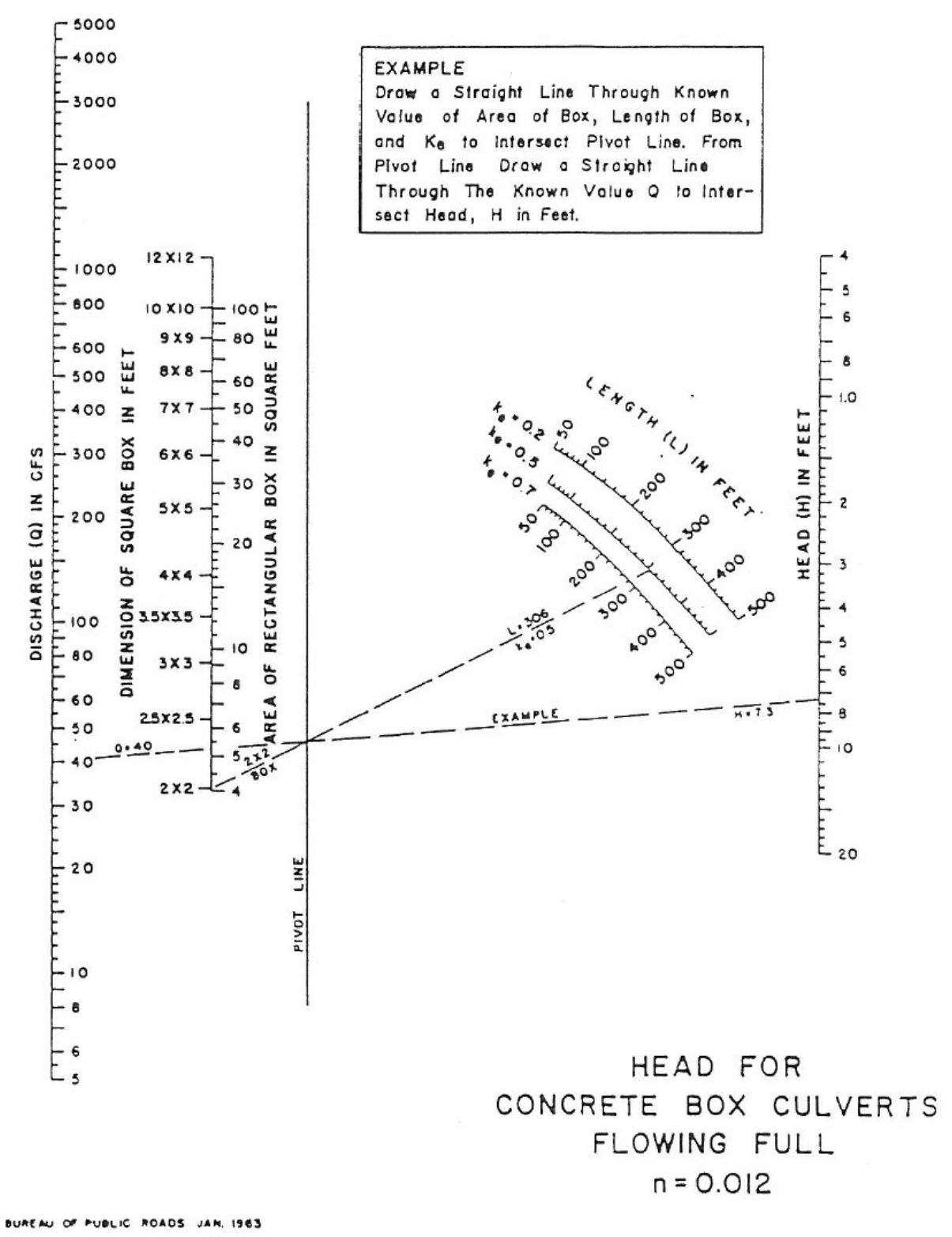


Figure 3.9: Head for Concrete Pipe culverts Flowing Full

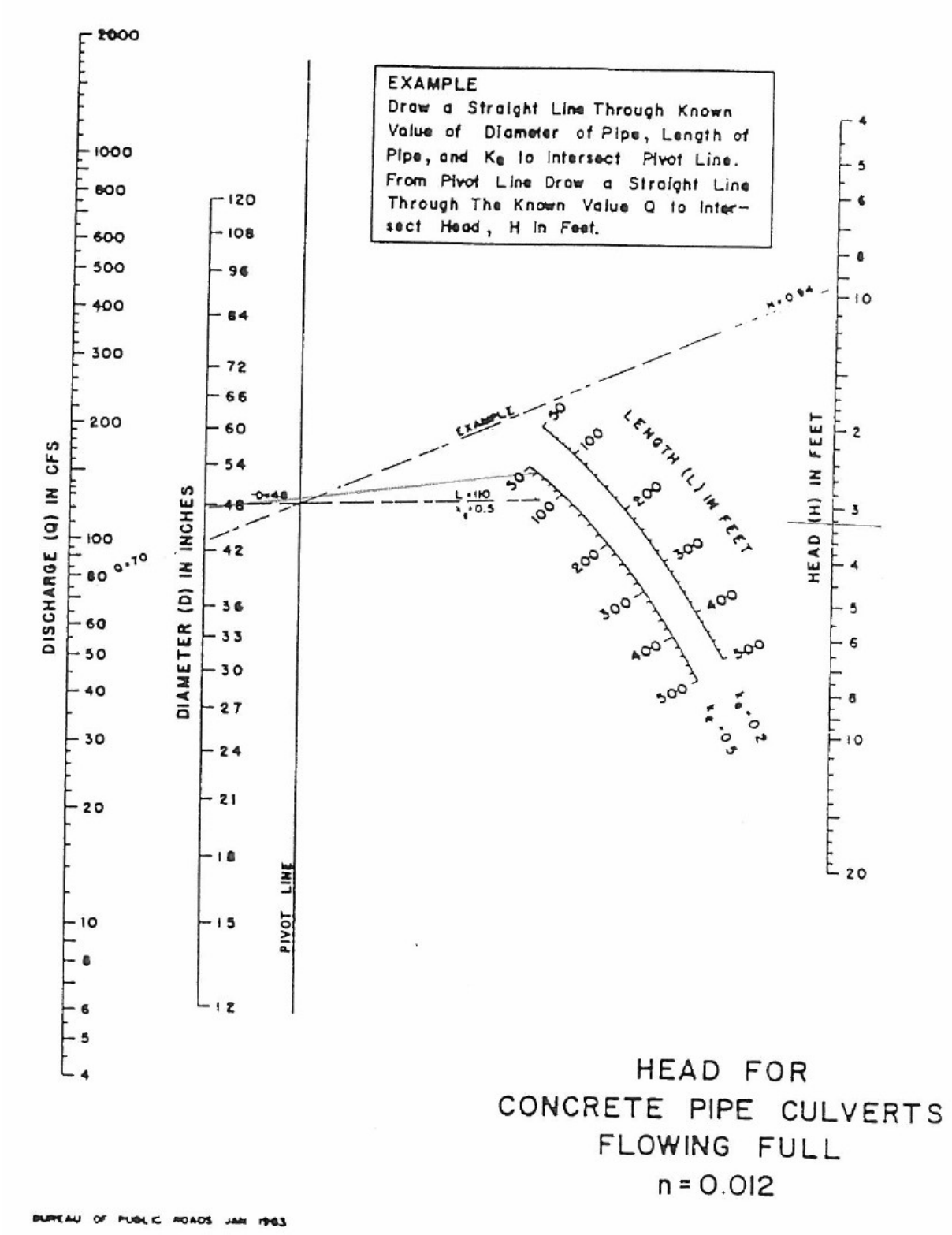


Figure 3.10: Critical Depth of Flow for Rectangular Conduits

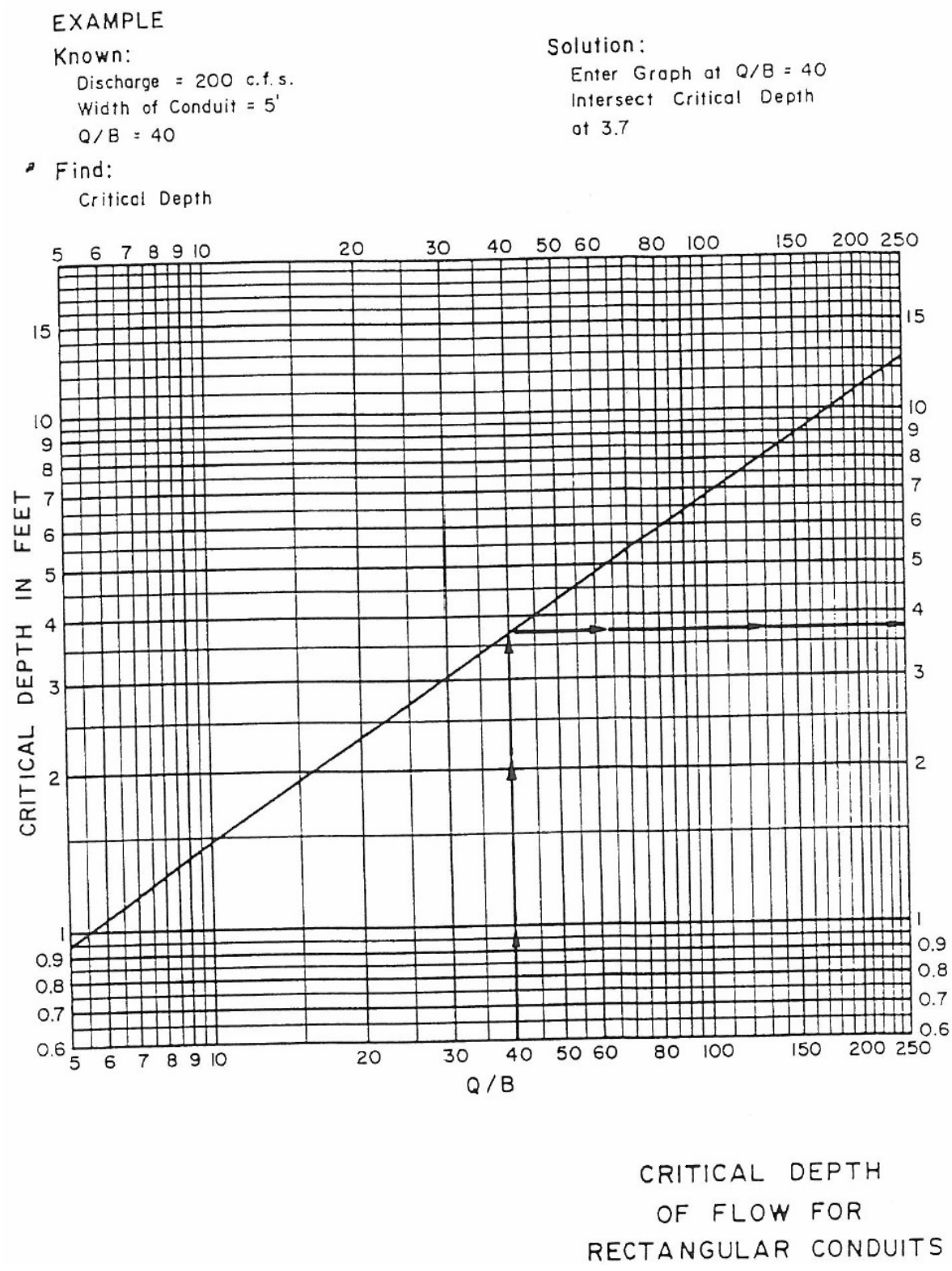
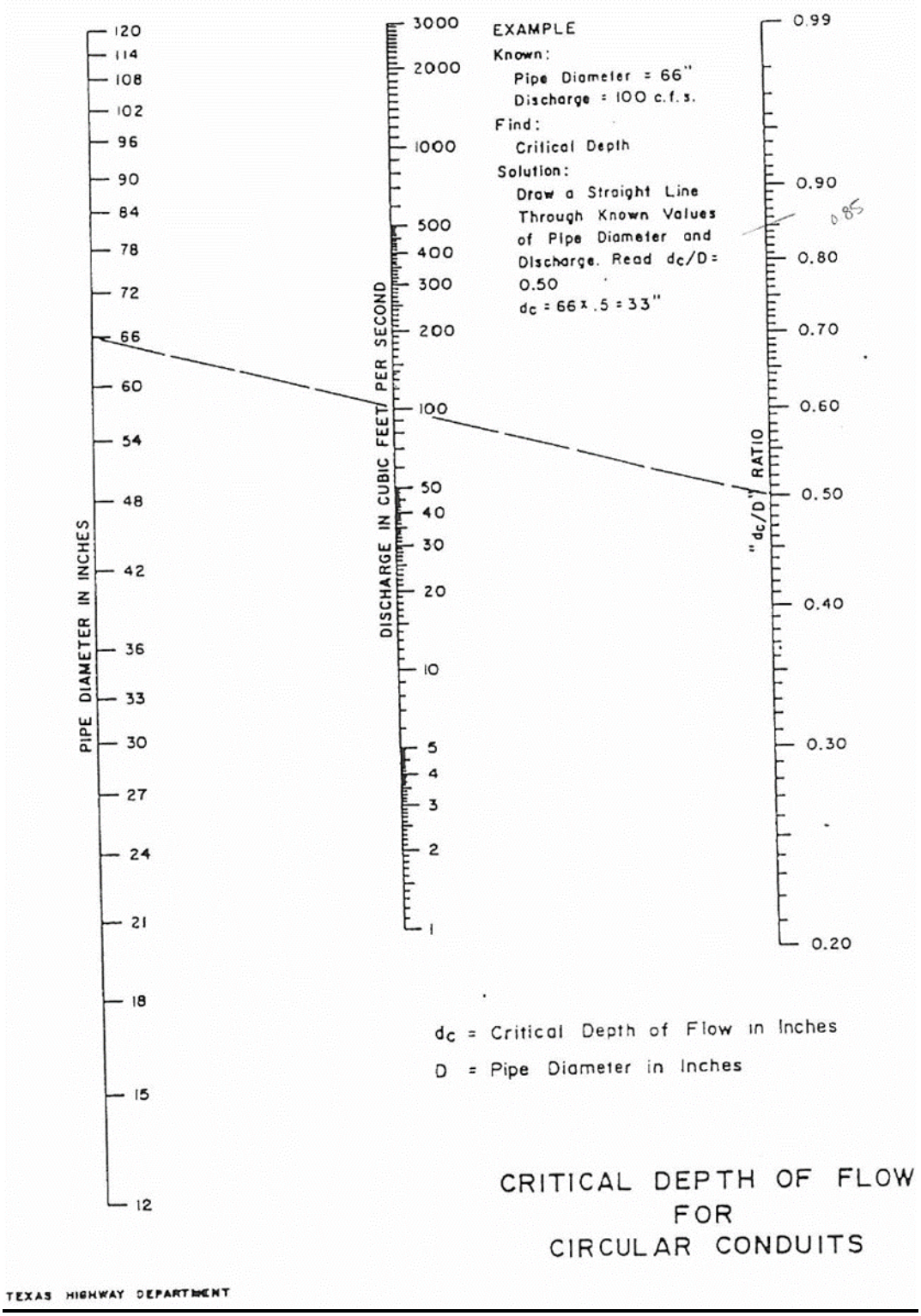


Figure 3.11: Critical Depth of Flow for Circular Conduits



SEC. 02.03.0317 ..... BRIDGE DESIGN

(a) A scour analysis shall be performed and submitted in or with the design plans.

(b) A flood study report shall be prepared by the Developer and provided to the Director of Public Works and/or the City Engineer, documenting the methodology, assumptions, derivation of all data used, and results of the study.

(c) The one-hundred-year (100-yr) projected fully developed water surface elevation shall not be increased upstream or downstream of the bridge.

SEC. 02.03.0318 ..... EROSION HAZARD SETBACKS

(a) **Definition and Purpose.**

(1) Erosion hazard setbacks shall be determined for every stream and creek (flowing or not) in which natural channels are to be preserved. The purpose of this setback is to reduce the potential for any damage to a private lot, building, utilities, or street right-of-way caused by the natural erosion of the creek bank and to minimize the expenditure of public funds for stream bank stabilization projects.

i. The Erosion Hazard Setback shall be included within the associated drainage Easement.

ii. The Erosion Hazard Setback shall be maintained by the property owner.

iii. The Erosion Hazard Setback and drainage Easement may not be located on a single-family residential lot in a new subdivision.

(b) **Setback Determination.**

(1) The Erosion Hazard Setback shall be determined by the following steps:

i. Located the toe of the natural stream bank. The toe may be located outside of the low flow channel;

ii. Project at a 4(H): 1(V) line sloping away from the center of the creek/stream until it intersects natural ground or the new proposed elevation, whichever results in the greater setback;

iii. From this intersection point continue an additional fifteen-feet (15') horizontally away from bank. This shall set the limit of the Erosion Hazard Setback;

iv. In certain scenarios, the calculated Erosion Hazard Setback is within the one-hundred-year (100-yr) fully developed floodplain. In these scenarios the one-hundred-year (100-yr) fully developed floodplain access area shall govern for setting the drainage/floodplain Easement;

v. The typical Erosion Hazard Setback established by the steps above is shown below in **Figure 3.12**.

(2) Proof of determination of the above shall be included in the Construction Plan Set. It shall include the following:

i. Locating and labeling of the toe of the natural stream bank. If trapezoidal in nature both toes shall be identified;

ii. Existing one-foot (1') topographic contours of the entire site;

iii. Projected hypothetical one-foot (1') contours representing the 4(H): 1 (V) line sloping away from the center of the creek/stream until it intersects natural ground or the new proposed elevation;

iv. Show and label hypothetical projected intersecting point/top of four to one ratio (4:1) slope line;

v. Show and label Erosion Hazard Setback (fifteen-foot (15') offset away from bank of intersecting point/top of four to one ratio (4:1) slope line;

vi. Show and label the one-hundred-year (100-yr) developed floodplain;

vii. Show and label fifteen-foot (15') offset from one-hundred-year (100-yr) fully developed floodplain to establish the floodplain access area;

viii. Show and label the require Drainage/Floodplain Easement. The easement will be the greater of the fifteen-foot (15') floodplain access area. Easement is a minimum fifteen-feet (15') on both sides of the floodplain or Erosion Hazard setback. A wider Easement may be required by the Director of Public Works and/or the City Engineer.

(c) **Non- Permitted Structures.**

(1) The following structures are not allowed within the Erosion Hazard Setbacks: building, wall, parking lot, driveway, fences, decks, swimming pools, signage, monumentation, detention structures/ponds or other structures.

(2) Water and wastewater lines shall be placed in an area with at least a four to one (4:1) slope line. The pipes shall be concrete encased when there is less than four foot (4') of cover.

(d) **Modifications**.

(1) Any Minor Modifications to the Erosion Hazard Setback will require the following items and approval by the Director of Public Works and/or the City Engineer:

i. A stream geomorphological stability analysis prepared by a qualified geomorphologist. The City reserves the right to verify the geomorphologist qualifications.

ii. Structural plans, calculations, and report of any permanent stream bank stabilization measures signed and sealed by a licensed professional structural engineer within the State of Texas.

iii. Grading permit.

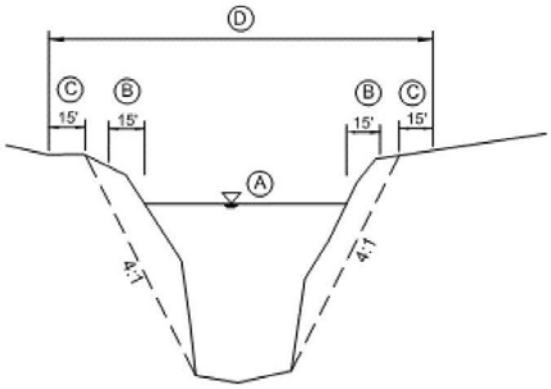
iv. Adequate access to maintain the stream bank stabilization measures indefinitely.

(2) Any Major Modification to the Erosion Hazard Setback will require an exception approved by the City Council in accordance with the procedures outlined in the Subdivision Regulations Section 02.03.086, Modifications, Appeals and Exceptions.

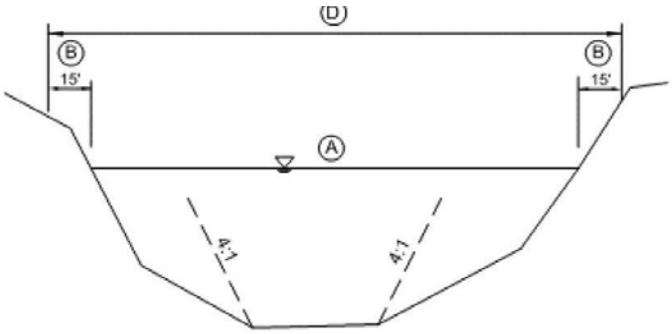
Figure 3.12: Erosion Hazard Setback and Drainage Easements

NATURAL CREEKS/CHANNELS: SETBACKS AND EASEMENTS

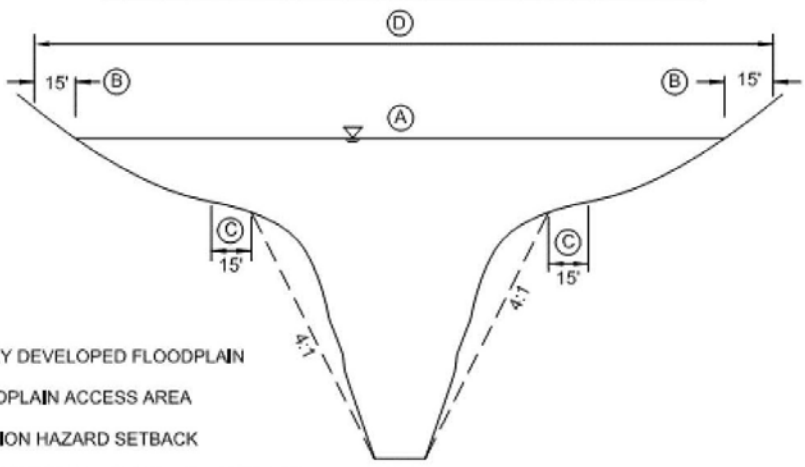
SCENARIO 1: (Floodplain within Erosion Hazard Setback)



SCENARIO 2: (Erosion Hazard Setback within Floodplain)



SCENARIO 3: (Erosion Hazard Setback within Floodplain)



NOTES:

Ⓐ 100 YEAR FULLY DEVELOPED FLOODPLAIN

Ⓑ 15 FOOT FLOODPLAIN ACCESS AREA

Ⓒ 15 FOOT EROSION HAZARD SETBACK

Ⓓ EXTENTS OF DRAINAGE/FLOODPLAIN EASEMENT

SEC. 02.03.0319 ..... MINIMUM FREEBOARD REQUIREMENTS

(a) To help prevent flood damages and protect public safety, all design elevation requirements related to water surface elevations and flood elevations shall be based, at a minimum, on the 100-year flood, fully-developed watershed conditions. The difference between a minimum design elevation above the one-hundred-year (100-yr) flood is commonly referred to as minimum freeboard.

(1) **Table 3.13 Minimum Free Board Requirements** provides a summary of absolute minimum freeboard requirements for design and construction in the City of Kaufman. However, prudent engineering in setting design elevations should be incorporated into any design. In some situations, a greater freeboard than those listed in **Table 3.13 Minimum Free Board Requirements** may be required by the City, at the discretion of the Director of Public Works and/or the City Engineer, or as required by State and Federal regulations and guidelines, depending on flood hazard potential in relation to property damages and public safety. The City's minimum freeboard requirements are not intended to take precedence over State and Federal regulations (except when the City's requirements exceed those set by State and Federal regulations).

(2) The minimum elevations of all flood protection levees and all dams must meet requirements of all State and Federal regulations and guidelines. If the minimum floor elevation based on floodplain is less than that based on roadway gutter elevation, the higher elevation of the frontage portion of the roadway shall be the minimum elevation.

Table 3.13: Minimum Freeboard Requirements

Description	Minimum Freeboard above 100-year Flood Elevation (ft)*
Minimum Floor Elevations (including basements and sunken floor areas):	
Residential	2.0
Non-Residential (unless flood proofed; see flood damage prevention ordinance	2.0
Building Pad Elevations for Structures (at lowest adjacent structure grade)	1.0
Dams (freeboard above effective crest elevation of dam, after allowing for settlement and consolidation of embankment):	
Less than or equal to 5-ft maximum height	1.0
More than 5-ft maximum height (must meet State and Federal Requirements)	2.0
Dams with entire embankment having overflow protection (such as concrete)	1.0
Detention and Retention Ponds (freeboard along all shoreline areas around the pond):	
When detention berms are classified as dams.:	
With Dams less than or equal to 5-ft maximum height	1.0
With Dams more than 5-ft maximum height	2.0
Incised Ponds (no dam)	1.0
When detention berms are not classified as dams:	

Table 3.13: Minimum Freeboard Requirements

Description	Minimum Freeboard above 100-year Flood Elevation (ft)*
Up to and including 5 acres	1.0
Greater than 5 acres	2.0
Flood Protection Levees, Dikes, or Walls (Director of Public Works and/or City Engineer Approval Required):	
Significant or High Hazard Flood Damage or Public Safety Potential	3.0
Low Hazard Flood Damage Potential or Public Safety Potential	2.0
Others	
Public Roadways, Alleys, and Parking Lots (as measured from edge of pavement/top of curb)	1.0
Channels	1.0
Bridges (as measured from lowest point of low chord)	1.0
Culverts (as measured from edge of pavement/top of curb)	1.0
Sanitary Sewer and Water Manhole Covers	2.0

SEC. 02.031.0320 ..... DETENTION

(a) **Intent**. It is the City's intent to utilize detention (or detention/retention) of storm water runoff as a solution towards control of potential flood hazards created by storm water runoff including; reduction in the impact on downstream storm water drainage facilities; prevention of erosive conditions in water drainage ways; protection against downstream and adjacent property damage; and preservation of existing floodplains along major creeks. Detention basins may also improve water quality by allowing some sediment to settle out.

(b) **Where Detention is Required**.

(1) Generally, non-residential development shall construct detention facilities. In some cases, detention may increase water surface elevations depending on its placement in the watershed and timing of discharges. When detention facilities are proposed adjacent to creeks and channels, a timing study will be required to determine impacts of the site on the adjacent creek or channel. If it can be shown that there will be no adverse impacts to surrounding properties or downstream, then detention may not be required.

(2) Residential developments shall construct detention facilities if it is determined that the downstream system does not have adequate hydraulic capacity for the developed flow. In addition a downstream assessment must be performed to show no adverse impacts.

(c) **Type of Detention Facilities**. The following detention facilities are to be utilized for detention.

(1) Site of Greater than One (1) Acre, On-Site.

i. ....Underground

ii. ....Detention Basin

a. Side slopes four to one ratio (4 to 1), or less (no fencing allowed).

b. Area to be landscaped.

c. Retaining walls not allowed within detention pond.

d. Maintained by Developer.

e. Additional amenities preferred

f. Ownership stays with property owner.

g. Dams over five-foot (5') to be approved by State. Dam must meet State dam safety guidelines.

(2) Greater Than One-Half (1/2) Acres, Off-Site Shared.

i. Detention Basis Shared with Other Developments

a. May expand existing pond.

b. No increase in one-hundred-year (100-yr) flood plain elevation.

c. Capacity expanded above existing water surface.

d. Required engineering study.

ii. Flow to Regional Detention Basin

a. Regional Facility Manager (owner of facility) must approve improvements.

b. Developer(s) funds improvements to regional basin.

c. Developer(s) improves stormwater conveyance system to basin (based on fully-developed one-hundred-year (100-yr) flow).

d. Dams over five-feet (5') to be approved by State. Dam must meet State dam safety guidelines.

e. Dam cannot be over fifteen-feet (15') tall.

f. Basins with water retention to have stored water depth of at least four-feet (4').

g. Need landscaping and amenity features as described in the Subdivision Regulations (Approved by Development Services Department).

h. Facility Manager to assure good, retained water quality (a post construction maintenance agreement may be used).

i. Trash collectors required at outfall structures.

j. Side Slopes to be four to one ratio (4 to 1) or less.

k. Developer/Owner owns and maintains basin.

l. Facility Manager to develop and perform maintenance program.

m. Inflow Facilities

1. Underground (preferred),
2. Natural open channel (existing creek with one-hundred-year (100-yr) developed capacity),
3. Developer(s) to obtain addition drainage easement for one-hundred-year (100-yr) developed flow area, no concrete or gabion sidewalls.

n. Possible Pro-rata from other developments that utilize basin.

iii. Existing Ponds. Developer(s) improve existing undesirable detention facilities.

a. Remove fencing where possible.

b. Provide concrete pilot channel in bottom.

c. Provide landscaping.

d. Improve maintenance access.

e. Reconstruct with underground system.

(d) Remove pond by conveying stormwater flow to shared detention facility without adverse impacts to other properties.

(e) **Geometry, Restrictions and Appurtenances**.

(1) Detention ponds shall have a side slope four to one ratio (4:1) or flatter. No retaining walls are allowed in detention ponds.

(2) The detention pond bottom grade shall be at a minimum of one-percent (1%) slope. A four-inch (4") thick concrete low flow pilot channel shall be installed from the pond's inlet structure/structures to the outfall structure.

(3) All detention ponds and reserved shoreline shall have the appropriate amount of freeboard as called out in **Table 3.13** – **Minimum Freeboard Requirements** from the one-hundred-year (100-yr) water surface, based on flood inflows determined assuming fully-developed watershed conditions (without consideration of any future upstream detention), including incised ponds (without embankment/dams), or a higher design criteria if required by the State.

(4) The State of Texas has jurisdiction of all dams, regardless of dam height or impoundment storage size, if they are classified by State regulations and guidelines with hazard classifications as "high – or significant-hazard". [Reference: TEXAS ADMINISTRATIVE CODE, Title 30, Part 1, Chapter 299, Subchapter A, (a)(3)].

i. Dams with maximum height of over five feet (5') must be approved by the State, unless the dam maximum height is less than fifteen feet (15') and a registered professional engineer licensed in Texas adequately shows, with an engineering study using the State of Texas Dam Safety guidelines and regulations, that a sudden breach of the dam during a major flood event, as specified and determined by the State's procedures, would not cause any significant increase in flooding or significant increase in flood damages as compared to a non-breach of the dam during a non-breach flood event.

ii. For dams permanently impounding water, the study should also determine the extent of additional flooding that would be caused by a sudden breach of the dam during non-flooding events. If the breach of the dam can be proven to not cause any significant flood damages (other than to the dam embankment), then it can be proven to be classified as a "low-hazard" dam by State definition, and the dam may be exempt, at the Director of Public Works and/or the City Engineer's discretion, from requiring State review and approval.

1. However, regardless of whether the dam design is reviewed by the State, all dams, regardless of size, must have an emergency spillway and be designed, constructed, maintained, and operated per State Dam Safety Guidelines, including emergency action management. The maximum height of the dam, hazard classifications, and "significant" increased flooding (as related to embankment breach analyses) are determined based on the State's definitions and regulations.

(5) No detention is allowed in the Federal Emergency Management Agency (FEMA) one-hundred-year (100-yr) and local one-hundred-year (100-yr) fully developed floodplain.

(6) No franchise utilities (Gas, Electric, Cable, Telephone, Communications, etc.), water lines and wastewater lines (except storm systems) are allowed in detention ponds, and detention easements.

(7) Underground detention systems must be a fully enclosed pipe system or other system approved by the Director of Public Works and/or the City Engineer.

(8) The detention pond shall have an emergency overflow in case the main outfall structure gets clogged. The emergency overflow shall be sized to pass the fully-developed one-hundred-year (100-yr) flood at a minimum, or greater based on State Dam Safety requirements. City-approved erosion protection shall be placed along the length of the emergency overflow to the flowline of the receiving structure, creek, or channel, and extended as necessary to prevent erosion of the dam structure.

(9) The detention systems are to be installed and verified for design compliance along with the associated storm sewer and outfall structures and drainage channels, prior to any paving operations. All constructed detention ponds, drainage ways, and open channels shall have the sides and bottom stabilized with sod or anchored seeded matting prior to any paving construction (including building slab). The matting or sod shall be anchored at high velocity locations if deemed necessary. Erosion protection is to be placed at the pond's outflow structure along with any associated erosion best management practices noted on the erosion control plan.

(10) Sometimes a detention facility will be utilized by several developments, and then a pro-rata agreement/detention masterplan may be entered into with the development constructing the facility and the other developments utilizing the facility. Without a pro-rata agreement/detention master plan of all parties in advance of construction of all combined developments, no new proposed development will be allowed to take credit for any "over detention" of a previous development or the reduction of discharges from a previous development within the watershed in the determination of detention requirements.

(11) Detention pond outfall structures shall be fitted with a trash rack to confine floatable and other trash within the detention pond.

(12) Detention ponds shall be designed to be fully emptied within twenty-four (24) hours.

(13) Detention ponds shall be designed, graded, and maintained so that standing water does not remain after the designed discharge timeframe.

(14) Detention ponds shall be irrigated.

(15) Detention ponds for new single-family residential subdivisions shall be located within a Homeowner's Association (HOA) maintained lot. Detention ponds and associated easements may not be located on a non-HOA lot. Non-single family residential development's detention system shall be maintained/repaired by property owner and/or a Property Owner's Association (POA).

(f) **Detention Calculations**. The detention design calculations and outfall rating curves shall be included in the plans and flood study. Increased peak discharges from the detention basin are not allowed for the two (2) year, five (5) year, ten (10) year, twenty-five (25) year and one hundred (100) year frequency floods based on existing off-site conditions.

(1) Methodology. Detention facilities that have a drainage area of less than twenty (20) acres may be sized using the Modified Rational Method. If the drainage area is equal to or greater than twenty (20) acres a Unit Hydrograph Method shall be used. The Modified Rational method may be used for preliminary sizing for drainage areas more than twenty (20) acres, but the Unit Hydrograph Method must be used for the design of all detention facilities serving more than twenty (20) acres. The following conditions shall be used when implementing the Modified Rational Method:

i. . The proposed development will construct detention facilities to detain the increase in runoff between the existing one-hundred-year (100-yr) flows. The "C" value is based on zoning, not pervious/impervious areas. Large area of dedicated open space dedicated to City can be considered by City in this value.

ii. . The storm rainfall intensity (in/hr.) for different storm years is found in **Table 3.5** AMS-Based Precipitation Frequency Estimates for Kaufman County.

iii. . The following is an example calculation on how the Modified Rational Method is performed to determine the required detention volume.

EXAMPLE OF MODIFIED RATIONAL METHOD DETENTION BASIN DESIGN

Given: A ten (10) acre site, currently agricultural use, is to be developed for townhouses. The entire area is the drainage area of the proposed detention basin.

Determine: Maximum release rate and required detention storage.

Solution:

1. Determine one hundred-year (100-yr) peak runoff rate prior to site development. This is the maximum release rate from site after development.

NOTE: Where a basin is being designed to provide detention for both its drainage area and a by-pass area; the maximum release rate is equal to the peak runoff rate prior to site development for the total of the areas minus the peak runoff rate after development for the by-pass area. This rate for the by-pass area will vary with the duration being considered.

2. Determine inflow hydrograph for storms of various durations in order to determine maximum volume required with release rate determined in Step 1.

NOTE: Incrementally increase durations by ten (10) minutes to determine maximum required volume. The duration with a peak inflow less than maximum release rate or where required storage is less than storage for the prior duration is the last increment.

PROCEDURE

STEP 1. Present Conditions (Agricultural)

Q = C*I*A
C = 0.35
T_c = 20 minutes
I_{100} = 8.3 in/hr.
Q_{100} = (0.35)(8.3)(10 acres) = 29.05 cfs (Maximum release rate)

STEP 2. Future Conditions (Townhouses)

C = 0.80
T_c = 10 minutes
I_{100} = 9.8 in/hr.
Q_{100} = (0.80)(9.8)(10 acres) = 78.40

Check various duration storms:

15 minutes	I = 9.0	Q = (0.80)(9.0)(10 acres)	= 72.0 cfs
20 minute	I = 8.3	Q = (0.80)(8.3)(10 acres)	= 66.4 cfs
30 minutes	I = 6.9	Q = (0.80)(6.9)(10 acres)	= 55.2 cfs
40 minutes	I = 5.8	Q = (0.80)(5.8)(10 acres)	= 46.4 cfs
50 minutes	I = 5.0	Q = (0.80)(5.0(10 acres)	= 40.0 cfs
60 minutes	I = 4.5	Q = (0.80)(4.5)(10 acres)	= 36.0 cfs
70 minutes	I = 4.0	Q = (0.80)(4.0)(10 acres)	= 32.0 cfs
80 minutes	I = 3.7	Q = (0.80)(3.7)(10 acres)	= 29.6 cfs
90 minutes	I = 3.5	Q = (0.80)(3.5)(10 acres)	= 28.0 cfs
100 minutes	I = 3.4	Q = (0.80)(3.4)(10 acres)	= 27.20 cfs
110 minutes	I = 3.2	Q = (0.80)(3.2)(10 acres)	= 25.6 cfs

Storage Volume required is determined by deducting the volume of runoff released during the time of inflow from the total inflow for each storage duration.

10 min. storm	Inflow = (10) (78.4 cfs)(60 sec/min) =	47,040 cf
	Outflow = (0.5)(20 min)(29.05 cfs)(60 sec/min) =	-17,430 cf
		29,610 cf
15 min. storm	Inflow = (15) (72.0 cfs)(60 sec/min) =	64,800 cf
	Outflow = (0.5)(25 min)(29.05 cfs)(60 sec/min) =	-21,788 cf
		43,012 cf
20 min. storm	Inflow = (20) (66.4 cfs)(60 sec/min) =	79,680 cf
	Outflow = (0.5)(30 min)(29.05 cfs)(60 sec/min) =	-26,145 cf
		53,535 cf
30 min. storm	Inflow = (30) (55.2 cfs)(60 sec/min) =	99,360 cf
	Outflow = (0.5)(40 min)(29.05 cfs)(60 sec/min) =	-34,860 cf
		64,500 cf
40 min. storm	Inflow = (40) (46.4 cfs)(60 sec/min) =	111,360 cf
	Outflow = (0.5)(50 min)(29.05 cfs)(60 sec/min) =	-43,575 cf
		67,785 cf
50 min. storm	Inflow = (50) (40.0 cfs)(60 sec/min) =	120,000 cf
	Outflow = (0.5)(60 min)(29.05 cfs)(60 sec/min) =	-52,290 cf
		67,710 cf
60 min. storm	Inflow = (60) (36.0 cfs)(60 sec/min) =	129,600 cf
	Outflow = (0.5)(70 min)(29.05 cfs)(60 sec/min) =	-61,005 cf
		68,595 cf
70 min. storm	Inflow = (70) (32.0 cfs)(60 sec/min) =	134,400 cf
	Outflow = (0.5)(80 min)(29.05 cfs)(60 sec/min) =	-69,720 cf
		64,680 cf
80 min. storm	Inflow = (80) (29.6 cfs)(60 sec/min) =	142,080 cf
	Outflow = (0.5)(90 min)(29.05 cfs)(60 sec/min) =	-78,435 cf
		63,645 cf
90 min. storm	Inflow = (90) (28.0 cfs)(60 sec/min) =	151,200 cf
	Outflow = (0.5)(100 min)(29.05 cfs)(60 sec/min) =	-87,150 cf
		64,050 cf
100 min. storm	Inflow = (100) (27.2 cfs)(60 sec/min) =	163,200 cf

	Outflow = (0.5)(110 min)(29.05 cfs)(60 sec/min) =	-95,865 cf
		67,335 cf
110 min. storm	Inflow = (110) (25.6 cfs)(60 sec/min) =	168,960 cf
	Outflow = (0.5)(120 min)(29.05 cfs)(60 sec/min) =	-104,680 cf
		64,380 cf

Maximum volume required is **68,595 cf** at the 60 min. storm duration.

(2) Outfall Structures.

i. Detention out fall structures shall be multi-staged and designed to detain the two-year (2-yr), five-year (5-yr), ten-year (10-yr), twenty-five-year (25-yr), and one hundred-year (100-yr) storm events without increasing the peak discharge. A chart shall be furnished by the design engineer showing the allowable flows verses the actual flows through the detention pond outflow structure for two-year (2-yr), five-year (5-yr), ten-year (10-yr), twenty-five-year (25-yr), and one hundred-year (100-yr) storm events.

ii. When the design is based on the Modified Rational Method, outfall structures shall be designed in accordance to the equations established in Hydraulic Engineering Circular No. 22, Urban Drainage Design Manual (HEC-22) and Hydraulic Engineering Circular No. 14, Hydraulic Design of Energy Dissipators for Culverts, and Channels (HEC-14). The Engineer shall include all calculations/ equations for the outfall structure in the plans, including each stage of the structure (two-year (2-yr), five-year (5-yr), ten-year (10-yr), twenty-five-year (25-yr), and one hundred-year (100-yr) storm events).

iii. When the detention pond and outfall structure is designed using a Unit Hydrograph Method (hydrology model) and a hydraulic model is being prepared (such as for a detention pond with dam located across a stream for which flood elevations will be determined), the outfall structure discharges may be determined with the hydraulic model. All flow characteristics and conditions of the outfall structure should be adequately represented in the hydraulic model or other calculations to account for orifice flow conditions, weir flow conditions, and full-pipe and partially-full pipe flow conditions for all discharge openings, pipes, and overflow areas of both the discharge structure and the dam. The resulting discharge versus pond flood elevation data should be adequately represented in the hydrology model to ensure that the flood elevations computed with the hydrology model reasonably agree with those computed by the hydraulic model for all ranges of discharges.

iv. City approved erosion protection shall be placed around the outfall structure and shall extend downstream the entire flow path length to the flowline of the receiving structure, creek, or channel. The erosion protection shall extend to two feet (2') feet above the one hundred-year (100-yr) water surface elevation.

SEC. 02.03.0321 ..... FLOODPLAIN STUDIES, RECLAMATION AND MODIFICATION

(a) All floodplain studies, reclamation, modification, flood boundary delineations and design of structures within or adjacent to creeks or streams shall meet the following guidelines set forth in this section and the most current Flood Damage Prevention Ordinance.

(b) The qualified professional engineer licensed in the State of Texas shall prepare a flood study report documenting all data, methodology, and assumptions used in the study.

(1) The study report shall be properly signed and sealed, and include a concluding statement certifying that the hydrologic and hydraulic study is based on standard engineering practice, that the project is constructed, or proposed to be constructed, as shown in certified engineering plans used in the study such that there will be no adverse increases in flooding or flood damages on other properties and that the project meets the requirements of all parts of the City's current Flood Damage Prevention Ordinance.

(c) Flood studies shall follow the general procedures set by FEMA for applying for a Letters of Map Revision (LOMR) or Condition Letters of Map Revision (CLOMR), including hydrologic and hydraulic modeling; drainage area work map; floodplain work map; annotated Flood Insurance Rate Map (FIRM); FEMA forms; and complete technical documentation of all data used in the study, including, but not limited to, calculations of times of concentrations or lag times and calculations of other runoff parameters such as NRCS curve numbers.

(1) For hydrology models, drainage areas should be determined to the nearest one hundredth (0.01) acre (fifteen million thousandths (0.000015) square miles); times of concentration and lag times should be computed to the nearest one hundredth (0.01) hour (six (6) minutes); and Natural Resources Conservation Service (NRCS) composite runoff curve numbers should be computed to the nearest one tenth (0.1) value.

(2) Other requirements are contained in Unit Hydrograph Method Section of these standards. These procedures shall be performed even for flood studies not being submitted to FEMA.

(d) Floodplains and watersheds shall be modeled using standard practice engineering models that are public domain. The use of computer modeling software that is not public domain will require approval by the Director of Public Works and/or the City Engineer. [The most recent versions of HEC-HMS and HEC-RAS are currently the City's required hydrology and hydraulic models for flood studies. The use of these models is required in cases where a conversion from older models is desired or in previously-unstudied areas where new models are to be created].

(e) All design elevations shall be based on computed flood elevations using flood discharges for one hundred-year (100-yr) projected fully-developed watershed conditions, including the effects of changes in storm water runoff and effects of encroachment caused by the proposed project.

(f) All flood study models shall utilize the most current available models from the City or FEMA as base models (if available) and shall incorporate all additional known modifications that have occurred since the last update of these models. Conversion of base models to newer approved digital models is allowed, as noted below.

(g) Results of hydrology and floodplain hydraulic computer models shall be summarized in tabular form, to show differences in computed one hundred-year (100-yr) flood discharges and flood elevations. The computer model results to be included in the comparison tables include:

(1) The original effective base hydrology and hydraulic models, if available, as provided by the City or FEMA.

(2) Improved modeling procedures may be allowed and included, such as conversion of original models to newer versions of computer modeling software, such as conversion of HEC-2 models to HEC-RAS and conversion of TR-20 or HEC-1 models to HEC-HMS. Conversion to computer software that is not free public domain software and that is not on FEMA's approved list of computer modeling software must receive approval by the Director of Public Works and/or the City Engineer. Results of conversion to improved modeling should be performed prior to any updates or corrections to the model data and compared in tabular form with the original base model results.

(3) Corrected hydrologic and hydraulic models (commonly referred to as "corrected effective" models by FEMA procedures) to include any improved data or needed corrections, such as new surveyed floodplain cross sections, inclusion of additional cross sections, or improved topographic mapping, but should not include any man-made changes to the watershed or floodplain.

(4) Pre-project hydrologic and hydraulic models, to update the computer models by adding man-made changes that have occurred in the watershed and floodplain since the date of the original effective base models. [If there are no updates based on man-made changes, then the "corrected effective" and "pre-project" models are the same].

(5) Post-project hydrologic and hydraulic models, to include all changes that are included in the pre-project models, plus hydrologic and hydraulic characteristics that are representative of changes based on the project's proposed final completed construction. The post-project hydrology should include changes in runoff conditions related to modifications of land cover and grading, changes in times of concentration or lag times, alteration of stream channels and floodplain areas (including changes in floodplain valley storage and changes in flow velocities), changes in drainage areas and drainage patterns, and any proposed mitigation to prevent increases in flood discharges. The post-project hydraulic models should include effects to floodplain hydraulic characteristics, including changes in floodplain and channel configuration, such as encroachments, excavations, channelization, proposed hydraulic structures, clearing of areas that will be continually maintained, and changes in hydrology (flood discharges). The effects of temporary clearing of vegetation in areas that will not be maintained should not be included.

(6) Hydrologic and hydraulic computer modeling must be provided for both existing watershed conditions (both pre-project and post-project conditions), with summary comparisons of various steps ("a" through "e", above) shown in tabular form, to include computed one hundred-year (100-yr) discharges and flood elevations. The results of hydrology and hydraulic post-project models will be compared with results of pre-project models to verify compliance of City Standards requiring no increased flooding on other properties. Additionally, hydrology and hydraulic models must be provided based on fully-developed watershed conditions with the proposed project. The results of the fully-developed condition models will be used to determine compliance with the City's design elevation standards. When construction of a project will be in phases, the Director of Public Works and/or the City Engineer may require flood studies to be submitted for each phase.

(h) When transferring discharges computed by the hydrology models as input data entered into the hydraulic models, round-off of discharges is allowed only to the nearest one (1) cfs. All hydrology models should be set to compute discharges to the nearest one (1) cfs and flood elevations (such as in ponds) to the nearest one hundredth (0.01) ft. All hydraulic models should be set to compute flood elevations to the nearest one hundredth (0.01) ft. Locations of flow changes in the hydraulic model should be carefully determined to avoid undue under-calculation of flood elevations. For example, in order to prevent unreasonable undercalculations of flood elevations along portions streams, discharges computed at sub-basin outlets along a stream should normally be used in the hydraulic model for a reasonable extended portion of the upstream floodplain reach, in order to avoid neglecting all of the lateral inflow within the upper stream reach in the hydraulic model computations.

(i) The completed flood study, including detailed technical documentation; printed hydraulic and hydrological model input data and output results, digital model files (as listed in "F", above, for both existing and projected future fully developed watershed conditions), supporting calculations, drainage area maps, floodplain boundary maps, and certification statement (as noted in "A.", above) and all CAD/GIS data shall be submitted to the City for review.

(j) The watershed work map(s) should include the following:

(1) Multiple watershed work maps may be submitted for pre-project and proposed project conditions, as long as all of the following items are provided.

(2) Total watershed drainage area and sub-basin drainage delineation boundaries, including those representative of the original base hydrology model, the corrected drainage delineations (if any), and proposed project changes in drainage delineations and any added sub-basins. All subareas should be labeled in agreement with sub-area labels used in the hydrology models.

(3) Topography overlaid on high-resolution aerial photography, with elevation contour labeling.

(4) Delineation of hydrologic soil groups and land cover conditions (these may be included on a separate map, with drainage delineations).

(5) Property boundaries of the tract of land where the proposed project is located, including any proposed division lines for the current and future project phases.

(6) Proposed project, with proposed grading and changes in land cover.

(7) Stream channel centerline flow path, with flow direction indicated.

(8) Flow path used in determining times-of-concentration or lag times (both pre-project and modifications based on proposed construction).

(9) Title block, legend, north arrow, and bar scale.

(k) The floodplain work map(s) should include the following:

(1) Multiple floodplain work maps may be submitted, as long as all of the following items are provided.

(2) Floodplain cross sections, with location and orientation relative to the floodplain, with labels in agreement with the stations referenced in the hydraulic models. If the study involves a stream that has been previously studied, stream stationing should be in general agreement with stationing used in the previous study. For streams with no previous flood studies, the stream stationing should be based on channel distance upstream from the stream's point of termination (downstream location of where the stream enters a larger receiving stream or major lake.

(3) Topography overlaid on high-resolution aerial photography, with elevation contour labeling.

(4) Floodplain boundaries and flood elevations for the one hundred-year (100-yr) flood using discharges for both pre-project existing watershed conditions and modifications based on proposed project discharges.

(5) Floodplain boundaries identified on the Flood Insurance Rate Maps (FIRM) as Special Flood Hazard Areas, and floodplain boundaries from previous studies (if available from the City) with one hundred-year (100-yr) flood elevations.

(6) Floodplain boundaries and flood elevations for the one hundred-year (100-yr) flood based on projected fully-developed watershed conditions, with the proposed project.

(7) Stream channel centerline (invert) with direction of flow indicated (for both pre-project and any changes in stream channel centerline based on the proposed construction).

(8) Property boundaries of the tract of land where the proposed project is located, including any proposed division lines for the current and future project phases.

(l) Title block, legend, north arrow, and bar scale. In order for the City to maintain and update their hydrology and hydraulic computer models, after construction is completed, the developer's engineer must update and submit to the City their final certified flood study report, with hydrology and hydraulic models, along with all supporting calculations, maps, report, AutoCAD (.dwg files), and GIS files and other exhibits to adequately represent as-built conditions. If the project has been submitted to FEMA for a LOMR, the updated models and revisions to flood study reports should include all modifications that were approved by FEMA.

(m) The Director of Public Works and/or the City Engineer will determine whether the proposed development will require a LOMR or CLOMR. All documentation prepared for submission to FEMA (LOMRs/CLOMRs) will be reviewed by the City. The City will not approve the flood study prepared for a LOMR, nor sign a LOMR application form, until construction grading associated with the LOMR has been completed, certified "as-built" plans are submitted to the City, construction has been verified by onsite inspection(s), and all required Local, Federal, and State permits and approvals have been received.

(n) The Developer, engineer, or property owner requesting the proposed change in land use shall enter into a Professional Services Agreement with the City to retain consultants to provide a wide variety of professional services including, but not limited to engineering, legal or other services as needed in accordance with the Subdivision Regulations Section 02.03.045, *Facilities and Professional Services Agreements, Financial Assurances and Construction Contracts for Public Improvements* agreeing to an estimated specified retainer to assist City staff in the analyzation and review of the flood study.

SEC. 02.031.0322 ..... STORM DRAINAGE MANAGEMENT PLAN

(a) **General**. Storm drainage facilities shall include all elements of a drainage system consisting of streets, alleys, storm drains, channels, culverts, bridges, swales and any other facility through which or over which storm water flows, all of which the City must have a right in, either in the form of a dedicated right-of-way, or easements.

(b) **Site Drainage**. All new subdivisions shall provide as part of the Construction Plan review process a complete storm drainage management plan. This plan will include, but not be limited to, the following:

(1) A complete review of all on-site, upstream, and downstream drainage within the impacted watershed;
(2) Determination of all onsite and downstream drainage facility improvements due to the increased runoff from the proposed development and future upstream and downstream developments; and
(3) Calculations necessary to determine compliance with the Standards of Design herein.
(4) Detention will be required if the downstream storm system is not capable of handling the proposed drainage flows.
(5) The plan shall be done, using current zoning conditions or land use prescribed by the City's Future Land Use Plan (whichever creates the greatest storm water runoff), with ultimate development considered throughout the watershed.

(6) The storm drainage plan shall show all necessary improvements with flow data provided at each point of interception of water.
   i. As part of the storm drainage plan, the developer shall show a lot grading plan to direct all water to proper intersection points avoiding cross flow of water from lot to lot.
   ii. All upstream discharge shall be intercepted and carried through the proper intersection points avoiding cross flow of water from lot to lot.
   iii. All upstream discharge shall be intercepted and carried through the proposed development in compliance with the Standards of Design herein.
   iv. All discharge from the proposed development shall be designed in accordance with the Standards of Design herein with all necessary improvements being installed by the developer to protect downstream property and adjacent properties from damage. The determination of necessary improvements to existing drainage facilities downstream of a proposed development shall be reviewed by the Director of Public Works and/or the City Engineer for compliance and adequacy.
   v. Deviations from the Director of Public Works and/or the City Engineer's recommendations and the Standards of Design herein may be approved through the requesting and granting of an exception by the City Council.

(c) **Subdivision Development**.

(1) All subdivision developments shall be built in complete compliance with a storm drainage plan as outlined herein. All lots shall be graded at the time of development in accordance with the plan. All grading shall not exceed a slope of four to one (4 to 1) unless approved by the Director of Public Works and/or the City Engineer.

(2) Approved erosion control shall be provided as part of the development construction on any or all lots within the development to protect the drainage, lot development and adjacent property.

(3) The finish building pad for all subdivision developments shall be elevated to a minimum of 1.0 foot above the crown of the road. In no circumstance shall a building pad and finish floor of any structure be placed below street grade

(d) **Construction Erosion Controls**. Developer is required to follow all requirements within the TCEQ Stormwater General Permit for Construction Activities (TXR150000). Construction Erosion Controls shall follow the guidelines set out in NCTCOG's integrated Storm Water Management (iSWM^{TM}) Technical Manual: Construction Controls updated November 2020 or more recent revision.

(1) In order to address the requirements of pollution reduction at construction sites, a variety of controls should be employed to:

i. Reduce soil erosion,

ii. Reduce sediment loss from the site, and

iii. Manage construction-generated waste and construction related toxic materials.

(2) Controls consist of both temporary and permanent methods to reduce pollution from a construction site. The majority of controls address loss of soil from the site. Soil loss in the form of erosion and sediment due to storm events and wind constitute the majority of pollution generated from construction sites. Controls that address erosion and sediment are typically more site specific than waste and toxics management. Erosion and sediment controls are dependent on-site slopes, drainage patterns and drainage quantities along with other site-specific conditions. Materials and waste management consists primarily of "good housekeeping" practices which are dependent on the type of construction and the quantity and type of building materials.

(3) The Director of Public Works and/or the City Engineer will review the information submitted for compliance with the approved grading and drainage management plan. Accepted City streets are not to be used as an erosion control. No inlet protection is allowed in an accepted City street.

(4) Control measures shall follow the control selection guide set forth in the iSWM manual. Control measures from each of the three categories; Erosion Controls, Sediment Controls and the Material and Waste Controls shall be used in the design of an Erosion Control Plan for a site. Standard details called out in Division 1000 of NCTCOG's Standard Specifications and Standard drawing shall be utilized as well in the development of an erosion control plan.

(5) Control Measures (such are silt fences, inlet protection, rock berms, etc.) shall be removed from the site once grass cover has been established to an efficient level. Types of erosion control may be removed depending on amount of disturbed area remaining. Erosion control shall remain and be maintained when the overall project has reached the minimum amount of disturbed area, one (1) acre. Grass cover shall be determined by the Section 4, Vegetation of these Standards.

(6) Erosion control for a development shall remain until the phase has the minimum disturbed are, one (1) acre, for the overall phase, not individual lots. By approval of the Director of Public Works and/or the City Engineer, erosion control may remain in place after phase is complete in anticipation of future phases.

(7) Erosion control shall be inspected by the contractor weekly, and before and after rain events. Deficiencies shall be corrected within a timely manner. If a deficiency is identified before a rain event, it shall be corrected before the end of the day or before the rain begins. Types of deficiencies include, but not limited to:

i. Holes or tears in silt fencing;

ii. Fallen silt fencing;

iii. Debris or sediment clogging erosion control device;

iv. Rock check dams or construction entrance rock sedimented over or covered; and

v. All other approved construction site erosion control devices shall be maintained to Storm Water Pollution Prevention Plan (SWP3) and City Public Works Inspector requirements.

(8) Construction Entrance: No crushed concrete is allowed, and rock must be a minimum of twelve inches (12") thick using well graded rock with minimum diameters of four (4) to six (6) inches.

(9) Silt Fence: No wooden stakes to be allowed on any erosion control device.

(10) Performance: Erosion from construction sites can be a significant water quality problem. Developing areas are cleared of vegetation during construction leaving the soil exposed and susceptible to erosion. Runoff then transports eroded sediment from these areas and deposits it downstream.

i. Prevention is a key aspect of erosion control. Many of the control methods presented herein can be placed in a manner that will protect highly erodible areas such as steep slopes. The prevention of erosion requires prior planning to ascertain the placement of selected control methods. The rewards of this planning will be a significant reduction in soil loss. Not only can soil loss be prevented, but eroded soil can be recovered on the construction site and used for fill.

ii. The particulate material in construction site runoff is generally heavier and larger than particulates in urban runoff. These attributes facilitate the removal of the material whether the removal is by settling in a sediment trap or by filtration through a filter fence. Temporary sediment traps, filters, and routing devices an effectively control erosion for construction sites if properly applied. These methods are even more effective when permanent management techniques are used in an effort to control temporary increases in sediment loads.

iii. Keep dirt/mud/debris off of all public streets, and fire lanes. It is required to have sufficient equipment and material on-site to safely remove dirt/mud/debris from the public streets, and fire lanes. Such equipment includes but not limited to: traffic control items, brooms, shovels, and personal protection equipment.

iv. Required documents and permits prior to construction release include:

1. Storm Water Pollution Prevention Plan (SWP3). A copy of the executed SWP3 is to be submitted electronically to the Director of Public Works and/or the City Engineer if the project disturbs one (1) acre or more of land.

2. Storm Water Noice of Intent (NOI). An electronic copy of the executed NOI will be required to be submitted to the Director of Public Works and/or the City Engineer, if the disturbed area of land of the project is:
    a. five (5) acres or more, or
    b. if the project will disturb land one (1) or more acres, but less than five (5) acres and is part of a larger common plan o development or sale that will disturb five (5) acres of land.
3. .Texas Pollutant Discharge Elimination System (TPDES) General Permit No TXR 150000. Provide an electronic executed copy of the general permit to the Director of Public Works and/or the City Engineer if the project is one (1) acre and less than five (5) acres of disturbed land.

(e) **Lot Development**.

(1) All lot developments shall include a drainage plan preventing all diversion of water from the approved path of discharge. The builder at the time of permit application shall furnish a grading plan in compliance with:
    i. The appropriate chapter of the building code adopted by the City,
    ii. The grading plan for the development; and
    iii. The storm drainage plan approved for that particular development.

(2) Residential lots shall generally drain to streets. Residential development shall be Type “A,” “B,” or “C” drainage for each lot within the subdivision.
    i. Type “A”: Drainage: All portions of the lot drain to the front.
    ii. Type “B” Drainage: Drainage is split between drainage to the front and drainage to the rear and sides.
    iii. Type “C” Drainage: All drainage is to the rear.

(3) The engineer shall provide grading information and spot elevations to show how the drainage type will be achieved. Generally, no more than one lot may drain through another. The options noted below do not necessarily guarantee that an exception will be approved:
    i. In cases where more than one lot will drain through a single lot, an improved drainage system (pipe or flume) shall be required.
    ii. If the site is complex and an overall site grading plan cannot be developed in accordance with City standards, an individual grading plan for each lot shall be submitted by the engineer prior to issuing the building permit. The individual grading plans shall be coordinated with surrounding lots. For individual grading plans, an “as-built” letter signed and sealed by a professional engineer in Texas shall be submitted prior to final inspection.

(4) The City reserves the right to set a minimum lot or finished floor elevation for any property for flood protection purposes.

(5) If the re-grading of a lot is necessary, the builder shall be required to furnish a new drainage plan indicating the diversion and rerouting of the affected storm water.

i. When the re-grading of a lot prevents the drainage from flowing to the proper structures as designated in the drainage plan, then the builder will furnish a registered engineer's review for adequacy of existing structures to which the water is diverted.

ii. If improvements are necessary to provide for adequate drainage due to regrading of a lot, then the improvement must be made at the builder's expense before a grading permit or other permits for construction will be issued by the City.

iii. The Director of Public Works and/or the City Engineer will review the information submitted for compliance with the approved grading and drainage management plan.

1. Accepted City streets are not to be used as an erosion control.

2. No inlet protection is allowed in an accepted City street.

(6) Off-Site Cost Sharing: The developer shall be fully responsible for the construction of off-site drainage improvements necessary for his subdivision and the surrounding area, unless other provisions are approved by the City Council in a Development Agreement and/or Facilities Agreement.

(7) Exemptions: when a development is of two lots or less and in the Director of Public Works and/or the City Engineer's opinion does not affect existing drainage facilities or affect the adjacent property, the Director of Public Works and/or the City Engineer may allow the developer to waive any off-site pro-rata costs.

(8) All City rights-of-way shall be sodded if disturbed. No artificial grass is allowed in any City right-of-way and/or easements.

(9) Before Acceptance of Streets and Alleys silt fencing shall be placed at the back of curb/edge of all pavement.

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Article 02.031.0400 ... VEGETATION

SEC. 02.031.0411 ..... GENERAL.

All seeding, sodding and fertilizer requirements are to be done in accordance with the North Central Texas Council of Governments (NCTCOG) *Standards and Specifications*.

SEC. 02.031.0412 ..... COVERAGE.

(a) The developer shall establish grass and maintain the seeded area, including watering, until a Permanent Stand of Grass is obtained at which time the project will be accepted by the City. A Stand of Grass shall consist of 75% to 80% coverage of the whole project area and a minimum of one (1) inch in height as determined by the City.

(b) There shall not be more than one (1) acre of land without proper grass coverage at the time of City acceptance. Re-seeding will be required in all washed areas and areas that have not been established.

(c) All City rights-of-way shall be sodded if disturbed. No artificial grass is allowed in any City right-of-way and/or easements.

SEC. 02.031.0413 ..... PLANTING SEASON.

Type No.	Variety	Hulled or Unhulled	Weight/Acre	Planting Season
Type 1	Bermuda Grass	Hulled	50 LBS/Acre	April thru June
Type 2	Annual Rye Grass	N/A	40 LBS/Acre	September thru March
Type 3	Bermuda Grass	Unhulled	50 LBS/Acre	January thru March & July thru August

(a) A mix of seed shall be used in overlapping planting seasons. A seed mix shall be submitted prior to application.

SEC. 02.031.0414 ..... ADDITIONAL INFORMATION.

(a) For a public utility less than ten inches (10”) in size no tree shall be planted within five feet (5’) of the utility.

(b) For a public utility greater than or equal to ten inches (10”) in size no tree shall be planted within ten feet (10 ‘) of the utility.

(c) If trees are approved by the Development Services Department and/or City Council to be within the right-of-way, then a City approved root barrier will be required to be installed in order to keep roots from degrading the pavement structure.

(d) Vegetation over two feet (2’) in height shall not be planted in any visibility easement or potential sight visibility (including medians).

Article 02.03.0500 ..... WATER AND WASTEWATER SYSTEMS

SEC. 02.031.0511 ..... GENERAL REQUIREMENTS.

(a) The design and construction of the water and wastewater system to serve the development shall be in accordance with good engineering principles, with these Standards of Design and Construction and the Standard Details and with the requirements of the Texas Commission on Environmental Quality (TCEQ).

(b) All on-site and off-site water and wastewater mains shall be sized and located to conform to projected demands in accordance with the current *Water Master Plan* and *Wastewater Master Plan* and the computer model with regard to the impact of each development on the existing and proposed water system. The alignment of future water and wastewater lines in the *Water Master* and *Wastewater Master Plans* may vary depending on design or layout. The water and wastewater lines in the *Master Plans* shall be minimums and should connect to the systems shown in the *Plans.*

(c) No construction shall commence prior to the approval of the plans and specifications by the City.

(d) The term “water main” shall refer to a water system that water meters, hydrants, and fire lines are connected to.

(1) Water mains may be located on private property but shall be within an easement and maintained by the City.

(e) The term “wastewater main” shall refer to a wastewater system that serves more than one (1) property.

(1) Wastewater mains may be located on private property but shall be within an easement and maintained by the City.

(2) If a system serves only one (1) property and is located on private property it shall be a private sewer service and not a wastewater main and therefore considered private unless to serve off-site properties.

(3) Manholes or cleanouts on a sanitary sewer line does not indicate or require the system to be a wastewater main.

(f) Water and wastewater mains should not cross a single-family lot unless along a street right-of-way or within an easement. Mains crossing between rights-of-way within a residential subdivision shall be within right-of-way, or within an easement, or within a HOA owned and maintained lot.

SEC. 02.031.0512 ..... SYSTEM CAPACITY STUDIES

(a) A water and wastewater system capacity study shall be performed for all developments or re-developments that propose a change in existing land use (change in density or higher water and sewer usage) that does not conform to the City’s current Water and Wastewater Master Plan.

(b) The Developer, engineer, or property owner requesting the proposed change in land use shall enter into a Professional Services Agreement with the City to retain consultants to provide a wide variety of professional services including, but not limited to engineering, financial and legal, services as needed in accordance with the Subdivision Regulations Section 02.03.045, *Facilities and Professional Services Agreements, Financial Assurances and Construction Contracts for Public Improvements* agreeing to an estimated specified retainer to assist City staff in the review of the water and wastewater system capacity studies.

SEC. 02.031.0513 ..... CONNECTION FOR FUTURE ADJACENT DEVELOPMENTS

(a) All development shall accommodate future adjacent and upstream/downstream developments by extending water and wastewater lines across the proposed development in order to create water and wastewater systems connectivity. This connectivity will provide for ease of future development and limited disturbance to existing developments. These extensions of the water and wastewater facilities shall match the City's *Water Master Plan* and *Wastewater Master Plan*.

(b) If the property adjacent to the proposed development is a Utility owned or City owned property, extension may be required across the subject property.

SEC. 02.031.0514 ..... EASEMENTS.

(a) If a water or wastewater main is located on private property, the mains shall be within an easement that conforms to the minimum width in **Table 5.1 Water & Wastewater Line Easements-Minimum Width**.

(b) The utility shall be centered within the easement or have a minimum of half the required easement width on both sides of utility.

TABLE 5.1 WATER & WASTEWATER LINE EASEMENTS – MINIMUM WIDTH

		Minimum Easement Width (ft)
Conduit Size	<= 48" diameter	20'
	> 48" diameter	Approval Director Of Public Works and/or the City Engineer
Depth of Conduit	< 14'	20'
	14' - 16'	25'
	17' – 20'	30'
	21' – 23'	35'
	> 23'	40'

SEC. 02.031.0515 ..... SEPARATION OF WATER AND WASTEWATER LINES.

(a) All water lines and wastewater lines shall be separated ten-foot (10') horizontally and per TCEQ Rules and Regulations. Refer to the following for additional requirements:

(1) Chapter 290-Public Drinking Water SUBCHAPTER D: RULES AND REGULATIONS FOR PUBLIC WATER SYSTEMS §§290.38 - 290.47.

(2) Chapter 217-Design Criteria for Domestic Wastewater Systems SUBCHAPTER C: CONVENTIONAL COLLECTION SYSTEMS §§217.51 - 217.70.

(b) For separation between stormsewer lines, a spacing of five-foot (5') horizontal shall be maintained from outside dimension of storm pipe to the water or wastewater line.

SEC. 02.031.0516 ..... WATER AND WASTEWATER LINES WITHIN TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT) RIGTH-OF-WAY (R0W).

(a) Water and wastewater lines within or crossing a TxDOT ROW shall meet the requirements of the TxDOT District Office and the TxDOT Utility Manual. Utility permits for lines within or crossing TxDOT rights-of-way shall be processed through the City's Development Services Department.

(1) TXDOT permit plan sets shall be eleven-inches by seventeen inches (11"x17") in size and signed and sealed by a licensed professional engineer with the State of Texas. Plan sets shall include all applicable TxDOT standard details and traffic control plans sheets to construct the lines.

(b) New proposed utility lines shall be outside of TxDOT ROW, on private property, within an easement.

SEC. 02.031.0517 ..... BORING, JACKING AND TUNNELING.

(a) All water and wastewater mains to be installed in steel casing under existing roadways, railroads, and creeks and shall be installed by a method other than open cut, unless otherwise approved by the Director of Public Works and/or the City Engineer.

(1) All boring of existing water lines mains shall be by dry bore methods.

(2) All boring of water and wastewater lines shall be by dry bore methods.

(3) No wet bores shall be allowed.

(b) Steel casing thickness and diameter size shall be designed by the engineer of record for construction and maintenance of the carrier pipe per the requirements below. Raci patented casing spacers, or approved equal, shall be used. No bends and/or curves are permitted with casing pipes.

(c) The construction bore and receiving pit shall be located at a minimum distance of four feet (4') behind the back of curb. The engineer of record shall provide a distance greater than four feet (4') where there is no curb or barrier protection at the edge of pavement.

(1) Additional bore setback distances or shoring shall be required to maintain roadway integrity and the safety of construction personnel.

(2) When bore and receiving pits are located on private property, permanent water and wastewater easements for the pits will be required for the installation and future maintenance of the line.

(d) The engineer of record shall design the pipe casing for the following loading conditions and/or applicable combinations thereof:

(1) Cooper's E-80 Railway loading or AASHTO HS20 loading, as applicable.

(2) Earth loading with the height of fill above the casing as shown on the plans as existing or finish grade whichever is greater.

(3) All other applicable loading conditions, including loads applied during transportation and handling.

(4) Maximum casing deflection of one-half-inch (½") from the above loading conditions.

(e) Engineer of records shall consider the location, size, and depth of bore and receiving pits relative to existing utilities when establishing the beginning and ending stations.

(f) Manufacturers: Paint Manufacturers for pipe casing shall be 46-465 H.B. Tnemecol – Tnemec Inc. or approved equal.

SEC. 02.031.0518 ..... CROSSINGS.

(a) City Roadway Crossings: All City roadway crossings shall be by dry bore. Open cut is by the Director of Public Works and/or the City Engineer's written approval only and shall require full panel concrete replacement at a minimum.

(b) Creek Crossings: Water and wastewater lines at creek crossing shall be designed to go under the flowline of the crossing. The lines shall be in steel encasement pipe with a minimum vertical clearance of four-feet (4') from the encasement pipe and the flowline of the creek to protect from future creek undercutting. The encasement pipe shall be extended to the creek's Erosion Hazard Setback line for future maintenance of the carrier pipe.

(1) Where an Erosion Hazard Setback does not exist due to a shallow creek the encasement pipe shall extend fifteen-feet (15') on either side of the main channel of the creek.

i. All creek crossings shall be profiled and shall show the Erosion Hazard Setback line along with the projected 4(H):1(V) sloping line and fifteen-foot (15') buffer from the intersecting point of the ground.

(2) Aerial crossing of water lines is not allowed.

(3) Aerial crossings for wastewater lines may be used only when all other alternatives have been evaluated and determined not to be feasible. Aerial crossings of wastewater lines require approval of the Director of Public Works and/or the City Engineer. If an aerial crossing is to be installed, reference additional requirements in the Wastewater System Section. No syphons are allowed.

(c) TxDOT Highway Crossing: A steel encasement pipe shall be used to encase the carrier pipe at all TxDOT highway crossings. The crossing shall be at ninety degree (90°) (perpendicular) to the highway.

(1) All boring of water and wastewater lines shall be by dry bore methods. No wet bores will be allowed unless approved in writing by the TxDOT District Office.

(d) Railroad Crossings: Prior to the design of any railroad crossing, the engineer of record shall contact the railroad and the appropriate regulatory agency to determine if there are any special design and/or construction requirements and shall copy the Director of Public Works and/or the City Engineer on all correspondence with each regulatory agency and approved permits.

SEC. 02.031.0519 ..... WATER SYSTEM.

(a) **General.** All facilities shall be sufficient size to provide adequate capacity for ultimate development as called out in the *Water Master Plan*, as amended. The water mains shall be sized to meet the maximum instant domestic requirements plus an appropriate allowance for fire protection water. The design criteria for water demand shall be submitted to the City with the plans and specifications.

(1) The City reserves the right to require larger water mains than required for the proposed development in order to provide capacities for areas outside the development. The Developer will be responsible to construct water mains adjacent to his property in accordance with the *Water Master Plan*, as amended or as required by the Director of Public Works and/or the City Engineer.

(b) **Connections to Existing Distribution System.**

(1) Preliminary discussions concerning take-off points in the water system should be conducted with the Director of Public Works and/or the City Engineer prior to finalizing the preliminary designs of the water system, which will serve the development.

(2) Connections to the City's existing water system will be allowed only at locations where sufficient quantity and pressures are available to meet the projected requirements of the development. In general, the connections to the existing water system shall be made in such a manner to keep "shut-downs" to minimum. Preference should be given to a tapping valve connection.

(3) In a proposed development where City water is not adjacent to the property but is accessible, the Developer shall provide, at their expense, a minimum of eight-inch (8") water main, or if required an off-site water main of sufficient size to serve the development or as shown on the City's *Water Master Plan*, whichever is larger.

i. Through a Pro Rata, a Development Agreement, and/or a Facilities Agreement a Developer can request the City participation (if funds are available) for water oversizing above twelve - inches (12"), where the City collects a pro-rated amount as other developments connect to the system. The City participation must be approved by the City Council. The proposed development may require a loop into the existing water system in order to provide adequate water pressure. The loop will be at the Developer's expense. All water mains shall be extended to the property lines for future connections.

(4) In general, the City will not approve a development which cannot be served by extensions to the City water system. Some areas in the City are served by public water supply corporations. The Developer shall contact these public water supply corporations for notification of future development. The Developer shall still be responsible to construct water facilities that meet City requirements and as shown on the City's *Water Master Plan*. The City will inspect the water facilities. All water facilities must pass North Texas Municipal Water District testing prior to acceptance of said facility.

(5) Under unusual circumstances, the City may consider approval of a private water system, which will supply an adequate quantity of potable water to every lot in a residential development. Such systems must meet the approval of the City, the Texas Commission on Environmental Quality (TCEQ), the State Board of Insurance, and other appropriate regulatory agencies. In addition, a Development Agreement between the City and the Developer must be executed whereby the City may acquire the system at such time as it can be connected into the City's owned and operated distribution network. In all cases, the Construction Plans shall show the source of water for the development.

(c) **Sizing of Water Mains.**

(1) Water mains shall be sized to have maximum velocities of seven-feet (7') per second for maximum daily demands and maximum velocities of ten-feet (10') per second for combined maximum daily demand and fire flow demands.

(2) The water demand for residential land uses and nonresidential land uses are shown in **Table 5.2 Water Demand Rates** and shall apply for any development where the lot layout has not been finalized. Land uses not listed shall be classified by the land use they most nearly resemble in **Table 5.2** or calculated by the engineer in accordance with the anticipated use. The engineer shall submit the maximum daily demand and the maximum hourly demand to the Director of Public Works and/or the City Engineer for review and approval.

i. The City reserves the right to assign a higher water usage rate, population per unit, and/or units per acre to be used for developments anticipated to generate higher than typical usage rates.

TABLE 5.2: WATER DEMAND RATES

Land Use	Units Per Acre	Population per Unit	Max Day per Capita (gpcd)	Max Hour per Capita (gpcd)	Max Day per Acre (gpad)	Max Hour per Acre (gpad)
Residential						
Single Family - Low Density	3.5	2.87	350	700		
Single Family - Medium Density	5.0	2.87	350	700		
Single Family - High Density	10.0	2.87	350	700		
Townhome	12.0	2.50	350	700		
Multi Family	24.0	2.00	350	700		
Mobile Home Park	10.0	2.87	200	360		
Non-Residential						
Mixed Use / Live Work / Downtown			350	700		
Commercial Retail / Business Center					1,500	3,000
Public / Quasi-Public					1,500	2,000
Commercial Industrial					2,000	3,000
Special Commercial Corridor / Technology Employment Center					3,000	3,900
Light Manufacturing [1]					2,000	3,000
Heavy Manufacturing *					2,500	3,000
Schools (Elementary)			39 per student	52 per student		
Schools (Middle / High Schools / Colleges)					1,500	2,000
Hospitals			720 gpd per bed	864 gpd per bed		
Nursing Homes / Assisted Living			240 gpd per bed	288 gpd per bed		
Restaurants					1,500	3,000
Parks and Open Space					1,500	1,500
Golf Course [2]					1,000	1,000

Notes:

[1] Engineer shall provide the maximum daily demand and maximum hourly demand flows and/or the number and size of water meters proposed for the particular land use for review by the City.

[2] Engineer shall provide the number and size of water and irrigation meters proposed for the golf course for review by the City.

(3) The engineer shall sufficiently size all water mains to provide adequate capacity for ultimate development as called out in the City's *Water Master Plan*, as amended. For all developments, re-developments, and any type of facility tying into the City's water distribution system, the following guidelines shall be used:

i. The engineer shall obtain the available record drawings. When record drawings are not available, field investigations and verifications shall be required prior to construction.

ii. The standard water main sizes that shall be used are noted in **Table 5.3. Standard Water Main Sizes.**

iii. The minimum water main size to serve residential areas shall be eight-inches (8") in diameter.

iv. The minimum water main size serving commercial, business, industrial, etc. shall be twelve-inches (12") in diameter.

v. Fire Flow Demands for all uses shall be calculated with a minimum residual pressure of twenty pounds per square inch (20 psi) under combined fire and domestic (Maximum Daily Demand) water flow conditions and/or the latest requirement by the TCEQ. The Developer shall provide facilities sufficient for fire flows in accordance with the minimum criteria set for by the City's Fire Department.

vi. Mains are to be sized to ensure less than one-foot (1') of head loss per one thousand-feet (1000') of water main using a Hazen Williams coefficient of C = 110 for the Maximum Hourly Demand flow rates within the subdivision internal distribution system.

vii. Mains shall be sized to provide service to adjacent properties.

Table 5.3: Standard Water Main Sizes

8 inch	10 inch	12 inch	14 inch	18 inch
20 inch	24 inch	30 inch	36 inch	42 inch
48 inch	54 inch	60 inch	66 inch	72 inch

(d) **Water Mains Location/Alignment.**

(1) Water pipelines shall be located in the parkways between the back of the curb and the street right-of-way. The location shall be six-feet (6') from the back of curb on the north side of east-west streets and on the west side of north-south streets. When horizontal curvature is used the minimum radius of curvature shall be equal to that recommended by the pipe manufacturer. No water main ten inches (10") or greater shall be located nearer than ten feet (10') from any tree, unless otherwise approved by the Director of Public Works and/or the City Engineer.

(2) Water mains should not be designed to pass through single-family lots or between single family lots unless fully within a Home Owner Association (HOA) owned and maintained lot.

(3) A blue EMS Locator Pad will be located as shown in the Standard Details. Water mains shall have blue EMS locator pads at every two hundred-fifty-feet (250'), change in direction, valve, curb stop, and service connection to the main water main.

(e) **Depth of Cover.**

(1) The minimum depth of cover for water mains are indicated in **Table 5.4. Depth of Cover to Top of Pipe**.

Table 5.4: Depth of Cover to Top of Pipe

Pipe Size	Minimum Depth of Cover
6 inch through 10 inch	4.0 feet
12 inch through 18 inch	5.0 feet
20 inch and larger	6.0 feet

(2) The engineer shall consider the ultimate roadway elevations in determining the depth of cover. Additional depth of cover shall be required for future development and as directed by the Director of Public Works and/or the City Engineer. Depths of cover greater than eight feet (8') shall be approved by the Director of Public Works and/or the City Engineer.

(f) **Pipe Material and Embedment.**

(1) Water mains shall be PVC pipe conforming to the NCTCOG Standard Specifications for Construction. In general, the water pipelines shall be AWWA C900-16 PVC Pipe (blue in color) for all sizes, DR 14 (PC 305) for pipeline sizes twelve-inch (12") and smaller, and DR 18 (PC 235) for fourteen-inch (14") and larger water pipelines.

(2) All pipes shall be installed in embedment material as shown on the NCTCOG Standard Drawings and in conformance with the Standards of Design and Construction.

(g) **Valves.**

(1) Valves shall be installed to isolate pipe at a minimum of every other fire hydrant and on both sides of all public roadways. All gate valves shall comply with the approved list or an approved equal with resilient seat only and shall conform to and shall be installed according to the NCTCOG Standard Specifications for Construction

i. Valves shall be placed in straight run sections at spacing no greater than five hundred-feet (500').

ii. All valve boxes shall be encased in a concrete pad that shall be twelve-inches by twelve-inches by six-inches (12" x 12" x 6") and reinforced with No. 3 steel bars. Valves larger than eight-inches (8") may require larger concrete pads.

iii. Valve extensions shall be 316 stainless steel.

iv. Unless otherwise requested by the Developer and approved by the Director of Public Works and/or the City Engineer, valves shall be located in the northwest quadrant of the street intersection.

v. Valves shall be placed at or near the ends of mains in such a manner that a shutdown can be made for a future main extension without causing loss of service on the existing main. A minimum of twenty-feet (20') of main shall be installed past the valve and mechanical pipe thrust restraints shall be used to anchor it.

vi. Valves should not be placed in vehicle parking spaces.

vii. Where fire lines are connected to the water main, valves shall be installed on one side of the connection to provide the ability to isolate the main line and continue to provide water to the fire line. The fire line shall be provided with a valve at the connection with the main line.

viii. Valve boxes shall be provided for buried valves. They shall be three (3)-piece screw-type cast iron boxes of the extension type. The three (3) pieces shall consist of the top section, bottom section, and cover.

ix. Two-inch (2") square nuts that would be over four-feet (4') deep shall have stainless steel valve stem extensions. In these cases, the two-inch (2") square valve operating nut shall be no greater than two-feet (2') from the finish grade. Valve box extensions may be cast iron or C-900 PVC.

x. Additional valves may be required by the Director of Public Works and/or the City Engineer. Additional valves may be required for fire support or isolation purposes.

(2) Gate Valves: Valves twelve-inches (12") and under shall be Resilient Wedge Gate Valves (RWGV). Valves are required to have 316 Stainless Steel hardware. Gate valves shall be located outside the paved streets and shall be six-feet (6') from back of curb of the intersecting street. In general, gate valves shall be located at street intersections (except for fire hydrant leads.

(3) Butterfly Valves: Valves greater than twelve-inches (12") shall be flanged butterfly type spaced at a maximum of one thousand-foot (1,000') intervals. All valves shall have horizontal mounted actuators with a manhole for access to the actuators.

(4) Air Release, Air/Vacuum, and Combination Air Valves:

i. Air release valves, air/vacuum, and combination air valves shall be required on sixteen-inch (16") and larger water mains and as necessary for proper system operation. There are three primary functions of the valves that the engineer shall consider as follows:

1. To vent large volumes of air during filling of the line;
2. To allow air into the pipe during emptying for maintenance and/or repairs; and
3. To vent small volumes of air that come out of solution during service.

ii. Typically these are installed at high points where the pipeline has a vertical change in gradient. Additional installation locations may be required by the Director of Public Works and/or the City Engineer.

iii. A fire hydrant shall be required at high points on twelve-inch (12") water mains for air relief and flushing maintenance operations. When a fire hydrant cannot be used, an air release valve may be approved by the Director of Public Works and/or the City Engineer.

(h) **Fittings.** Mega-lugs or the approved equal shall be installed. No compaction fittings shall be allowed. Fittings shall be ductile iron in accordance with AWWA C110 or AWWA C153. All buried metal shall be wrapped in polyethylene tube wrap.

(i) **Connection to Existing Water Mains.**

(1) Tapping Sleeves and Valves

i. Size-on-size tapping sleeves are not allowed. The largest allowable tapping sleeve shall be the main line size less one standard pipe size (Example: sixteen-inch by twelve-inch (16" x 12"), eight-inch by six-inch (8" x 6"), etc.). If a size-on-size connection is required, then a cut-in connection shall be used.

ii. Connections to an existing line shall be made with full body stainless steel tapping sleeve and valve. A resilient wedge gate valve shall be flanged to the tapping sleeve.

iii. Age, material, or condition of existing main may prohibit the use of a tapping sleeve for connections. Older mains can have major failures when tapping is attempted.

(2) Cut-In Connection. When connecting to an existing main, it may be required to provide a cut-in connection with a tee and valve being installed into the existing main in lieu of a tapping sleeve and valve where there is not an existing main line valve between proposed water connection locations as directed by the Director of Public Works and/or the City Engineer. A test shut down of the existing water main(s) shall be conducted by the Public Works Department. The requirement for a test shut-down may be waived with approval by the Director of Public Works and/or the City Engineer. Only the City's Public Works Department may perform a water shut down.

(j) **Dead-End Mains.**

(1) Dead-end mains shall be avoided and may only be considered when a looped or interconnected water main system is not available. The design of all water distribution systems should include the opportunity for future looping or interconnect of any approved or proposed dead-end line.

(2) All dead-end lines shall only be installed upon approval from the Director of Public Works and/or the City Engineer and at a maximum length of one-hundred-fifty-feet (150') regardless of main diameter or valve placement.

(3) Dead-end non-residential water mains shall only have one (1) fire hydrant or service without looping the water main.

(4) Where dead-end mains are approved, a flush point at the end of the dead-end main shall be provided.

(k) **Fire Hydrants.** In general, fire hydrants shall be located at each street intersection and at intervals on the interior of each block.

(1) Residential and Duplex Residential and duplex areas shall have a fire hydrant at each street intersection and at a maximum of four-hundred-foot (400') intervals on the interior of each block. The City Fire Department may alter spacing requirements along roadways depending on subdivision layout.

(2) Multi-Family: Multi-Family areas shall have a fire hydrant at each street intersection and at four-hundred-foot (400') intervals on the interior of each block and along fire lanes. The City Fire Department may alter spacing requirements along fire lanes depending on fire suppression systems being installed.

(3) Commercial, Retail and Industrial: Commercial, retail, and industrial areas shall have a fire hydrant at each street intersection and at a maximum of four-hundred-foot (400') intervals on the interior of each block and along fire lanes. The City Fire Department may alter spacing requirements along fire lanes depending on the fire suppression systems being installed.

(4) Rural Undeveloped Roadway: Water lines along roadways in rural areas that have not been developed, or development is sparse shall have fire hydrants installed a maximum of every one-thousand-feet (1000'). Additional hydrants may be required by the Director of Public Works and/or the City Engineer.

i. Fire hydrants shall be installed a minimum of three-feet (3') and no greater than six-feet (6') behind curb of a fire lane, driveway, access, and/or street as measured from the centerline of the fire hydrant to back of curb, edge of pavement, or fire lane. All fire hydrants shall have a minimum of five-feet (5') of clearance around, including but not limited to trees, shrubs, bollards, walls, signs, structures, and parking stall curbs.

ii. The spacing of fire hydrants shall be measured along the street frontage or fire lanes. The Fire Department and Public Works Department shall review all fire hydrant spacing. When a special condition exists due to land use, the Fire Department, or the Director of Public Works and/or the City Engineer may require additional hydrants for fire protection. All existing fire flows and pressure tests shall be obtained from a private company (THE CITY DOES NOT PERFORM THIS TEST.).

iii. Fire hydrants shall comply with the approved list or an approved equal conforming to the requirements set forth in the NCTCOG Standards Specifications for Construction. All fire hydrants shall be installed with a six-inch (6") gate valve on the hydrant lead. The installation shall be as set forth in these Standards of Design and Construction. Fire hydrants shall be painted to meet the City's requirements for color code as set forth in the NCTCOG Standard Specifications. In general, the fire hydrant will be reflective silver with differing cap color, which corresponds to the size of hydrant feeder line, as detailed in Approved Water Materials List in the Attachment D.

iv. Fire hydrants shall be installed at the end of each dead-end line. Minimum lead size for a fire hydrant shall be eight-inches (8") if main is fifty-feet (50') or longer. Fire hydrant leads may not be longer than one-hundred-fifty-feet (150'). Fire hydrants are not to be powder coated. Fire hydrant nozzles are to be a minimum of nineteen-inches (19") to a maximum of twenty-eight-inches (28") above final grade.

v. Nozzle diameter shall be two (2) hose nozzles measuring two and one-half-inches (2 ½") nominal inner diameter and one (1) pumper nozzle measuring four-and-one-half-inches (4 ½") nominal inner diameter. All nozzles are to have National Standard Hose Threads. The operating nut and nozzle nuts shall be one-and-one-half-inch (1 ½") pentagon-point to flat size/shape.

1. Standard fire hydrant barrel shoe depth wherever practical shall be five-feet (5'). The fire hydrant lead line shall be adjusted to meet the standard fire hydrant depth.

2. 2. The connection to the main line shall include a flanged tee connected to a flange by mechanical joint gate valve. The mechanical joint shall be restrained so that the fire hydrant is anchored to the valve.

3. Specifications - Fire hydrants shall be three-way breakaway type no less than five and one-quarter-inch (5-1/4") size. Mechanical joint connection is required.

(l) **Water Service Connections.** Service connections shall be in accordance with the designs shown on the Standard Details. The materials shall comply with approved list or approved equal and shall be installed in accordance with this *Standards of Design and Construction*.

(1) All service pipelines shall be constructed of SDR-9 (Polytube) having a minimum size of one-inch (1"). All connections shall be compression type or approved equal.

(2) Detector pads embedded in sand shall be installed above all service connections.

(3) All meter boxes for residential properties shall be set between the sidewalk and the back of curb. If sidewalk is located on the back of curb, the water meter shall be set between sidewalk and edge of ROW.

i. Meter box tops shall be set one-half-inch to one-and one-half-inch (1/2" to 1 ½") above the curb, and a meter stop shall be set six-inches (6") below the meter box top.

ii. An angle meter stop shall be set six-inches (6") below the meter box.

iii. Meter boxes shall have a one-inch (1") wide slot from five inches (5") below the top of the box to the bottom of the box on the side facing the lot for service connection.

(4) Any meter box installed in paving shall be traffic rated.

(5) Water meter shall not be located within a driveway or drive approach unless it is a traffic rated box and lid.

(6) A domestic and/or irrigation service connection shall not be allowed on fire hydrant leads.

(7) Installation of multiple meters per water service will not be allowed. Only one (1) meter service shall be allowed. Bull Heading of services and meters shall not be allowed except for special conditions and approved by the Director of Public Works and/or the City Engineer.

(8) Service saddle shall be double bronze flattened straps (**no banded straps shall be allowed**) with brass body. Service saddle shall be per the approved material list. Minimum size tap shall be one-inch (1") diameter.

(9) Water meter sizes shall not be bigger than the service line size from the water main to the meter.

(10) All meters two-inch (2") and under shall be purchased from the City and will be at developer's/contractor's expense. All meters greater than two inches (2") must be approved by the City and shall be furnished and paid for by the Developer/contractor.

(11) Concrete meter vaults are required for meter sizes three-inches (3") and larger, meters and vaults shall be provided by the contractor. Meter vaults shall be sealed on the outside of the vault to prevent water from draining in to the vault. Meter vault and meter requirements are shown in the Standard Details.

(12) Bending of water service from main to meter should be avoided.

(13) Residential Water Meters:

i. In single family residential developments, the nearest edge of the water meter box shall be a minimum of six-inches (6") behind the back of curb, and the water service shall be no more than twelve-inches (12") deep, covered with a meter box in place at grade.

1. If no curb is present, the water meter shall be located at the right-of-way line, no more than twelve-inches (12") deep, covered with a meter box in place at grade.

2. Along roadways without a curb, the water service line shall be constructed at a minimum of twenty-four-inches (24") below the ditch flowline. Meter boxes shall not be placed in the invert of a ditch.

ii. For multi-family, condominium, and townhouse developments installation of multiple meter boxes: may only be installed at approved locations. Each service box shall service one (1) lot/building. Installation on multiple meters per water service will not be allowed. Only one (1) meter per service will be allowed. All meters are to have a testable double check backflow device install below grade at the meter.

(14) .....Non-Residential Water Meters:

i. Installation of non-residential three-inches (3") and larger meters will include two (2) mainline valves, one (1) bypass valve with chain and lock, and bypass line, all located inside the vault. Clearances between fasteners on valves, strainers, and meters to interior surfaces shall provide adequate room for maintenance. All meters are to have a testable double check backflow device install below grade at the meter.

ii. Non-residential and multi-family water meters shall be located within the right-of-way or within a water easement and clear of high traffic areas. Location within the ROW shall match that of **Section 02.031.0519(l)(3) Water Service Connections** above. All meters are to have a testable double check backflow device install below grade at the meter.

iii. Water meter vaults shall be sized according to the size of the water meter and to allow for a minimum of a twelve-inch (12") clear working area for maintenance and operation. Minimum water meter vault sizes are shown in the *Standard Details*.

iv. Non-residential domestic irrigation meters shall have a testable double check backflow preventer at the meter.

(m) **Abandonment of Water Mains.**

(1) The engineer is to note the limits and appropriate conditions for abandoning existing water mains that are being replaced. For lines being abandoned, the engineer should note and locate points of cut and plug at the junction with the line that remains in service.

(2) The engineer shall make allowances to permit the existing and proposed mains to remain in service simultaneously thereby providing a means for transferring customer's services from the old main to the new main with minimum interruption.

i. If the construction of a proposed water main necessitates the abandoning of the existing main prior to the new main's placement into service, then provisions for a temporary water main with services must be addressed with the design.

(3) Abandoned water lines to remain in place shall be cut and plugged and all void spaces within the abandoned line shall be filled with grout, flowable fill or an expandable permanent foam product.

i. Valves, to be abandoned, in place shall have any extensions and the valve box removed and shall be capped in concrete.

(4) Existing fire hydrants and valves located on mains being abandoned are to be removed and delivered to the Public Works Department.

SEC. 02.031.0520 ..... WASTEWATER SYSTEM

(a) **General.**

(1) All facilities shall be sufficient size to provide adequate capacity for the ultimate development. The wastewater lines shall be sized to meet the peak day dry weather flow plus an appropriate allowance for infiltration of storm water per TCEQ. The minimum wastewater main size (other than service lines) for all developments shall be eight-inches (8") in diameter.

i. The design criteria and calculation shall be submitted to the City with the Construction Plans.

ii. Wastewater systems shall be designed so that all wastewater mains will be gravity flow. The use of a wastewater lift station can only be allowed with written approval by the Director of Public Works and/or the City Engineer.

iii. The City reserves the right to require a wastewater main of a larger size than that required by the development in order to provide capacities for areas outside of the development.

(2) Connections to substandard mains and manholes shall not be allowed. Substandard mains shall be determined by the Director of Public Works and/or the City Engineer based on criteria including, but not limited to: size, material, condition, flow rate, capacity, etc. Offsite improvements may be necessary to provide adequate wastewater service to the site.

(3) All wastewater mains shall be installed at a depth sufficient to permit all water mains to be above the wastewater when the water main has a minimum cover of four-feet (4').

i. In such cases where water mains either cross or otherwise come within ten-feet (10') of a wastewater main, the wastewater main may be PVC pressure pipe with a minimum working pressure class of one-hundred-fifty-pounds-per-square-inch (150 psi) or encased in concrete.

(b) **Ownership and Maintenance**.

(1) Ownership - Ownership of wastewater systems shall conform to the following:

i. Wastewater mains within right-of-way or easements shall be owned by the City. This shall include the manholes and cleanouts on those lines.

ii. Wastewater service laterals shall be owned by the property being serviced, from the wastewater main connection to the structure being serviced. This includes any and all manholes and cleanouts on the service lateral.

(2) Maintenance - Maintenance of wastewater system shall conform to the following:

i. Wastewater mains within right-of-way or easements shall be maintained by the City. This shall include the manholes and cleanouts on those lines.

ii. Wastewater service lateral shall be maintained by the property owner being served from the structure to the right-of-way line and the City shall maintain from the right-of-way line cleanout to the wastewater main.

(c) **Connections to Existing Wastewater Collection System**.

(1) Preliminary discussion concerning entrance points in the wastewater system should be conducted with the Director of Public Works and/or the City Engineer prior to finalizing the preliminary designs of the wastewater collection system to serve the development.

(2) In a proposed development where City wastewater facilities are not adjacent to the property but are accessible, the developer shall provide, at his expense, an off-site wastewater interceptor of sufficient size to serve his development and the contributing service area (using fully developed flows), or as shown on the City's *Wastewater Master Plan*, whichever is larger.

i. Through a Pro Rata, a Development Agreement and/or a Facilities Agreement a Developer can request City participation (if funds are available) for wastewater over-sizing above twelve - inches (12"), where the City collects a pro-rated amount as other developments connect to the system. The City participation must be approved by the City Council. This money would be distributed back to the Developer that constructed the over-sized system. All wastewater mains shall be extended to the property lines for future connections.

(3) Connections to Existing Wastewater Mains – When connecting a six inch (6") or larger new line to an existing wastewater main the engineer shall provide a new manhole at the point of connection. Prior to breaking into the existing line the new manhole and upstream pipe segment shall pass inspection by the Director of Public Works and/or the City Engineer. Connections in residential locations shall be completed after the preliminary walk through has been performed by the Director of Public Works and/or the City Engineer and approval is granted.

(4) In general, the City will not approve a development which cannot be served by extensions to the City's wastewater collection system unless the development has received an approved exception granted by City Council.

(d) **Design Flow**.

(1) All wastewater collection systems shall be designed in accordance with the current City's *Wastewater Master Plan*.

(2) Where possible, all collection systems will be laid out so that all lines will be gravity flow, unless approved by the Director of Public Works and/or the City Engineer.

(3) All wastewater collection systems must be designed to covey the peak wet weather flow from the entire service area including off-site areas through the system. The basin delineation shall be provided by using the latest Light Detection and Ranging (LiDAR) and surveyed contours. Contours shall be provided on two-foot (2') or less intervals.

(4) Flow calculations must include the specifics of the average daily flows, peak factor (ratio of peak to average flows) and the allowance for inflow and infiltration.

(e) **Sizing Wastewater Collection Mains**.

(1) General.

i. The engineer shall reference the *Wastewater Master Plan* to determine the size of wastewater mains required in order to serve the development. For all developments or re-developments that propose a change in existing land use (change in density) that does not conform to the City's current *Wastewater Master Plan* a Wastewater System Capacity Study shall be performed. This shall be done as per **Section 02.03.0512 – System Capacity Studies.**

ii. The standard wastewater pipe sizes that shall be used are noted in the **Table 5.5. Standard Wastewater Collection System Pipe Sizes**.

Table 5.5: Standard Wastewater Collection System Pipe Sizes

8 inch	10 inch	12 inch	15 inch	18 inch
21 inch	24 inch	27 inch	30 inch	33 inch
36 inch	39 inch	42 inch	48 inch	54 inch
60 inch	------	------	------	------

(2) Average Daily Flow.

i. **Table 5.6 Wastewater Per Capita and Usage Rates** shall be used to calculate the average daily wastewater flow. The collection system shall be designed based on the peak flow calculations, plus an allowance for Inflow and Infiltration per TCEQ.

ii. For replacement of existing sewer for additional capacity, wastewater flow data will be provided by the Director of Public Works and/or the City Engineer.

iii. Wastewater mains with direct connections to service lines shall be designed to be no more than seventy-percent (70%) full and interceptors shall be designed for one-hundred-percent (100%) full.

iv. **Table 5.6 Wastewater Per Capita and Usage Rates** summarizes the residential and non-residential land use wastewater usage rates. Land uses not listed shall be classified by the land use they most nearly resemble in **Table 5.6 Wastewater Per Capita and Usage Rates** or calculated by the engineer in accordance with the anticipated use. The engineer shall submit the average daily flow and peak flow calculations including off-site flows within the drainage basin to the Director of Public Works and/or the City Engineer for review and approval.

1. .The City reserves the right to assign a higher wastewater usage rate and/or population per unit to be used for developments anticipated to generate higher than typical usage rates.

(3) Peak Flow Factor are as follows:

i. For average daily flow less than 0.05 MGD – Peak Flow Factor = 5.

ii. For average daily flow between 0.05 MGD and 1.0 MGD – Peak Flow Factor = 4.

iii. For average daily flow between 1.0 MGD and 2.0 MGD – Peak Flow Factor = 3.5.

iv. For average daily flow greater than 2.0 MGD – Peak Flow Factor = 3.

(4) Inflow and Infiltration - After determining the peak flow amount, the engineer shall add an average daily inflow and infiltration rate in accordance with TCEQ guidelines. The inflow and infiltration amount calculated shall be added to the peak flow calculated, with the resultant being the peak wet weather flow, the basis for design.

Table 5.6: Wastewater Per Capita and Usage Rates

Land Use	Units per Acre	Population per Unit	Average Daily Flow (gallons per person or unit /day)	Average Daily Flow per Acre (GPAD)
Residential				
Single Family - Low Density	3.5	2.87	90	
Single Family - Medium Density	5.0	2.87	90	
Single Family - High Density	10.0	2.87	90	
Townhome	12.0	2.5	90	
Multi Family	24.0	2.00	80	
Mobile Home Park	10	2.87	150	
Non-Residential				
Mixed Use / Live Work / Downtown				800
Commercial Retail / Business Center				800
Public / Quasi-Public				1,000
Commercial Industrial				1,500
Special Commercial Corridor / Technology Employment Center				1,200
Light Manufacturing[1]				1,500
Heavy Manufacturing[1]				3,000
Schools (Elementary)			30 per student	
Schools (Middle / High Schools / Colleges)			30 per student	
Hospitals			400 per bed	
Nursing Homes / Assisted Living			300 per bed	
Restaurants			50 per seat	
Hotels			200 per room	
Parks and Open Space				0
Golf Course				100

NOTES:

[1] USAGE RATES SUBJECT TO CHANGE. ENGINEER FOR THE PROPOSED DEVELOPMENT SHALL PROVIDE ESTIMATES OF THE AVERAGE DAY AND PEAK HOUR WASTEWATER FLOWS BASED ON THE EXPECTED RATES OF USE FOR THE PROPOSED DEVELOPMENT. CITY WILL REVIEW AND PROVIDE DETERMININATION OF ANY REQUIRED CHANGES.

(f) **Wastewater Mains**.

(1) Wastewater pipelines shall be located in the parkways between the back of the curb and the street right-of-way. The location shall be six-feet (6') from the back of the curb on the south side of east-west streets and on the east side of north-south streets.

(2) A green EMS Locator Pad is to be installed at every manhole, cleanout, and service connection to the wastewater main.

(3) If a wastewater line is to be constructed greater than ten-feet (10') in depth and services are required, then a parallel line is to be constructed at a depth shallower than ten-feet (10'). The deeper line shall be in the center of the pavement and the shallower line with services shall be six-feet (6') from the back of curb toward the right of way and not on the same side as the water line. Depending on depth and exact location of the main, additional easement width may be required. An alternative to a parallel line is a special service connection, with approval by Director of Public Works and/or the City Engineer only.

(4) No wastewater main less than ten (10) inches shall be located nearer than five (5) feet from any tree. No wastewater main ten (10) inches or greater shall be located nearer than ten (10) feet from any tree.

(5) Wastewater mains should not be designed to pass through single-family lots or between single-family lots.

(g) **Wastewater Pipe Material.** – Allowable pipe materials for gravity wastewater mains shall be per **Table 5.7. Pipe Materials for Wastewater Gravity Mains**.

Table 5.7 Pipe Materials for Wastewater Gravity Mains

Pipe Size	Pipe Material
4 inch through 15 inch	Green PVC – SDR 35 (ASTM D3034) [less 10 ft cover] Green PVC – SDR 26 (ASTM D3034) [10 ft or more cover]
18 inch and Larger	Green PVC – PS 46 (ASTM F679) [less 10 ft cover] Green PVC – PS 115 (ASTM F679) [10 ft or more cover]

(1) Pipe shall have a minimum earth cover of four feet (4'). All pipes shall be installed in embedment material as shown on the Standard Details and in conformance for the Standard Specification for Construction.

i. Any main with less than the minimum cover shall be encased in concrete and is subject to approval by the Director of Public Works and/or the City Engineer. Depth of cover greater than twenty feet (20') must be approved by the Director of Public Works and/or the City Engineer.

ii. All pipelines shall be tested for infiltration in accordance with TCEQ.

(h) **Minimum Grades. -** Wastewater lines should operate with velocities of flow sufficient to prevent excessive deposits of solid materials, otherwise objectionable clogging may result. The controlling velocity with regard to sediment deposition is near the bottom of the conduit and considerably less than the mean velocity flowing full of two and a half feet per second (2.5 fps). **Table 5.8**. **Minimum Grades for Wastewater Pipelines** indicates the minimum grades for wastewater pipe with a Manning's "n" = 0.013 and flowing at two and four tenths' feet per second (2.4 fps).

TABLE 5.8: MINIMUM GRADES FOR WASTWATER PIPELINES

Pipe Size (Inches)	Slope (n = 0.013) (Foot/Foot)	Pipe Size (Inches)	Slope (n = 0.013) (Foot/Foot)
6	0.0050	39	0.0006
8	0.0033	42	0.0006
10	0.0025	45	0.0005
12	0.0023	48	0.0005
15	0.0023	54	0.0004
18	0.0018	60	0.0004
21	0.0015	66	0.0004
24	0.0013	72	0.0003
27	0.0011	78	0.0003
30	0.0009	84	0.0003
33	0.0008	96	0.0002
36	0.0007		

(i) **Curved Sewers.**

(1) No vertical curves will be allowed. Horizontal curvature may be allowed by joint deflection or pipe flexure but not both. The Engineer must specify on the plans the method of deflection allowed and the allowable radius or joint deflection for each pipe size. Refer to TCEQ for additional requirements.

(2) When pipe flexure is used, the minimum radius of curvature shall be equal to that recommended by the pipe manufacturer or three hundred (300)*OD, where OD is the average outside diameter of the pipe in inches, whichever is greater. The Engineer shall note on the plans that when using pipe flexure, all joints are to remain fully seated.

(3) If a joint deflection will be used to provide horizontal curvature, the allowable deflection shall be five degrees (5°) or eighty percent (80%) of the manufacturer's recommended maximum joint deflection, or eighty percent (80%) of the National Reference Standard maximum recommended joint reflection, whichever is less. When joint reflection is used, the Engineer must specify the size of mandrel used for reflection testing. The mandrel shall be sized to verify that the maximum joint deflection has not been exceeded.

(4) Horizontal curves shall match change in street direction as near as possible.

(j) **Wastewater Service Laterals.**

(1) Wastewater service pipelines shall be laid to each lot. The service pipelines shall be plastic pipe having a minimum diameter of four inches (4") and shall extend to the property line. Wastewater service pipelines shall be located on the lower side of each lot and as approved on the final Construction Plans by the City. In general, a service pipeline shall serve only one (1) lot.

(2) Special wastewater service sizing may be required in some instances. Where water and wastewater pipelines pass within ten feet (10') of each other horizontally, the method of construction shall be specified in order to meet TCEQ criteria.

(3) No wastewater main less than ten (10") shall be located nearer than five feet (5') from any tree. No wastewater main 10-inches or greater shall be located nearer than ten (10) feet from any tree.

(4) Service lines cannot connect to wastewater mains that are over ten feet (10') deep unless a special service connection is approved by the Director of Public Works and/or the City Engineer.

(5) Service laterals shall have a minimum horizontal separation of ten feet (10') downstream from any water service.

(6) Bends in services under roadway pavement should be avoided.

(7) *Retail and Commercial*. Service lateral size shall be six (6) inch minimum at a two percent (2%) minimum grade.

(k) **Manholes.**

(1) In general, manholes shall be located at all intersections of wastewater pipelines, changes in grade, changes in alignment, non-single family residential service connections, and at distances not to exceed five hundred-feet (500'). A manhole maybe required for a residential sewer service six inches (6") or larger.

(2) Manholes should not be installed in parking stalls, inverts within pavement, gutter lines, or sidewalk ramp flares.

(3) All manholes will be hydrostatically, or vacuum tested. For manholes that have an epoxy coating after constructed, a test will be required prior to acceptance. Manhole sizing shall be per **Table 5.9. Minimum Manhole Sizes** with a thirty-inch (30") lid. If a manhole exceeds ten feet (10') in depth, increase the diameter by one -foot (1') from the sizes given in **Table 5.9.** *Minimum Manhole Sizes.*

Table 5.9: Minimum Manhole Sizes

Wastewater Main Size	Minimum Manhole Diameter
6", 8" and 10"	4.0 foot [1]
12", 15", 18", 21", 24" and 27"	5.0 foot [1]
30" and 36"	6.0 foot [1]

Notes:

[1] INTERNAL DROP MANHOLES SHALL BE SIX FEET (6') MINIMUM.

(4) Manholes shall be a minimum of four thousand two-hundred pounds per square inch (4,200 psi) pre-cast concrete (minimum six and a half (6.5) sack mix) or cast-in-place (minimum seven (7.0) sack mix) and shall conform to Standard Details and the Standard Specifications for Construction. Existing brick manholes shall be replaced. All private manholes shall have covers with the label "Private" forged into the cover.

(l) **Internal Drop Manholes.**

(1) Internal drop manholes shall be required when the inflow elevation is more than eighteen-inches (18") above the outflow elevation. New internal drop manholes shall be constructed with inside drops with a six-foot(6') minimum diameter.

(2) Depending on the depth of the drop manhole and inside clearances between drop bowl apparatus and the manhole, the Director of Public Works and/or the City Engineer may increase the minimum diameter above six-feet (6').

(3) Drop manholes shall increase in diameter as necessary to accommodate the pipe for an internal drop connection as necessary to provide forty-eight-inches (48") of clear space for construction and maintenance operations.

(4) Within the manhole the inverts shall be sloped to maintain a smooth transition through the manhole connecting all inlets and outlets.

(5) Outside drop connections will not be allowed.

(6) Only one (1) internal drop is allowed per manhole.

(m) **Manhole Corrosion Protection.**

(1) All manholes shall have Raven Liner 405 epoxy coating, ConShield, or approved equal. ConShield must have terracotta color dye mixed in the precast and cast-in-place concrete.

(2) Where connections to existing manholes are made the contractor shall rehab manhole as necessary and install a 250-mil thick coating of Raven Liner 405 or approved equal. Manhole shall be replaced at the Developer's/contractor's expense if it cannot be rehabilitated.

(n) **Watertight Sealed Manholes.**

(1) All manholes shall be sealed if located in an area of storm water flow (paving, creek, drain way, etc.). When manholes are placed within the limits of the fully developed one hundred-year (100-yr) floodplain, watertight sealed manholes (Type S) shall be used to prevent the entrance of stormwater and properly vent manhole.

i. Manholes installed in the floodplain shall be a minimum of sixty-inch (60") diameter with a concentric flat top that has a rim elevation two-feet (2') above the limits of the fully developed one hundred-year (100-yr) floodplain. When allowed by the Director of Public Works and/or the City Engineer, manholes may be below the one hundred-year (100-yr) floodplain but must be bolted and gasketed.

ii. Every third (3rd) manhole shall be vented two-feet (2') above the fully developed one hundred-year (100-yr) floodplain elevation or four-feet (4') above the adjacent ground line, whichever is higher.

iii. Manhole rim shall be a minimum of two-feet (2') above ground line but not to exceed four-feet (4') above ground line.

iv. The engineer shall obtain and provide the elevation of the fully developed one hundred-year (100-yr) floodplain. When manholes are installed within a floodplain or open space, a location indicator pole shall be installed on the manhole to help prevent damage and for City to easily locate.

(o) **Inflow Prevention.** - In order to reduce the size of wastewater system main trunk lines and reduce the cost of wastewater treatment, efforts to reduce inflow and infiltration into the wastewater collection system shall be taken. All manholes (public or private) shall be fitted with inflow prevention.

(p) **Cleanouts. -** Cleanouts shall be constructed on the end of all lines. The maximum distance between a manhole and an upstream cleanout is two-hundred-fifty feet (250'). Cleanouts may be located at the end of the line only. Double clean outs shall be installed for non-residential services at the right-of-way line, property line, or easement line where a public line changes to a private service. Cleanouts shall conform to the Standard Details and the Standard Specifications for Construction.

(q) **Testing.**

(1) All wastewater lines shall be tested for infiltration in accordance with the procedures set forth in the Standard Specifications for Construction. In general, all wastewater pipes shall be installed so that the completed wastewater will have a maximum exfiltration of one-hundred fifty (150) gallons per inch of internal diameter, per mile of pipe, per twenty-four (24) hours, where the maximum hydrostatic head at the centerline of the pipe does not exceed twenty-five-feet (25').

(2) All wastewater pipes shall be inspected by photographic means (video/camera) after franchise utility installation but prior to final acceptance. The contractor shall furnish a DVD or flash drive to the Public Works Department Construction Inspector for review. Any sags, open joints, cracked pipes, etc. shall be repaired or removed by the contractor at the contractor's expense. A television survey will be performed as part of the final testing in the twentieth (20th) month of the maintenance period. The City's representative shall be present at all testing. All expenses for this work shall be the Developer's responsibility.

(r) **Abandoning Existing Wastewater Mains and Manholes.**

(1) When an existing wastewater line is to be abandoned all services and laterals on the main to be abandoned shall connect back into the system. All existing wastewater mains that are to be abandoned shall be digitally recorded to determine the location of the services and laterals. A digital copy shall be given to the City Public Works Department Construction Inspector for review before the line is fully abandoned.

(2) All abandoned wastewater and force main lines shall be cut and plugged and all void spaces within the abandoned line shall be filled with grout, flowable fill or an expandable permanent foam product.

(3) Wastewater manholes shall be abandoned per Standard Specifications for Construction.

(s) **Aerial Creek Crossings.**

(1) Aerial crossings for wastewater lines may be used only when all other alternatives have been evaluated and determine not to be feasible. Aerial crossings of wastewater lines require approval of the Director of Public Works and/or the City Engineer.

(2) Aerial crossing shall meet the following requirements:

i. The design of all piers, bents, restraints, abutments, steel casing, etc. for the aerial crossing shall be performed and signed and sealed by a Professional Structural Engineer licensed in the State of Texas.

ii. The engineer of record shall use steel encasement pipe around all aerial carrier pipes. The carrier pipe shall be restrained or welded all around joints or be a monolithic pipe between a span section.

iii. The pier spacing for the aerial crossing supports must maintain adequate grade, and span the one hundred-year (100-yr) floodway.

iv. A span section must withstand the hydraulic forces applied by the occurrence of a one hundred-year (100-yr) flood including buoyancy. Both the aerial crossing encasement pipe and the supporting structure shall be capable of withstanding impacts from debris and water.

v. A scour analysis report prepared by a geotechnical professional engineer shall be submitted to the Director of Public Works and/or the City Engineer.

vi. A Hydrologic and Hydraulics Study of the aerial crossing shall be performed. The aerial crossing shall not increase the one hundred-year (100-yr) floodplain water surface elevations or velocities.

vii. Geotechnical borings at the creek crossing and report shall be prepared by a Professional Geotechnical Engineer licensed in the State of Texas.

viii. Wastewater lines shall have manholes on each side of the crossing.

ix. The upstream bent/abutment section of the aerial crossing shall be designed with a minimum two-inch (2") underdrain at the flowline of the embedment to collect infiltration that is traveling within the upstream embedment of the aerial crossing. This shall day light at the aerial crossing current day slope to prevent erosion of the aerial crossing at the upstream end.

x. The aerial crossing shall be designed to extend to the erosion hazard setback line with piers and bents.

(t) **Inverted Siphon**. Inverted siphons at creek crossings for wastewater lines are not allowed.

SEC. 02.031.0521 ..... WASTEWATER LIFT STATIONS AND FORCE MAINS.

(a) **General.**

(1) All lift station design plans and specifications shall be submitted to the Director of Public Works and/or the City Engineer, and TCEQ for review and approval prior to construction. Lift stations and force mains shall be designed and built for the upstream drainage area using a fully developed condition. This will include off-site areas if applicable. Developers are responsible for the construction of regional lift stations and force mains, per the *Wastewater Master Plan*.

(2) Developments which increase the flow to existing lift stations will be subject to a pro-rata charge if sufficient capacity is available in the existing lift station or will be required to increase the capacity of the existing facility. Developers can request a pro-rata agreement, Facilities Agreement and/or Development Agreement be executed with the City, where the City collects a pro-rated amount as other developments connect to the system. This money would be distributed back to the developer that constructed the oversized system. The pro-rata agreement requires approval by City Council.

(3) The Developer, engineer, or property owner requesting the proposed change in land use shall enter into a Professional Services Agreement with the City to retain consultants to provide a wide variety of professional services including, but not limited to engineering, financial and legal services as needed in accordance with the Subdivision Regulations, Section 02.03.044 *Facilities and Professional Services Agreements, Financial Assurances and Construction Contracts for Public Improvements* agreeing to an estimated specified retainer to assist City staff in the review of a report, study, and/or plans for wastewater lift stations and force main

(b) **Lift Station and Force Main Design Report and Plans.** A lift station and force main design report shall be prepared and signed and sealed by a register professional engineer licensed in the State of Texas.

(1) Lift Station and Force Main Design Report. The digital report shall include the following information at a minimum:

i. A brief summary of project that includes:
    1. General description of proposed development
    2. General explanation on circumstances that warrant a lift station including other options considered.
    3. Description of any potential phasing of lift station until sewer basin is built-out if Director of Public Works and/or the City Engineer approves lift station size less than fully developed conditions.

ii. Influent hydraulic calculations showing:
    1. Area in acres of the sewer basin and the development.
    2. The area of each proposed use for the development and the ultimate projected use for the basin per City Future Land Use Plan.
    3. The average design flow and the maximum peak flow for the basin and the development.
    4. Elevation of the proposed lift station site.
    5. The elevation of the proposed discharge point of the force main.

iii. Wet well volume calculations.

iv. Force main size with proposed velocities in pipe.

v. Power outage records on electric provider letterhead for power outages in area for the past twenty-four (24) months.

vi. Opinion of probable costs for lift station, force-main, and annual operating and maintenance costs.

vii. Ground water levels in proposed site area.

viii. Proposed system's effect on existing system's capacity.

ix. Odor control methods shall be submitted to the Director of Public Works and/or the City Engineer for review and approval. The potential odor determination must include the estimated flows immediately following construction and throughout a system's fifty-year (50-yr) expected life cycle.

(2) Lift Station and Force Main Design Plans. The plan or plans submitted shall contain the following minimum information.

i. Scale.

ii. North Arrow.

iii. Vicinity map.

iv. Delineation of the boundary of the proposed development and off-site areas of the sewer basin (service area) in which the development lies. Basin delineation shall be provided using NCTCOG, LiDAR or surveyed contours. Contours shall be provided on two (2') foot or less intervals. USGS topo is not permissible.

v. Area in acres of the development and of the sewer basin contributing to the lift station.

vi. Proposed use or uses for the development and service area.

vii. The proposed lift station location.

viii. Delineation of the one-hundred-year (100-yr) fully developed flood plain, FEMA one-hundred-year (100-yr) flood plain and erosion hazard setbacks.

ix. The location and size of the existing collection system at the tie-in point.

x. Property lines, easement lines, and right-of-way lines.

(3) Lift Station Site Requirements. The lift station site shall conform to the requirements in these subsections and **Figure 5.1**, **Typical Lift Station Site Layout**.

i. Lift Station Site Access.

1. Access drive will be provided by a reinforced concrete pavement from a public street and/or dedicated access easement. Concrete shall be a minimum eight-inches (8") thick, 3,600 PSI (six and half (6.5) sack/CY) with #4 bars at eighteen-inch (18") OCEW reinforced concrete pavement with a minimum of twenty-feet (20') in width and forty-feet (40') in length (within fenced area of lift station) to allow maintenance vehicles to park fully outside of the right-of-way.

2. When an access drive for the lift station connects to a City Thoroughfare or Texas Department of Transportation (TXDOT) designated highway a "T" shaped turnaround shall be provided with applicable turning radii. The alignment of the drive shall allow maintenance vehicles the ability to back up straight to the wet well.

3. Access shall be functional during a one-hundred-year (100-yr) flood. All area within the lift station fencing and access drive shall be a minimum of one-foot (1') above the water level caused by a one-hundred-year (100-yr) fully developed floodplain.

(4) Lift Station Security.

i. At a minimum, security of the lift station site shall be provided by an intruder-resistant fence (IRF) to restrict access by an unauthorized person(s). The IRF shall be placed around the perimeter of the site encompassing all interior structures and appurtenances shall maintain a minimum five-foot (5') clearance from all lift station components and seven and a half -foot (7.5') minimum off of lift station piping.

ii. The IRF shall comply with all TCEQ regulations and shall comply with the requirements for ground mounted utility structures as specified in Section 38.3.E., Fence Regulation of the Zoning Ordinance. The IRF shall be a minimum of eight-feet (8') aluminum picket fence with a twenty-foot-wide (20') minimum double swing gate for access. All components shall be manufactured from aluminum extrusions having a minimum ultimate strength of thirty-five thousand pounds per square inch (35,000 PSI), using 6005 T5 alloy. The fence, post and gates shall be powder coated black with a minimum cure film thickness of two (2) mils.

iii. Technical Data.

1. Pickets. The hollow pickets shall pass through the rails and are to be attached using stainless-steel screws allowing the pickets to be always parallel to the terrain. Screws shall be on one (1) side of rail only. Pickets shall be one (1) inch square x 0.062-inch thick.

2. Horizontal Rails. Rails shall be C-Channels with ribbed reinforced side walls. Square holes shall be punched in the top of the rails to allow the pickets to pass through.

    a. Four (4) rails are required.

    b. *Heavy Industrial Rails* shall be 1⅝-inch by 1⅝-inch with a side thickness of 0.100-inch, top wall thickness 0.070-inch and bottom wall thickness of 0.062-inch, which snaps into the top allowing all screws to be enclosed inside the rail.

3. Posts. . Posts shall be hollow square extrusion with holes pre-punched to allow the rails from the fence sections to slide into them. All posts shall include aluminum post caps. Posts can be placed no more than six-feet (6') apart.

    a. Line Posts and End Posts are three (3) inch square by 0.125-inch thick.

    b. Gate Posts are four (4) inch square x 0.125-inch-thick weighing nine (9) pounds per foot.

4. Gates. Gates shall be fabricated with two (2) inch or 2½-inch square ends, 1⅝-inch by 1⅝-inch rails and one (1) inch square pickets. The gate shall be a double swing gate. Gate shall match appearance of fence panel. The gate shall have a double rail that allows for hidden fasteners and no exposed cavities under the rail. Gate shall be designed and manufactured by the fence manufacturer.

    a. Each gate shall have a hasp for chain locking welded to the frame as detailed in the construction plans.

    b. Gates shall be designed and manufactured by the fence manufacturer.

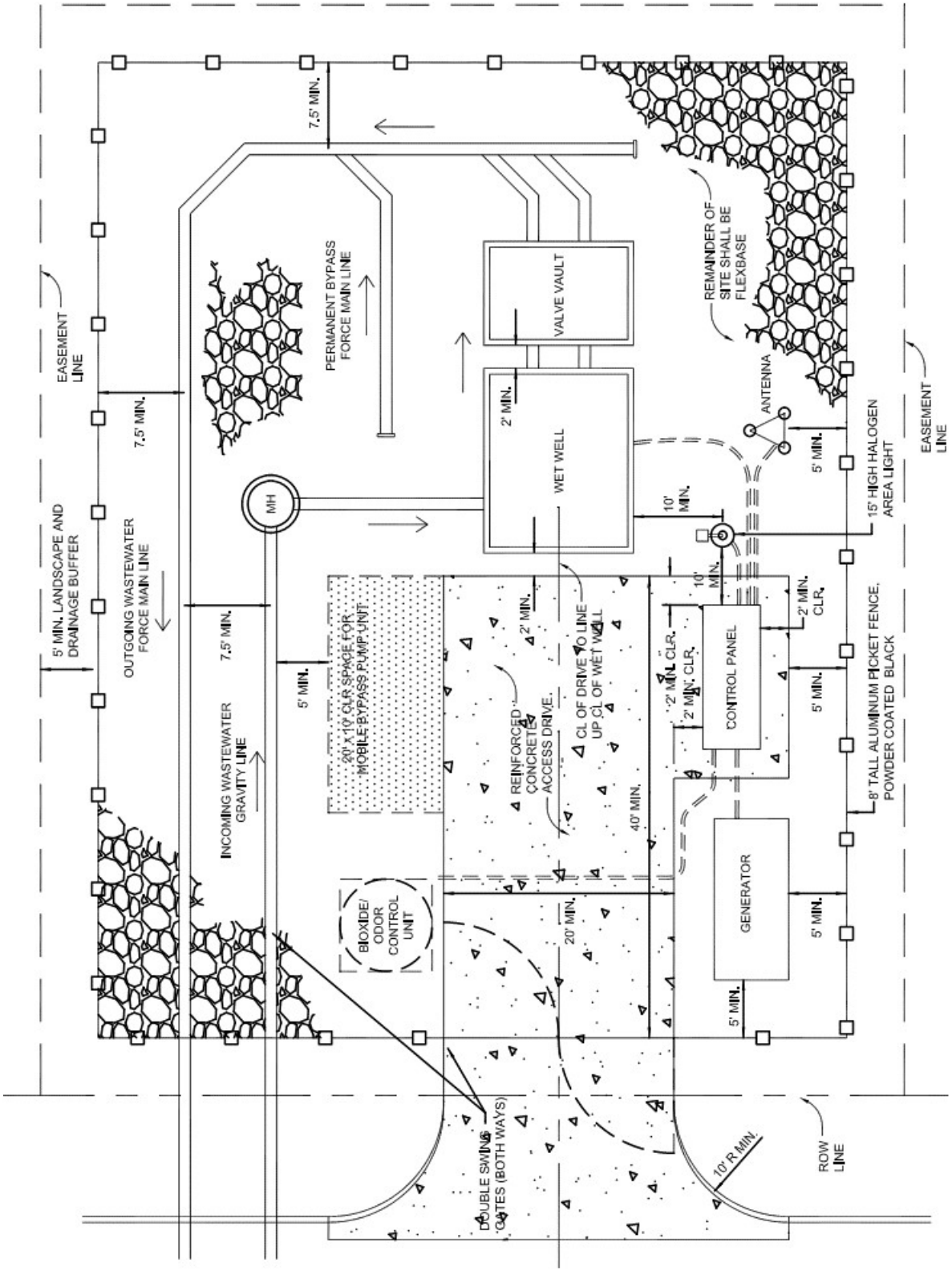
    c. Gates shall be designed and manufactured by the fence manufacturer.

    d. Swing gates shall include cane-bolts for each gate panel. The cane-boll shall have a stop to hold it in the up position for operating the gate.

    e. Hinges shall have minimum ⅜-inch stainless-steel pins.

5. There should be a minimum of a five (5) foot landscape and drainage buffer from the easement line to the lift station fencing. The five (5) foot buffer shall have Chinese Variegated Privet (or similar vegetation as approved by the Director of Public Works and/or Director of Development Services) place within the buffer to screen the lift station site. In residential zoning districts the five-foot (5') buffer shall include dense evergreen shrubs to screen the lift station site

Figure 5.1: Depiction of Lift Station Site Layout



(5) Lift Station Site Interior.

i. Interior of the site that is not part of the access drive shall be a minimum six (6) inches thick flex base. Site shall be graded to drain away from the station to prevent storm water inflow or infiltration into the wet well, valve vault and manholes. The wet well and valve vault top elevation shall be a minimum of twelve-inches (12") higher that interior concrete and flex base.

ii. Control panel shall have a two-foot (2') minimum clear reinforced concrete working area away from face, sides and back of cabinet. Electrical and instrumentation panels shall be located where they do not obstruct vehicle access to the wet well or the dry well. They shall be placed at an elevation so that they are easily accessible.

iii. A fifteen-foot (15') high halogen or light-emitting diode (LED) area light with photometric cell on an aluminum pole shall be placed within ten-feet (10') of wet well and control panel without obstructing daily operations.

(c) **Wet Well Design.** Wet well shall be cast in place or pre-cast watertight and gas tight walls with watertight joint meeting ASTM C478-90. Steel, high-density polyethylene (HDPE) and reinforced concrete pipe (RCP) are not acceptable materials.

(1) Orientation.

i. Orientation shall consider the routing of incoming sewer and force main for ease of maintenance and to minimize effluent turbulence.

ii. Orientation shall allow a five (5) ton vehicle to pull in forwards or backwards directly to the wet well or the dry well.

iii. All influent gravity mains discharging into the wet well shall be located so that the invert/flowline is above the "on" setting liquid level of the pumps.

(2) .Level Sensors.

i. Level control system shall use a pressure transducer with built-in surge protection for pump operation with Off and High-Level Floats as back-up in case transducer fails.

ii. Sensors shall be provided for "All Pumps Off," "Lead Pump On," "Lag Pump On," and "High Level Alarm" levels as well as additional "Lag-Lag Pump On" for lift stations with more than two pumps.

iii. Level Sensors shall be placed in the wet well.

(3) Wet Well and Valve Vault Separation.

i. Wet wells and valve vaults shall be separated by a minimum of two-feet (2').

(4) Wet Well Liner and Coatings.

i. Wet wells shall have a minimum of ten-percent (10%) sloped bottoms to the pump intakes and shall have a smooth finish to avoid excess sludge deposits.

ii. Wet wells shall be ConShield, Raven Lining or approved equal to protect against hydrogen sulfide gases.

iii. Wet wells and valve vaults shall have inflow protection as called out in Standard Details of Construction.

(5) Wet Well Hatches.

i. The wet well shall have a lockable odor suppressing aluminum door with an aluminum frame and safety grate. The minimum opening size shall be four-feet(4') by six-feet (6') with two (2) doors large enough to adequately maintain the wet well.

ii. All hatches shall have accommodations for locking above grade with three-eights - inch (⅜") shaft padlocks provided by the City.

iii. All hatches shall include fall protection as required for safety and approved by the City.

(6) Wet Well Ventilation.

i. The design of a wet well must reduce odor potential in a populated area or as directed by the Director of Public Works and/or the City Engineer.

ii. Passive ventilation structures shall be provided and must include screening to prevent the entry of birds and insects to the wet well. An air vent pipe shall have a minimum diameter of four (4) inches with outlet located one-foot(1') above wet well top.

iii. Continuous mechanical ventilation structures shall be provided with ventilation equipment providing a minimum capacity of twelve (12) air exchanges per hour and be constructed of corrosion resistant material.

(7) Wet Well Cable Strain Relief. A stainless-steel cable holder shall be provided for all cables in the wet well for cable strain relief purposes.

(d) **Wet Well Volume.**

(1) Wet well volume for a submersible pump station is the volume contained above the top of the motor, or as specified by the pump manufacturer.

(2) High level alarm elevation shall be a minimum of sixty-inches (60") below the top of the wet well or forty-eight-inches (48") below the flowline elevation of the lowest service tap, whichever elevation is lower.

i. Alarm shall be sent when both pumps are running on a duplex station or when the level is six-inches (6") to twelve-inches (12") over all pumps running. The Director of Public Works and/or the City Engineer shall approve all situations and levels that need to trigger an alarm.

ii. Wet well volume shall be calculated by **Equation 5.1.** Wet Well Volume:

$$V = \frac{TQ}{4(7.48)}$$

Equation 5.1. Wet Well Volume where:
V = Active Volume, (Cubic Feet)
Q = Pump Capacity, (Gallons Per Minute)
T = Cycle Time, (Minutes)
7.48 = Conversion Factor, (Gallons Per Cubic Foot)

iii. Pump cycle time, based on Peak Flow, must equal or exceed the criteria shown in **Table 5.10: Minimum Pump Cycle Time.**

Table 5.10: Minimum Pump Cycle Time

Pump Horsepower	Minimum Cycle Times
< 50	6 minutes
50-100	10 minutes
> 100	15 minutes

(3) The operation cycle "T" shall not be less than ten (10) minutes for average flow and not more than 60-minutes for minimum flow conditions. The operation cycle time must exceed the manufacturer's requirements.

(e) **Valve Vault**.

(1) Valve vaults shall have sloped bottoms towards a floor drain to remove liquid build up. The floor drain line from the valve vault connecting to the wet well must prevent gas and liquids from entering valve vault.

(2) The valve vault shall have a lockable aluminum door with an aluminum frame. The minimum opening size shall be two-feet (2') by three-feet (3') or large enough to adequately maintain the valve vault.

SEC. 02.031.0522 ..... PUMPS, LIFT STATION PIPING, AND VALVES.

(a) **Pumps.**

(1) Stations shall contain a minimum of two (2) pumps and shall be capable of handling peak flows with one (1) pump out of service.

(2) All pumps shall be explosion proof, non-clog, submersible type capable of passing a two-and-a-half-inch (2½") diameter sphere or greater. Vortex impellers shall be used to prevent clogging.

(3) Pumps shall be sized to operate at optimum efficiency. Minimum acceptable efficiency at the operating point will be-percent sixty-percent (60%). The minimum required horsepower for the motor must be capable of handling the entire range as shown in the pump curve. Where necessary, a higher horsepower pump will be required to prevent any damage to the motor as a result of loss of hydraulic head situation.

(4) All submersible pumps shall be equipped with an automatic flush valve attached to the pump volute using the hydraulic energy created by the pump operation to temporarily suspend settled materials.

(5) The pump rail system shall be MTM Sch 40 stainless-steel with supports on eight (8) feet maximum spacing.

(b) **Pump Capacity.**

(1) The firm pumping capacity shall be greater than the peak flow for the entire fully developed drainage basin. If the fully developed drainage basin is significantly larger than the proposed development and it is not feasible to design for this flow, the firm capacity may be designed to handle a portion of the basin with the ability to expand for the ultimate basin capacity with approval from the Director of Public Works and/or the City Engineer.

(2) The pump curves shall be selected so that during normal operating conditions the pumps will run near the best efficiency point. The curves shall not approach shut off head when the pumps are running together.

(3) System head curves, pump curves, and head calculations shall be submitted. Calculations and pump curves at both minimum (*all pumps off*) and maximum (*last normal operating pump on*) static heads, and for a C value of both one-hundred (100) and one-hundred-forty (140) must be provided for each pump and for the combination of pumps with modified pump curves. Head calculations shall be the sum of static head, friction head in force main and lift station piping, and a fittings head.

(4) Flow calculations, system curves, and head calculations shall be shown in the construction drawings as well as in a final design report. Final design report shall include all of the preliminary design submittal requirements with the exception of the replacement of final design information.

(c) **Lift Station Piping.**

(1) Piping inside the lift station shall be ductile iron Class 200 PSI, AWWA C151-75, C171-76, or latest edition thereof. Pipe joints within the wet well or valve vault shall be flanged. All fittings shall be ductile iron Class 250 meeting AWWA C110-77 or latest revision for sizes 12-inches and smaller or Class 150 on sizes 14-inches and larger. All pipe and fittings shall have a prime coat on the outside surface and shall have an interior lining of forty-manual-in-line-stabilization (40-mils) nominal dry film thickness of Protecto 401 Ceramic Epoxy Lining or approved equal, applied in accordance to the manufacturer's recommendations.

(2) All nut and bolt assemblies inside the wet well shall be ASTM 316 stainless-steel.

(3) Lift station piping shall be designed with an additional emergency by-pass pump connection, allowing the station to be operated with the primary pump(s) out of service for an extended period of time. The by-pass pump connection shall be fitted with a CamLock fitting and cap. Bypass piping shall be supported by a strut type pipe support set in a reinforced concrete pad. By-pass piping and valves shall maintain a minimum of a twenty-four-inch (24") clearance from the ground.

(d) **Valves.** (Isolation valves, check valves, and air release/vacuum valves shall be located in the valve vault)

(1) Isolation Valves.

i. Each pump shall have one isolation valve downstream of the pump and check valve, including a discharge pressure gauge between the pump and isolation valve. Isolation valves shall be resilient seated gate valves meeting the City Standard Specifications. The discharge pressure gauge shall be a minimum of four-inch (4") diameter within the appropriate pressure ranges for the design.

ii. All external nuts and bolts shall be ASTM 316 stainless-steel.

(2) Check Valves.

i. Check valves shall be a controlled closing swing check valve with a lever and spring.

ii. Check valves shall be located upstream of the isolation valve.

iii. All external nuts and bolts shall be ASTM 316 stainless-steel.

(3) Air Release/Vacuum Valves.

i. Air release valves of a type suitable for wastewater service shall be installed along the force main where the force main would be prone to trapped air.

ii. The type of valve shall be air release or a combination of air release and vacuum breaker. Valves shall be fitted with blow off valves, quick disconnect coupling and hose to permit back flushing after installation without dismantling the valve.

iii. All external nuts and bolts shall be ASTM 316 stainless-steel.

iv. The engineer shall determine the valve type and location. The calculations for valve type and valve sizing shall be provided to the Director of Public Works and/or the City Engineer.

v. Isolation valves for three-inch (3") and smaller air release valves shall be all bronze or brass. Isolation valves four-inch (4") and larger shall meet standard specifications for resilient wedge gate valve.

vi. Locations of the air release/vacuum valves shall be shown on the plan and profile sheets for the force main

SEC. 02.03.0523. ..... **FORCE MAIN.**

(a) **General.**

(1) Force main capacity shall be sized to meet the pump capacity. The force main shall be sized to handle the ultimate basin capacity. The force main may be designed to handle a portion of the basin with the ability to expand for the ultimate basin capacity if approved by the Director of Public Works and/or the City Engineer. The minimum force main size shall be four-inch (4") diameter except for grinder pump lift stations.

(2) The minimum recommended velocity is three-feet (3') per second, and the velocity shall not be less than two-and-a-half feet (2.50') per second when only the smallest pump is in operation.

(3) Force main sewer pipe shall be designed to meet the working pressure requirements of the particular application. Design calculations and pipe selection shall be submitted to the Director of Public Works and/or the City Engineer in report format.

(4) A force main must be designed to abate any anticipated odor.

(5) Force main pipe materials shall AWWA C900-16 PVC Pipe (*green in color*) for all sizes, DR 14 (*PC 305*) for pipeline sizes twelve-inch (12") and smaller, and DR 18 (PC 235) for fourteen-inch (14") and larger wastewater pipelines. The design engineer shall select the DR specification based on design for pressure and including surge, and submit calculations with design report.

(6) For trench depths greater than twelve-feet (12') or other dead and/or live loading considerations, the engineer shall provide a pipe with the appropriate DR rating which shall exceed the minimum requirements.

(7) All fittings shall be wrapped in ductile iron in accordance with AWWA C110 or AWWA C153. Fittings shall have a prime coat on the outside surface and shall have an interior lining of forty-manual-in-line stabilization (40-mils) nominal dry film thickness of Protecto 401 Ceramic Epoxy Lining or approved equal, applied in accordance to the manufacturer's recommendations.

(8) Isolation valves shall be a maximum spacing of one-thousand-feet (1,000') and at critical locations along the force main.

(9) All valves and fittings shall be restrained with Mega-lug or approved equal. Joint material for PVC shall conform to ASTM F471.

(10) Plans shall include plan and profile for the force main.

(11) Force main shall have a minimum of four-feet (4') of cover and be laid to standard specifications for potable waterline.

(12) Force main separation and design criteria from water mains and all other utility lines shall meet the minimum requirements from TCEQ.

(13) All force mains shall have green EMS locator pads at every two-hundred-fifty-feet (250'), change in direction, valve, manhole, etc.

(b) **Embedment.** All force main pipes shall be installed in embedment material as shown on the *Standard Construction Details* in and in conformance for the *Standard Specification for Construction*.

SEC. 02.03.0524 ..... Control Panel.

(a) **General.**

(1) The control system shall be designed to operate the required number of pumps specified on the drawing at the power characteristics shown on the plans.

(2) The control function shall provide for the operation of the pumps in Hand (manual) and Auto (controlled by Programmable Logic Controller (PLC). See *24VAC Regulator System* for further information. The control shall function as described below. The equipment listed below is a guide and does not relieve the supplier from providing a system that will function as required.

(b) **Control Panel Enclosure**. The enclosure shall be a National Electrical Manufacturers Association (NEMA) 4x rated stainless-steel. The enclosure shall be a wall mount type with a minimum depth of eight-inch (8") sized to adequately house all the components. The door gasket shall be rubber composition with a retainer to assure a positive weatherproof seal. The door shall operate with a single action handle that accepts a three-eights-inch (⅜") shaft padlock and opens a minimum of one-hundred-eighty (180) degrees.

(c) **Inner Dead Door.**

(1) A polished aluminum dead front shall be mounted on a continuous aircraft type hinge, contain cutouts for mounted equipment, and provide protection of personnel from live internal wiring. Cutouts for breaker handles shall be provided to allow operation of breakers without entering the compartment. **No door mounted operating mechanisms allowed for breaker operation**.

(2) All control switches, indicator pilot lights, one (1) general purpose ground fault interrupter (GFI) duplex receptacle and other operational devices shall be mounted on the external surface of the dead front. The dead front shall open a minimum of one-hundred-fifty-feet (150) degrees to allow access to equipment for maintenance. A three-quarter-inch (¾") break shall be formed around the perimeter of the dead front to provide rigidity.

(d) **Back Plate.** The back plate shall be manufactured of twelve (12) gauge sheet steel and be finished with a primer coat and two (2) coats of baked on white enamel. All devices shall be permanently identified.

(e) **Power Distribution.**

(1) The panel power distribution shall include all necessary components and be wired with stranded copper conductors rated at a minimum of ninety-degrees (90°) Celsius.

(2) System shall be equipped with an **Emergency Generator** with an automatic transfer switch capable of programmable test dates and times. Inputs shall be provided to PLC to indicate Generator Running, Generator Alarm, and Generator Low Fuel Level **OR** a Stand Alone Manual Double Throw Safety Switch to allow hard wiring to a portable generator. Emergency Generator shall meet the requirements of the most recently adopted noise ordinance and be a minimum Level I noise control compliant.

(3) **No door mounted operating mechanisms allowed for breaker operation in control panel**. All conductor terminations shall be as recommended by the device manufacturer.

(f) **Circuit Breakers.**

(1) All circuit breakers shall be heavy-duty thermal magnetic or motor circuit protectors similar and equal to Square D type FAL. Each motor breaker shall be adequately sized to meet the pump motor operating characteristics and shall have a minimum of ten-thousand (10,000) amps interrupting capacity for two-hundred-thirty voltage in alternating current (230 VAC) and fourteen-thousand (14,000) amps at four-hundred eighty voltage in alternating current (480 VAC). The control circuit and the duplex receptacles shall be individually controlled by heavy-duty breakers.

(2) Circuit breakers shall be indicating type, providing “ON-OFF-TRIP” positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position indicating “TRIP”.

(3) Thermal magnetic breakers shall be quick-made and quick-break on both manual and automatic operation and have inverse time characteristics secured through the use of bimetallic tripping elements supplemented by a magnetic trip.

(4) Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handled ties shall not be acceptable.

(g) **Motor Starters.**

(1) Motor starters shall be open frame, across the line, NEMA rated with individual overload protection in each leg. Motor starter contact and coil shall be replaceable from the front of the starter without being removed from its mounted position.

(2) Overload heaters shall be solid state motor logic type with the following features:

i. Three (3) to one (1) adjustment for trip current,

ii. Phase loss and unbalance protection,

iii. LED power indication,

iv. Ambient insensitive and self-powered, and

v. Shall have availability of electrical remote reset.

(3) Overloads shall be sized for the full load amperage draw of the pumps. Definite purpose contactors, fractional size starters and horsepower rated contactors or relays shall not be acceptable.

(h) **Transformers.** Control transformers shall provide the one-hundred (120) VAC and/or twenty-four (24) VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. The secondary shall be grounded.

(i) **Lighting Transient Protection.** A lightning-transient protector with tell-tale warning lights on each phase to indicate loss of protection on the individual phases shall be provided. The device shall be solid state with a response time of less than five (5) nanoseconds withstanding surge capacity of six-thousand- five-hundred amperes (6,500 amps). Unit shall be instant recovery, long life and have no holdover currents.

(j) **Phase Monitor.** A line voltage rated, adjustable phase monitor shall be installed to sense low voltage, loss of power, reversed phasing and loss of a phase. Control circuit shall de-energize upon sensing any of the faults and shall automatically restore service upon return to normal power.

(k) **Alarm System.**

(1) The alarm light shall be a weatherproof, shatterproof, red-light fixture with five-hundred (500) lumens minimum to indicate alarm conditions. The alarm light shall be turned on by the alarm level.

(2) The alarm light shall be mounted on the exterior of the cabinet. The alarm horn shall provide an audio signal of not less than ninety-decibels (90 DB) at ten-feet (10'). An **alarm silence switch** shall be **mounted on the exterior of the cabinet** and deactivate the alarm horn; however, the alarm light shall flash until the alarm condition ceases to exist. An Input shall be provided to PLC to indicate High Wet Well Condition.

(l) **Twenty-four VAC Regulator System.**

(1) Supervisory Control and Data Analysis (SCADA). Equipment for SCADA shall consist of a PLC, Radio, Antenna, etc. to operate the system. Control cabinet components shall be installed when the panel is built. Engineer shall contact the Public Works Department at 972-771-7730 for current requirements for SCADA system and contact for City's current SCADA supplier. The control system shall provide for both automatic and manual control and alternation of the pumps to maintain a pumped down condition of the wet well.

(2) Wet well levels shall be sensed by a pressure transducer. Float regulators shall be installed as back-up for HIGH and LOW levels only. The transducer shall sense the "OFF", "LEAD", "LAG", and "HIGH" levels as given on the plans. As the level in the wet well raises the lead pump, as determined by the alternator, shall start and pump the station to the "OFF" position. In the event the incoming flow exceeds the capacity of the lead pump, the lag pump shall start, and both pumps shall run to the off level. If the wet well level continues to rise, high well alarm functions shall be activated. The alternator shall switch when the off level is reached.

(3) All inputs and outputs shall be wired to a terminal strip at bottom of cabinet.

(m) **Ancillary Equipment.**

(1) Hand-Off-Auto (HOA) Switches. A three (3) position HOA switch shall be provided on the inner dead front for each pump. **Inputs shall be provided to PLC to indicate position of HOA**.

(2) Run Indicators. A run pilot indicator shall be provided on the inner dead front. All indicator lights shall be push-to-test. Inputs shall be provided to PLC to indicate pump running.

(3) Elapsed Time. Elapse time meter shall be mounted on the dead front door.

(4) Cabinet Temperature Control. The cabinet shall be equipped with a panel heater controlled by a thermostat and a vent fan controlled by a thermostat.

(5) Receptacles. One (1) duplex receptacle located on inner dead front door for general purpose use. This receptacle shall be of the ground fault type, one-hundred-twenty volts (120 V) and protected by a twenty (20)-amp breaker. A second single receptacle shall be located on the back panel to provide power for uninterruptible power supply (UPS) back up system. This receptacle shall be one-hundred-twenty volts (120 V) and protected by a separate twenty (20) amp breaker.

(6) UPS Back Up System. Will provide one-hundred-twenty-volts (120 V) power to SCADA communication equipment and all low voltage power transformers. This must be installed in the control panel. UPS shall be Advanced Process Control (APC) six-hundred-fifty volt-ampere (650VA) one-hundred-twenty-volts (120 V) or equivalent. **The System must be able to transmit all alarms and wet well levels when on backup power.**

(7) Motor Protection. A control and status module shall sense either motor over temperature or seal leakage, and shall turn off the pump, lock out the pump, and send an alarm. Inputs shall be provided to PLC to indicate Pump Fail, Seal Fail and Temp Fail individually for each pump.

(n) **Miscellaneous.**

(1) Panel Racks. Posts supporting racks shall be **three-inch (3") minimum rigid conduit capped and bolted directly to channel framework supporting the panels**. Panels shall have a "rain shield" structure using one-quarter-inch (¼") minimum aluminum plating providing a solid back plate behind panels continuous to overhead plate to protect panel from rain. Provide lighting mounted on structure with switch mounted on exterior of panel to light up panel area. Contact City of Kaufman at 972-771-7730 or 972-962-8007 for location of existing type structure. Each pump must have its own conduit for power cord and a separate conduit for all float wires.

(2) Drawings. Control panel schematic drawings shall be submitted for approval with the Construction Plan submittal. Final control panel wire schematic drawings including a list of all legends (two [2] sets total) shall be provided. One (1) set shall be encapsulated in Mylar and attached to the inside of the front door of the control cabinet. A second set shall be delivered to the City of Kaufman Public Works Department.

(3) Panel Markings. All component parts in the control panel shall be permanently marked and identified as they are indicated on the drawing. Marking shall be on the back plate adjacent to the component. All control conductors shall be identified with wire markers as close as practical to each end of conductors.

(4) Panel Wiring. All wiring in panel shall maintain a minimum of one-and-a-half-inch (1½") spacing between components and wire ways.

(5) Testing. All panels shall be tested to the power requirements as shown on the plans to assure proper operation of all the components. Each control function shall be activated to check for proper operation and indication.

(6) Guarantee. All equipment shall be guaranteed for a period of three (3) years from date of acceptance. The guarantee is effective against all defects in workmanship and/or defective components. The warranty is limited to replacement or repair of the defective equipment.

ARTICLE 02.031.0600 .....GRADING

SEC.02.031.0611 ..... GRADING.

(a) All backfill or grading material shall be placed in layers not to exceed eight-inches (8") loose thickness. The moisture content shall be uniform and near the optimum moisture content for the material. In cases where the materials being placed do not have the proper moisture, the material shall be dried out or additional moisture shall be added by satisfactory methods such that the additional water is distributed uniformly throughout the material being placed. The layers of the backfill shall be reduced in thickness when satisfactory compaction cannot be obtained with the equipment being used. In all cases, a density of not less than ninety-five-percent (95%) of the standard proctor density must be obtained.

(b) The contractor shall arrange for the necessary laboratory testing, at their expense, to determine the density of the material. All density reports shall be provided to the City of Kaufman. All franchise utility companies (phone, gas, electrical, cable, internet, and any utility that is not supplied by the City) working within the rights-of-way of streets or alleys shall also comply with the above noted specifications with laboratory testing results provided to the City of Kaufman. Easement locations under pavement shall also have a minimum density control backfill to ninety-five-percent (95%) of the standard proctor density. All densities are to be within the acceptable moisture range of negative-two-percent to positive-four-percent (-2 % to +4%) of optimum moisture unless otherwise approved by the Director of Public Works and/or the City Engineer.

(c) A sheep's-foot roller shall be utilized for compaction of all fill material. Mechanical tamping is allowed for trench backfill. The sheep's-foot roller is to be on-site and active whenever fill material is being placed.

(d) It shall be the responsibility of the Developer to adjust all City and franchise utilities to the final grades of the development. Depending on changes in grade over existing utilities, utility relocation may be required.

(e) All slopes should be a maximum of ratio of four to one (4:1) and a minimum of one-percent (1%) percent. In locations where a ratio of four to one (4:1) slope is not possible, retaining walls, gabion baskets, concrete slope protection, or other approved retaining methods may be required. Retaining methods must be approved by the Director of Public Works and/or the City Engineer.

(f) At the beginning of the project the Developer will provide offset stakes at intervals of fifty-feet (50'). The stakes will be offset from the back of the outside curb, a convenient distance to permit all operations to be completed without disturbing these stakes. Information that shall be included on the stakes includes the station number, offset distance from back of curb, and elevations of hub. It will be the contractor's responsibility to maintain these stakes, and use the information for all other horizontal and vertical control required. The contractor will set all forms using the data shown on the approved plans.

SEC.02.031.0612 ..... GRADING, FILL EXCAVATION, AND EARTHWORK PERMIT.

(a) A grading, fill, excavation, and earthwork permit shall be obtained from the Development Services Department prior to stockpiling or filling property within the City limits.

(1) No filling in drainage swales, creeks, wetlands, flood plains, etc. is allowed without a flood study approval.

(2) Erosion protection shall be installed around stockpiled or stored material until grass is established. If fill is placed for use other than stockpiling or storage, a grading plan shall be prepared by a Professional Engineer and submitted with the grading, fill, excavation, and earthwork permit. Temporary stockpiles have a maximum time limit of six (6) months.

(3) Densities shall be taken, and proper compaction techniques used when placing the fill. In all cases, a Professional Engineer shall certify that the proposed fill location is not within a stream, creek (flowing or not), or floodplain. If the Director of Public Works and/or the City Engineer determines the fill is to be placed near a creek or stream or possible drainage way, the one-hundred-year (100-yr) floodplain shall be staked by a registered surveyor.

(b) All grading permits shall be issued in accordance with Section 02.03.042 of the Subdivision Regulations.

(c) Residential (including infill) lots shall submit a grading plan with the building permit. This is to ensure drainage and structure elevations will meet City requirements.

(d) The City of Kaufman requires that the design engineer provide a letter of concurrence. The letter is to verify that the drainage patterns, grade to drains locations, detention systems including outfall structures, detention pond volume, pad elevations, and drainage structures located within the project scope were installed to the general elevations as shown on the approved plans. The letter shall also verify that the project was constructed to meet the approved design requirements or is within acceptable design tolerances (maximum two-tenths-of-a-foot (0.2') for residential pad elevations). The design engineer or their designated representative shall direct all survey work necessary to verify elevations and design compliance. The letter of concurrence is to have the seal and signature of the design engineer.

SEC. 02.031.0613 ..... PRIVATE UTILITY CONSTRUCTION.

(a) Trench Backfill in City Right-of-Way.

(1) No concrete streets shall be open cut by utility companies without City approval. All contractors and/or sub-contractors working in the City Right-of-Way shall contact the Public Works Department before any work is begun. Utilities crossing concrete streets shall be tunneled or bored (dry only). If open cut is approved by City, full panel replacement will be required to nearest joints. Additional pavement removal and replacement may be required for connection.

(2) Asphalt streets may be open cut. Backfill above utilities shall be concrete stabilized sand or cement. The asphalt pavement shall be repaired per City detail.

(3) All trench backfill is to be compacted to ninety-five-percent (95%) Standard Proctor Density within City rights-of-way. The compaction may be obtained by mechanical tamping, rolling, etc. No water jetting is allowed.

i. In the parkway, the backfill material may be from the excavated trench, except no rocks larger than two-inches (2") shall be used. Material from rock or shale excavation cannot be used.

ii. The contractor for the utility company or the utility company shall furnish density reports from a material testing company verifying the densities. Densities shall be taken at each twelve-inches (12") lift at a maximum spacing of one-hundred-fifty-feet (150').

iii. The moisture content shall be uniform and near the optimum moisture content for the material. In cases, where the materials being placed do not have the proper moisture, the material shall be dried out or additional moisture shall be added by satisfactory methods such that the additional water is distributed uniformly throughout the material being placed.

(b) Parkway Cleanup. The contractor for the utility company or utility company shall remove any rocks or excess trench material from the parkway and replace any disturbed areas with grass sod.

SEC. 02.031.0614 ..... ADDITIONAL PERMITS OR APPROVALS.

(a) Developer or developer's representative is responsible for obtaining any other approvals or permits needed for their development, for example: TCEQ, TXDOT, Kaufman County, FEMA, USACOE etc. prior to start of construction. Copies of the permits/approvals shall be furnished to the City.

SEC. 02.031.0615 ..... RETAINING WALLS.

(a) Retaining walls or concrete slope protection shall be installed where lot slope is greater than a ratio of four to one (4:1).

(b) No railroad tie, wood, or steel retaining walls shall be constructed in public or private property.

(c) No retaining walls, including the footings, shall be placed in the right-of-way, easements, detention ponds or overlapping property lines. Retaining walls shall be entirely on the lot with the higher elevation.

(d) All retaining walls (18-inches and taller) shall be stone, masonry or reinforced concrete with a stone face or form liner. No smooth concrete retaining walls to be installed.

(e) Retaining walls three-feet (3') and taller shall be designed (signed and sealed) and inspected by a professional licensed engineer in the State of Texas. Property lines and rights-of-way shall be noted on the wall plans.

(1) The City requires a verification letter (signed/sealed) from the design engineer stating that the retaining walls installed with the site/subdivision were inspected by the engineer or their designated representative and that the walls were installed to the engineered design and general construction standards. The verification letter shall be delivered to the Public Works Department prior to the project acceptance by the City.

(f) Retaining walls over thirty-inches (30") in height that have sidewalk, trail, or other walking surface on the top side of the wall will require railing.

(g) Traffic rated guard rail or barrier will be required when roadway, parking lot, drive isle or alley is within ten-feet (10') of a retaining wall that is over thirty-inches (30") in height. Details of the railing or barrier shall be provided in the Construction Plans.

(h) The design of retaining walls (not screening walls) in close proximity to trash enclosures shall take into account the weight of a fully loaded dumpster, fully loaded trash truck, and the force exerted when the dumpster is placed back on the ground in the enclosure.

(i) Gabion retaining walls may be used only with the Director of Public Works and/or the City Engineer's approval for walls less than three-feet (3') along drainage ways.

(j) All retaining walls shall be placed according to offset hubs set by certified professional surveyors noting grade cuts, wall elevations, and stop points for each wall end. Wall locations and elevations shall match those shown on the approved site grading plans.

(k) All retaining wall plans shall indicate property lines, swales, easements, and rights-of-way. If the retaining wall is designed to be the high point of the lot/area, the wall shall have a stone cap that is installed a minimum of six (6) inch above the final adjacent grade**.**

SEC. 02.031.0616 ..... MAINTENANCE BONDS.

(a) The City requires one-hundred-percent (100%) two (2) year maintenance bond for paving, paving improvements, water systems, wastewater systems, storm sewer systems including detention systems, and associated fixtures and structures which are located within the rights-of-way or defined easements. The two (2) year maintenance bond is to state "from date of City acceptance" as the starting time. All maintenance bonds shall be in accordance with the *Subdivision Regulations*, Section 02.03.045 *Facilities and Personal Services Agreements, Financial Assurances and Construction Contracts for Public Improvements.*

(b) A review of the site shall be conducted at twenty (20) months into the two (2) year maintenance period. The design engineer or their designated representative shall be present to walk the site with the City of Kaufman Public Works Inspection personnel..

SEC. 02.031.0617 .CONSTRUCTION.

(a) Preliminary Site Preparation: The noted site preparation items below are to be in place, inspected and approved by the City, prior to the start of any clearing, grubbing or grading operations.

(1) All tree preservation in the limits and in the ETJ shall be in accordance with the *Subdivision Regulations* Section 02.03.065 *Tree Preservation in the ETJ* and Section 02.03.072 *Tree Preservation*.

(2) No Clear-Cutting of land is allowed without a permit issued from the Department of Development Services.

(3) Protected trees which are designated to remain on site are to be identified, tagged, and banded with bright orange or red bands.

(4) Protected trees which are designated to be removed from the site are to be identified, tagged and banded with blue bands or blue paint markings.

(5) Tree identification tags are to consist of metal tags which have the tree identification number stenciled or stamped or engraved on the tag. The numbers used to identify the protected trees shall correspond to the tree identification number noted on the approved Tree Preservation Plans.

(6) Types of Protected Tree Barrier Fencing.

i. Chain link barrier fencing shall be placed around the drip lines of the individual protected trees or groups of protected trees, which are designated to remain at the site.

ii. Plastic mesh barrier fencing shall be placed around the drip lines of individual protected trees or groups of protected trees.

(7) Silt fence along with construction entrance and any other designated erosion BMP's must be installed and inspected by the Public Works Department. No silt fencing may be installed at the site until the trees have been identified, banded, tagged, fenced, and inspected by the City. Silt fence should not be installed within a floodplain.

(8) Portable toilet facilities will be required on all construction sites or as otherwise deemed necessary by the City of Kaufman. It is essential that adequate on-site restroom facilities be available for all construction workers. It will be the responsibility of the contractor to install and maintain the facilities through the completion of the project. These facilities must be on site and verified prior to moving personnel on site and before construction can begin.

(9) Portable trash receptacle is to remain on the job site through the course of construction. The site is to remain free of construction litter and debris. Construction workers shall place all lunch trash in the "trash containers" immediately after lunch. Trash receptacle must be on site and verified prior to moving personnel on site and before construction can begin.

(10) If a detention pond system is required per the plans, the detention pond must be installed with outfall structure and soil stabilization before pavement/cement, slab, or any non-impervious area may be placed.

(11) Construction Site Working Hours and Noise Control Signage. Construction and construction related activities including the erection, excavation, demolition, alteration, or repair work on any development may regularly occur at the following times:

i. From June 1 to September 30; development activity may occur Monday through Friday between the hours of 7:00 a.m. and 8:30 p.m., but **not** between the hours of 6:00 a.m. and 8:30 p.m.;

ii. From October 1 to May 31; development activity may occur Monday through Saturday between the hours of 8:00 a.m. and 8:30 p.m., and on Sunday and between the hours of 1:00 p.m. and 8:30 p.m.; provided,

iii. However, the city manager may issue special permits for such work at other hours in case of urgent necessity and in the interest of public safety and convenience;

iv. The City requires a three-feet (3') wide x two-feet (2') tall sign as shown in **Figure 6.1**. *Construction Site/Noise Ordinance Sign Example* be posted at each Commercial/Residential development construction site. The sign must be installed at the site and verified prior to moving personnel on site and before construction can begin. The construction related activities are to include but not be limited to the following:

v. Maintenance, servicing and fueling of construction equipment.

vi. The delivery of construction-related materials and/or construction equipment.

(12) .....At locations where compliance to Ordinance 20-99 is not being observed, the City of Kaufman may issue written orders to stop work or further regulate the site construction work hours. The City may also issue citations if it is determined that a violation of the construction ordinance exists.

Figure 6.1. Construction Site/Noise Ordinance Sign Example

(Sign Size: three-feet (3') wide x two-feet (2') tall)

ORDINANCE # 20-99
CONSTRUCTION SITE WORKING HOURS AND NOISE CONTROL

City Ordinance – No. 02-99 limits construction and construction related activities to the hours of 6:00 a.m. – 8:30 p.m. Monday through Friday from June 1 to September 30, between 7:00 a.m. and 8:30 p.m. Monday through Friday, form October 1 to May 31, between 8:00 a.m. and 8:30 p.m. on Saturday, and between 1:00 p.m. and 8:30 p.m. on Sunday.

ORDENANZA # 20-99
HORAS DE TRABAJO EN EL SITIO DE CONSTRUCCIÓN Y CONTROL DE RUIDO

La Ordenanza de la Ciudad No. 02-99 limita la construcción y las actividades relacionadas con la construcción al horario de 6:00 a. m. a 8:30 p. m. De lunes a Viernes del 1 de junio al 30 de septiembre, de 7:00 a 20:30 horas. De lunes a Viernes, del 1 de octubre al 31 de mayo, de 8:00 a 20:30 horas. el sábado, y entre las 13:00 y las 13:00 horas. y 20:30 h. el Domingo.

(b) Inspection Scheduling.

(1) It is the responsibility of the contractor to schedule inspections prior to construction. Inspections may be scheduled and coordinated in the field or by cell phone directly with the Public Works Construction Inspector. Inspection of construction and verification of compliance to plans and specifications shall be conducted by the City Public Works Inspector. The general contractor shall notify all of his construction contractors of this requirement. Items to be inspected must be sufficiently ready for inspection at the time of your requested inspection appointment as inspector's time is limited. Failure to be ready for inspections may result in inspection rescheduled to the following day. No development will be accepted by the City until all construction has been approved by the City inspectors.

(2) Saturday Inspections. The contractor will be charged a minimum of two (2) hours' inspection charge for all Saturday inspections. All Saturday inspections must be scheduled in writing to the Public Works Department by noon on the Thursday before the inspection date.

i. A signed Saturday Engineering Inspection Request form must be emailed to the Public Works Director and Public Works Inspector. Approval/disapproval will be emailed back to the requesting contractor with the Saturday inspector's information.

ii. All cancellations must be given verbally and in writing to the Saturday inspector no later than 8:00 AM on day of inspection.

iii. Two (2) hours of overtime inspection will be charged to the contractor if no cancellation is given prior to the inspector arriving at the project site.

iv. Contractor must sign form to finalize the inspection. No acceptance and/or certificate of occupancy will be given until all overtime engineering inspection fees are paid in full.

v. If any City holiday occurs on a Friday, there will be no inspections or inspectable construction on the Saturday after this holiday . If any City holiday occurs on a Monday, there will be no inspections or inspectable construction on the Saturday prior to this holiday.

(3) Before/After Weekday Hours Inspections. Contractor will be charged on 15-minute intervals for any before/after hour's inspections. Contractor must sign form to finalize the inspection. No acceptance and/or certificate of occupancy will be given until all overtime engineering inspection fees are paid in full.

(c) Building Permit. No vertical (above slab) construction will be allowed until such time as the following minimum site requirements have been addressed at the site, verified by a City Representative, and a building permit issued by the Development Services Department permit has been issued. Minimum requirements for vertical construction are subject to but not necessarily limited to the below noted items.

(1) Fire lane pavement is installed, tested, and approved for use.

(2) Fire lane pavement is painted and marked to Fire Department specifications.

(3) Water lines for the site are installed, tested, and approved for use.

(4) All fire hydrants are installed and approved for use.

(5) Fire hydrant nozzles and bonnets are painted as per line size color code.

(6) Reflective fire hydrant locator buttons are in place at hydrant pavement locations.

(7) Fire hydrants are flow tested to verify flow at designated hydrant locations.

(8) Fire hydrant nozzle diameters, proper height above final grade, and clearance are verified and approved.

(9) Silt fence is placed above the fire lane if it is deemed necessary at positive flow areas.

(10) Exterior building materials are approved by the Development Services Department.

(d) Disposal of Excess Materials. The contractor shall properly dispose of all excess material by removing from the job site all the brush, trash, debris, etc. upon completion of construction. All material shall be properly disposed outside of the City limits. No dumping of dirt/fill material inside the City of Kaufman without a permit

(e) Construction Site Safety.

(1) Construction site safety measures are to be in place at all construction projects located within the City of Kaufman. All necessary measures required to ensure that safe work zones exist for the protection of construction workers and general public living in or near such construction zones. Construction zones shall comply with work zone traffic control specifications and requirements.

(2) Occupational Health and Safety Administration requirements and regulations must be in compliance.

(3) Temporary construction fencing is to be placed around open trenches, pits, or other locations deemed necessary by the City of Kaufman. Any miscellaneous items that may pose direct or potential hazard to workers or the general public that is known by the contractor or brought to the attention of the contractor shall be addressed immediately.

(4) It is the responsibility of the contractor(s) to establish and maintain construction site safety measures; however, the City will temporarily suspend work at a construction site if it is deemed necessary due to unsafe or hazardous conditions until such conditions have been corrected.

(5) In each circumstance where it is deemed that proper safety measures are not being followed, a warning will be issued by the Public Works Inspector. Construction may be temporarily suspended if deemed necessary until items responsible for issuance of the safety warning have been properly addressed.

    i. Issuance of three (3) or more safety warnings will require that the designated construction be suspended until such time that a safety meeting is scheduled with contractor personnel along with City representatives to discuss the appropriate measures to correct the identified problems and determine any further possible actions which may be necessary.

ATTACHMENTS

1. **Attachment “A” – Construction Plan Review General Checklist**
2. **Attachment “B” – Example - Residential Checklist for Final Acceptance**
3. **Attachment "C” – Example - Commercial Checklist for Final Acceptance**
4. **Attachment "D” – Approved Water Materials List**
5. **Attachment “E” - Kaufman Standard Construction Drawing Details**

Attachment "A"- Construction Plan Review General Checklist

		Item Description
1.	**Administrative Items**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Engineering Plan Submission Application with submittal checklist;
b.	☐	Engineering-Plan Review Checklist;
c.	☐	Four Complete Copies of Engineering Plans Initial Submittal; Three Complete Copies of Engineering Plans Re-Submittal; Two additional sets each submittal is proposed lift station;
d.	☐	Markups from Previous Submittals, if subsequent submittal;
e.	☐	Annotated Review Comments, if applicable;
f.	☐	Two copies of any Study or Report Completed in Support of the Project;
g.	☐	Submission of Required Fire Flows Form to Fire Marshal;
h.	☐	Submission of Fire Hydrant Flow Form to Fire Marshal;
i.	☐	Floodplain Administrator Development Permit Application;
j.	☐	Storm Drainage Management Plan;
.k	☐	TxDOT preliminary letter of approval for Drive Approach Connections;
l.	☐	TxDOT permits obtained ;
m.	☐	Franchised Utility Approval Obtained (specify);
n.	☐	Other Agency or Land Owner Approval Obtained (specify);
o.	☐	Corps of Engineers (COE) Wetland Permit Obtained (if applicable) or letter of determination ;
p.	☐	Federal Emergency Management Agency (FEMA) Letter of Map Revision (LOMR);
q.	☐	Other Agreements (explain);
2.	**Studies - If Required**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Geotechnical Report ;
b.	☐	Federal Emergency Management Agency (FEMA) Letter of Map Revision (LOMR) Flood Study;
c.	☐	Wetland Determination;
d.	☐	Lift Station Report;
e.	☐	Hydraulic Study Submitted;
f.	☐	Water Study Submitted;
g.	☐	Sanitary Sewer Capacity Study Submitted;
h.	☐	Traffic Impact Analysis;

Attachment "A"- Construction Plan Review General Checklist

		Item Description
i.	☐	Flood Study (100 year-fully developed) (Local or FEMA);
j.	☐	Sight Visibility Determination for easements;
3.	**All Sheets** Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A	
a.	☐	Sheet Size 24" x 36";
b.	☐	Title Block with Subdivision Name, Project Name and Sheet Description;
c.	☐	Revision Block - Filled Out;
d.	☐	North Arrow;
e.	☐	Vertical and Horizontal Scale Listed and Accurate;
f.	☐	Benchmarks Listed and Described;
g.	☐	Legend of All Drawing Symbols and Line Types Used;
h.	☐	Engineer's Seal, Signature and Date per Texas Engineering Practices Act;
i.	☐	Responsibility Note Required on All Sheets except site plan and standard details: "ALL RESPONSIBILITY FOR ADEQUACY OF DESIGN REMAINS WITH THE DESIGN ENGINEER. THE CITY OF KAUFMAN, IN REVIEWING AND RELEASING PLANS FOR CONSTRUCTION, ASSUMES NO RESPONSIBILITY FOR ADEQUACY OR ACCURACY OF DESIGN.";
j.	☐	Provide Key Map for Large Projects Showing Sheet Locations;
k.	☐	Clear Drafting with Proper Line Weights for Ease of Reading;
l.	☐	No Overlapping Text;
m.	☐	Drafting at Adequate Scale to Obtain Ease of Reading and Scanning;
4.	**Cover Sheet** Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A	
a.	☐	Project Name;
b.	☐	Official Plat Name as Assigned by the Planning and Zoning Department (including Block & Lot);
c.	☐	Official Project Address Assigned by the City Planning and Zoning Department;
d.	☐	Mapsco Grid Reference;
e.	☐	Month and Year of Probable Start of Project Construction;
f.	☐	Revision Table;
g.	☐	Engineer Contact Information (Name, Address, Phone Number, email address);
h.	☐	Owner Contact Information (Name, Address, Phone Number, email address);
i.	☐	Sheet Index - List ALL sheets included in plan set including details;

Attachment "A"- Construction Plan Review General Checklist

		Item Description
j.	☐	Location Map with North Arrow;
k.	☐	Side Bar - Plat Subdivision Name & Project Name;
l.	☐	Title of type of sheet (i.e. Grading, Utility, Water,….);
5.	**Approved Site Plan**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Approved Site Plan;
6.	**Approved Landscape/Treescape Plan**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Approved Landscape and Treescape Plan;
7.	**Proposed Lot Layout**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Lot Layout included;
b.	☐	Correct Lot Layout Name
c.	☐	Tract Closure Calculations (Sealed by Registered Surveyor or Engineer);
d.	☐	GPS Grid Coordinates Shown for the Property Corners Properly Into City Monumentation System (x, y coordinates on 2 property corners);
e.	☐	Location map;
f.	☐	Approved Street Names with Right-of-Ways Widths Identified;
g.	☐	Benchmark (if near drainage feature or flood zone);
h.	☐	Basis of bearing;
i.	☐	Metes and Bounds of Tract;
j.	☐	Adjacent Land Ownership Information;
k.	☐	List Corners Found or Set
l.	☐	Property Pins Shown for tracts across ROW with verification of existing ROW Widths;
m.	☐	Front and Corner Lot Building Setback Lines Shown;
n.	☐	Recording Volume and Page Information for all separate easements and ROW dedications within proposed lot layout area or adjacent tracts
o.	☐	100-Year Floodplain for Fully Developed Conditions showing cross sections and elevations;
P	☐	Minimum Finished Floor Elevations Shown (if near drainage feature or flood zone);
q.	☐	Drainage & Drainage Maintenance Easements Shown and annotated ;
r.	☐	Required Utility Easements Shown (10' minimum width) and annotated
s.	☐	Access Easements Shown and annotated;
t.	☐	ROW. Dedication Shown and annotated;
u.	☐	ROW Corner Clips and annotated;
v.	☐	All Existing easements (on-site) shown and annotated;

Attachment "A"- Construction Plan Review General Checklist		
		Item Description
x.	☐	Visibility Easements Shown and annotated;
y.	☐	Surveyor Seal, Signature and Date;
8.	**Demolition Plan**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	All existing topographic features including but not limited to: pavement, curbs sidewalks, barrier free-ramps, light poles, driveways, storm sewer inlets, manholes, junction boxes headwalls retaining walls, fences , mailboxes, landscape planters, trees, etc.;
b.	☐	All wet utilities (water lines, wastewater lines and storm sewer) including sizes;
c.	☐	All franchise utilities (electric, cable, communications, gas, etc.);
d.	☐	Pavement removals with full depth pavement sawcut locations;
e.	☐	Water line, wastewater line and storm sewer removals;
9.	**Dimensional Control & Paving Plan**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Lot Boundary with Dimensions and Bearings;
b.	☐	Approved Street Names Shown;
c.	☐	Existing ROW;
d.	☐	ROW Dedication and ROW Corner Clips Shown with Dimensions;
e.	☐	Verification of public rights-of-way width ("variable width" is not acceptable) (When Required);
f.	☐	Visibility Easements Shown as Required by City Code;
g.	☐	Front and Corner Lot Building Setback Lines Shown;
h.	☐	Dimensions (thickness, width, length, radius) for all paved areas (parking areas, driveways, fire lanes, turn lanes, drive aisles, sidewalks, etc.);
i.	☐	Driveways Location, Spacing and Width Meet City Code and TxDOT Requirements;
j.	☐	Driveways- Width, Radius, Distance to Adjacent Drives, Alignment with other Drives Across Street Shown;
K	☐	Fire Lane - Width, Radius & Distance from Building Shown and Detailed including turn-arounds and dead-ends;
l.	☐	All Pavement Thickness, Concrete Strength, Reinforcing, Subgrade Detailed Per City Requirements;
m.	☐	Location of Fire Sprinkler Fire Department Connection (FDC) Shown;
n.	☐	Location of Electrical Transformers Shown;
o.	☐	Dumpster Location, Access and Construction Requirements Met and approved by Planning and Zoning Department (Backing Distance and Maneuver - Accessible by SU-30 Turning Template);
p.	☐	All Existing and Proposed Utility and Drainage Easements and Widths Shown ;
q.	☐	Existing and Required Access Easements and Widths Shown;
r.	☐	Screening Wall Location, Foundation, Height, Start/End of Wall;

Attachment "A"- Construction Plan Review General Checklist

		Item Description
s.	☐	Retaining Wall Location, Foundation, Height, Start/End of Wall;
t.	☐	Existing and Required Sidewalks and Trails Shown with Dimensions;
u.	☐	Show Location of Required ADA Ramps;
v.	☐	Limits of 100-Year Ultimate Flood Plain Shown (FEMA and local);
x.	☐	Note Identifying Reference for 100-Year Floodplain and WSE Information with cross section with elevations;
y.	☐	New/Relocating Left Turn Lane and/or deceleration lanes complies with City and TxDOT Requirements (Spacing, Length, Construction);
z.	☐	Existing and Proposed Infrastructure within Median Modifications Shown (Trees, Street Lights, Conduit, Irrigation, pavers, etc.);
aa.	☐	Street Lighting and Street Sign Plan;
10.	**Roadway Paving Plan and Profile** Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A	
a.	☐	Approved Street Name and Cross Street Names;
b.	☐	Block, Lot, and Address Labels;
c.	☐	All existing and proposed easements and easement widths;
d.	☐	Dimensions labels of roadway width, ROW width, sidewalk widths, curb return radius, etc.;
e.	☐	Show and label all storm sewer inlets with roadway stationing;
f.	☐	Legend showing type of pavements, thickness, strength, reinforcing, etc. ;
g.	☐	Roadway centerline stationing every 100 ft, alignment labels for all Start, PC, PT, PI, PRC, etc.;
h.	☐	Driveway centerline stationing location off roadway;
i.	☐	Label Cross-slope (At cross-slope transitions the cross-slope shall be labeled every 25 ft and at critical design points);
j.	☐	Show and Label Proposed Profile station and elevation (All Slopes, VPI, PI, Vertical Curves, LP, HP, K, e, PC, PT,VPRC, etc.);
k.	☐	Show and Label Existing ground Centerline, Left ROW, Right ROW, and any other critical profiles;
l.	☐	Show in Profile and Major Utility Crossing (Culverts, Water/Wastewater Transmission Lines, Gas Transmission Lines, Electric and Communication Duct Banks);
m.	☐	Existing and Proposed Ground lines elevation in profile every 50 ft;
n.	☐	100-Year floodplain line and water surface elevation (WSEL);
11.	**Cross-Sections** Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A	
a.	☐	Cross sections shall be provided for all Arterial and Collector Roadways;

Attachment "A"- Construction Plan Review General Checklist		
		Item Description
b.	☐	Cross-Sections shall be taken every 50 feet, driveway centerline, intersecting streets, and other critical points or features;
c.	☐	Include Existing and Proposed ROW lines;
d.	☐	Existing Ground Line;
e.	☐	Proposed Pavement thickness, and subgrade depths, and sidewalks;
f.	☐	Proposed Slopes;
g.	☐	Cross-sections at Driveways shall have all slope and VC Labeled;
12.	**Grading Plans**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☒	Benchmarks;
b.	☐	Exist Lot Lines & Corners (lot lines screened if being changed);
c.	☐	Proposed Lot Lines;
d.	☐	Existing (screened) & Proposed ROW;
e.	☐	Approved Street Names Shown;
f.	☐	Drainage Easements and Widths for Drainage Features and Structures Shown;
g.	☐	Existing & Proposed Improvements (paving and building footprints);
h.	☐	Minimum Finished Floor (FF) Elevations for Structures meet Requirements of Drainage Section in Design Manual;
i.	☐	Minimum Finished Floor (FF) Elevation Shown for each Structure;
j.	☐	Existing & Proposed Contours for Site and Minimum of 50' Beyond Property Lines (with appropriate contour interval) with all ponds and waterways labeled;
k.	☐	Existing & Proposed Spot Elev. Showing Grade; High & Low Points; Swales, Inverts & Ridges with Flow Arrows;
l.	☐	Label Lot Area and Disturbed Land Area;
m.	☐	Adjacent Property Improvements Within Minimum 25' of site,
n.	☐	Existing & Proposed On-site and Off-site Drainage Features (Design Info Shown);
o.	☐	Maximum Cross Slope 4H:1V (H=Horizontal, V=Vertical) Min Running Slope 1% for unpaved areas;
p.	☐	Ditches Adjacent to Site Cleared, Cleaned & Regraded (only with permission from property owner);
q.	☐	Positive Overflow Routes with elevations (All public roads that have a sag require an overflow route);
r.	☐	Lot grading to be above street elevation (Residential Only);
s.	☐	Limits of existing and proposed100-Year Ultimate Floodplain Shown and wetland and water of U.S. delineation;
t.	☐	Ultimate (Fully Developed) 100-Year Floodplain Water Surface Elevations (WSE's) shown on cross sections ;

Attachment "A"- Construction Plan Review General Checklist

		Item Description
u.	☐	Note Identifying Reference for 100-Year Floodplain and WSE Information;
v.	☐	Cross sections to scale with hydraulic calculations;
x.	☐	Location of Cross-Sections With Stationing Shown;
y.	☐	Cut or Fill Areas shown on Cross-Sections;
z.	☐	Existing and Proposed Retaining Walls with Top & Bottom Spot Elevations and calculations as required;
aa.	☐	No Residential Cross Lot Drainage;
bb.	☐	Grading Plan Matches Drainage Area Map;
cc.	☐	Does Grading Plan Address Impacts to Adjacent Properties Requiring Easements or Letters of Permission;
dd.	☐	All Detention Areas with Flumes with Elevations and Side Slopes Labeled;
13.	**Retaining Wall Plan and Profiles**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Label Beginning and Ending of Wall;
b.	☐	Label Top of Wall, Bottom of Wall, Bottom of Footing;
c.	☐	Railing type and limits;
d.	☐	Detailed Structural Sections for each differing section type;
e.	☐	Flume locations shown in plan and sections (no water allowed to overtop retaining walls);
f.	☐	Show locations of all Water, Sanitary Sewer, Storm Sewer, Franchise Utility Crossings in Plan;
g.	☐	Show locations of all Water, Sanitary Sewer, Storm Sewer, Franchise Utility Crossings in Profile along with elevations;
h.	☐	Profile Existing Natural Ground Line, Proposed Ground Line at Bottom and Top of Wall;
14	**Drainage Area Map**	Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Existing Drainage Area Map (Pre-Project Conditions), Proposed Drainage Area Map (Current proposed phase of development conditions) and Ultimate Drainage Area Map (Built-out conditions of development);
b.	☐	Storm Drainage Analysis and design shall comply with the Drainage Ordinance and the Flood Hazard Damage Prevention and Control Ordinance;
c.	☐	Existing and Proposed Drainage System and Structures Shown (pipe, inlets, etc.);
d.	☐	Current Zoning or Anticipated Ultimate Development Shown and Correct For Off-Site Areas;
e.	☐	Ensure Site Drainage is Collected on Site ;
f.	☐	Design for an Ultimate (Fully Developed) 100 Year Storm Event;
g.	☐	Design showing Elevation Contours for the Entire Off-Site Drainage Basin and 50' beyond Property;
h.	☐	Design with most recent surveyed Contour Information;
i.	☐	Drainage Area Map shows Subbasins For Each Collection Point and Inlet;

Attachment "A"- Construction Plan Review General Checklist

		Item Description
j.	☐	Each Drainage Area has ID, Q100, Acres and Direction of Flow to the Outfall Shown;
k.	☐	Each Outfall labeled with an Identification, direction of flow and Total Flow;
l.	☐	Drainage Direction Arrows for Both On-site and Off-site Drainage Basins;
m.	☐	Indicate all Sags and Crests With Flow Arrows;
n.	☐	City Standard Drainage Area Map Calculation Table for Current and Future Conditions With Outfall Summary Included;
o.	☐	I - Values Meet City Requirements;
p.	☐	C - Values Meet City Requirements (based on Zoning);
q.	☐	Time of Concentration Values Used Meet City Requirements;
r.	☐	Q - Calculated Flow in cfs;
s.	☐	Provide a Subtotal for each Major Drainage Line;
t.	☐	Drainage Area Map & Calculations for all Offsite Drainage;
u.	☐	Limits of 100-Year Ultimate Floodplain Shown ;
v.	☐	Ultimate (Fully Developed) 100-Year Floodplain Water Surface Elevations (WSE's) shown (FEMA and local);
w.	☐	Note Identifying Reference for 100 Year Floodplain and WSE Information (FEMA and local) ;
x.	☐	Show Limits of Each Plan Sheet (Tile);
y.	☐	Show Detention;
z.	☐	Show Existing Drainage Areas (lighter line type);
aa.	☐	Label where each drainage area drains (inlet number, swale, etc.);
15.		**Storm Drainage Plans and Profiles (Storm Drainage Structures including Pipe, Inlets, Etc.)** Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.		Benchmark Location and Elevation;
b.		Flood Study / FEMA FIRM Map Reference Information Listed by Note;
c.		Storm Sewer Alignment Logical, Sharp Bends Eliminated;
d.		Collecting On-Site Drainage with Storm Sewer/Inlets;
e.		Profile Given for all Storm Sewer Mains and Laterals (shall be along the centerline of pipe);
f.		Pipe Size, Material and Class Identified on Plan and Profile;
g.	☐	Hydraulic Grade Line Shown on all Storm Sewer Profiles for Mains/Laterals, in both full and partial flow conduit conditions;
h.	☐	Hydraulic Grade Line Elevations labeled on Storm Sewer Profiles at every change in flow, change in pipe size, horizontal bend, vertical bend, wye, manhole, inlet, headwall, etc.;

Attachment “A”- Construction Plan Review General Checklist

		Item Description
i.	☐	Other Hydraulic Info Shown on Storm Sewer Profiles for all Mains/Laterals (Q100, Qcap, Velocity, V2/2g) on every conduit section between every junction and/or increase in flow;
j.	☐	Vertical and Horizontal Alignment and Slope Shown for all Mains/Laterals on Plan and Profile;
k.	☐	Hydraulic Grade Line Meets City Design Requirements;
l.	☐	Starting Hydraulic Grade Line Calculations/Assumptions Listed;
m.	☐	Starting Hydraulic Grade Line Meets City Design Requirements;
n.	☐	Pipe Velocity Within Ordinance Requirements and Limitations;
o.	☐	Elevation Information on Plan View (Flowlines, Top-of-Curb, Hgl or 100 yr water surface (partial flow) at every inlet, etc.) Matches Profile View;
p.	☐	Show Crossings of Existing and Proposed Water and Sanitary Sewer on Storm Sewer Profile;
q.	☐	Note minimum Cover for Pipes and Culverts;
r.	☐	Drainage System Reviewed for Constructability - Depth and Clearance From Streets, Structures, Other Utilities (dimensions);
s.	☐	Inlet Capacity Calculations Provided In City Standard Tabular Form;
t.	☐	Inlets Placed to Capture Runoff Before It Enters Street or Major Thoroughfare;
u.	☐	Storm Sewer Calculations Provided In City Standard Tabular Form;
v.	☐	If Street Drainage, Calculations Showing Curb & Street Capacity;
w.	☐	If Street Drainage, Show Nearest Inlet & all Upstream Drainage;
x.	☐	Inlet Construction Layout Information Shown (Top of Curb, Flowline, Throat Elevation, Type, Size, Hgl, Q100, etc.)
y.	☐	Inlet Construction Layout Information Shown (Top of Curb, Flowline, Throat Elevation, Type, Size, Hgl, Q100, etc.)
z.	☐	Storm Sewer Inlet Location, Size, Type, and Construction Detail Per City Requirements
aa.	☐	Storm Sewer Manhole Location, Size, Type, and Construction Detail Per City Requirements
bb.	☐	Outfall, Headwall, and Other Structure Location, Type, Velocity and Erosion/Scouring Protection Per City Standards
cc.	☐	Positive Overflow Route Through Site with grades
dd.	☐	Sag Points Identified and Paved Positive Overflow Designed
ee.	☐	Outfall/Headwall Locations No Greater Than 1' Above Creek Flowline and Pointed Down Stream
ff.	☐	Outfalls Discharge into Existing Drainage Features or Provide Easements as Required
gg.	☐	Outfall Velocity Meets City Requirements ;
hh.	☐	Outfall Protection / Energy Dissipation When Required;
ii.	☐	Appropriate Details are Included for Structures, Junction Boxes, Headwalls, and Inlets (if different than NCTCOG 4th Ed. or City details);;

Attachment "A"- Construction Plan Review General Checklist

		Item Description
jj.	☐	Connection Details Provided for Non-Standard Connections;
kk	☐	Limits of Existing and Proposed 100-Year Ultimate Floodplain Shown (FEMA and local) and Wetland and Water of .U.S. Delineation;
ll.	☐	Ultimate (Fully Developed) 100-Year Floodplain Water Surface Elevations (WSE's) shown (FEMA and local) ;
mm.	☐	Note Identifying Reference for 100 Year Floodplain and WSE Information ;
nn.	☐	Drainage Easements for Drainage Features and Structures Shown (15' minimum width);
16.		**Storm Drainage Plans and Profiles(Ditches, Swales, and Open Channels)** Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Direction Of Flow Indicated For Ditches, Swales And Open Channels
b.	☐	Ditches, Swales And Open Channels Have 100 Year Ultimate Water Surface Shown On Profile (Min 1% Running Slope)
c.	☐	Ditches, Swales And Open Channels Have 100 Year Ultimate Water Surface Shown On Cross Sections
d.	☐	Ditches, Swales And Open Channels Armored With Approved Material In Areas Where Average & Localized Velocities Are Above 6 Fps
e.	☐	Ditches, Swales And Open Channels Can Carry 100-Year Ultimate Storm With Required Freeboard
f.	☐	Ditches, Swales And Open Channels Hydraulic Information Shown On Plans
g.	☐	Ditches, Swales And Open Channels Hydraulic Information Shown On Plans Matches Hydraulic Report Or Flood Study Submitted
h.	☐	Ditches, Swales And Open Channels Side Slopes Less Than 4h:1v For Grassed/Un-Armored Sections
i.	☐	Ditch, Swale And Open Channel Width, Depth, Running And Side Slopes And Capacity Per City Requirements
j.	☐	Drainage Easements For Drainage Features And Structures Shown
17.		**Storm Drainage Plans (Detention And Ponds)** Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A
a.	☐	Required Detention Shown
b.	☐	Detention Calculation Shown And Correct
c.	☐	Outfall Discharge Curves For Required Storm Events
d.	☐	Detention/Retention Pond Location, Size, Depth, Capacity, And Material Per City Requirements, 100 Year Water Surface Elevations
e.	☐	Provide Access And Structures That Contribute To Long Term Maintenance Of Detention Pond
f.	☐	Drainage Easements For Drainage Features And Structures Shown (15' Minimum Width)
g.	☐	Provide Chart Showing Flow Allowable Vs. Flow Actual For Q5, Q10, Q25, And Q100

Attachment "A"- Construction Plan Review General Checklist

		Item Description
18.	**Water** Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A	
a.	☐	Water Main Sized In Compliance With Water System Master Plan
b.	☐	Water Mains Provided To Front Property Along All Street Frontages Or Otherwise Extended To Serve Adjacent Properties
c.	☐	Water Main Extension Required By Code Shown
d.	☐	Water Mains Looped To Provide Circulating And Redundant Feed
e.	☐	Water Main Size, Material And Class Called Out
f.	☐	Existing Water Mains And Valves Shown; Show Valves On Both Sides Of Tap In Case Area Needs To Be Isolated
g.	☐	Existing & Proposed Fire Hydrants Shown
h.	☐	Utility Easements For Water Mains Shown
i.	☐	Proposed And Existing Fire Lanes Shown
j.	☐	Fire Hydrant Spacing Meets Requirements Of Adopted International Fire Code (IFC)
k.	☐	Fire Sprinkler Fire Department Connection (FDC) Location Shown
l.	☐	Water Main Fittings, Valves, etc. Identified
m.	☐	Water Mains 16" And Larger Profiled
n.	☐	All Water Main Bores Profiled
o.	☐	All Crossings Identified On Appropriate Profile
p.	☐	Bore Complies With Bore And Utility Crossing General Design Standards And TxDOT Standards If In TxDOT Row
q.	☐	Existing Water Meters Shown
r.	☐	Proposed Water Meters Shown (Both Domestic And Irrigation)
s.	☐	Domestic And Irrigation Water Meters On Looped/Circulating Main
t.	☐	All Water Meters On Separate Service - No Water Meter "Bullheads" Or Manifolds Allowed
u.	☐	Water Meters Location, Preferred To Be In Unpaved Area
v.	☐	Water Meter Sizes Identified
w.	☐	Appropriate Double Check/Backflow Prevention Shown On Private Side Of All Meters
x.	☐	Water System Reviewed For Constructability And Maintenance - Depth And Clearance From Streets, Structures, Other Utilities (Dimensions)
y.	☐	Water Mains Identified As Either Public Or Private With Lines Of Demarcation
z.	☐	Utility Crossings Shown In All Profiles And Bore Profiles Including Franchise Utilities And Street Light Utilities
aa.	☐	If Fire Sprinkler Line Is Shown, Add Note To Plans To Indicated The Requirement For Separate Permit From The Fire Department And Label Min 10-Foot Separation Distance From All Other Utilities
19	**Wastewater** Notes: ☑ = COMPLETE | ☒ = DEFICIENT | ☐ = N/A	

Attachment "A"- Construction Plan Review General Checklist

		Item Description
a.	☐	Wastewater Mains Provided To Front Property Or Otherwise Extended To Serve Upstream Property
b.	☐	Existing Wastewater Mains, Manholes, Cleanouts And Services Shown
c.	☐	Proposed Wastewater Mains, Manholes, Cleanouts And Services Shown
d.	☐	Sanitary Sewer Mains Profiled Along Centerline Of Pipe
e.	☐	Bore Complies With Bore And Utility Crossing General Design Standards And TxDOT Standards If In TxDOT Row
f.	☐	Wastewater Main Size, Material And Class Identified On Plan And Profile
g.	☐	Wastewater Main Depth, Slope, Service Locations, Cleanouts And Manholes Shown In All Profiles
h.	☐	Wastewater Rim, Flow Line In & Flow Line Out Elevations For All Manholes (Min 2% Drop Between Manhole Flow-In And Flow-Out)
i.	☐	Utility Crossings Shown In All Profiles And Bore Profiles Including Franchise Utilities And Street Light Utilities
j.	☐	Wastewater System Reviewed For Constructability And Maintainability - Depth And Clearance From Streets, Structures, Other Utilities (Dimensions)
k.	☐	All Existing And Proposed Public And Private Easements And Rights Of Way Shown
l.	☐	Wastewater Mains Identified As Either Public Or Private With Lines Of Demarcation And Private Utility Note
m.	☐	Private Utility Note: "All Wastewater Work Designated As "Private" In This Set Of Plans Shall Be Installed In Accordance With The International Plumbing Code, Permitted And Inspected By The City Building Inspection Department And Installed By A Licensed Plumber."
n.	☐	Limits Of Existing And Proposed 100-Year Ultimate Floodplain Shown (FEMA And Local) And Wetland And Water Of U.S. Delineation
o.	☐	Ultimate (Fully Developed) 100-Year Floodplain Water Surface Elevations (WSE's) Shown (FEMA And Local)
p.	☐	Note Identifying Reference For 100 Year Floodplain And WSE Information And Wetland And Water Of U.S. Delineation
20.		**Lift Station** Notes: ☑ = COMPLETE | ☐ = DEFICIENT | ☐ = N/A
a.	☐	Lift Station Report
b.	☐	Dimension And Site Plans
c.	☐	Grading Plan
d.	☐	Force Main Plan And Profile
e.	☐	Landscape Plan
f.	☐	Electrical And Control Plans
g.	☐	Detail Sheets
21.		**Erosion Control (For Sites Greater 1- Acre Or Larger) / SWP3 (If Required By TCEQ Regulations)** Notes: ☑ = Complete | ☒ = Deficient | ☐ = N/A
a.	☐	Owners Name, Address & Phone No.
b.	☐	Developers Name Address & Phone No.

Attachment “A”- Construction Plan Review General Checklist

Item		Description
c.	☐	Engineers Name Address & Phone No.
d.	☐	Site Acreage Listed
e.	☐	Disturbed Acreage Listed (Acres)
f.	☐	Limits Of Construction And Disturbed Areas Shown
g.	☐	Existing Ground Contours, Drainage Features And Structures
h.	☐	100-Yr Flood Plain With Elevations (FEMA And Local) And Wetland And Water Of U.S. Delineation
i.	☐	Limits Of Trees/Shrubs To Remain
j.	☐	Grades To Match Grading Plan
k.	☐	Proposed Storm Drainage, Structures & Pavement
l.	☐	Borrow & Spoil Area Identified
m.	☐	Bmp Locations, Details, Calculations, And Maintenance Schedule
n.	☐	Sediment Basin, Required If Disturbed Area Greater Than 10 Acres
22.	**Standard Details and City General Notes**	Notes: ☑ = Complete | ☒ = Deficient | ☐ = N/A
a.	☐	All Standard Details That Are Required For Construction From Standard Specifications For Public Works Construction, North Central Texas, Fifth Edition, Or The City Of Rockwall Standards Of Design And Construction Shall Be Included In All Plan Sets.
b.	☐	City General Notes Sheets
23.	**TxDOT Details**	Notes: ☑ = Complete | ☒ = Deficient | ☐ = N/A
a.	☐	Include All Pertinent Details Called Out In Plans

ATTACHMENT "B"

Example - Residential Checklist For Final Acceptance

(DATE)

(ENGINEER'S NAME)
(ENGINEERING COMPANY)
(ADDRESS)
(CITY, TX ZIP)

Re. *(PROJECT NAME)* – Checklist for final acceptance

Dear *(ENGINEER'S NAME)*,

The following items are to be completed at the above-mentioned site to bring the project into compliance with City specifications and to meet specific project requirements. The listed items are items identified during the walkover of the site and are to be addressed prior to final acceptance of the project. The City will conduct daily site visits (during daily rounds) at the project until completion of the noted items. A copy of this list will also be directed to the developer/owner and general contractor. The below listed items are to be directed to the appropriate responsible parties for completion.

Walk-Through Punch List

1) ??

Required documentation from the design engineer:-

1. Letter of Concurrence - The City of Kaufman requires that the design engineer provide a letter of concurrence with the following verifications:
    a. The letter is to verify that the drainage flow patterns, grade to drain locations, pad elevations, and drainage structures, including the volume of the surface and/or subsurface detention system and detention outlet structure located at the project were installed to the general elevations as shown on the approved plans.
    b. The letter shall also verify that the project was constructed to meet the approved design requirements or is within acceptable design tolerances.
    c. The Design Engineer or his designated representative shall direct all "survey-work" necessary to verify elevations and design compliance. The letter of concurrence is to have the seal and signature of the design engineer
    d. Example of Letter of Concurrence verbiage **which will NOT be accepted** by the City: *"A representative of this company visited the site and has visually verified to the best of the engineer's professional opinion, knowledge and belief, the final grading and site drainage comply with the City approved plans and details."*

e. Example of Letter of Concurrence verbiage **which WILL be accepted** by the City: *"A representative of this company visited the site and has visually verified to the best of the engineer's professional opinion, knowledge and belief, that based on my observations along with survey work conducted at the site, the final grading, site drainage, and detention outfall with required volume comply with the City approved plans and details."*

2. Paper "Record Drawings" or "As Built" Drawings - Submit one (1) set of blue line drawings of the "Record Drawings" containing copies of all sheets. The blue line copy will be reviewed by the construction inspector **PRIOR** to producing the "Record Drawing" disk. This will allow any revisions to be addressed prior to producing the disk.

3. Digital "Record Drawings" or "As Built" Drawings - The Design Engineer shall furnish a digital file of the project formatted in Auto Cad 14, or 2000 format or newer **and** Adobe Acrobat (pdf.) format with a CD-ROM. The disk shall include a full set of plans along with any landscaping, wall plans, and details sheets.

    a. The "Record Drawing" disk drawings shall have the design engineer's seal, signature and must be stamped and dated as "Record Drawings" or "As Built Drawings" **on all sheets**.

    b. The City of Kaufman **will not accept** any "Record Drawing" disk drawings which include a disclaimer with the like or similar verbiage: A disclaimer shall **NOT** directly or indirectly state or indicate that the design engineer or the design engineers, surveyor/surveyors **did not verify the grades** after construction, or that the Record Drawings were based solely on information provided by the construction contractor/contractors.

    c. The City of Kaufman **will accept** any "Record Drawing" disk drawings which include a disclaimer with the like or similar verbiage.(Example of Acceptable Disclaimer) "*To the best of our knowledge Smith Engineering, Inc., hereby states that this plan is "As-Built". This information provided is based on surveying at the site and information provided by the contractor."*

4. Engineering Inspection Fee (Final "As-Built" Adjustments) – Prior to the start of construction at the project, engineering inspection fees for the project were established. The preliminary inspection fee amounts were based upon the projected quantity and unit price amounts which were approved by the City Engineer. A fee based on percentage of the projected quantity cost was paid to the City. The final fee amounts are to be adjusted if necessary to match the unit quantity and unit price amounts based on the "As-Built" unit quantity amounts.

    a. Please provide a copy of the "As-Built" quantity amounts with total amounts for each item. The "As Built "amounts should be noted or stamped as*: "As Built contract quantity and unit price amounts"*.

    b. The engineering inspection fee charged by the City will be adjusted to match these amounts if necessary. The City is to receive payment on the adjusted cost amounts prior to project acceptance.

c. "As-built" contract **unit quantity and unit price** include but are not limited to amounts for the pavement, drive approaches, sidewalks, barrier free ramps, wastewater, storm sewer, drainage structures (including underground detention), water lines, along with all associated fixtures which are located within the defined rights-of-way and easements of the project.

d. All weekday and weekend overtime engineering inspections fees are to be paid prior to final acceptance.

5. Flood study review fees in accordance with the approved Professional Services Agreement, the Facilities Agreement and/or the Development Agreement are to be paid if there is an excess due over the initial review fee. If all of the initial fees were not utilized for the flood study review, those monies will be refunded.

6. Gas and Electric facilities are to be installed at the site and be ready to provide service to each lot.

a. A letter of installation verification and operation will be required from electric and gas project managers and will need to be directed to the City of Kaufman prior to project acceptance or any early lot releases. The letter may be from the above noted parties or their designated representatives.

7. Storm Sewer Outfall Coordinates - It is now necessary to tie down all the storm sewer outfall pipes to our state plane Coordinate System. The design engineer will be required to provide the following coordinate information which is to be submitted in letter form showing the x, y, and z coordinates at the end of all storm sewer outfalls of the project.

8. Elevation Survey Monuments which are to be installed at the project shall be tied to the City of Kaufman monument coordinates both horizontally and vertically. The information shall be transferred to the City of Kaufman.

   a. Elevations and monument locations are to be shown on the "As Built" mylars on both the paving plans and the storm sewer plans and shall also be submitted to the City in similar or like letter-form: **"***The monuments are to be supplied by the City of Kaufman and installed by the utility contractor. The monument locations are as follows: 1 (Location), 2. (Location)"*

9. Right-of-Way Compaction and Density Reports –

   a. Final grade densities are to be conducted at approximately each five hundred (500) foot intervals on both sides of each street in the general fill areas of the rights-of-way.

   b. Full Depth trench densities are to be taken at all utility trenching locations where trenching operations consisted of cutting trench ten (10) inches wide or wider.

   c. All final grade right-of-way and easement compaction density tests are to be a minimum of ninety-five percent (95%) of the standard proctor density.

   d. Copies of the compaction tests performed for the developer's contractors as well as by the franchise utility company's contractors shall be provided to the City prior to project acceptance.

10. Maintenance bonds are to be submitted to the City of Kaufman for the paving and utilities installed at the project. The bonds shall be **two-year (2-yr)** one-hundred percent (100%) maintenance bonds to cover maintenance, for a two-year timeline starting from the **"***Date of City of Kaufman's Acceptance"* for the project. There is to be no date in the starting timeline only the above wording.
11. Utility Bond - The utility bond shall cover the following utility systems and their associated fixtures:
    a. Water & Wastewater;
    b. Storm Sewer (including detention systems);
12. Paving Bond – The paving bond shall cover the following:
    a. Street pavement;
    b. Driveway approaches
    c. Sidewalks;
    d. Barrier free ramp.
13. Engineered Retaining Wall Inspection & Letter of Concurrence – The City requires the design engineer for any retaining wall which is three-feet in height or taller, to periodically inspect, or make arrangements for his designated representative to periodically inspect the retaining wall/walls during the construction process. The design engineer is to submit letter of concurrence for the retaining wall/walls to the City prior to project acceptance. The letter shall contain the **seal and signature** of the retaining wall design engineer.

-Site Items-

1. Site Working Hours and Noise Control Signage **- Ordinance No. 20-99 –** signs are to be placed at all entrances, which provides an access entry way into the subdivision. The signs are to note allowed hours of construction as mandated by the City Ordinance. The signs must be installed prior to project acceptance or prior to the start of any early lot release construction. The signs may be placed in the City right-of-way provided that it is not placed within the 30-feet visibility easement clips, which are located at all street intersections. Each posted sign shall contain the following ordinance work-hours information and contain both the English and the Spanish version of the ordinance (see next page),
    a. The face of the sign shall be a minimum of 3-feet wide by 2-feet tall with the sign post being approximately 4-feet tall when measured from the top of the ground to the bottom of the sign face. The maximum height of the sign shall not exceed a height of 7-feet, 6 inches when measured from the top of the ground to the top of the sign. The sign face shall consist of a white background with blue or black lettering. The letters shall be of sufficient size so as to be readily visible to all vehicular traffic entering the subdivision.

ORDINANCE # 20-99

CONSTRUCTION SITE WORKING HOURS AND NOISE CONTROL

City Ordinance – No. 02-99 limits construction and construction related activities to the hours of 6:00 a.m. – 8:30 p.m. Monday through Friday from June 1 to September 30, between 7:00 a.m. and 8:30 p.m. Monday through Friday, form October 1 to May 31, between 8:00 a.m. and 8:30 p.m. on Saturday, and between 1:00 p.m. and 8:30 p.m. on Sunday.

ORDENANZA # 20-99

HORAS DE TRABAJO EN EL SITIO DE CONSTRUCCIÓN Y CONTROL DE RUIDO

La Ordenanza de la Ciudad No. 02-99 limita la construcción y las actividades relacionadas con la construcción al horario de 6:00 a. m. a 8:30 p. m. De lunes a Viernes del 1 de junio al 30 de septiembre, de 7:00 a 20:30 horas. De lunes a Viernes, del 1 de octubre al 31 de mayo, de 8:00 a 20:30 horas. el sábado, y entre las 13:00 y las 13:00 horas. y 20:30 h. el Domingo.

2. Maximum Slope - The maximum slope allowed by the City will be a 4:1 slope, however this slope will only be allowed when it is not possible or feasible to achieve a slope of 4:1 or less. Retaining walls or other City approved retaining methods will be required where it is not possible or feasible to comply with the 4:1 maximum slope requirement. All slopes are to be compacted to 95% of the standard proctor density.

3. Install floodway monument markers - The City will furnish the marker cap, which is to be set in concrete as directed by the City of Kaufman. The developers designated representative shall install the marker prior to project acceptance. Monument installation shall meet City of Kaufman specifications.

    a. The monument marker location is to be shown on the “Record Drawing” on the grading plan;

    b. The City of Kaufman will furnish the marker cap;

    c. Install “No Dumping, Drains to Waterway” inlet markers to be installed on each inlet by the developer.

4. Interior Erosion Protection – Install reinforced silt fencing which complies with (NCTCOG) standard drawing (1020A) Third Addition. Silt fencing is to be installed at the back of the street pavement curbs and at 1-foot off the outside pavement edge of the alleys. The silt fence should contain the entire perimeter of the disturbed lot.

5. Silt Fence Installation - When installing the silt fence at the street (back of curb) and alley (edge of paving) locations take care to address the following issues:

    a. Allow for a clearance radius of 5-feet around each hydrant;

    b. Block the silt fence around and to the backside of each water meter;

c. When placing the silt fence at an alley intersection be sure to transition the silt fence to allow a turning radius for vehicles;

d. Do place the silt fence within the sight visibility easements which are located at the street and alley intersections;

e. Maintain existing or install additional construction site erosion BMP's as necessary, to stabilize the disturbed soil or contain silt migration.

6. Street and Alley Parkway Grading - All street and alley parkways and right-of-way locations are to be graded so as to obtain a 2% grade (1/4-inch per foot) slope. All parkways and right-of-way locations are to have positive drainage flow towards the street or alley to the right-of-way. The transitional grading from the right-of-way to the existing natural grade is to match the approved grading plans.

7. Final Site Grading – All grading is to be completed and verified to meet the approved grading plans. All graded areas including slopes are to be brought to a final grade surface that is smooth and uniform being relatively free of erosion washouts, tire ruts, dirt clods, silt deposits, etc. Care should be taken to re-grade any rough surface areas prior to the application of grass seed, sod or erosion matting.

8. Site Maintenance - Remove and dispose any miscellaneous construction related debris, trash rocks etc., from the job-site and properly dispose.

9. Rout and seal all miscellaneous random cracks which are located in the street and alley locations.

10. Testing Report Copies - Provide the Public Works inspector with electronic copies of **ALL** testing reports for the project. These shall include but not be limited to soils reports, utility densities, utility videos along with supporting documents, subgrade test reports and all concrete related reports for utilities and paving.

11. Video Survey - Conduct a video survey of the public sanitary and storm lines to the Public Works inspector assigned to the project. Videos shall be taken after the franchise utilities on the project have been completed.

12. Barrier Free Ramps - Complete the installation of all barrier free ramps.

13. Construct all sidewalks that are located in the common open areas.

14. Roadway Maintenance - Clean and sweep all roadways to remove all of the dirt and debris that has accumulated during construction.

15. Random Pavement Depth Checks – Conduct random depth core tests at various street and alley locations, as directed by the engineering inspector. The location of the test and the number of test necessary will be left to the discretion of the engineering inspector.

16. Landscaping - Complete the landscaping per the approved landscaping plans.

17. Fire Hydrants - Fire hydrants are required to have a nozzle height of 19-inches to 28-inches above the final grade elevation. Hydrant nozzles that do not meet this specification are to be raised or lowered as necessary to obtain compliance.

a. All fire hydrants are to have a clearance radius of 5-feet in all directions. No structures, traffic bollards, silt fencing, landscaping etc., are to be placed within the clearance area;

b. Paint all fire hydrants located at the site to City specifications. A minimum of two coats of aluminum paint, Mobile 11-A-19 or Tnemec 2-color Tnemec-Gloss or approved equal are to be applied to each hydrant. The fire hydrant body shall be painted silver. The hydrant nozzle and bonnet are to be painted to comply with the following line size color code. The color indicating the line size shall be as follows:

   i. Solid silver for 6-inch water mains;

   ii. Blue for 8-inch lines water mains;

   iii. Yellow for 10-inch water mains and above.

18. Water Valve and Waste Water Manhole Curb Cut Marks – The pavement curbs are to be marked at all water valve and waste water manhole locations. The curb cut marks are to be sawn into the pavement curb. The curb cut marks are to consist of the following:

    a. Valves – place a (V) mark on the curb to note the valve locations, (blue paint for general, white paint for stub outs or dead ends, and red paint for fire hydrants and or fire lines);
    b. Manholes – place a (M-H) mark on the pavement curb to indicate manhole locations (green paint);
    c. Curb stops – place a (I) mark on the pavement curb to indicate curb stop locations (blue paint);
    d. Cleanouts – place a (II) mark on the pavement curb to indicate sewer clean out locations (green paint).

19. Manholes - Seal and vacuum test all manholes. All manholes which require grade adjustments are to be re-tested.

20. Camera Inspections - Perform a television camera inspection of all sanitary sewer and storm sewers, along with the associated storm sewer laterals. Copies of the inspection tapes which are to be on a thumb drive or DVD format are to be submitted to *Engineering Inspector* with the City of Kaufman Engineering Department. Videos shall be taken after the franchise utilities on the project have been completed. Also forward the results of all air and mandrel tests to the Engineering Inspector.

21. Lift Station - The lift station is to be operational and approved for use by the design engineer and the City of Kaufman.

22. Guard Rails - Install guard rail at all locations as noted on the approved plans.

23. Landscaping and Screening Inspection – The Development Services Director or his designated representative shall conduct an inspection of the landscaping and project screening upon completion.

24. Information (Future Item) – Twenty-Month Maintenance Review – The City of Kaufman requires a twenty-month maintenance review of every project. This review is to be conducted at twenty-months into the two-year maintenance warranty. The design engineer or his designated representative along with the contractors' designated representatives shall be present to perform a walkover of the project with the City of Kaufman. A second T.V. camera of sanitary sewer main shall be done at this time with a thumb drive or DVD formatted copy provided to the City of Kaufman.
25. Grass is to be established in all disturbed areas. Grass shall be at least 1'' in height with seventy-five to eighty percent (75%-80%) coverage of all disturbed areas.

For additional information regarding this check list or site work status please contact – the Public Works Inspector and/or the City Engineer for the designated inspector for the site-work on this project for the City of Kaufman, regarding this list. Project acceptance is subject to but not necessarily limited to the above-listed punch list items. The *Public Works Inspector* may be reached at telephone no. 972-771-7730 or 972-962-8007.

Sincerely,

City Engineer or Public Works Inspector
City of Kaufman Public Works Department

ATTACHMENT "C"

Example – Commercial Checklist For Final Acceptance

(DATE)

(ENGINEER'S NAME)
(ENGINEERING COMPANY)
(ADDRESS)
(CITY, TX ZIP)

Re. *(PROJECT NAME)* – Checklist for final acceptance

Dear *(ENGINEER'S NAME)*,

The following items are to be completed at the above-mentioned site to bring the project into compliance with City specifications and to meet specific project requirements. The listed items are items identified during the walkover of the site and are to be addressed prior to final acceptance of the project. The City will conduct daily site visits (during daily rounds) at the project until completion of the noted items. A copy of this list will also be directed to the developer/owner and general contractor. The below listed items are to be directed to the appropriate responsible parties for completion.

Walk-Through Punch List

1) ??

Required documentation from the design engineer:-

1. Letter of Concurrence - The City of Kaufman requires that the design engineer provide a letter of concurrence with the following verifications:
    a. The letter is to verify that the drainage flow patterns, grade to drain locations, pad elevations, and drainage structures, including the volume of the surface and/or subsurface detention system and detention outlet structure located at the project were installed to the general elevations as shown on the approved plans.
    b. The letter shall also verify that the project was constructed to meet the approved design requirements or is within acceptable design tolerances.
    c. The Design Engineer or his designated representative shall direct all "survey-work" necessary to verify elevations and design compliance. The letter of concurrence is to have the seal and signature of the design engineer
    d. Example of Letter of Concurrence verbiage **which will NOT be accepted** by the City: *"A representative of this company visited the site and has visually verified to the best of the engineer's professional opinion, knowledge and belief, the final grading and site drainage comply with the City approved plans and details."*

e. Example of Letter of Concurrence verbiage **which WILL be accepted** by the City: *"A representative of this company visited the site and has visually verified to the best of the engineer's professional opinion, knowledge and belief, that based on my observations along with survey work conducted at the site, the final grading, site drainage, and detention outfall with required volume comply with the City approved plans and details."*

2. Paper "Record Drawings" or "As Built" Drawings - Submit one (1) set of blue line drawings of the "Record Drawings" containing copies of all sheets. The blue line copy will be reviewed by the construction inspector **PRIOR** to producing the "Record Drawing" disk. This will allow any revisions to be addressed prior to producing the disk.

3. Digital "Record Drawings" or "As Built" Drawings - The Design Engineer shall furnish a digital file of the project formatted in Auto Cad 14, or 2000 format or newer **and** Adobe Acrobat (pdf.) format with a CD-ROM. The disk shall include a full set of plans along with any landscaping, wall plans, and details sheets.

   a. The "Record Drawing" disk drawings shall have the design engineer's seal, signature and must be stamped and dated as "Record Drawings" or "As Built Drawings" **on all sheets**.

   b. The City of Kaufman **will not accept** any "Record Drawing" disk drawings which include a disclaimer with the like or similar verbiage: A disclaimer shall **NOT** directly or indirectly state or indicate that the design engineer or the design engineers, surveyor/surveyors **did not verify the grades** after construction, or that the Record Drawings were based solely on information provided by the construction contractor/contractors.

   c. The City of Kaufman **will accept** any "Record Drawing" disk drawings which include a disclaimer with the like or similar verbiage.(Example of Acceptable Disclaimer) "*To the best of our knowledge Smith Engineering, Inc., hereby states that this plan is "As-Built". This information provided is based on surveying at the site and information provided by the contractor."*

4. Engineering Inspection Fee (Final "As-Built" Adjustments) – Prior to the start of construction at the project, engineering inspection fees for the project were established. The preliminary inspection fee amounts were based upon the projected quantity and unit price amounts which were approved by the City Engineer. A fee based on percentage of the projected quantity cost was paid to the City. The final fee amounts are to be adjusted if necessary to match the unit quantity and unit price amounts based on the "As-Built" unit quantity amounts.

   a. Please provide a copy of the "As-Built" quantity amounts with total amounts for each item. The "As Built "amounts should be noted or stamped as*: "As Built contract quantity and unit price amounts"*.

   b. The engineering inspection fee charged by the City will be adjusted to match these amounts if necessary. The City is to receive payment on the adjusted cost amounts prior to project acceptance.

c. "As-built" contract **unit quantity and unit price** include but are not limited to amounts for the pavement, drive approaches, sidewalks, barrier free ramps, wastewater, storm sewer, drainage structures (including underground detention), water lines, along with all associated fixtures which are located within the defined rights-of-way and easements of the project.

d. All weekday and weekend overtime engineering inspections fees are to be paid prior to final acceptance.

5. Flood study review fees in accordance with the approved Professional Services Agreement, the Facilities Agreement and/or the Development Agreement are to be paid if there is an excess due over the initial review fee. If all of the initial fees were not utilized for the flood study review, those monies will be refunded.

6. Gas and Electric facilities are to be installed at the site and be ready to provide service to each lot.

   a. A letter of installation verification and operation will be required from electric and gas project managers and will need to be directed to the City of Kaufman prior to project acceptance or any early lot releases. The letter may be from the above noted parties or their designated representatives.

7. Storm Sewer Outfall Coordinates - It is now necessary to tie down all the storm sewer outfall pipes to our state plane Coordinate System. The design engineer will be required to provide the following coordinate information which is to be submitted in letter form showing the x, y, and z coordinates at the end of all storm sewer outfalls of the project.

8. Elevation Survey Monuments which are to be installed at the project shall be tied to the City of Kaufman monument coordinates both horizontally and vertically. The information shall be transferred to the City of Kaufman.

   a. Elevations and monument locations are to be shown on the "As Built" mylars on both the paving plans and the storm sewer plans and shall also be submitted to the City in similar or like letter-form: **"***The monuments are to be supplied by the City of Kaufman and installed by the utility contractor. The monument locations are as follows: 1 (Location), 2. (Location)"*

9. Right-of-Way Compaction and Density Reports –

   a. Final grade densities are to be conducted at approximately each five hundred (500) foot intervals on both sides of each street in the general fill areas of the rights-of-way.

   b. Full Depth trench densities are to be taken at all utility trenching locations where trenching operations consisted of cutting trench ten (10) inches wide or wider.

   c. All final grade right-of-way and easement compaction density tests are to be a minimum of ninety-five percent (95%) of the standard proctor density.

   d. Copies of the compaction tests performed for the developer's contractors as well as by the franchise utility company's contractors shall be provided to the City prior to project acceptance.

10. Maintenance bonds are to be submitted to the City of Kaufman for the paving and utilities installed at the project. The bonds shall be **two-year (2-yr)** one-hundred percent (100%) maintenance bonds to cover maintenance, for a two-year timeline starting from the **"***Date of City of Kaufman's Acceptance"* for the project. There is to be no date in the starting timeline only the above wording.
11. Utility Bond - The utility bond shall cover the following utility systems and their associated fixtures:
    a. Water & Wastewater;
    b. Storm Sewer (including detention systems);
12. Paving Bond – The paving bond shall cover the following:
    a. Street pavement;
    b. Driveway approaches
    c. Sidewalks;
    d. Barrier free ramp.
13. Engineered Retaining Wall Inspection & Letter of Concurrence – The City requires the design engineer for any retaining wall which is three-feet in height or taller, to periodically inspect, or make arrangements for his designated representative to periodically inspect the retaining wall/walls during the construction process. The design engineer is to submit letter of concurrence for the retaining wall/walls to the City prior to project acceptance. The letter shall contain the **seal and signature** of the retaining wall design engineer.

-Site Items-

1. Site Working Hours and Noise Control Signage **- Ordinance No. 20-99 –** signs are to be placed at all entrances, which provides an access entry way into the subdivision. The signs are to note allowed hours of construction as mandated by the City Ordinance. The signs must be installed prior to project acceptance or prior to the start of any early lot release construction. The signs may be placed in the City right-of-way provided that it is not placed within the 30-feet visibility easement clips, which are located at all street intersections. Each posted sign shall contain the following ordinance work-hours information and contain both the English and the Spanish version of the ordinance (see next page),
    a. The face of the sign shall be a minimum of 3-feet wide by 2-feet tall with the sign post being approximately 4-feet tall when measured from the top of the ground to the bottom of the sign face. The maximum height of the sign shall not exceed a height of 7-feet, 6 inches when measured from the top of the ground to the top of the sign. The sign face shall consist of a white background with blue or black lettering. The letters shall be of sufficient size so as to be readily visible to all vehicular traffic entering the subdivision.

ORDINANCE # 20-99
CONSTRUCTION SITE WORKING HOURS AND NOISE CONTROL

City Ordinance – No. 02-99 limits construction and construction related activities to the hours of 6:00 a.m. – 8:30 p.m. Monday through Friday from June 1 to September 30, between 7:00 a.m. and 8:30 p.m. Monday through Friday, form October 1 to May 31, between 8:00 a.m. and 8:30 p.m. on Saturday, and between 1:00 p.m. and 8:30 p.m. on Sunday.

ORDENANZA # 20-99
HORAS DE TRABAJO EN EL SITIO DE CONSTRUCCIÓN Y CONTROL DE RUIDO

La Ordenanza de la Ciudad No. 02-99 limita la construcción y las actividades relacionadas con la construcción al horario de 6:00 a. m. a 8:30 p. m. De lunes a Viernes del 1 de junio al 30 de septiembre, de 7:00 a 20:30 horas. De lunes a Viernes, del 1 de octubre al 31 de mayo, de 8:00 a 20:30 horas. el sábado, y entre las 13:00 y las 13:00 horas. y 20:30 h. el Domingo.

2. Maximum Slope - The maximum slope allowed by the City will be a 4:1 slope, however this slope will only be allowed when it is not possible or feasible to achieve a slope of 4:1 or less. Retaining walls or other City approved retaining methods will be required where it is not possible or feasible to comply with the 4:1 maximum slope requirement. All slopes are to be compacted to 95% of the standard proctor density.
3. Install floodway monument markers - The City will furnish the marker cap, which is to be set in concrete as directed by the City of Kaufman. The developers designated representative shall install the marker prior to project acceptance. Monument installation shall meet City of Kaufman specifications.
    a. The monument marker location is to be shown on the “Record Drawing” on the grading plan;
    b. The City of Kaufman will furnish the marker cap;
    c. Install “No Dumping, Drains to Waterway” inlet markers to be installed on each inlet by the developer.
4. Interior Erosion Protection – Install reinforced silt fencing which complies with (NCTCOG) standard drawing (1020A) Third Addition. Silt fencing is to be installed at the back of the street pavement curbs and at 1-foot off the outside pavement edge of the alleys. The silt fence should contain the entire perimeter of the disturbed lot.
5. Silt Fence Installation - When installing the silt fence at the street (back of curb) and alley (edge of paving) locations take care to address the following issues:
    a. Allow for a clearance radius of 5-feet around each hydrant;
    b. Block the silt fence around and to the backside of each water meter;

c. When placing the silt fence at an alley intersection be sure to transition the silt fence to allow a turning radius for vehicles;

d. Do place the silt fence within the sight visibility easements which are located at the street and alley intersections;

e. Maintain existing or install additional construction site erosion BMP's as necessary, to stabilize the disturbed soil or contain silt migration.

6. Street and Alley Parkway Grading - All street and alley parkways and right-of-way locations are to be graded so as to obtain a 2% grade (1/4-inch per foot) slope. All parkways and right-of-way locations are to have positive drainage flow towards the street or alley to the right-of-way. The transitional grading from the right-of-way to the existing natural grade is to match the approved grading plans.

7. Final Site Grading – All grading is to be completed and verified to meet the approved grading plans. Re-establish all drainage swales, as necessary to achieve conformance to the drainage patterns shown on the approved grading plans. Grade to drain any locations which may hold water or obstruct approved drainage flow patterns.

    a. All graded areas including slopes are to be brought to a final grade surface that is smooth and uniform being relatively free of erosion washouts, tire ruts, dirt clods, silt deposits, etc. Care should be taken to re-grade any rough surface areas prior to the application of grass seed, sod or erosion matting.

8. Site Maintenance - Remove and dispose any miscellaneous construction related debris, trash, rocks etc., from the job-site and properly dispose.

9. Street Repairs - Repair all gouges, cracks and deformities on the curbs. Rout and seal all miscellaneous random cracks which are located in the street and alley locations.

10. Testing Report Copies - Provide the Public Works inspector with electronic copies of **ALL** testing reports for the project. These shall include but not be limited to soils reports, utility densities, utility videos along with supporting documents, subgrade test reports and all concrete related reports for utilities and paving.

11. Video Survey - Conduct a video survey of the public sanitary and storm lines to the Public Works inspector assigned to the project. Videos shall be taken after the franchise utilities on the project have been completed.

12. Barrier Free Ramps - Complete the installation of all barrier free ramps.

13. Street Maintenance - Clean and sweep all roadways to remove all of the dirt and debris that has accumulated during construction.

14. Random Pavement Depth Checks – Conduct random depth core tests at various street and alley locations, as directed by the engineering inspector. The location of the test and the number of test necessary will be left to the discretion of the engineering inspector.

15. Fire Hydrants - Fire hydrants are required to have a nozzle height of 19-inches to 28-inches above the final grade elevation. Hydrant nozzles that do not meet this specification are to be raised or lowered as necessary to obtain compliance.

a. All fire hydrants are to have a clearance radius of 5-feet in all directions. No structures, traffic bollards, silt fencing, landscaping etc., are to be placed within the clearance area;

b. Paint all fire hydrants located at the site to City specifications. A minimum of two coats of aluminum paint, Mobile 11-A-19 or Tnemec 2-color Tnemec-Gloss or approved equal are to be applied to each hydrant. The fire hydrant body shall be painted silver. The hydrant nozzle and bonnet are to be painted to comply with the following line size color code. The color indicating the line size shall be as follows:

   i. Solid silver for 6-inch water mains;

   ii. Blue for 8-inch lines water mains;

   iii. Yellow for 10-inch water mains and above.

c. All fire lanes are to be sawn, and crack sealed. All miscellaneous cracks are to be routed and sealed. All expansion joints are to be sealed in the fire lane.

d. The fire lane is to be re-painted where necessary, if there are locations where the fire lane is scuffed or is flaking. The locations which require re-painting shall be sandblasted, prior to re-painting.

16. Parking Lot Striping & Signage - All parking lot and handicap striping along with all associated signs must be installed

17. Water Valve and Waste Water Manhole Curb Cut Marks – The pavement curbs are to be marked at all water valve and waste water manhole locations. The curb cut marks are to be sawn into the pavement curb. The curb cut marks are to consist of the following:

    a. Valves – place a (V) mark on the curb to note the valve locations, (blue paint for general, white paint for stub outs or dead ends, and red paint for fire hydrants and or fire lines);
    b. Manholes – place a (M-H) mark on the pavement curb to indicate manhole locations (green paint);
    c. Curb stops – place a (I) mark on the pavement curb to indicate curb stop locations (blue paint);
    d. Cleanouts – place a (II) mark on the pavement curb to indicate sewer clean out locations (green paint).

18. Meter Cans and Valve Stacks - Adjust meter cans and valve stacks to final grade elevation.

    a. All valve stacks located outside of paving are to have a 2’ x 2’ four-inch-thick reinforced concrete pad around them.

19. Manholes - Seal and vacuum test all manholes. All manholes which require grade adjustments are to be re-tested.

    a. Wipe the inside ring and cover of the sanitary sewer manhole, using “Non-Shrink” grout and seal if necessary.

    b. Cut an invert in the sanitary sewer connection into the existing manhole at station 0+00, and re-seal the bottom of the manhole.

c.

20. Camera Inspections - Perform a television camera inspection of all sanitary sewer and storm sewers, along with the associated storm sewer laterals. Copies of the inspection tapes which are to be on a thumb drive or DVD format are to be submitted to Public Works Inspector with the Public Works Department. Videos shall be taken after the franchise utilities on the project have been completed. Also forward the results of all air and mandrel tests to the Public Works Inspector.
21. Lift Station - The lift station is to be operational and approved for use by the design engineer and the City of Kaufman.
22. Guard Rails - Install guard rail at all locations as noted on the approved plans.
23. Detention Pond Flume Maintenance – Clean mud from concrete flume in detention pond
24. Screening Inspection – The Development Services Director or his designated representative shall conduct an inspection of the project screening upon completion.
25. Information (Future Item) – Twenty-Month Maintenance Review – The City of Kaufman requires a twenty-month maintenance review of every project. This review is to be conducted at twenty-months into the two-year maintenance warranty. The design engineer or his designated representative along with the contractors' designated representatives shall be present to perform a walkover of the project with the City of Kaufman. A second T.V. camera of sanitary sewer main shall be done at this time with a thumb drive or DVD formatted copy provided to the City of Kaufman.
26. Grass is to be established in all disturbed areas. Grass shall be at least 1'' in height with seventy-five to eighty percent (75%-80%) coverage of all disturbed areas.

For additional information regarding this check list or site work status please contact – the Public Works Inspector and/or the City Engineer for the designated inspector for the site-work on this project for the City of Kaufman, regarding this list. Project acceptance is subject to but not necessarily limited to the above-listed punch list items. The *Public Works Inspector* may be reached at telephone no. 972-771-7730 or 972-962-8007.

Sincerely,

City Engineer or Public Works Inspector
City of Kaufman Public Works Department

ATTACHMENT "D"
Approved Water and Wastewater Materials List

Approved Water Materials List:

All materials on this list do not require separate submittals. All materials must be new and in good condition. All materials to be installed for use on projects in the City of Kaufman shall be produced in the United States of America.

FIRE HYDRANTS

NOTE: All bolts, nuts and washers below bury line to be type 316 stainless-steel.

- Mueller "Super Centurion 250-A423"
- American Darling "B-84B-5"
- Waterous "Pacer WB67"
- Clow "Medallion"
- M&H "Model 129 & 929"
- WaterMaster 5CD250

VALVES

NOTE: All bolts, nuts and washers for valves to be type 316 stainless-steel.

- Mueller Resilient Seat
- Mueller Resilient Wedge
- Mueller Butterfly
- American Darling Resilient Wedge
- American Darling Butterfly
- U.S. Pipe & Foundry "Metro-Seal" Resilient Wedge
- American Flow Control – Series 2500 Resilient Wedge Valve
- Clow Resilient Wedge
- Pratt Butterfly
- American AVK Resilient Seated Gate Valve Series 25, 4"-12"

VALVES (AIR RELEASE / COMBINATION AIR & VACUUM)

- Vent-O-Mat 025 RBX 2521 – 1"
- Vent-O-Mat 050 RBX 2521 – 2"

TAPPING SLEEVES AND VALVES

NOTE: All bolts, nuts and washers to be type 316 stainless-steel.

- All require ¾" NPT brass test plug.

SLEEVES

NOTE: All bolts, nuts and washers to be type 316 stainless-steel.

- Mueller H-304 Stainless-steel Tapping Sleeve w/Stainless-steel Flange
- Tyler Traverse Tapping Sleeve

- Clow Traverse Tapping Sleeve
- Dresser Style 630 Heavy Stainless-Steel Tapping Sleeve
- PowerSeal Model 3490 Stainless-steel Tapping Sleeve
- Ford All Stainless Tapping Sleeve Style FTSS
- Ford All Stainless Tapping Sleeve Style FTSS-MJ
- Smith-Blair 665 Stainless-steel Tapping Sleeve with Stainless-steel Flange, Smith-Blair 665MJ Stainless-steel Tapping Sleeve with Stainless-steel Flange Romac Industries, SST III

TABLE D1: SERVICE SADDLES (FOR PVC, DI OR CI)				
Size/Manufacturer	Mueller	Jones	Ford	A.Y. McDonald
¾-INCH, 2 STRAP	BR-2B, BR-2S	J-979, J-969	202B, 202BS	3825, 3845
1-INCH, 2 STRAP	BR-2B, BR-2S	J-979, J-969	202B, 202BS	3825, 3845
1 ½ -INCH, 2 STRAP	BR-2B, BR-2S	J-979, J-969	202B, 202BS	3825, 3845
2-INCH, 2 STRAP	BR-2B, BR-2S	J-979, J-969	202B, 202BS	3825, 3845

NOTE: All of the above service saddles are to be CC thread. Saddles must be supplied with stainless-steel bolt/nut/washer, with the exception of a double strap bronze saddle.

RESTRAINT (RETAINER) GLANDS

NOTE: All bolts, nuts and washers to be type 316 stainless-steel.

- Uni-Flange Series 1400 for 4" thru 12" (Ductile Iron)
- Uni-Flange Series 1500 for 4" thru 12" (C900 PVC)
- EBAA Iron 1100 Series Megalug (Ductile Iron)
- EBAA Iron 2000PV Series Megalug (C900 PVC)
- Stargrip Series 4000 (C900 PVC)
- Stargrip Series 3000 (Ductile Iron)
- Sigma – One Lok (C900/905 PVC)
- Tyler Union Field Lock (Ductile Iron)
- Tyler Union Tufgrip 1000 (Ductile Iron)
- Tyler Union Tufgrip 2000 (PVC)

RESTRAINT (INTERNAL JOINT RESTRAINED)

NOTE: All bolts, nuts and washers to be type 316 stainless-steel.

- Eagle LOC 900 for 4" thru 12" C900 DR14 PVC Pipe
- Diamond Lok-21 for 4" thru 12" C900 DR14 PVC Pipe

TABLE D2: CORPORATION VALVE (STOPS)				
Size/Manufacturer	Mueller	Jones	Ford	A.Y. McDonald
¾-INCH	B-25008	J-1937-SG	FB-1000-3-Q	4701BQ
1-INCH	B-25008	J-1937-SG	FB-1000-4-Q	4701BQ
1 ½ -INCH	B-25008	J-1937-SG	FB-1000-6-Q	4701BQ
2-INCH	B-25008	J-1937-SG	FB-1000-7-Q	4701BQ

TABLE D3: ANGLE METER VALVES (STOPS

Size/Manufacturer	Mueller	Jones	Ford	A.Y. McDonald
¾-INCH	B-24258	J-1963W-SG	BA43-332-WQ	4602BQ 3/4
1-INCH	B-24258	J-1963W-SG	BA43-444-WQ	4602BQ 1
1 ½ -INCH	B-24276	J-1975W-SG	BFA43-666-WQ	4602BQ 1 ½
2-INCH	B-24276	J-1975W-SG	BFA43-777-WQ	4602BQ 2

DUCTILE IRON FITTINGS (COMPACT ONLY C153)

- American Pipe
- Tyler Pipe Products
- Clow Products
- Star Pipe Products (tees, bends & anchor nipples)
- Sigma/Nappco Products (tees, bends & anchor nipples)
- Griffin Pipe Products

VALVE STACKS AND BOXES

- Bass & Hays adjustable valve box Model No. 2436S

TABLE D4: FIRE HYDRANT PAINT		
Main Size	Color	Paint
6”	Silver/Top & Bottom	Sherwin Williams Silver-Brite Heavy Duty Rust Resistant Aluminum Paint B59s11
8”	Safety Blue Top/Aluminum Bottom	Sherwin Williams Heavy Duty Rust Resistant Aluminum Paint-Safety Blue B54t104
10” Or Larger	Yellow Top/Aluminum Bottom	Sherwin Williams Heavy Duty Rust Resistant Aluminum Paint-Safety Yellow B54y37

TABLE D5: METER BOXES	
< 1 Inch Service	DFW1814F-1BA | DFW Plastics, Inc | Not Traffic Rated
1-1/2-Inch & 2-Inch Service	DFW2818F-1BA | DFW Plastics, Inc | Not Traffic Rated
Traffic Rated Meter Box	DFW65C-14-10BA | DFW65C-1BA – CAN | DFW65C-Overlay-Lid | DFW Plastics
Lids	DFW 18-AMRL-LID E Series

Approved Wastewater Materials List:

NOTE: all specified materials on this list do not require separate submittals. All materials must be new and in good condition. All materials to be installed for use on projects in the City of Kaufman shall be produced in the United States of America.

WASTEWATER MAIN AND SERVICE PIPE (GRAVITY FLOW ONLY)

- ASTM D3034 SDR-35 PVC 4" to 15" Diameter (Green in color)
- ASTM D3034 SDR-26 PVC 18" to 30" Diameter and for any wastewater installed 10' and deeper (Green in color)
- ASTM D3262 Fiberglass Sewer Pipe 18" to 54" and ASTM 4161 Fiberglass Fittings (must submit thickness design for wall thickness calculations) Approved Manufactures for Fiberglass Pipe and fitting are Hobas Pipe, US Composite Pipe South and Ameron International.

MANHOLE PIPE CONNECTORS

- Link-Seal
- A-LOC
- KOR-N-SEAL – 306 Series by National Pollution Control Systems Inc.
- PS (Press-Seal) – PSX: Direct Drive

WASTEWATER MANHOLE LIDS AND RINGS

- Pamrex with Lock
- East Jordan Iron Works 30" ERGO XL with Camlock Security closing device, MPIC Pick slot, elastomer T-Gasket in lid and infiltration plugs at the hinges. – Product No. 00148026L01
- East Jordan Iron Works 24" ERGO with Camlock Security closing device, MPIC Pick slot, elastomer T-Gasket in lid and infiltration plugs at the hinges – Product No. NPR10-1213A (for retrofit work only).

MANHOLE COATINGS (NO DARK COLORS ALLOWED)

- Raven 405 (125 mils thick)-light blue colored only
- ConShield-terra cotta colored only (must be spark tested per NACE International Standard)

GEOTEXTILE MATERIAL (INSTALLED UNDER PRECAST MANHOLES)

- Mirafi 140N
- Geotex 401

MANHOLE GRADE RINGS

- HDPE Adjustment Rings by Ladtech Inc.
- ARPRO Expanded Polypropylene, ASTM D3575, by Cretex Seals
- East Jordan Iron Works Infra-Riser.

PRE-CAST MANHOLE GASKETS

- Hanson – CR 097
- Hydroconduit – Profile

MANHOLE CHIMNEY SEALS AND RING & COVER SEALING SYSTEMS

- Cretex with stainless-steel self-locking bands. (interior & exterior)
- Riser Wrap by PSI

MANHOLE DROP BOWL

- Reliner / Duran Inc., Inside Drop Bowl with Stainless-steel anchor assemblies
- Approved Equal

CLEANOUT

- Bass & Hays 404 Lateral Cleanout with lid and gasket within pavement only
- Bass & Hays 339 Wastewater Cleanout Boot
- Stan Roberts G-1504

DOUBLE CLEANOUT METER BOX

- Bass & Hays 3-LID2 (Sewer)
- Approved Equal

THREADED ANCHOR

- Hilti – KB3-SS304 5/8" anchor bolts or equal
- Stainless-steel all thread 5/8" (embedded min 4-1/2" into cone with an epoxy or Wedge-it)
- Simpson Strong Tie – Strong-Bolt 5/8"

FORCE MAIN PIPE

- AWWA C-905 pipe, green colored

AIR RELEASE VALVE

- Vent-O-Mat Anti-Shock Air Release and Vacuum Break Valves
- Approved Equal

ISOLATION GATE VALVE

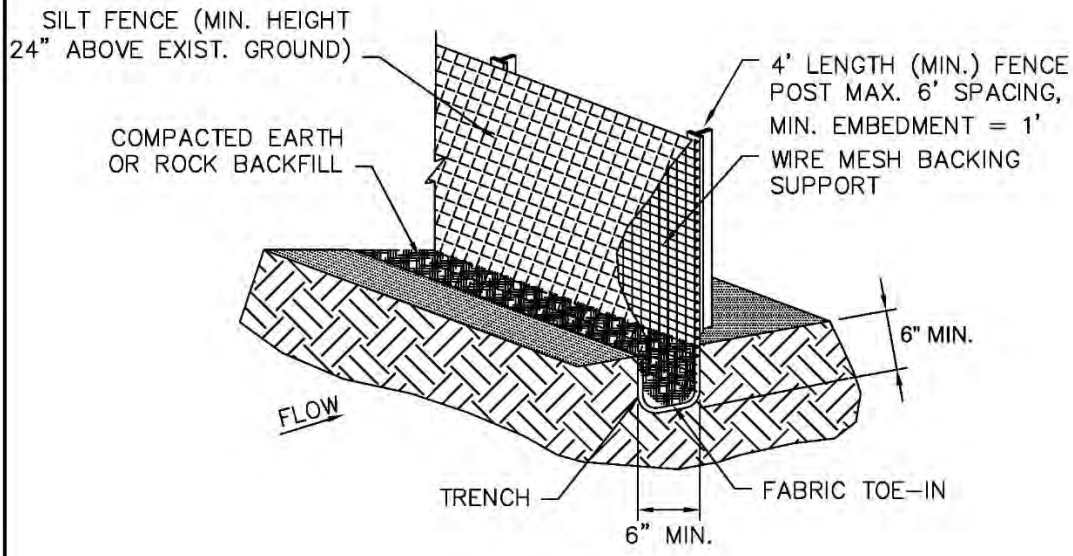
- American-Series 2500 2"-12" Resilient Wedge Gate Valves with Flanged Ends
- Approved Equal

GENERAL NOTES:

(1) all exposed stainless-steel bolts and nuts must be coated with approved anti-seize compound: permatex nickel anti-seize or approved equal.

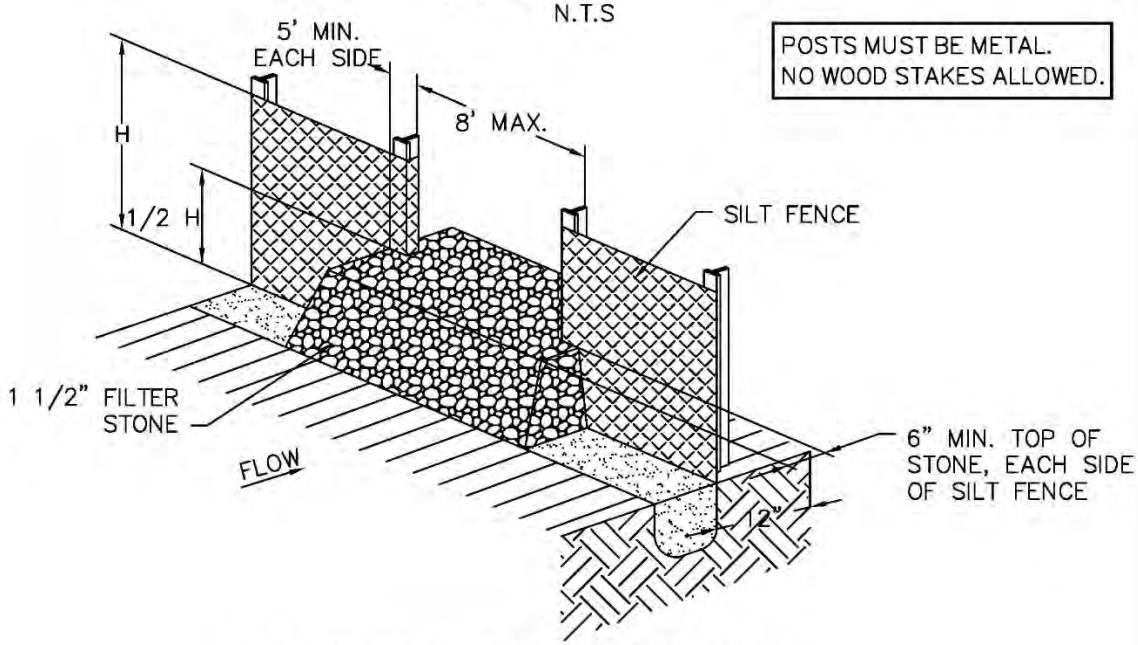
(2) materials not on this list will need to be submitted for review

ATTACHMENT “E”
Kaufman Standard Construction Drawing Details



SILT FENCE

N.T.S



POSTS MUST BE METAL.
NO WOOD STAKES ALLOWED.

SILT FENCE OVERFLOW STRUCTURE

N.T.S

SILT FENCE		STANDARD SPECIFICATION REFERENCE 202.5	
		DATE AUG '23	STANDARD DRAWING NO. 1020A

SILT FENCE GENERAL NOTES:

1. POST WHICH SUPPORT THE SILT FENCE SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POST MUST BE EMBEDDED A MINIMUM OF ONE FOOT.

2. THE TOE OF THE SILT FENCE SHALL BE TRENCHED IN WITH A SPADE OR MECHANICAL TRENCHER, SO THAT THE DOWNSLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF FLOW. WHERE FENCE CANNOT BE TRENCHED IN (e.g. PAVEMENT), WEIGHT FABRIC FLAP WITH ROCK ON UPHILL SIDE TO PREVENT FLOW FROM SEEPING UNDER FENCE.

3. THE TRENCH MUST BE A MINIMUM OF 6 INCHES DEEP AND 6 INCHES WIDE TO ALLOW FOR THE SILT FENCE FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.

4. SILT FENCE SHOULD BE SECURELY FASTENED TO EACH SUPPORT POST OR TO WIRE BACKING, WHICH IN TURN IS ATTACHED TO THE FENCE POST. THERE SHALL BE A 3 FOOT OVERLAP, SECURELY FASTENED WHERE ENDS OF FABRIC MEET.

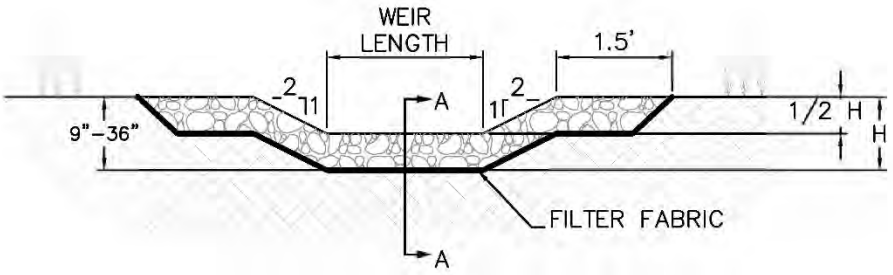
5. INSPECTION SHALL BE AS SPECIFIED IN THE SWPPP. REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.

6. SILT FENCE SHALL BE REMOVED WHEN FINAL STABILIZATION IS ACHIEVED OR ANOTHER EROSION OR SEDIMENT CONTROL DEVICE IS EMPLOYED.

7. ACCUMULATED SILT SHALL BE REMOVED WHEN IT REACHES A DEPTH OF HALF THE HEIGHT OF THE FENCE. THE SILT SHALL BE DISPOSED OF AT AN APPROVED SITE AND IN SUCH A MANNER AS TO NOT CONTRIBUTE TO ADDITIONAL SILTATION.

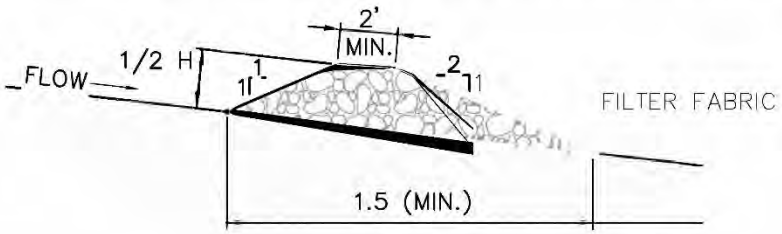
8. FILTER STONE SHALL BE WRAPPED IN FILTER FABRIC AND BURIED SIX (6") INCHES MINIMUM.

SILT FENCE GENERAL NOTES		STANDARD SPECIFICATION REFERENCE 202.5	
		DATE AUG '23	STANDARD DRAWING NO. 1020B



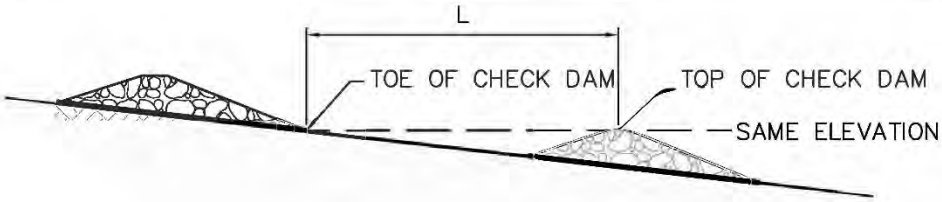
ROCK CHECK DAM VIEW LOOKING UPSTREAM

N.T.S.



CROSS SECTION A–A

N.T.S.



SPACE BETWEEN ROCK CHECK DAMS

N.T.S.

NOTES:
ACTUAL DIMENSIONS OF THE CHECK DAMS SHALL BE DESIGNED BASED ON FLOW CONDITIONS IN THE DRAINAGE SWALE OR DITCH. HEIGHT (H) AND SPACING (L) OF CHECK DAM AS PROVIDED IN PLANS BY OWNER OR OWNER'S REPRESENTATIVE. PROVIDE CALCULATIONS UPON REQUEST OF THE REVIEWING AGENCY.

ROCK CHECK DAM		STANDARD SPECIFICATION REFERENCE 202.9	
		DATE AUG '23	STANDARD DRAWING NO. 1060A

ROCK CHECK DAM GENERAL NOTES:

1. STONE SHALL BE WELL GRADED WITH SIZE RANGE FROM 1½ TO 3½ INCHES IN DIAMETER DEPENDING ON EXPECTED FLOWS.

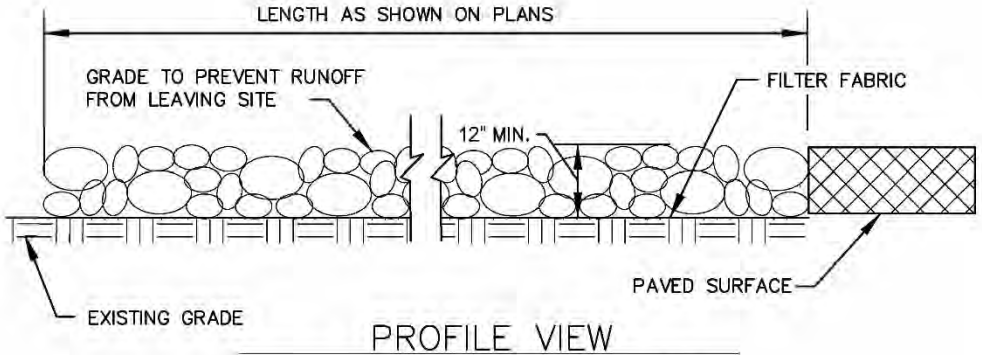
2. THE CHECK DAM SHALL BE INSPECTED AS SPECIFIED IN THE SWPPP AND SHALL BE REPLACED WHEN THE STRUCTURE CEASES TO FUNCTION AS INTENDED DUE TO SILT ACCUMULATION AMONG THE ROCKS, WASHOUT, CONSTRUCTION TRAFFIC DAMAGE, ETC.

3. WHEN SILT REACHES A DEPTH EQUAL TO ONE–THIRD OF THE HEIGHT OF THE CHECK DAM OR ONE FOOT, WHICHEVER IS LESS, THE SILT SHALL BE REMOVED AND DISPOSED OF PROPERLY.

4. WHEN THE SITE HAS ACHIEVED FINAL STABILIZATION OR ANOTHER EROSION OR SEDIMENT CONTROL DEVICE IS EMPLOYED, THE CHECK DAM AND ACCUMULATED SILT SHALL BE REMOVED AND DISPOSED OF IN AN APPROVED MANNER.

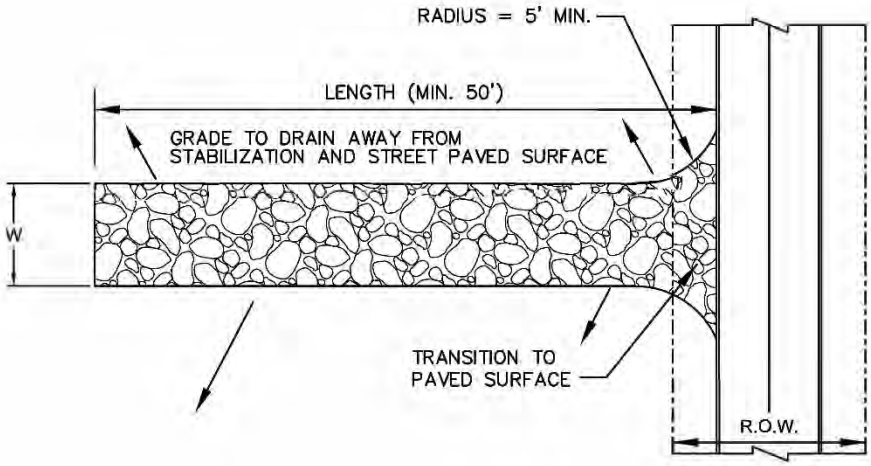
5. FILTER STONE SHALL BE WRAPPED IN APPROPRIATE SIZED WIRE MESH TO CONTAIN STONE AND BURIED SIX (6") INCHES MINIMUM.

ROCK CHECK DAM		STANDARD SPECIFICATION REFERENCE 202.9	
GENERAL NOTES		DATE AUG '23	STANDARD DRAWING NO. 1060B



PROFILE VIEW

N.T.S.



WIDTH (W)
20' MIN. FOR < 5 AC SITES
30' MIN. FOR > 5 AC SITES

PLAN VIEW

N.T.S.

EXIT MUST BE SLOPED SO THAT STORM WATER IS NOT ALLOWED TO LEAVE THE SITE AND ENTER ROADWAYS

NOTE:
NO CRUSHED OR RECYCLED CONCRETE ALLOWED.

STABILIZED CONSTRUCTION EXIT		STANDARD SPECIFICATION REFERENCE 202.11	
		DATE AUG '23	STANDARD DRAWING NO. 1070A

STABILIZED CONSTRUCTION EXIT GENERAL NOTES:

1. THE THICKNESS SHALL NOT BE LESS THAN 12 INCHES.

2. STONE SHALL BE 4 TO 6 INCH DIAMETER COURSE AGGREGATE, NO CRUSHED PORTLAND CEMENT CONCRETE OR RECYCLED CONCRETE ALLOWED.

3. LENGTH SHALL BE SHOWN ON PLANS, WITH A MINIMUM LENGTH OF 50 FEET.

4. THE WIDTH SHALL BE NO LESS THAN 20' FOR SITES LESS THAN 5 AC, AND 30' FOR SITES GREATER THAN 5 AC, AT ALL POINTS OF INGRESS OR EGRESS.

5. WHEN NECESSARY, VEHICLES SHALL BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO A PUBLIC ROADWAY. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE WITH DRAINAGE FLOWING AWAY FROM BOTH THE STREET AND THE STABILIZED EXIT. ALL SEDIMENT SHALL BE PREVENTED FROM ENTERING ANY STORM DRAIN, DITCH OR WATERCOURSE USING APPROVED METHODS.

6. THE EXIT SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PAVED SURFACES. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO PAVED SURFACES MUST BE REMOVED IMMEDIATELY.

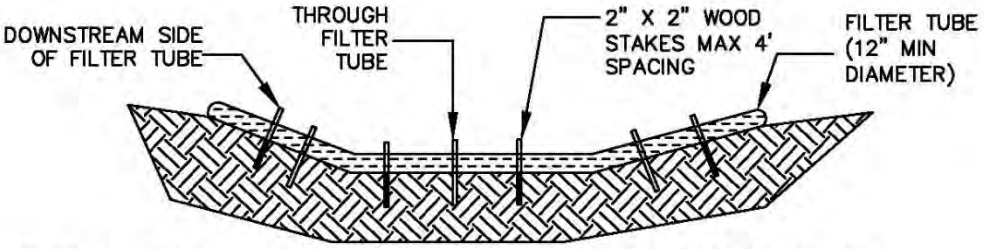
7. THE EXIT MUST BE PROPERLY GRADED OR INCORPORATE A DRAINAGE SWALE TO PREVENT RUNOFF FROM LEAVING THE CONSTRUCTION SITE.

8. PREVENT SHORTCUTTING OF THE FULL LENGTH OF THE CONSTRUCTION EXIT BY INSTALLING BARRIERS AS NECESSARY.

9. INSPECTION SHALL BE AS SPECIFIED IN THE SWPPP.

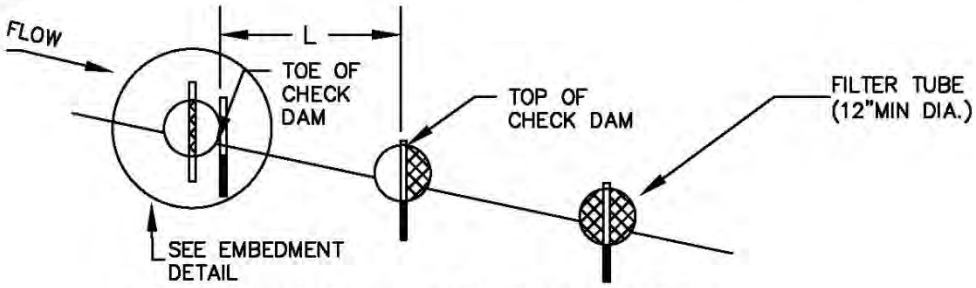
10. NO CRUSHED OR RECYCLED CONCRETE ALLOWED.

STABILIZED CONSTRUCTION EXIT, GENERAL NOTES		STANDARD SPECIFICATION REFERENCE 202.11	
		DATE AUG '23	STANDARD DRAWING NO. 1070B



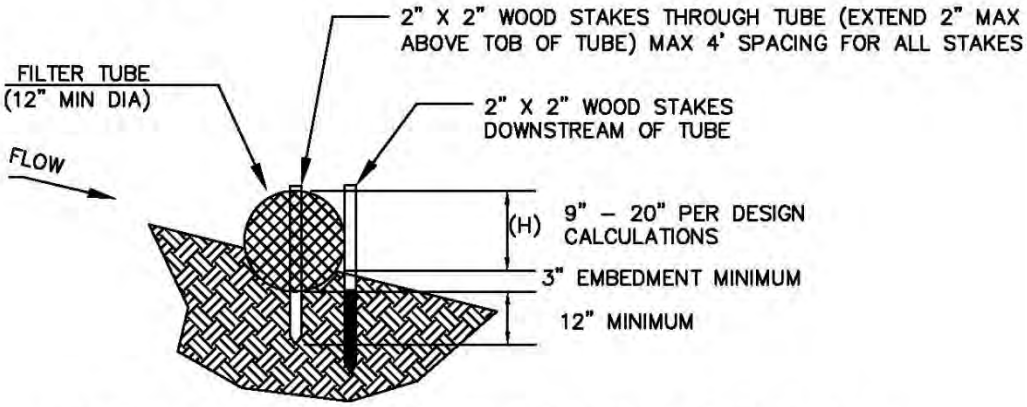
FILTER TUBE CHECK DAM VIEW LOOKING UPSTREAM

N.T.S.



FILTER TUBE CHECK DAM PROFILE

N.T.S.



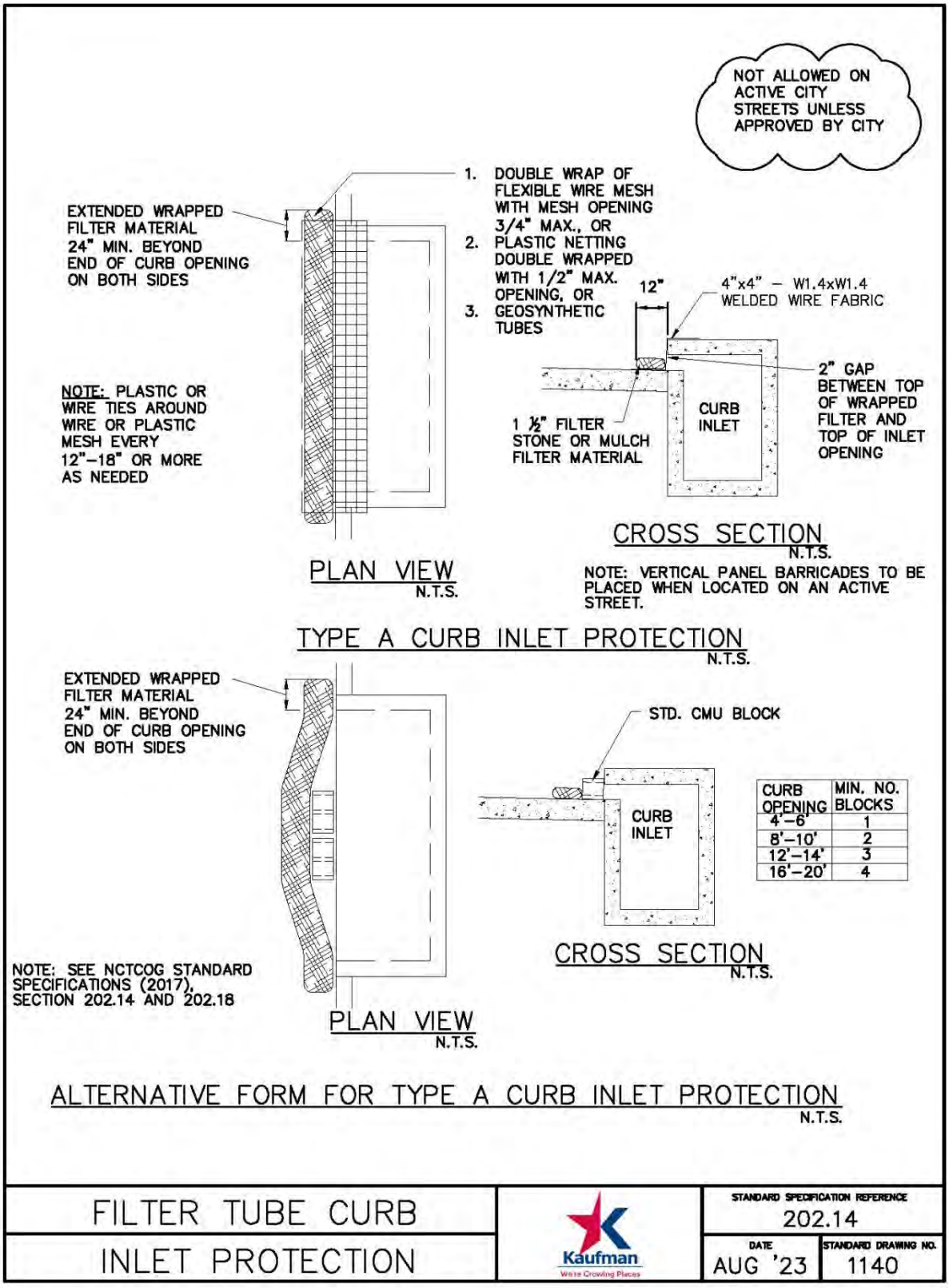
EMBEDMENT DETAIL FOR FILTER TUBE CHECK DAM

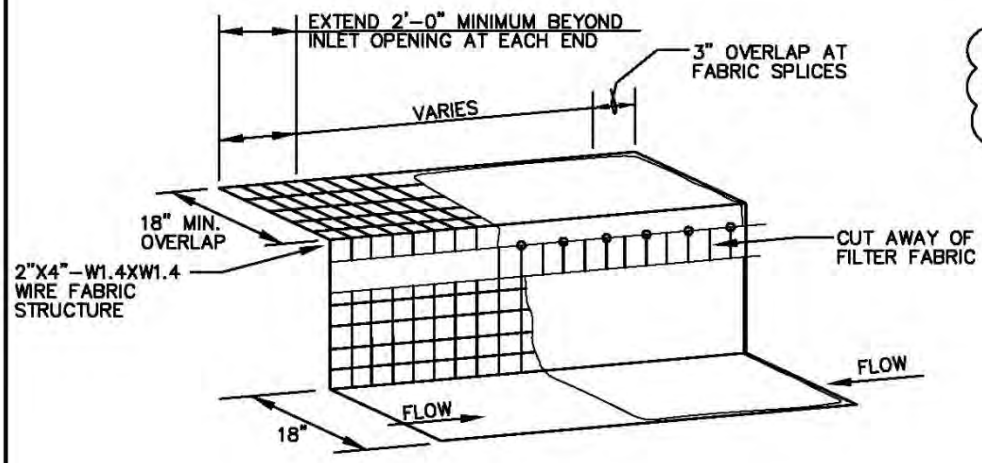
N.T.S.

GENERAL NOTES:

1. ACTUAL DIMENSIONS OF THE CHECK DAMS SHALL BE DESIGNED BASED ON FLOW CONDITIONS IN THE DRAINAGE SWALE OR DITCH.
2. HEIGHT (H) AND SPACING (L) OF CHECK DAM AS PROVIDED IN PLANS BY OWNER OR OWNER'S REPRESENTATIVE. PROVIDE CALCULATIONS UPON REQUEST OF THE REVIEWING AGENCY.

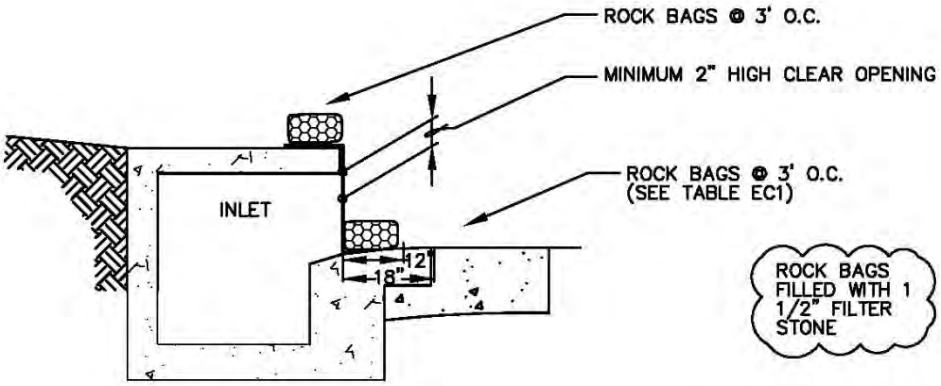
FILTER TUBE CHECK DAM		STANDARD SPECIFICATION REFERENCE 202.10	
		DATE AUG '23	STANDARD DRAWING NO. 1090


NOT ALLOWED ON ACTIVE CITY STREETS UNLESS APPROVED BY CITY
EXTENDED WRAPPED FILTER MATERIAL 24" MIN. BEYOND END OF CURB OPENING ON BOTH SIDES
1. DOUBLE WRAP OF FLEXIBLE WIRE MESH WITH MESH OPENING 3/4" MAX., OR
2. PLASTIC NETTING DOUBLE WRAPPED WITH 1/2" MAX. OPENING, OR
3. GEOSYNTHETIC TUBES
NOTE: PLASTIC OR WIRE TIES AROUND WIRE OR PLASTIC MESH EVERY 12"–18" OR MORE AS NEEDED
PLAN VIEW
N.T.S.
12"
4"x4" – W1.4xW1.4 WELDED WIRE FABRIC
2" GAP BETWEEN TOP OF WRAPPED FILTER AND TOP OF INLET OPENING
1 ½" FILTER STONE OR MULCH FILTER MATERIAL
CURB INLET
CROSS SECTION
N.T.S.
NOTE: VERTICAL PANEL BARRICADES TO BE PLACED WHEN LOCATED ON AN ACTIVE STREET.
TYPE A CURB INLET PROTECTION
N.T.S.
EXTENDED WRAPPED FILTER MATERIAL 24" MIN. BEYOND END OF CURB OPENING ON BOTH SIDES
NOTE: SEE NCTCOG STANDARD SPECIFICATIONS (2017), SECTION 202.14 AND 202.18
PLAN VIEW
N.T.S.
STD. CMU BLOCK
CURB INLET
CURB OPENING | MIN. NO. BLOCKS
4'–6' | 1
8'–10' | 2
12'–14' | 3
16'–20' | 4
CROSS SECTION
N.T.S.
ALTERNATIVE FORM FOR TYPE A CURB INLET PROTECTION
N.T.S.
FILTER TUBE CURB INLET PROTECTION
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
202.14
DATE
AUG '23
STANDARD DRAWING NO.
1140



WIRE WEIR CURB INLET PROTECTION ISOMETRIC VIEW

N.T.S.

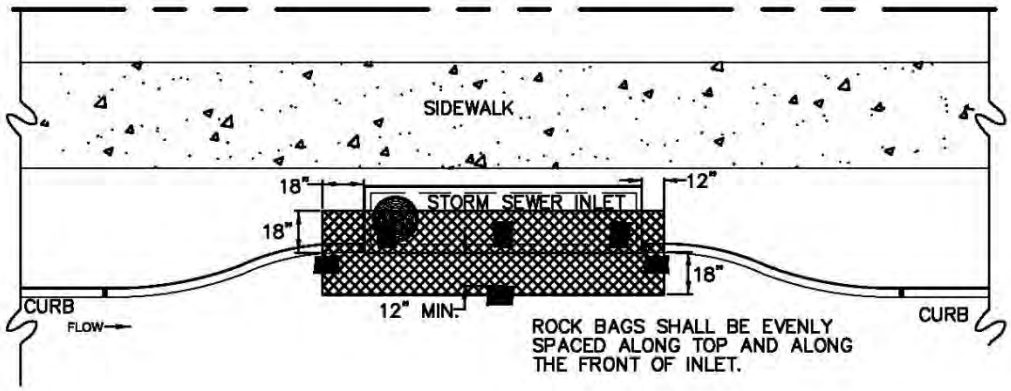


WIRE WEIR CURB INLET PROTECTION CROSS SECTION

N.T.S.

NOTE: THIS CONTROL WILL DECREASE THE CAPACITY OF THE INLET. IT SHALL ONLY BE USED WHEN AN ENGINEER HAS DETERMINED THERE IS ADEQUATE STORAGE OR POSITIVE OVERFLOW.

WIRE WEIR CURB INLET PROTECTION		STANDARD SPECIFICATION REFERENCE 202.14	
		DATE AUG '23	STANDARD DRAWING NO. 1150A



WIRE WEIR CURB INLET PROTECTION PLAN VIEW

N.T.S

TABLE EC1

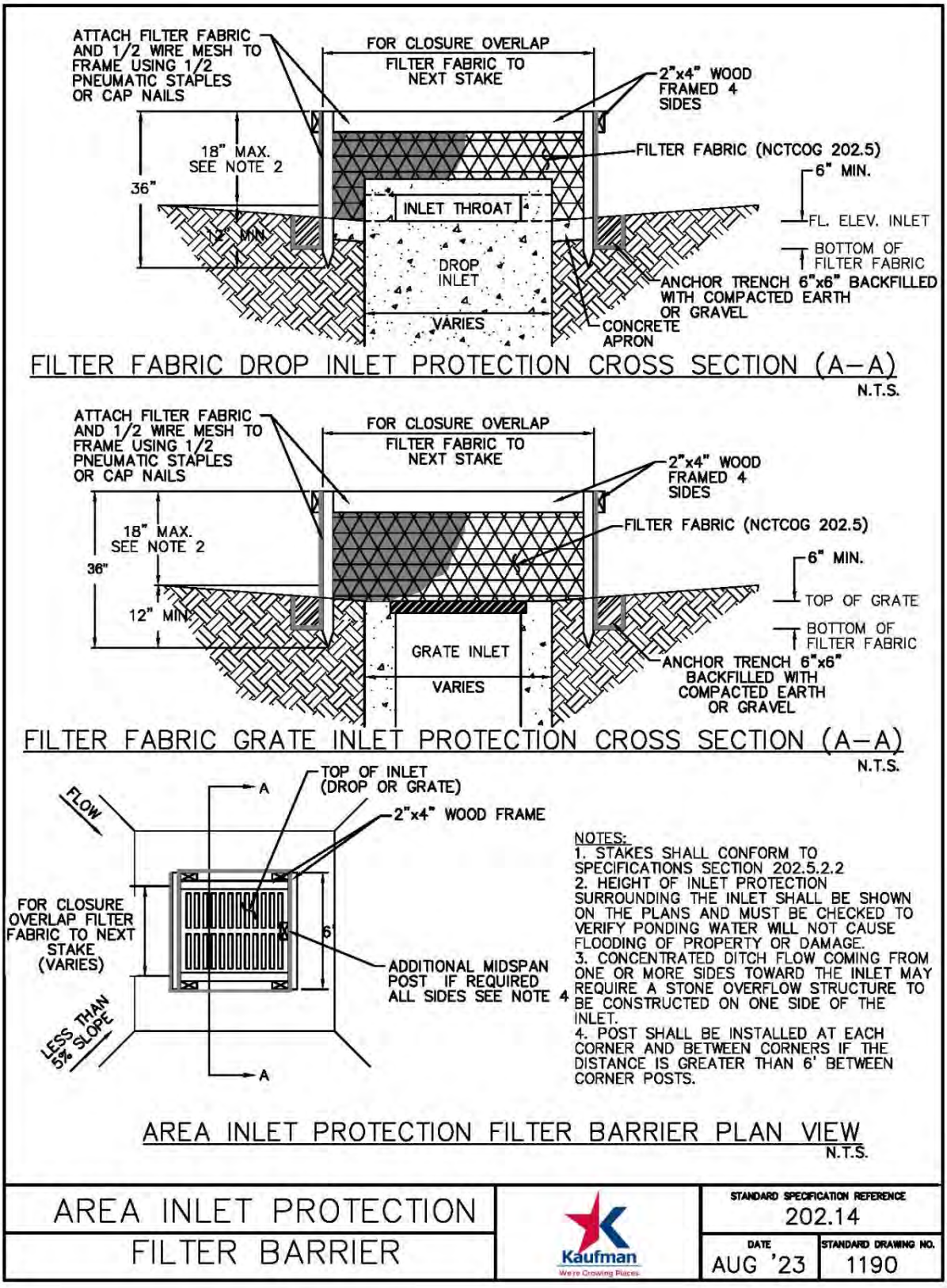
INLET OPENING	MINIMUM NUMBER OF ROCK BAGS	
	TOP	FRONT
5'–0"	2	3
10'–0"	3	3
15'–0"	3	4
20'–0"	4	4

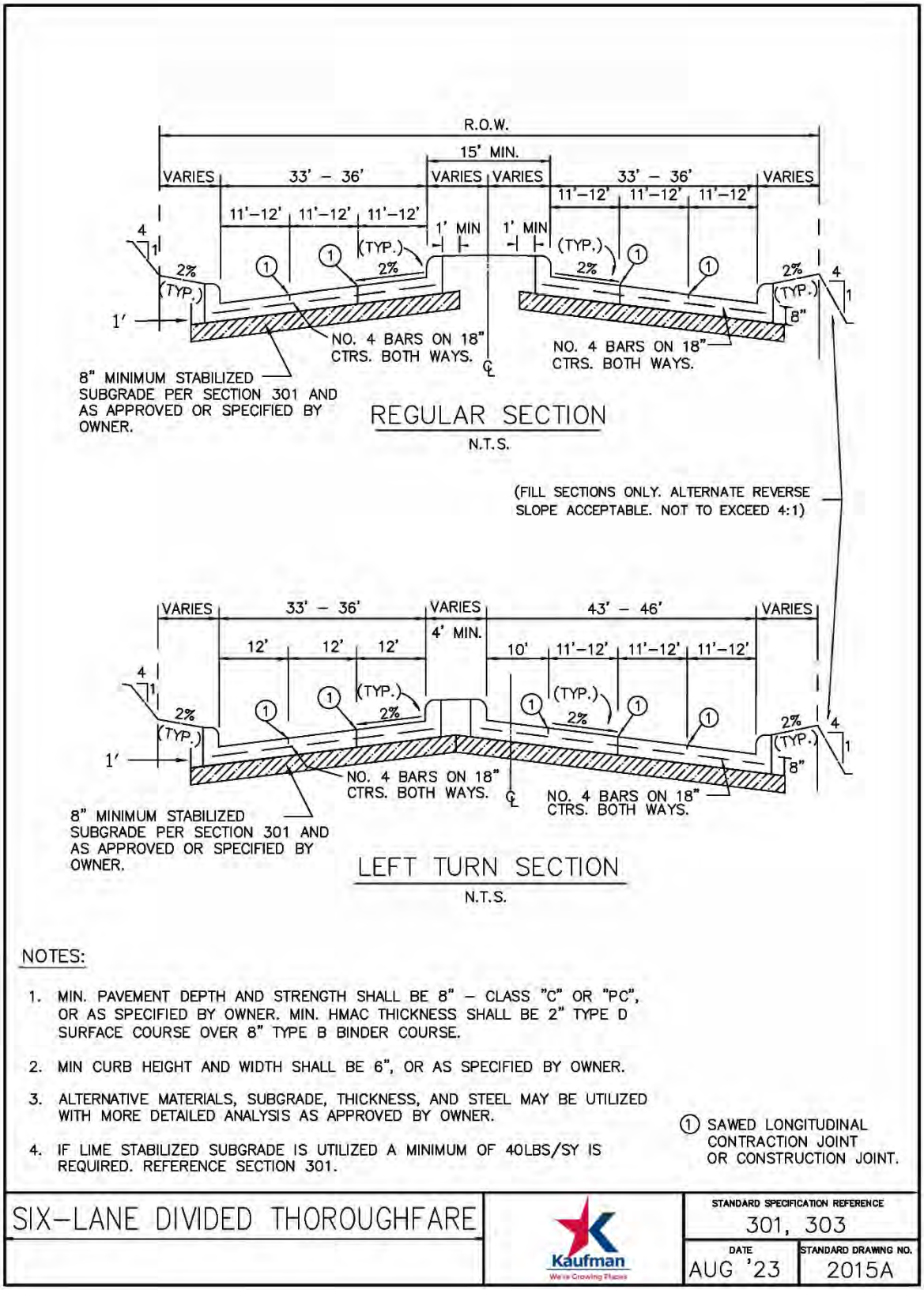
NOT ALLOWED ON ACTIVE CITY STREETS UNLESS APPROVED BY CITY

NOTES:

1. A SECTION OF FILTER FABRIC SHALL BE REMOVED AS SHOWN ON THIS DETAIL TO PROVIDE A 2" MINIMUM CLEAR OPENING. FABRIC MUST BE SECURED TO WIRE BACKING WITH CLIPS OR HOG RINGS AT THIS LOCATION.
2. INSPECTION SHALL BE MADE BY THE CONTRACTOR AND SILT ACCUMULATION MUST BE REMOVED WHEN DEPTH REACHES 2".
3. INLET PROTECTIONS SHALL BE REMOVED AS SOON AS THE SOURCE OF SEDIMENT IS STABILIZED.

WIRE WEIR CURB INLET PROTECTION		STANDARD SPECIFICATION REFERENCE 202.14	
		DATE AUG '23	STANDARD DRAWING NO. 1150B


ATTACH FILTER FABRIC AND 1/2 WIRE MESH TO FRAME USING 1/2 PNEUMATIC STAPLES OR CAP NAILS
FOR CLOSURE OVERLAP
FILTER FABRIC TO NEXT STAKE
2"x4" WOOD FRAMED 4 SIDES
FILTER FABRIC (NCTCOG 202.5)
18" MAX. SEE NOTE 2
36"
12" MIN.
INLET THROAT
DROP INLET
VARIES
6" MIN.
FL. ELEV. INLET
BOTTOM OF FILTER FABRIC
ANCHOR TRENCH 6"x6" BACKFILLED WITH COMPACTED EARTH OR GRAVEL
CONCRETE APRON
FILTER FABRIC DROP INLET PROTECTION CROSS SECTION (A-A)
N.T.S.
ATTACH FILTER FABRIC AND 1/2 WIRE MESH TO FRAME USING 1/2 PNEUMATIC STAPLES OR CAP NAILS
FOR CLOSURE OVERLAP
FILTER FABRIC TO NEXT STAKE
2"x4" WOOD FRAMED 4 SIDES
FILTER FABRIC (NCTCOG 202.5)
18" MAX. SEE NOTE 2
36"
12" MIN.
GRATE INLET
VARIES
6" MIN.
TOP OF GRATE
BOTTOM OF FILTER FABRIC
ANCHOR TRENCH 6"x6" BACKFILLED WITH COMPACTED EARTH OR GRAVEL
FILTER FABRIC GRATE INLET PROTECTION CROSS SECTION (A-A)
N.T.S.
FLOW
A
TOP OF INLET (DROP OR GRATE)
2"x4" WOOD FRAME
FOR CLOSURE OVERLAP FILTER FABRIC TO NEXT STAKE (VARIES)
6'
ADDITIONAL MIDSPAN POST IF REQUIRED ALL SIDES SEE NOTE 4
LESS THAN 5% SLOPE
A
NOTES:
1. STAKES SHALL CONFORM TO SPECIFICATIONS SECTION 202.5.2.2
2. HEIGHT OF INLET PROTECTION SURROUNDING THE INLET SHALL BE SHOWN ON THE PLANS AND MUST BE CHECKED TO VERIFY PONDING WATER WILL NOT CAUSE FLOODING OF PROPERTY OR DAMAGE.
3. CONCENTRATED DITCH FLOW COMING FROM ONE OR MORE SIDES TOWARD THE INLET MAY REQUIRE A STONE OVERFLOW STRUCTURE TO BE CONSTRUCTED ON ONE SIDE OF THE INLET.
4. POST SHALL BE INSTALLED AT EACH CORNER AND BETWEEN CORNERS IF THE DISTANCE IS GREATER THAN 6' BETWEEN CORNER POSTS.
AREA INLET PROTECTION FILTER BARRIER PLAN VIEW
N.T.S.
AREA INLET PROTECTION
FILTER BARRIER
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
202.14
DATE
AUG '23
STANDARD DRAWING NO.
1190

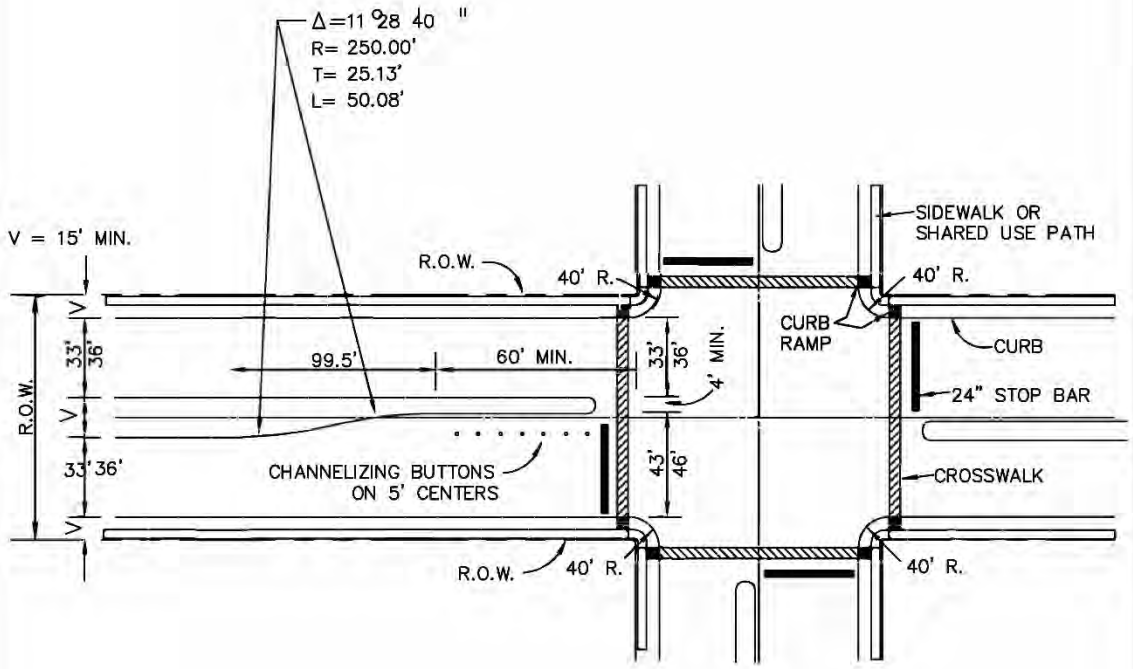


NOTES:

1. MIN. PAVEMENT DEPTH AND STRENGTH SHALL BE 8" – CLASS "C" OR "PC", OR AS SPECIFIED BY OWNER. MIN. HMAC THICKNESS SHALL BE 2" TYPE D SURFACE COURSE OVER 8" TYPE B BINDER COURSE.
2. MIN CURB HEIGHT AND WIDTH SHALL BE 6", OR AS SPECIFIED BY OWNER.
3. ALTERNATIVE MATERIALS, SUBGRADE, THICKNESS, AND STEEL MAY BE UTILIZED WITH MORE DETAILED ANALYSIS AS APPROVED BY OWNER.
4. IF LIME STABILIZED SUBGRADE IS UTILIZED A MINIMUM OF 40LBS/SY IS REQUIRED. REFERENCE SECTION 301.

① SAWED LONGITUDINAL CONTRACTION JOINT OR CONSTRUCTION JOINT.

SIX–LANE DIVIDED THOROUGHFARE		STANDARD SPECIFICATION REFERENCE 301, 303
	DATE AUG '23	STANDARD DRAWING NO. 2015A

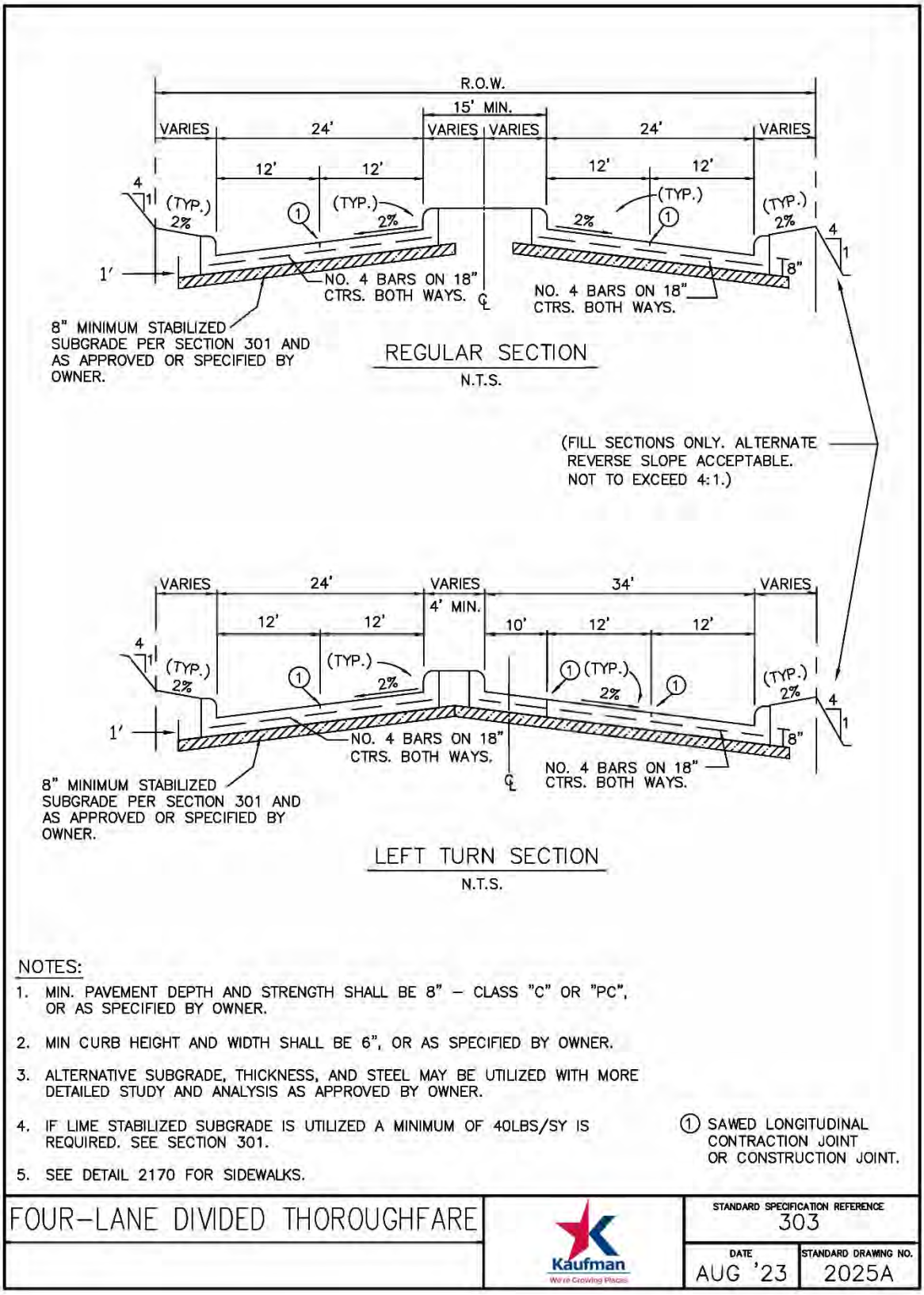


SCHEMATIC PLAN
N.T.S.

NOTES:

1. FOR ALTERNATE OFF-STREET BIKE OPTIONS, SEE AASHTO SHARED USE PATH GUIDELINES.
2. THIS LAYOUT IS SCHEMATIC AND NOT INTENDED TO BE USED FOR CONSTRUCTION.

SIX-LANE DIVIDED THOROUGHFARE		STANDARD SPECIFICATION REFERENCE 303	
		DATE AUG '23	STANDARD DRAWING NO. 2015B

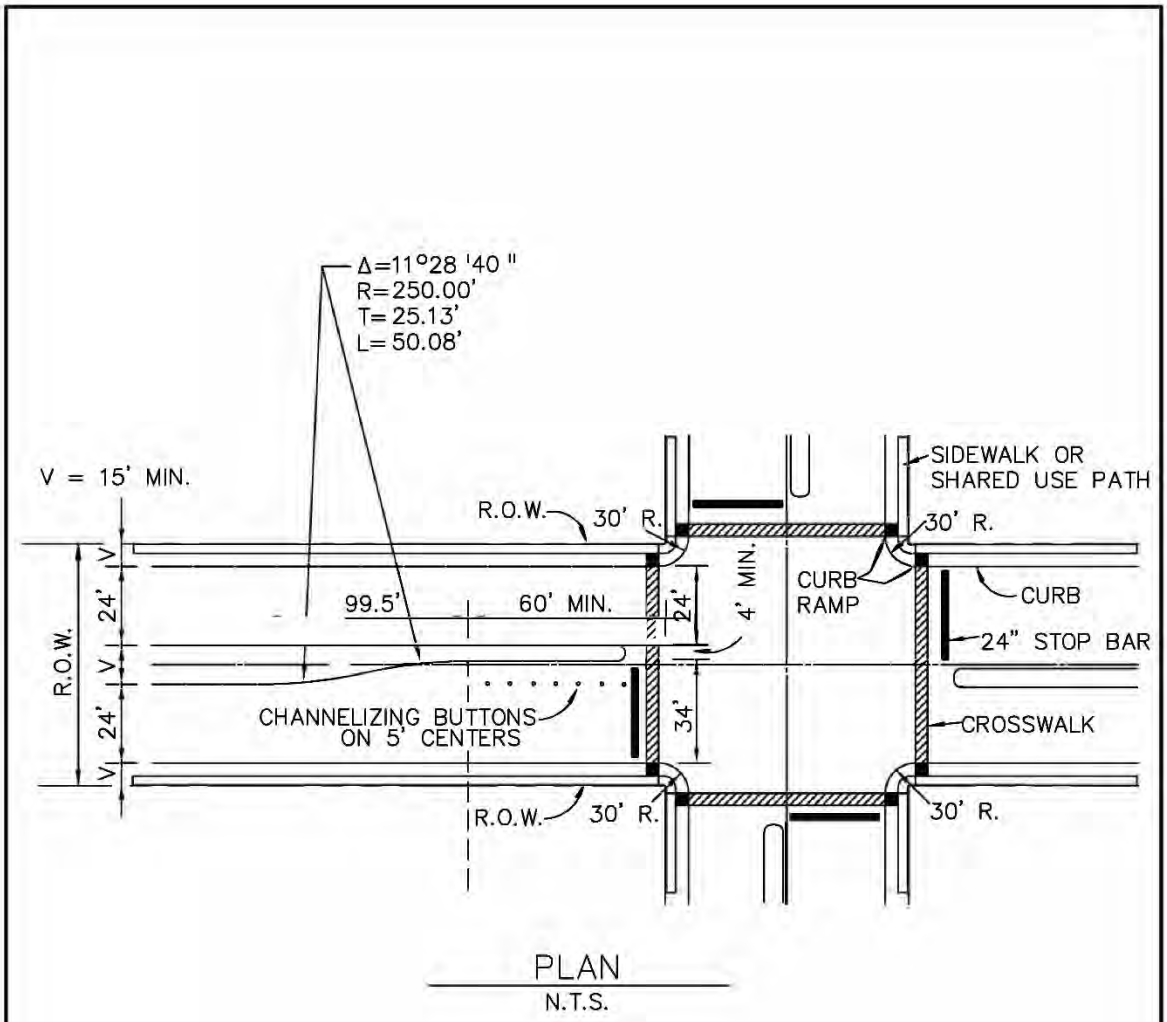


NOTES:

1. MIN. PAVEMENT DEPTH AND STRENGTH SHALL BE 8" – CLASS "C" OR "PC", OR AS SPECIFIED BY OWNER.
2. MIN CURB HEIGHT AND WIDTH SHALL BE 6", OR AS SPECIFIED BY OWNER.
3. ALTERNATIVE SUBGRADE, THICKNESS, AND STEEL MAY BE UTILIZED WITH MORE DETAILED STUDY AND ANALYSIS AS APPROVED BY OWNER.
4. IF LIME STABILIZED SUBGRADE IS UTILIZED A MINIMUM OF 40LBS/SY IS REQUIRED. SEE SECTION 301.
5. SEE DETAIL 2170 FOR SIDEWALKS.

① SAWED LONGITUDINAL CONTRACTION JOINT OR CONSTRUCTION JOINT.

FOUR–LANE DIVIDED THOROUGHFARE		STANDARD SPECIFICATION REFERENCE 303	
		DATE AUG '23	STANDARD DRAWING NO. 2025A

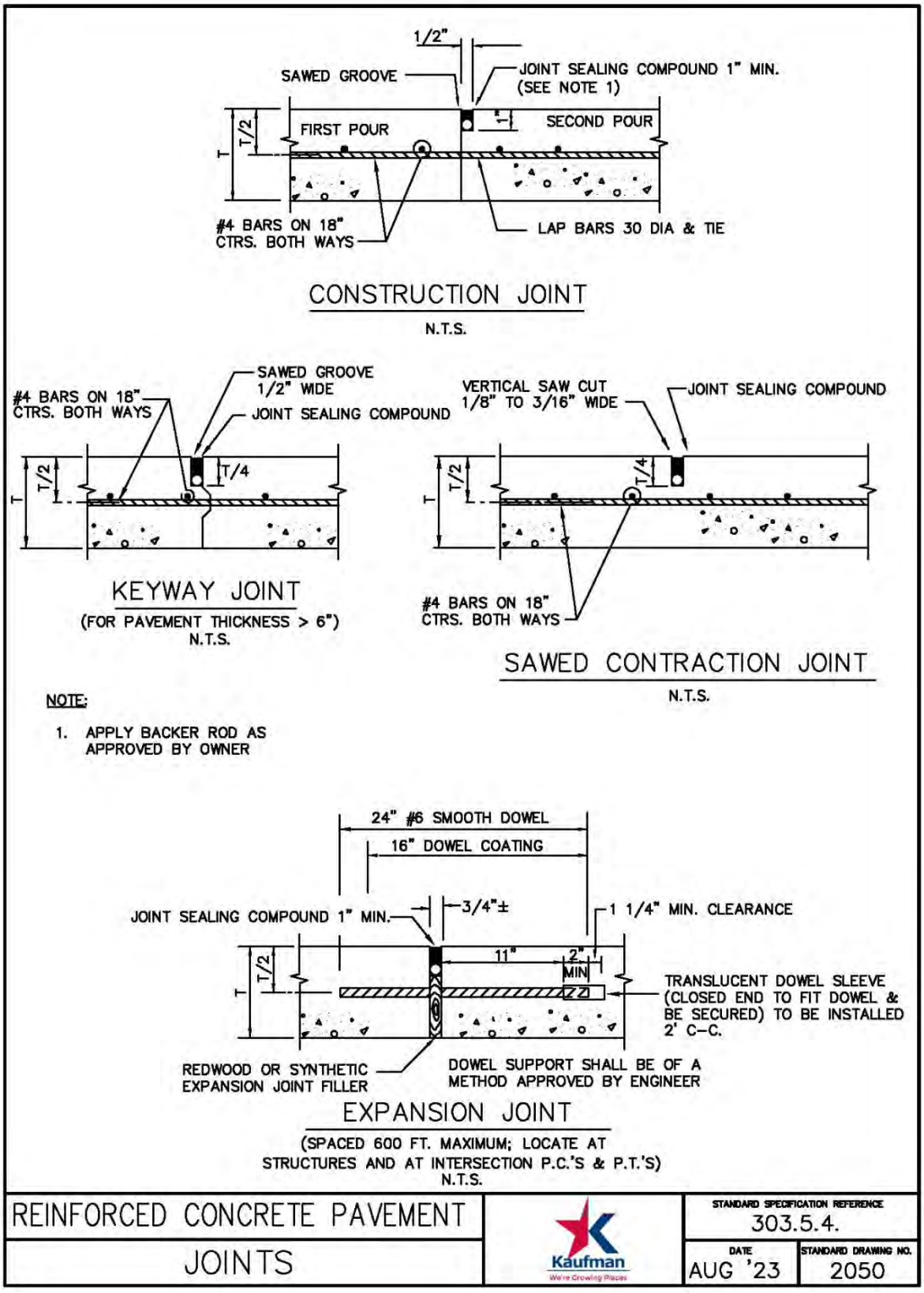


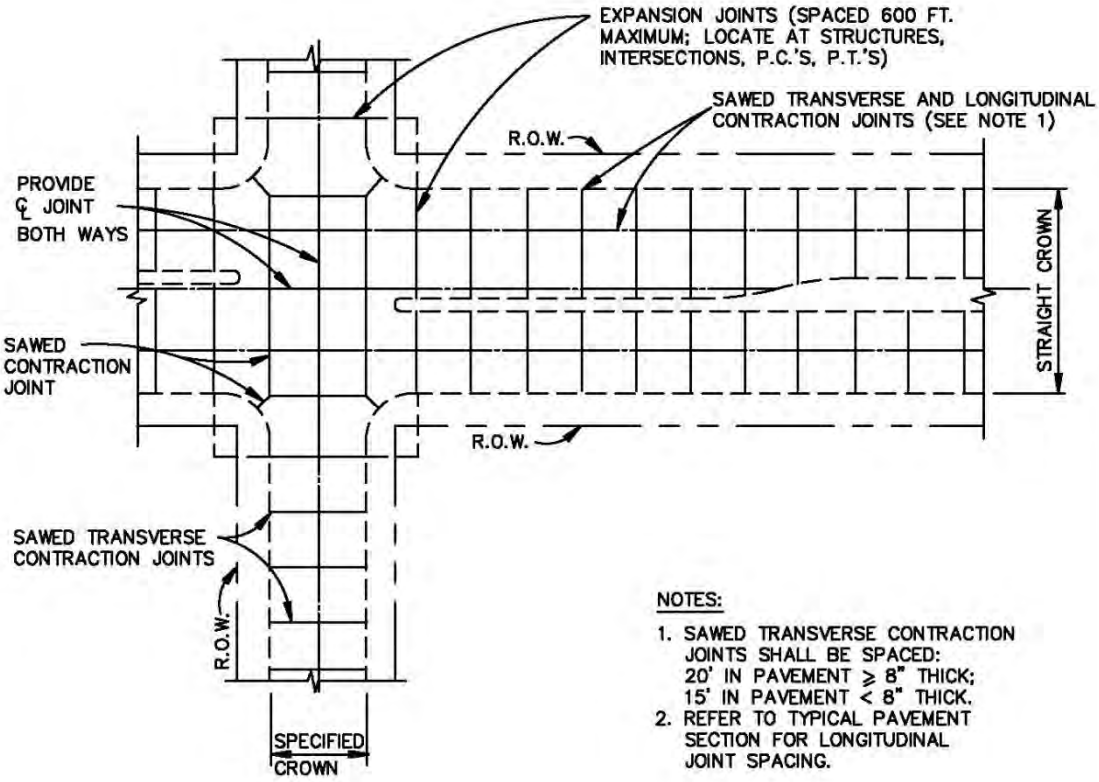
PLAN
N.T.S.

NOTES:

1. FOR ALTERNATE OFF-STREET BIKE OPTIONS, SEE AASHTO SHARED USE PATH GUIDELINES.

FOUR-LANE DIVIDED THOROUGHFARE		STANDARD SPECIFICATION REFERENCE 303	
		DATE AUG '23	STANDARD DRAWING NO. 2025B

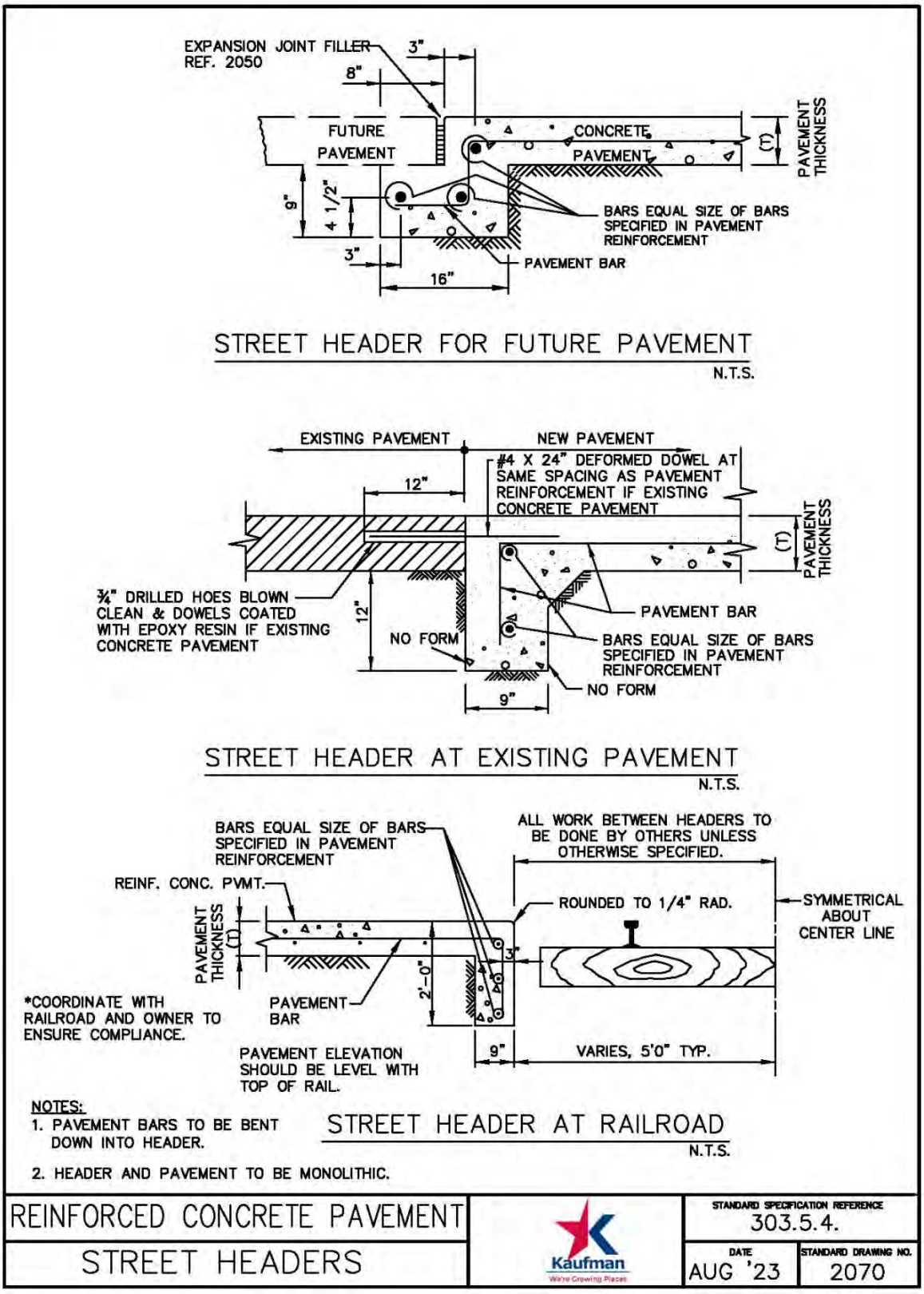

1/2"
SAWED GROOVE
JOINT SEALING COMPOUND 1" MIN.
(SEE NOTE 1)
FIRST POUR
SECOND POUR
T/2
T
#4 BARS ON 18"
CTRS. BOTH WAYS
LAP BARS 30 DIA & TIE
CONSTRUCTION JOINT
N.T.S.
SAWED GROOVE
1/2" WIDE
#4 BARS ON 18"
CTRS. BOTH WAYS
JOINT SEALING COMPOUND
T/4
KEYWAY JOINT
(FOR PAVEMENT THICKNESS > 6")
N.T.S.
VERTICAL SAW CUT
1/8" TO 3/16" WIDE
JOINT SEALING COMPOUND
#4 BARS ON 18"
CTRS. BOTH WAYS
SAWED CONTRACTION JOINT
N.T.S.
NOTE:
1. APPLY BACKER ROD AS APPROVED BY OWNER
24" #6 SMOOTH DOWEL
16" DOWEL COATING
JOINT SEALING COMPOUND 1" MIN.
3/4"±
1 1/4" MIN. CLEARANCE
11"
2" MIN
TRANSLUCENT DOWEL SLEEVE
(CLOSED END TO FIT DOWEL & BE SECURED) TO BE INSTALLED 2' C-C.
REDWOOD OR SYNTHETIC
EXPANSION JOINT FILLER
DOWEL SUPPORT SHALL BE OF A METHOD APPROVED BY ENGINEER
EXPANSION JOINT
(SPACED 600 FT. MAXIMUM; LOCATE AT STRUCTURES AND AT INTERSECTION P.C.'S & P.T.'S)
N.T.S.
REINFORCED CONCRETE PAVEMENT
JOINTS
STANDARD SPECIFICATION REFERENCE
303.5.4.
DATE
AUG '23
STANDARD DRAWING NO.
2050



SPACING DIAGRAM FOR TRANSVERSE JOINTS

N.T.S.

REINFORCED CONCRETE PAVEMENT		STANDARD SPECIFICATION REFERENCE 303.5.4.	
TRANSVERSE JOINT SPACING		DATE AUG '23	STANDARD DRAWING NO. 2060


EXPANSION JOINT FILLER
REF. 2050
3"
8"
FUTURE
PAVEMENT
CONCRETE
PAVEMENT
(T)
PAVEMENT
THICKNESS
9"
4 1/2"
3"
16"
BARS EQUAL SIZE OF BARS
SPECIFIED IN PAVEMENT
REINFORCEMENT
PAVEMENT BAR
STREET HEADER FOR FUTURE PAVEMENT
N.T.S.
EXISTING PAVEMENT
NEW PAVEMENT
#4 X 24" DEFORMED DOWEL AT
SAME SPACING AS PAVEMENT
REINFORCEMENT IF EXISTING
CONCRETE PAVEMENT
12"
(T)
PAVEMENT
THICKNESS
¾" DRILLED HOES BLOWN
CLEAN & DOWELS COATED
WITH EPOXY RESIN IF EXISTING
CONCRETE PAVEMENT
12"
NO FORM
PAVEMENT BAR
BARS EQUAL SIZE OF BARS
SPECIFIED IN PAVEMENT
REINFORCEMENT
NO FORM
9"
STREET HEADER AT EXISTING PAVEMENT
N.T.S.
BARS EQUAL SIZE OF BARS
SPECIFIED IN PAVEMENT
REINFORCEMENT
ALL WORK BETWEEN HEADERS TO
BE DONE BY OTHERS UNLESS
OTHERWISE SPECIFIED.
REINF. CONC. PVMT.
ROUNDED TO 1/4" RAD.
SYMMETRICAL
ABOUT
CENTER LINE
PAVEMENT
THICKNESS
(T)
3"
2'-0"
*COORDINATE WITH
RAILROAD AND OWNER TO
ENSURE COMPLIANCE.
PAVEMENT
BAR
9"
VARIES, 5'0" TYP.
PAVEMENT ELEVATION
SHOULD BE LEVEL WITH
TOP OF RAIL.
NOTES:
1. PAVEMENT BARS TO BE BENT
DOWN INTO HEADER.
2. HEADER AND PAVEMENT TO BE MONOLITHIC.
STREET HEADER AT RAILROAD
N.T.S.
REINFORCED CONCRETE PAVEMENT
STREET HEADERS
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
303.5.4.
DATE
AUG '23
STANDARD DRAWING NO.
2070

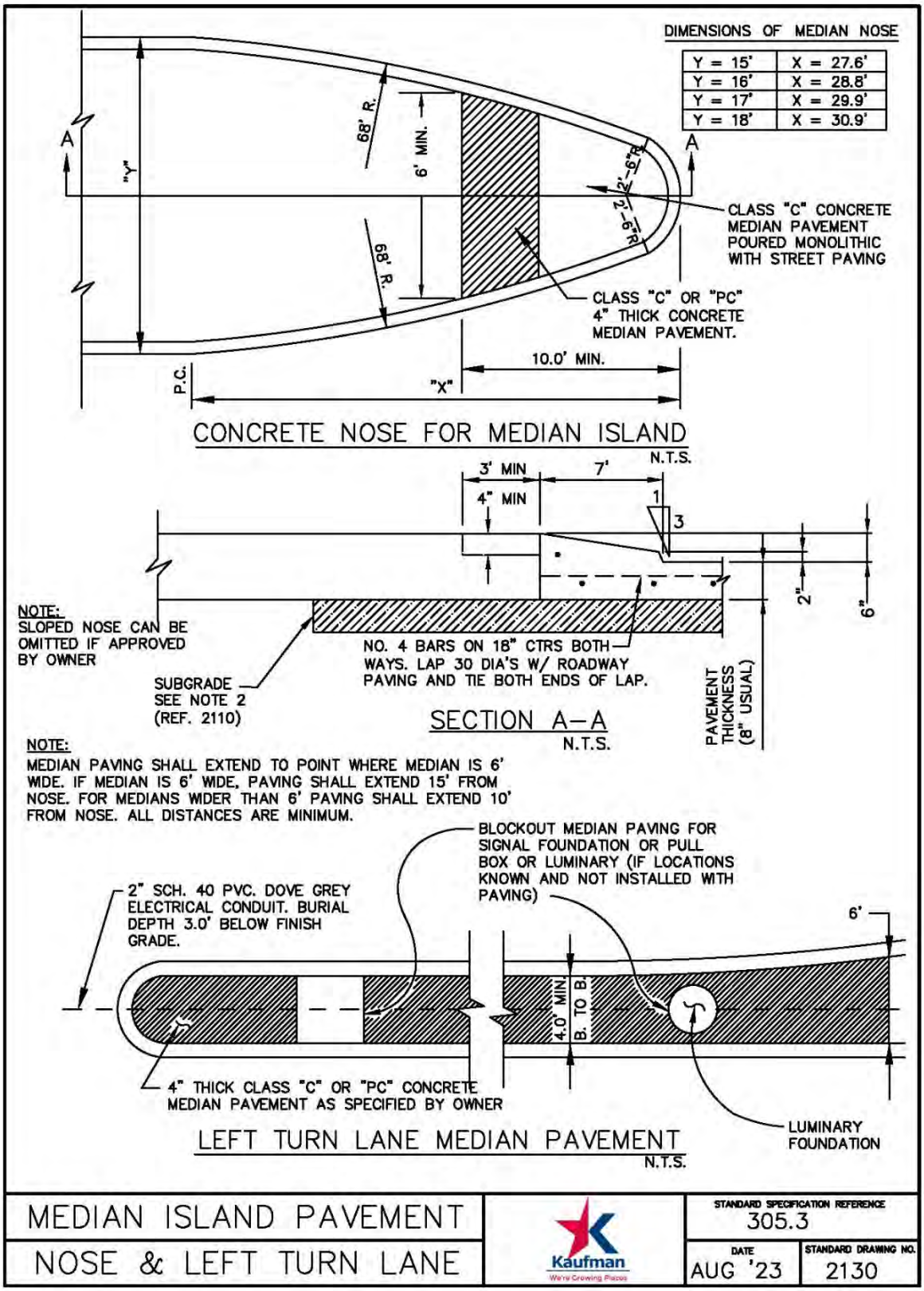
GENERAL NOTES:

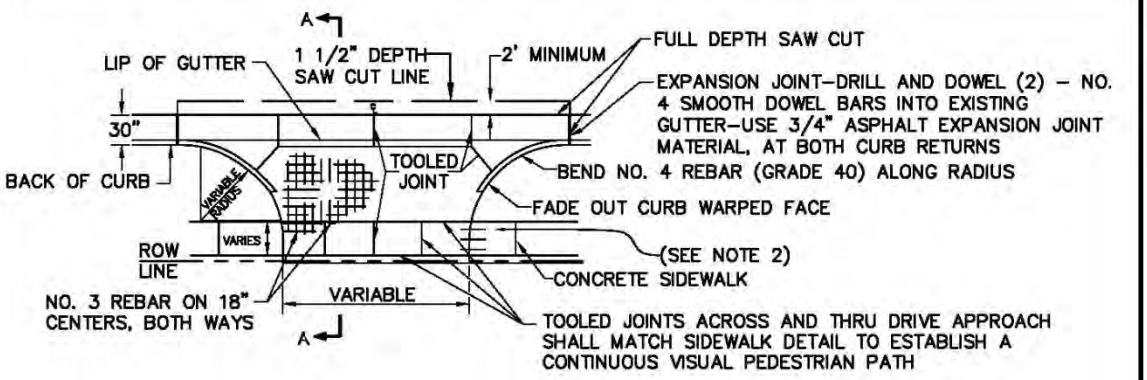
1. REINFORCED CONCRETE PAVEMENT:
   A. ALL CURBS SHALL BE PLACED INTEGRAL WITH PAVEMENT UNLESS OTHERWISE APPROVED BY THE OWNER.
   B. CURBS SHALL MEET THE SAME COMPRESSIVE STRENGTH AS SPECIFIED FOR THE PAVEMENT.
   C. BAR LAPS SHALL BE 30 DIAMETERS.
   D. REINFORCING BARS SHALL BE SUPPORTED BY CHAIRS OR OTHER DEVICES APPROVED BY THE OWNER.

2. SUBGRADE: (UNLESS OTHERWISE SPECIFIED BY OWNER)
   A. SUBGRADE UNDER ALL PAVEMENTS SHALL BE STABILIZED TO MINIMUM DEPTH OF 6" FOR 2 LANE RESIDENTIAL ROAD AND 8" FOR ALL OTHERS. IF THE P.I. IS 15 OR GREATER, LIME SHALL BE USED, IF THE P.I. IS LESS THAN 15, CEMENT SHALL USED OR AS RECOMMENDED BY A GEOTECH ENGINEER. LABORATORY TESTS MUST BE PERFORMED TO DETERMINE THE AMOUNT OF CEMENT REQUIRED TO LOWER THE P.I. TO 15 OR BELOW SATURATION P.I. (PH≥ 12.4) WILL BE THE LIMIT WHEN A SOIL'S P.I. CANNOT BE BROUGHT TO 15 OR LOWER.
   B. WHERE THE IN PLACE MATERIAL HAS A P.I. OF LESS THAN 15, THE SUBGRADE SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 6" AND RECOMPACTED.
   C. WHERE SULFATES ARE PRESENT, CONSULT A GEOTECHNICIAL ENGINEER FOR RECOMMEND SUBGRADE TREATMENT.

3. IF THE ROADWAY IS A DESIGNATED BIKE ROUTE OR BIKE USAGE IS ANTICIPATED, REFER TO AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS AASHTO GUIDE FOR THE DEVELOPMENT OF BICYCLE FACILITIES (2012, 4TH EDITION) AND THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (TMUTCD):
   https://mutcd.fhwa.dot.gov/resources/state_info/texas/tx.htm

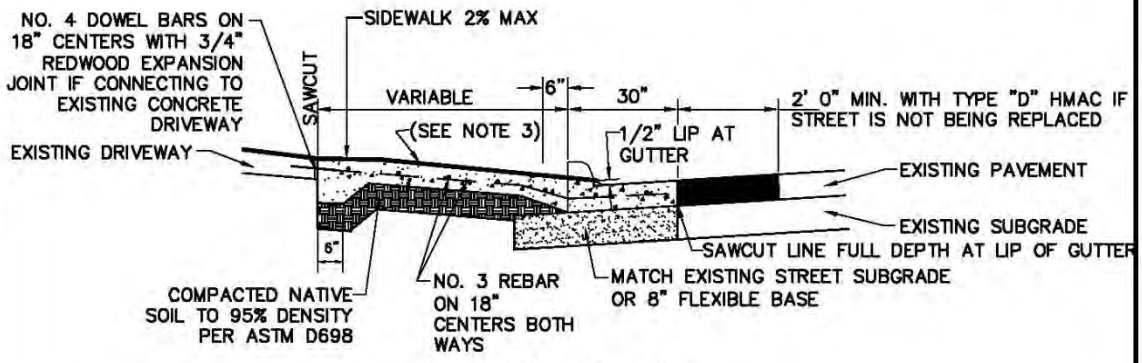
PAVEMENT SYSTEMS		STANDARD SPECIFICATION REFERENCE: 301. 302. 303.	
GENERAL NOTES		DATE: AUG '23	STANDARD DRAWING NO.: 2110


DIMENSIONS OF MEDIAN NOSE
Y = 15' X = 27.6'
Y = 16' X = 28.8'
Y = 17' X = 29.9'
Y = 18' X = 30.9'
A
A
"Y"
68' R.
6' MIN.
2'-6" R.
2'-6" R.
68' R.
CLASS "C" CONCRETE MEDIAN PAVEMENT POURED MONOLITHIC WITH STREET PAVING
CLASS "C" OR "PC" 4" THICK CONCRETE MEDIAN PAVEMENT.
P.C.
10.0' MIN.
"X"
CONCRETE NOSE FOR MEDIAN ISLAND
N.T.S.
3' MIN
4" MIN
7'
1
3
2"
6"
NOTE:
SLOPED NOSE CAN BE OMITTED IF APPROVED BY OWNER
SUBGRADE SEE NOTE 2 (REF. 2110)
NO. 4 BARS ON 18" CTRS BOTH WAYS. LAP 30 DIA'S W/ ROADWAY PAVING AND TIE BOTH ENDS OF LAP.
PAVEMENT THICKNESS (8" USUAL)
SECTION A-A
N.T.S.
NOTE:
MEDIAN PAVING SHALL EXTEND TO POINT WHERE MEDIAN IS 6' WIDE. IF MEDIAN IS 6' WIDE, PAVING SHALL EXTEND 15' FROM NOSE. FOR MEDIANS WIDER THAN 6' PAVING SHALL EXTEND 10' FROM NOSE. ALL DISTANCES ARE MINIMUM.
BLOCKOUT MEDIAN PAVING FOR SIGNAL FOUNDATION OR PULL BOX OR LUMINARY (IF LOCATIONS KNOWN AND NOT INSTALLED WITH PAVING)
2" SCH. 40 PVC. DOVE GREY ELECTRICAL CONDUIT. BURIAL DEPTH 3.0' BELOW FINISH GRADE.
6'
4.0' MIN. B. TO B.
4" THICK CLASS "C" OR "PC" CONCRETE MEDIAN PAVEMENT AS SPECIFIED BY OWNER
LUMINARY FOUNDATION
LEFT TURN LANE MEDIAN PAVEMENT
N.T.S.
MEDIAN ISLAND PAVEMENT
NOSE & LEFT TURN LANE
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
305.3
DATE
AUG '23
STANDARD DRAWING NO.
2130



TYPICAL DRIVE APPROACH CONNECTING TO ASPHALT STREETS WITH CURB AND GUTTER

N.T.S.



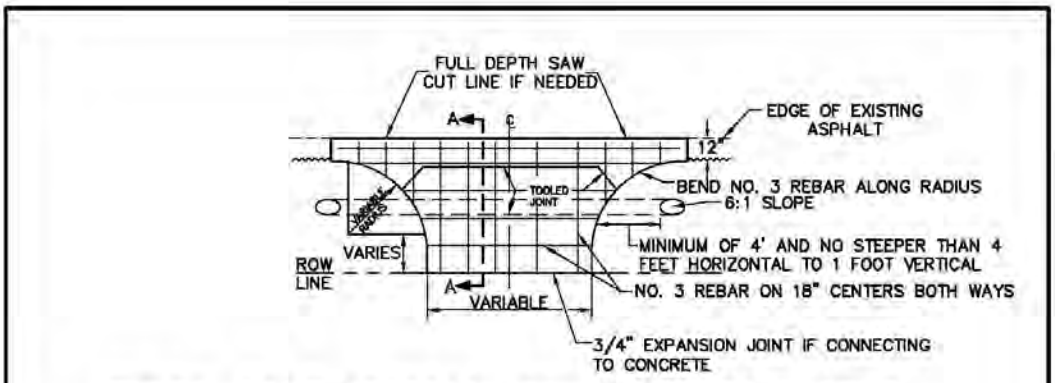
SECTION 'A–A'

N.T.S.

NOTES:

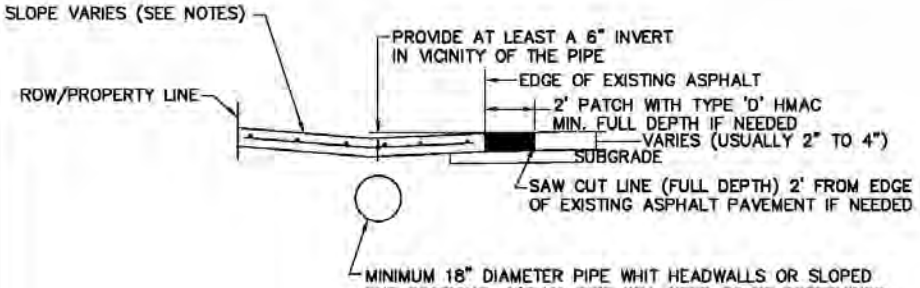
1. THE SLOPE OF THE DRIVE WHERE SIDEWALKS CROSS SHALL HAVE A MAXIMUM CROSS SLOPE OF 2%.
2. REMOVE ANY EXISTING SIDEWALK AT NEAREST JOINT AND CONNECT REPLACED SECTION TO DRIVE WITH (3) – NO. 4 SMOOTH DOWEL BARS ON 18" CENTERS WITH 3/4" REDWOOD EXPANSION JOINT, WITH 1" REMOVABLE CAP STRIP. SEAL WITH SELF LEVELING GRAY SILICONE SEALANT.
3. RESIDENTIAL DRIVE APPROACH 10% MAX SLOPE*; MIN. 5" SLAB THICKNESS
   * MAXIMUM SLOPE AS APPROVED BY OWNER
4. ALL CONNECTIONS TO STATE RIGHT–OF–WAY SHALL USE TXDOT DETAILS.
5. ALL CURB AND GUTTER SHALL BE 30" UNLESS OTHERWISE DIRECTED BY THE CITY.
6. CONCRETE SHALL BE CLASS C, 6 SACK AND HAVE COMPRESSIVE STRENGTH OF 3600 PSI @28 DAYS.
7. IF STREET IS BEING REPLACED, PAVEMENT THICKNESS SHALL BE 6" FOR RESIDENTIAL AND 8" FOR COLLECTOR OR LARGER.

RESIDENTIAL DRIVE APPROACH CONNECTING TO ASPHALT STREETS WITH CURB AND GUTTER		STANDARD SPECIFICATION REFERENCE 305.2	
		DATE AUG '23	STANDARD DRAWING NO. 2150A



TYPICAL DRIVE APPROACH CONNECTING TO EXISTING RURAL TYPE ASPHALT STREETS

N.T.S.



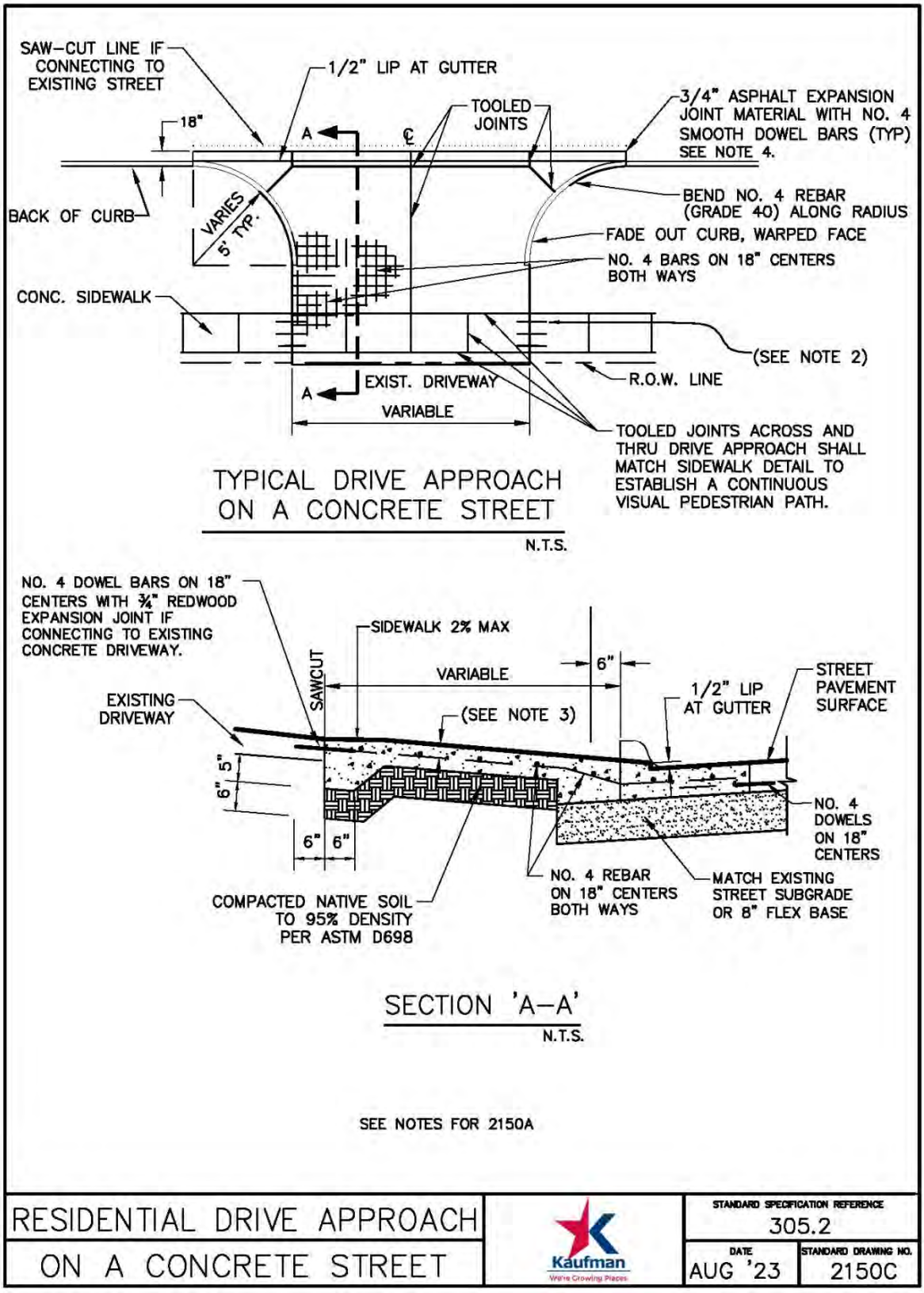
SECTION 'A–A'

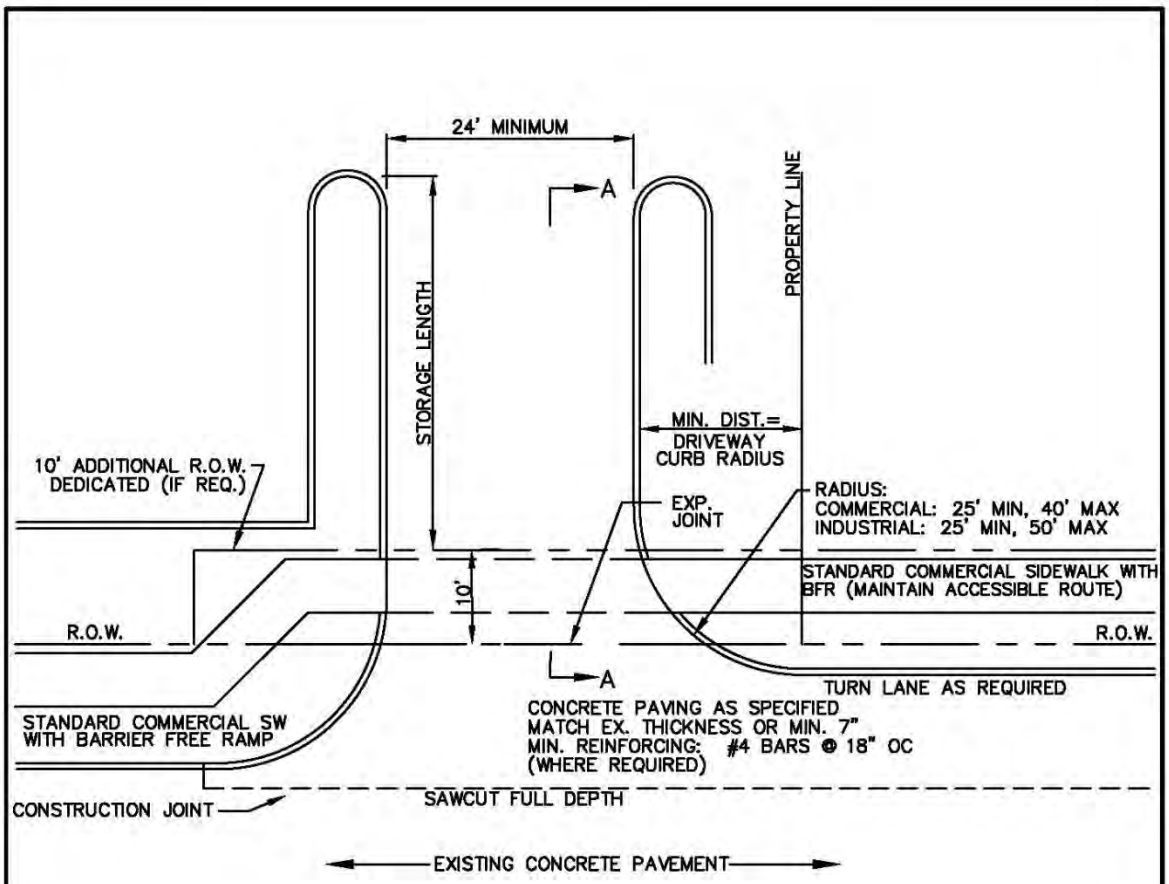
N.T.S.

NOTES:

1. THE SLOPE OF THE DRIVE WHERE SIDEWALKS CROSS SHALL HAVE A MAXIMUM CROSS SLOPE OF 2%.
2. RESIDENTIAL DRIVE APPROACH 10% MAX SLOPE*; MIN. 5" SLAB THICKNESS
   * MAXIMUM SLOPE AS APPROVED BY OWNER
3. ALL CONNECTIONS TO STATE RIGHT-OF-WAY SHALL USE TXDOT DETAILS.
4. CONCRETE SHALL BE CLASS C, 6 SACK AND HAVE COMPRESSIVE STRENGTH OF 3600 PSI @ 28 DAYS.
5. MINIMUM VELOCITY THROUGH PIPE IS 2.5fps. MINIMUM SLOPE IN PIPE IS 0.5% UNLESS OTHERWISE DESIGNED TO MEET MINIMUM SLOPE REQUIREMENTS
6. IN SOME CASES A SWALE MAY BE PROVIDED IN LIEU OF THE PIPE. THE PROPERTY OWNER AND OWNER'S ENGINEERS WILL NEED TO DETERMINE IF A SWALE CAN BE USED IN LIEU OF A PIPE.
7. USE OF RURAL SECTION AS APPROVED BY OWNER.

RESIDENTIAL DRIVE APPROACH CONNECTING TO EXISTING RURAL TYPE ASPHALT STREET		STANDARD SPECIFICATION REFERENCE: 305.2	
		DATE: AUG '23	STANDARD DRAWING NO.: 2150B

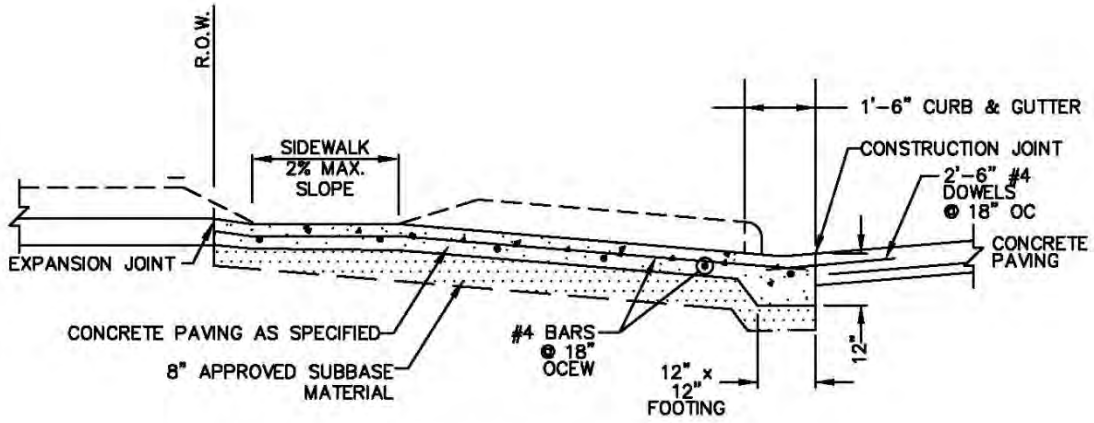

SAW-CUT LINE IF CONNECTING TO EXISTING STREET
1/2" LIP AT GUTTER
TOOLED JOINTS
3/4" ASPHALT EXPANSION JOINT MATERIAL WITH NO. 4 SMOOTH DOWEL BARS (TYP) SEE NOTE 4.
18"
A
℄
BACK OF CURB
VARIES 5' TYP.
BEND NO. 4 REBAR (GRADE 40) ALONG RADIUS
FADE OUT CURB, WARPED FACE
NO. 4 BARS ON 18" CENTERS BOTH WAYS
CONC. SIDEWALK
(SEE NOTE 2)
R.O.W. LINE
EXIST. DRIVEWAY
VARIABLE
TOOLED JOINTS ACROSS AND THRU DRIVE APPROACH SHALL MATCH SIDEWALK DETAIL TO ESTABLISH A CONTINUOUS VISUAL PEDESTRIAN PATH.
TYPICAL DRIVE APPROACH ON A CONCRETE STREET
N.T.S.
NO. 4 DOWEL BARS ON 18" CENTERS WITH ¾" REDWOOD EXPANSION JOINT IF CONNECTING TO EXISTING CONCRETE DRIVEWAY.
SIDEWALK 2% MAX
SAWCUT
VARIABLE
6"
EXISTING DRIVEWAY
(SEE NOTE 3)
1/2" LIP AT GUTTER
STREET PAVEMENT SURFACE
6" 5"
6" 6"
NO. 4 DOWELS ON 18" CENTERS
NO. 4 REBAR ON 18" CENTERS BOTH WAYS
MATCH EXISTING STREET SUBGRADE OR 8" FLEX BASE
COMPACTED NATIVE SOIL TO 95% DENSITY PER ASTM D698
SECTION 'A-A'
N.T.S.
SEE NOTES FOR 2150A
RESIDENTIAL DRIVE APPROACH ON A CONCRETE STREET
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
305.2
DATE
AUG '23
STANDARD DRAWING NO.
2150C



NOTES:

1. THE SLOPE OF THE DRIVE WHERE SIDEWALKS CROSS SHALL HAVE A MAXIMUM CROSS SLOPE OF 2%.
2. REMOVE ANY EXISTING SIDEWALK AT NEAREST JOINT AND CONNECT REPLACED SECTION TO DRIVE WITH (3) – NO. 4 SMOOTH DOWEL BARS ON 18" CENTERS WITH 3/4" REDWOOD EXPANSION JOINT, WITH 1" REMOVABLE CAP STRIP. SEAL WITH SELF LEVELING GRAY SILICONE SEALANT.
3. COMMERCIAL DRIVE APPROACH 10% MAX SLOPE*; MIN. 7" SLAB THICKNESS
   * MAXIMUM SLOPE AS APPROVED BY OWNER
4. ALL CONNECTIONS TO STATE RIGHT-OF-WAY SHALL USE TXDOT DETAILS.
5. ALL CURB AND GUTTER SHALL BE 30" UNLESS OTHERWISE DIRECTED BY THE CITY.
6. CONCRETE SHALL BE CLASS C, 6 SACK AND HAVE COMPRESSIVE STRENGTH OF 3600 PSI @28 DAYS.
7. IF STREET IS BEING REPLACED, PAVEMENT THICKNESS SHALL BE 6" FOR RESIDENTIAL AND 8" FOR COLLECTOR OR LARGER.

COMMERCIAL DRIVEWAY APPROACH		STANDARD SPECIFICATION REFERENCE 305.2	
		DATE AUG '23	STANDARD DRAWING NO. 2155A



SECTION 'A–A'

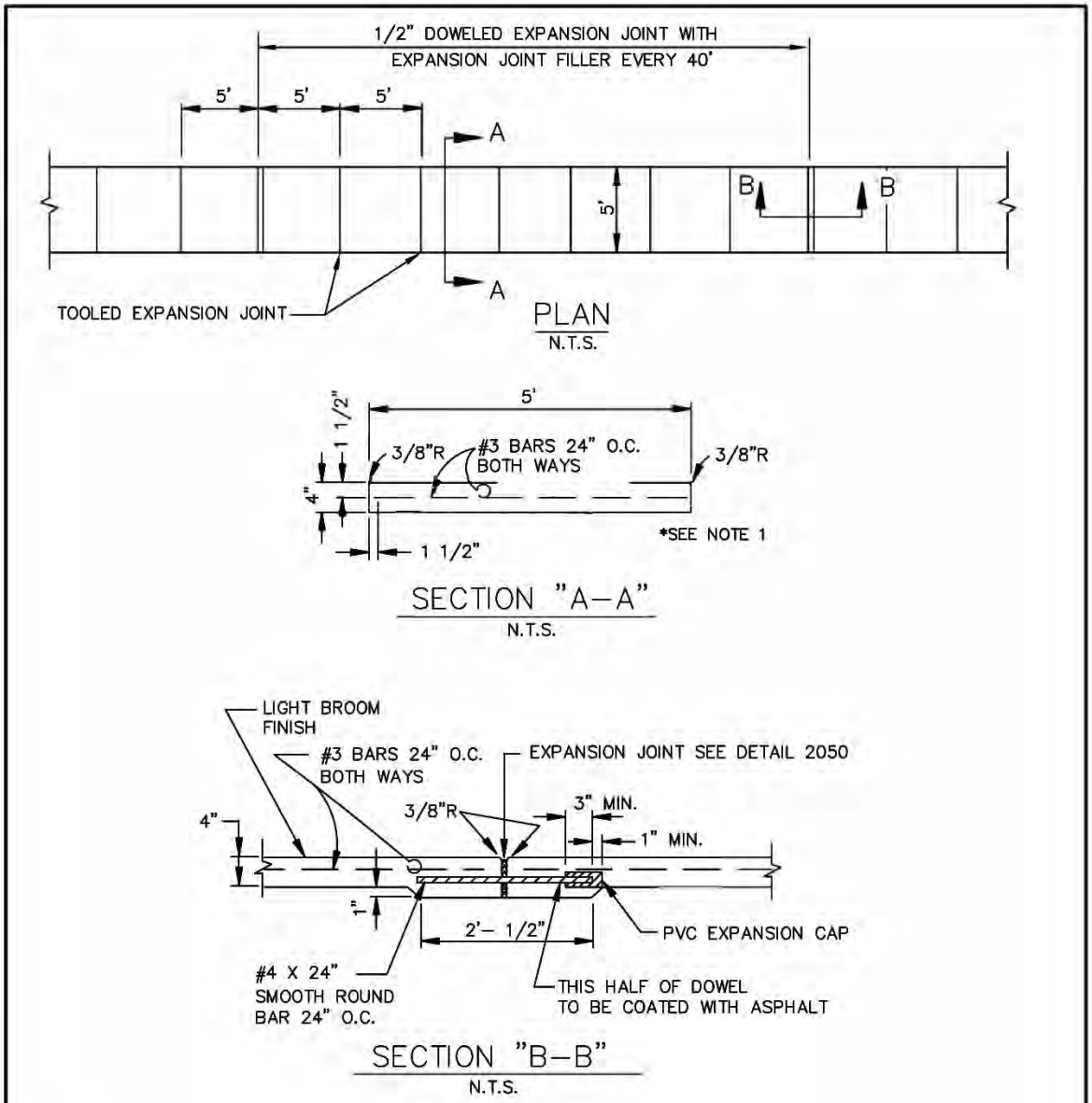
N.T.S.

COMMERCIAL APPROACH (CONCRETE PAVING)

NOTES:

1. THE SLOPE OF THE DRIVE WHERE SIDEWALKS CROSS SHALL HAVE A MAXIMUM CROSS SLOPE OF 2%.
2. REMOVE ANY EXISTING SIDEWALK AT NEAREST JOINT AND CONNECT REPLACED SECTION TO DRIVE WITH (3) – NO. 4 SMOOTH DOWEL BARS ON 18" CENTERS WITH 3/4" REDWOOD EXPANSION JOINT, WITH 1" REMOVABLE CAP STRIP. SEAL WITH SELF LEVELING GRAY SILICONE SEALANT.
3. COMMERCIAL DRIVE APPROACH 10% MAX SLOPE*; MIN. 7" SLAB THICKNESS
   * MAXIMUM SLOPE AS APPROVED BY OWNER
4. ALL CONNECTIONS TO STATE RIGHT–OF–WAY SHALL USE TXDOT DETAILS.
5. ALL CURB AND GUTTER SHALL BE 30" UNLESS OTHERWISE DIRECTED BY THE CITY.
6. CONCRETE SHALL BE CLASS C, 6 SACK AND HAVE COMPRESSIVE STRENGTH OF 3600 PSI @28 DAYS.
7. IF STREET IS BEING REPLACED, PAVEMENT THICKNESS SHALL BE 6" FOR RESIDENTIAL AND 8" FOR COLLECTOR OR LARGER.

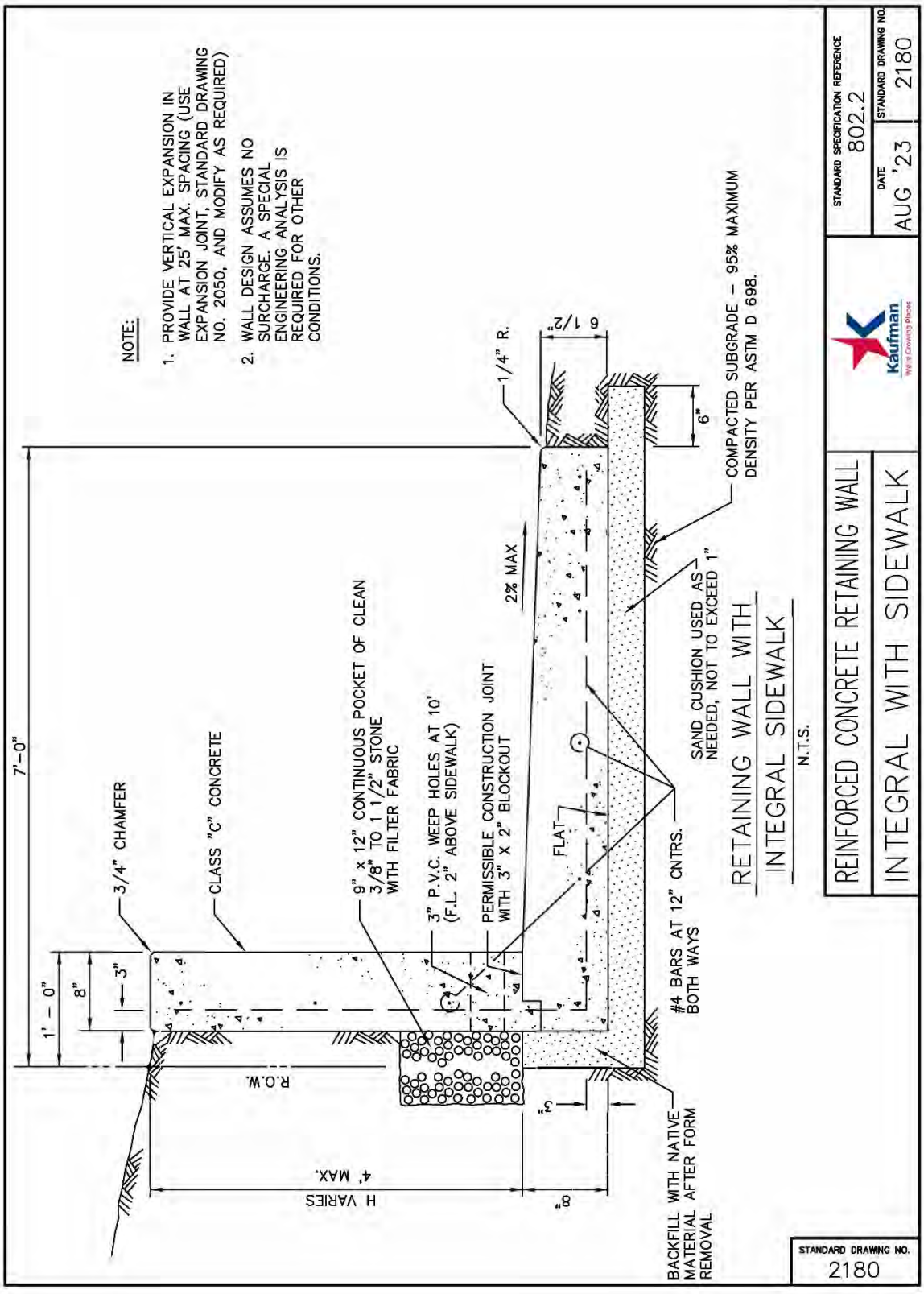
COMMERCIAL DRIVEWAY APPROACH		STANDARD SPECIFICATION REFERENCE 305	
SECTION VIEW		DATE AUG '23	STANDARD DRAWING NO. 2155B



NOTE:

1. REFER TO STANDARD SPECIFICATION ITEM 305.2 FOR ALTERNATE REINFORCEMENT.
2. CROSS SLOPE OF SIDEWALK SHALL BE 2% MAX.
3. OTHER THAN 5'-0" SIDEWALK WIDTH MAY BE SPECIFIED BY OWNER.
4. SIDEWALK SHALL BE CLASS "C" CONCRETE UNLESS OTHERWISE SPECIFIED BY OWNER.
5. ALL HONEYCOMB IN BACK OF CURB TO BE TROWEL-PLASTERED BEFORE POURING SIDEWALK.
6. LUG MAY BE FORMED BY SHAPING SUBGRADE TO APPROXIMATE DIMENSIONS SHOWN.
7. IF 5' WIDTH CANNOT BE ACHIEVED, MUST BE COMPLIANT WITH ADA AND PROWAG PASSING REQUIREMENTS.

REINFORCED CONCRETE SIDEWALKS		STANDARD SPECIFICATION REFERENCE 305.2	
JOINTS AND SPACING		DATE AUG '23	STANDARD DRAWING NO. 2170


NOTE:
1. PROVIDE VERTICAL EXPANSION IN WALL AT 25' MAX. SPACING (USE EXPANSION JOINT, STANDARD DRAWING NO. 2050, AND MODIFY AS REQUIRED)
2. WALL DESIGN ASSUMES NO SURCHARGE. A SPECIAL ENGINEERING ANALYSIS IS REQUIRED FOR OTHER CONDITIONS.
7'-0"
1' - 0"
8"
3"
3/4" CHAMFER
CLASS "C" CONCRETE
9" x 12" CONTINUOUS POCKET OF CLEAN 3/8" TO 1 1/2" STONE WITH FILTER FABRIC
3" P.V.C. WEEP HOLES AT 10' (F.L. 2" ABOVE SIDEWALK)
PERMISSIBLE CONSTRUCTION JOINT WITH 3" X 2" BLOCKOUT
2% MAX
FLAT
1/4" R.
6 1/2"
6"
COMPACTED SUBGRADE - 95% MAXIMUM DENSITY PER ASTM D 698.
SAND CUSHION USED AS NEEDED, NOT TO EXCEED 1"
#4 BARS AT 12" CNTRS. BOTH WAYS
R.O.W.
3"
H VARIES 4' MAX.
8"
BACKFILL WITH NATIVE MATERIAL AFTER FORM REMOVAL
RETAINING WALL WITH INTEGRAL SIDEWALK
N.T.S.
REINFORCED CONCRETE RETAINING WALL
INTEGRAL WITH SIDEWALK
STANDARD SPECIFICATION REFERENCE
802.2
DATE
AUG '23
STANDARD DRAWING NO.
2180
STANDARD DRAWING NO.
2180

1 EACH

MFG NOTES:

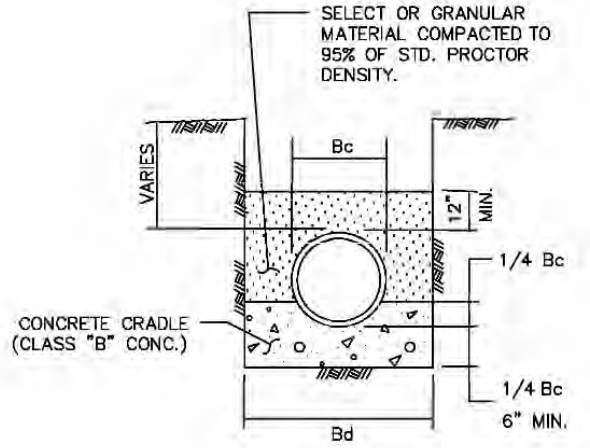
FONT COLOR	SEE NOTES
BACK COLOR	WHITE
BORDER	1/2"
FONT	FHWA
U/L?	UPPER/LOWERCASE
LTR SERIES	B SERIES
LTR HGT	6" 3"

HIP - HI INTENSITY PRISMATIC REFLECTIVE 3930 SERIES (TYPE III)
OVERLAY - 3M 1170 CLEAR

NOTES:

1. COLORS SHALL BE: BLUE - TRAFFIC BLUE; RED - TRAFFIC RED.
2. ALL SIGNS SHALL BE 0.080 THICKNESS REFLECTIVE SIGNS.
3. RADIUS ON THE EDGES OF THE SIGN SHALL BE 3/4".
4. SIGN POSTS SHALL BE 2 3/8" O.D. GALVANIZED STEEL TUBE SIGN POLE.

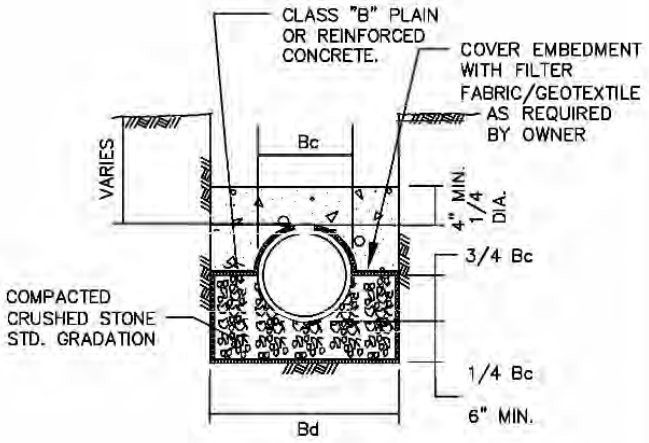
STREET SIGNAGE		DATE	STANDARD DRAWING NO.
		AUG '23	2300



CLASS "A"

CLASS "B" CONCRETE CRADLE
PLAIN CONC. LF 2.8
REINF. CONC. LF 3.4 P=0.4%

N.T.S



CLASS "A-1"

CLASS "B" CONCRETE CAP
PLAIN CONC. LF 2.8
REINF. CONC. LF 3.4 P=0.4%
REINF. CONC. LF 4.8 P=1.0%

N.T.S

NOTES:

1. LF. = LOAD FACTOR TO BE USED TO DETERMINE 3 EDGE BEARING BASED ON TYPE OF EMBEDMENT.
2. FREE-FALL OF CONCRETE NOT TO EXCEED 5 FT. MAXIMUM.
3. P = Rho FOR STEEL %
4. Bc = OUTSIDE DIAMETER OF PIPE
5. Bd = TRENCH WIDTH

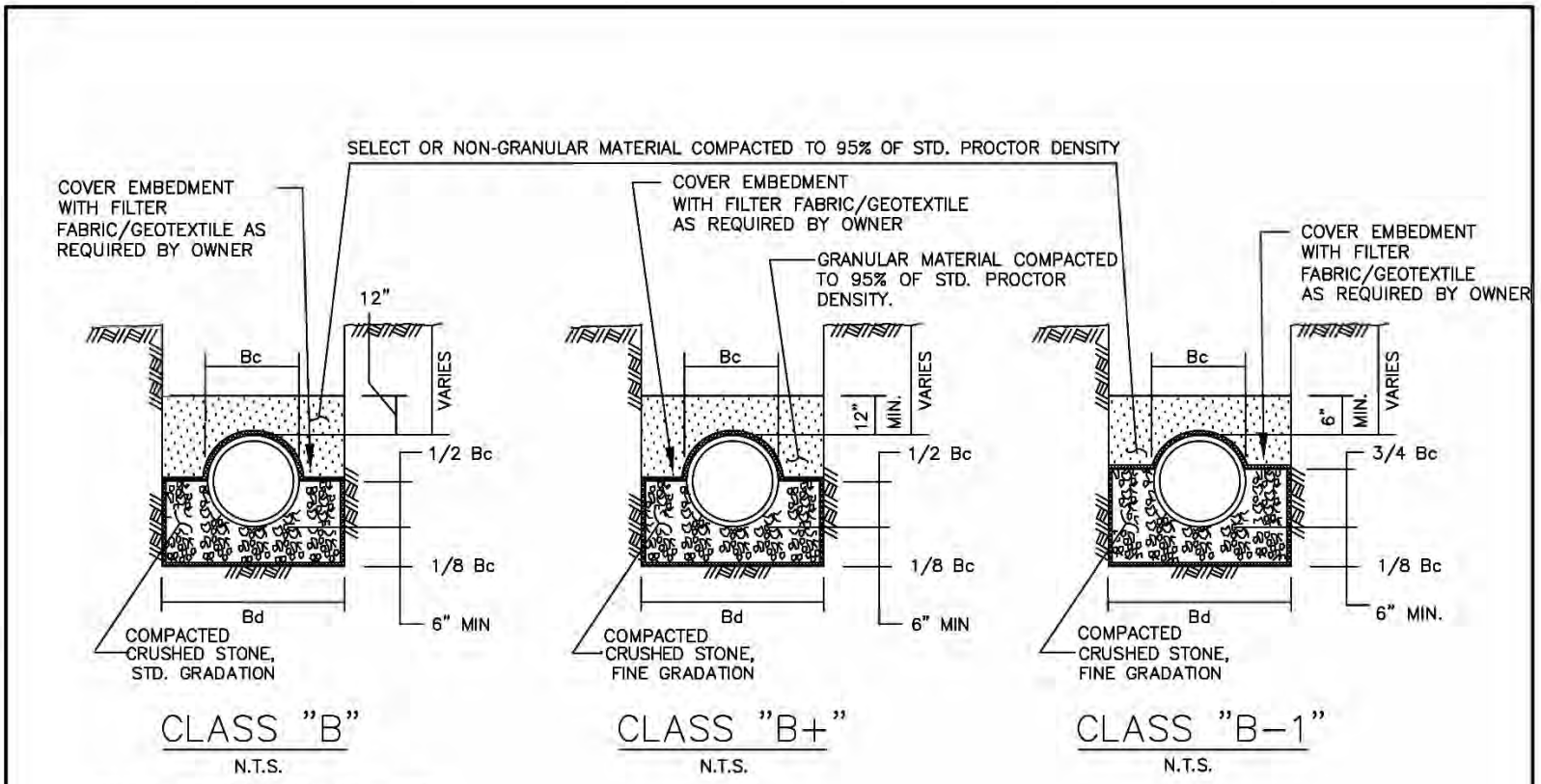
STANDARD DRAWING NO. 3010

EMBEDMENT
CLASS "A" & "A-1"

STANDARD SPECIFICATION REFERENCE: 504.5

DATE: AUG '23

STANDARD DRAWING NO.: 3010



(TO BE USED FOR RCP STORM SEWER PIPE)

NOTES:

1. Bc = OUTSIDE DIAMETER OF PIPE
2. Bd = TRENCH WIDTH
3. FOR MAINS 42" DIAMETER AND LARGER, 1/8 Bc SHALL BE TAKEN AS 6"

STANDARD DRAWING NO. 3020

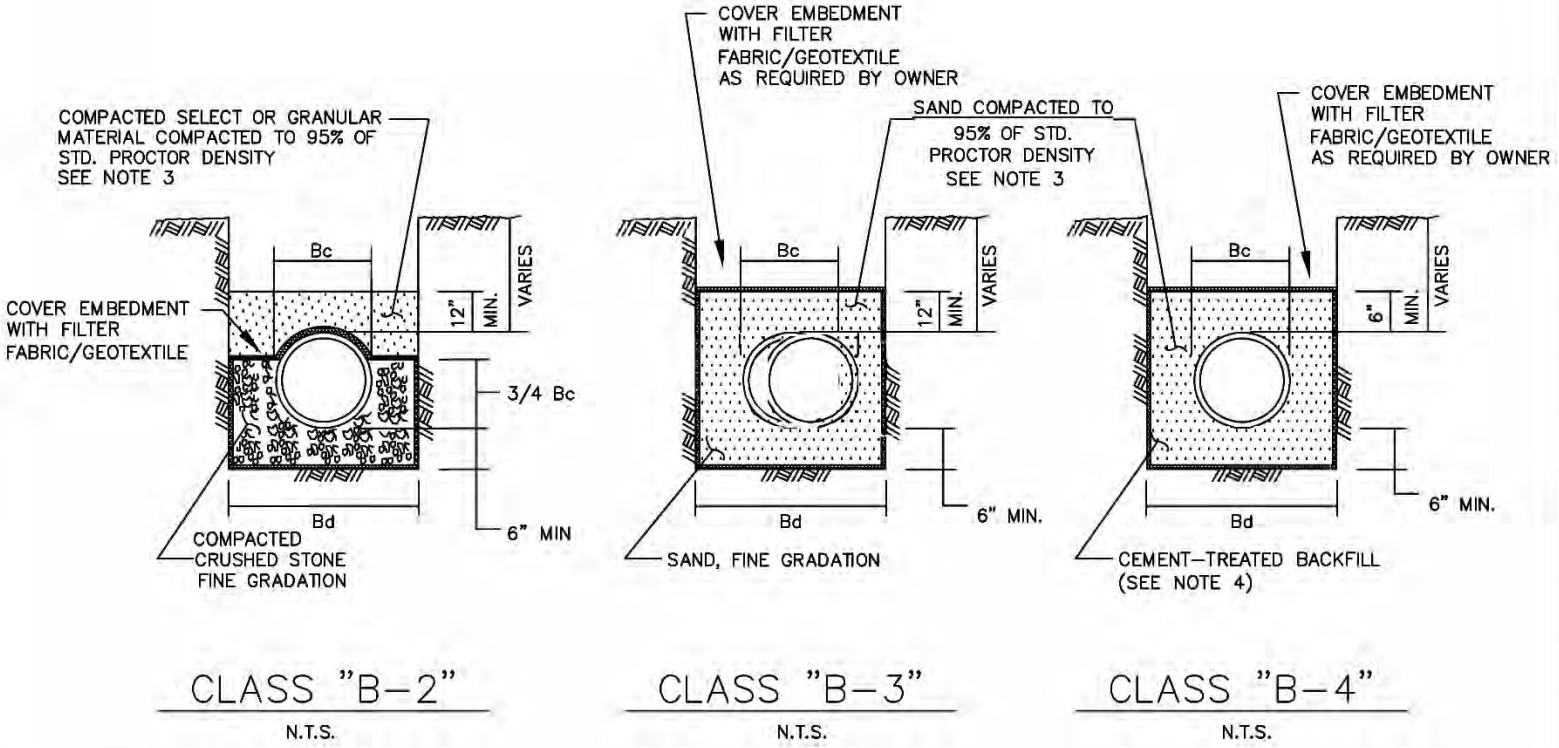
EMBEDMENT

CLASS "B", "B+", & "B-1"

STANDARD SPECIFICATION REFERENCE 504.5

DATE AUG '23

STANDARD DRAWING NO. 3020



CLASS "B-2"
N.T.S.

CLASS "B-3"
N.T.S.

CLASS "B-4"
N.T.S.

NOTES:

1. Bc = OUTSIDE DIAMETER OF PIPE
2. Bd = TRENCH WIDTH
3. NO GRANULAR MATERIAL ABOVE ROCK OR STONE EMBEDMENT
4. REFER TO 504.6.2

(TO BE USED FOR PVC WATER PIPE AND PVC WASTE WATER FORCE MAIN PIPE)

STANDARD DRAWING NO. 3030

EMBEDMENT

CLASS "B-2", "B-3", & "B-4"

Kaufman
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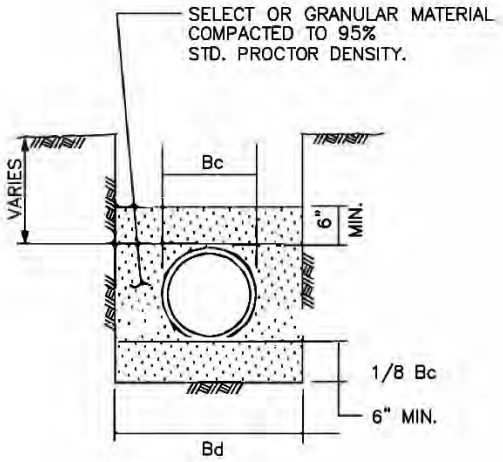
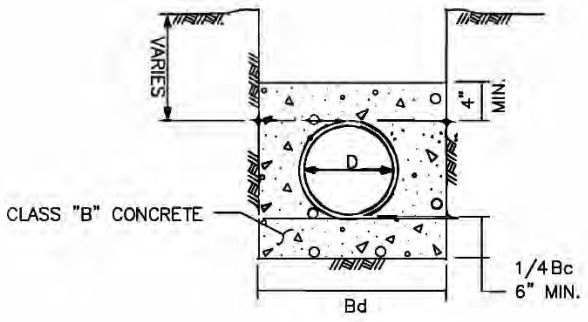
STANDARD SPECIFICATION REFERENCE	
504.5	
DATE	STANDARD DRAWING
AUG '23	3030



CLASS "D+"
N.T.S.

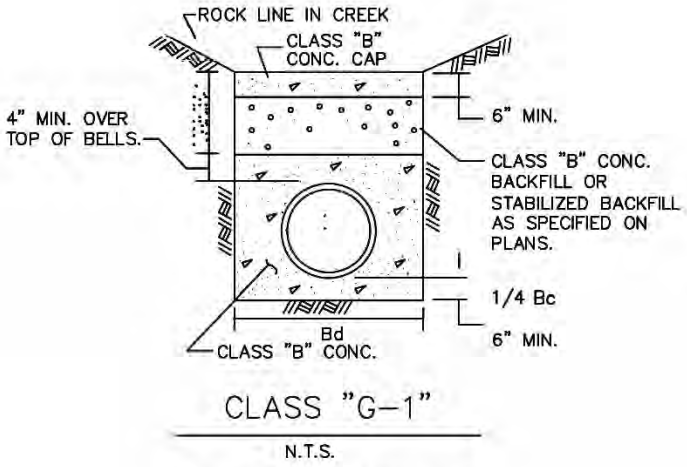


CLASS "G"
N.T.S.

NOTES:

1. Bc = OUTSIDE DIAMETER OF PIPE
2. Bd = TRENCH WIDTH
3. D = INSIDE DIAMETER OF PIPE
4. FOR MAINS 42" DIAMETER AND LARGER, 1/8 Bc SHALL BE TAKEN AS 6"

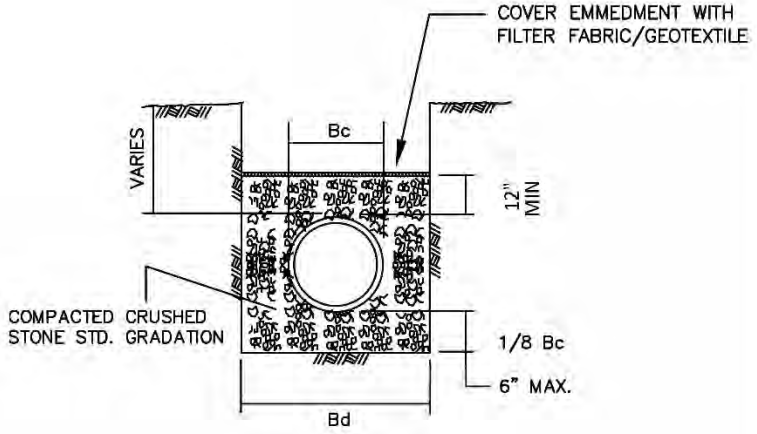
STANDARD DRAWING NO.	EMBEDMENT		STANDARD SPECIFICATION REFERENCE
3050	CLASS "D+" & "G"	Kaufman We're Growing Places	504.5
			DATE: AUG '23 / STANDARD DRAWING NO.: 3050



CLASS "G-1"

N.T.S.

(FOR ROCK DITCHES IN CREEKS)



CLASS "H"

N.T.S.

(TO BE USED FOR PVC WASTEWATER PIPE)

NOTES:
1. Bc = OUTSIDE DIAMETER OF PIPE
2. Bd = TRENCH WIDTH
3. D = INSIDE DIAMETER OF PIPE
4. FOR MAINS 42" DIAMETER AND LARGER - 1/8 Bc SHALL BE TAKEN AS 6"

STANDARD DRAWING NO. 3060

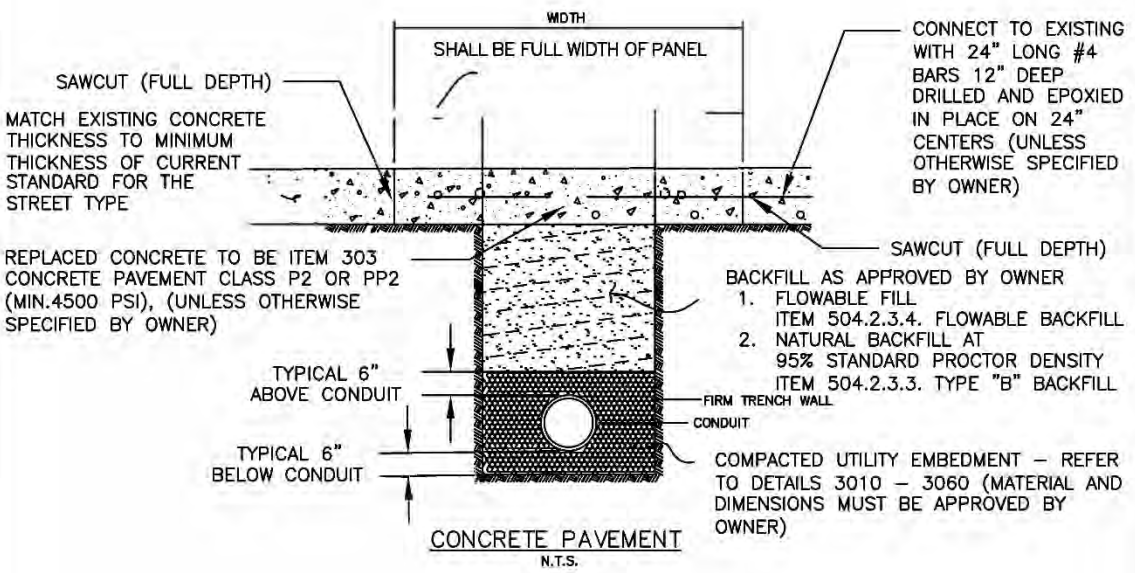
EMBEDMENT

CLASS "G-1" & "H"

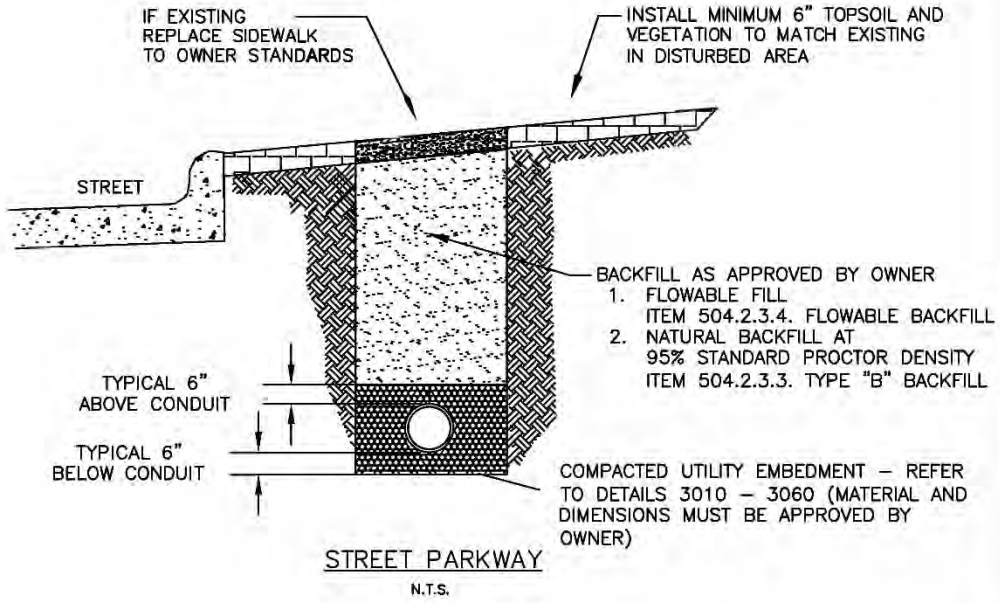
Kaufman We're Growing Places

STANDARD SPECIFICATION REFERENCE	
504.5	
DATE	STANDARD DRAWING NO.
AUG '23	3060

GENERAL NOTE: CHECK WITH STREET OWNER FOR SPECIFIC REQUIREMENTS NOT CONTAINED HEREIN

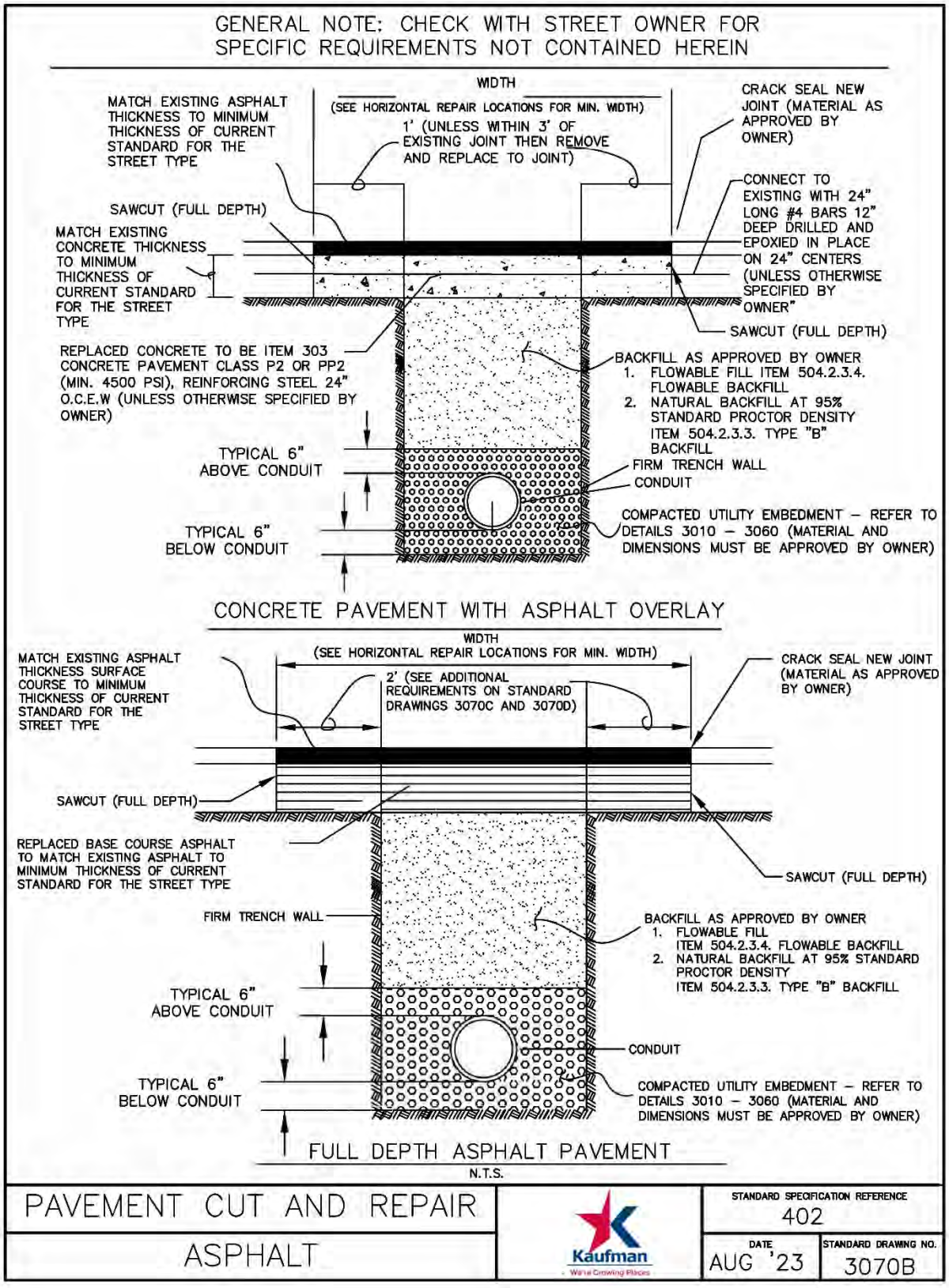


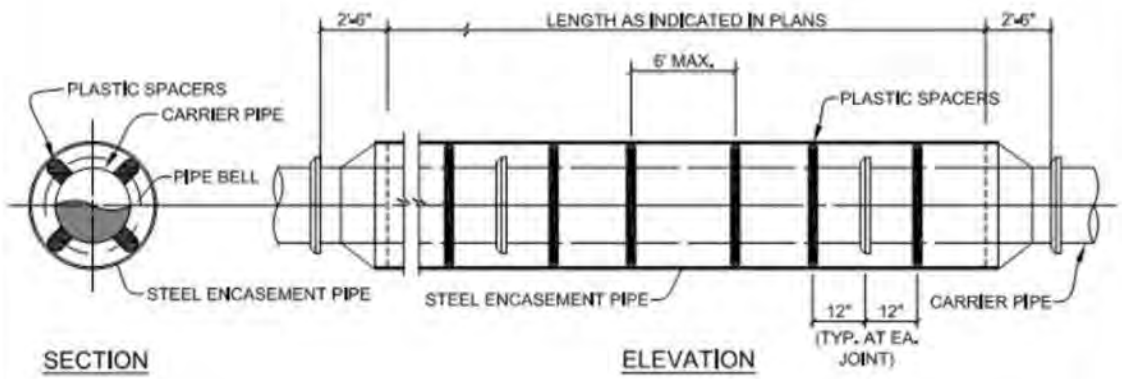
CONCRETE PAVEMENT
N.T.S.



STREET PARKWAY
N.T.S.

PAVEMENT CUT AND REPAIR		STANDARD SPECIFICATION REFERENCE 402	
CONCRETE AND PARKWAY		DATE AUG '23	STANDARD DRAWING NO. 3070A


GENERAL NOTE: CHECK WITH STREET OWNER FOR SPECIFIC REQUIREMENTS NOT CONTAINED HEREIN
WIDTH
(SEE HORIZONTAL REPAIR LOCATIONS FOR MIN. WIDTH)
MATCH EXISTING ASPHALT THICKNESS TO MINIMUM THICKNESS OF CURRENT STANDARD FOR THE STREET TYPE
1' (UNLESS WITHIN 3' OF EXISTING JOINT THEN REMOVE AND REPLACE TO JOINT)
CRACK SEAL NEW JOINT (MATERIAL AS APPROVED BY OWNER)
CONNECT TO EXISTING WITH 24" LONG #4 BARS 12" DEEP DRILLED AND EPOXIED IN PLACE ON 24" CENTERS (UNLESS OTHERWISE SPECIFIED BY OWNER"
SAWCUT (FULL DEPTH)
MATCH EXISTING CONCRETE THICKNESS TO MINIMUM THICKNESS OF CURRENT STANDARD FOR THE STREET TYPE
SAWCUT (FULL DEPTH)
REPLACED CONCRETE TO BE ITEM 303 CONCRETE PAVEMENT CLASS P2 OR PP2 (MIN. 4500 PSI), REINFORCING STEEL 24" O.C.E.W (UNLESS OTHERWISE SPECIFIED BY OWNER)
BACKFILL AS APPROVED BY OWNER
1. FLOWABLE FILL ITEM 504.2.3.4. FLOWABLE BACKFILL
2. NATURAL BACKFILL AT 95% STANDARD PROCTOR DENSITY ITEM 504.2.3.3. TYPE "B" BACKFILL
TYPICAL 6" ABOVE CONDUIT
FIRM TRENCH WALL
CONDUIT
TYPICAL 6" BELOW CONDUIT
COMPACTED UTILITY EMBEDMENT – REFER TO DETAILS 3010 – 3060 (MATERIAL AND DIMENSIONS MUST BE APPROVED BY OWNER)
CONCRETE PAVEMENT WITH ASPHALT OVERLAY
WIDTH
(SEE HORIZONTAL REPAIR LOCATIONS FOR MIN. WIDTH)
MATCH EXISTING ASPHALT THICKNESS SURFACE COURSE TO MINIMUM THICKNESS OF CURRENT STANDARD FOR THE STREET TYPE
2' (SEE ADDITIONAL REQUIREMENTS ON STANDARD DRAWINGS 3070C AND 3070D)
CRACK SEAL NEW JOINT (MATERIAL AS APPROVED BY OWNER)
SAWCUT (FULL DEPTH)
REPLACED BASE COURSE ASPHALT TO MATCH EXISTING ASPHALT TO MINIMUM THICKNESS OF CURRENT STANDARD FOR THE STREET TYPE
SAWCUT (FULL DEPTH)
FIRM TRENCH WALL
BACKFILL AS APPROVED BY OWNER
1. FLOWABLE FILL ITEM 504.2.3.4. FLOWABLE BACKFILL
2. NATURAL BACKFILL AT 95% STANDARD PROCTOR DENSITY ITEM 504.2.3.3. TYPE "B" BACKFILL
TYPICAL 6" ABOVE CONDUIT
CONDUIT
TYPICAL 6" BELOW CONDUIT
COMPACTED UTILITY EMBEDMENT – REFER TO DETAILS 3010 – 3060 (MATERIAL AND DIMENSIONS MUST BE APPROVED BY OWNER)
FULL DEPTH ASPHALT PAVEMENT
N.T.S.
PAVEMENT CUT AND REPAIR
ASPHALT
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
402
DATE
AUG '23
STANDARD DRAWING NO.
3070B



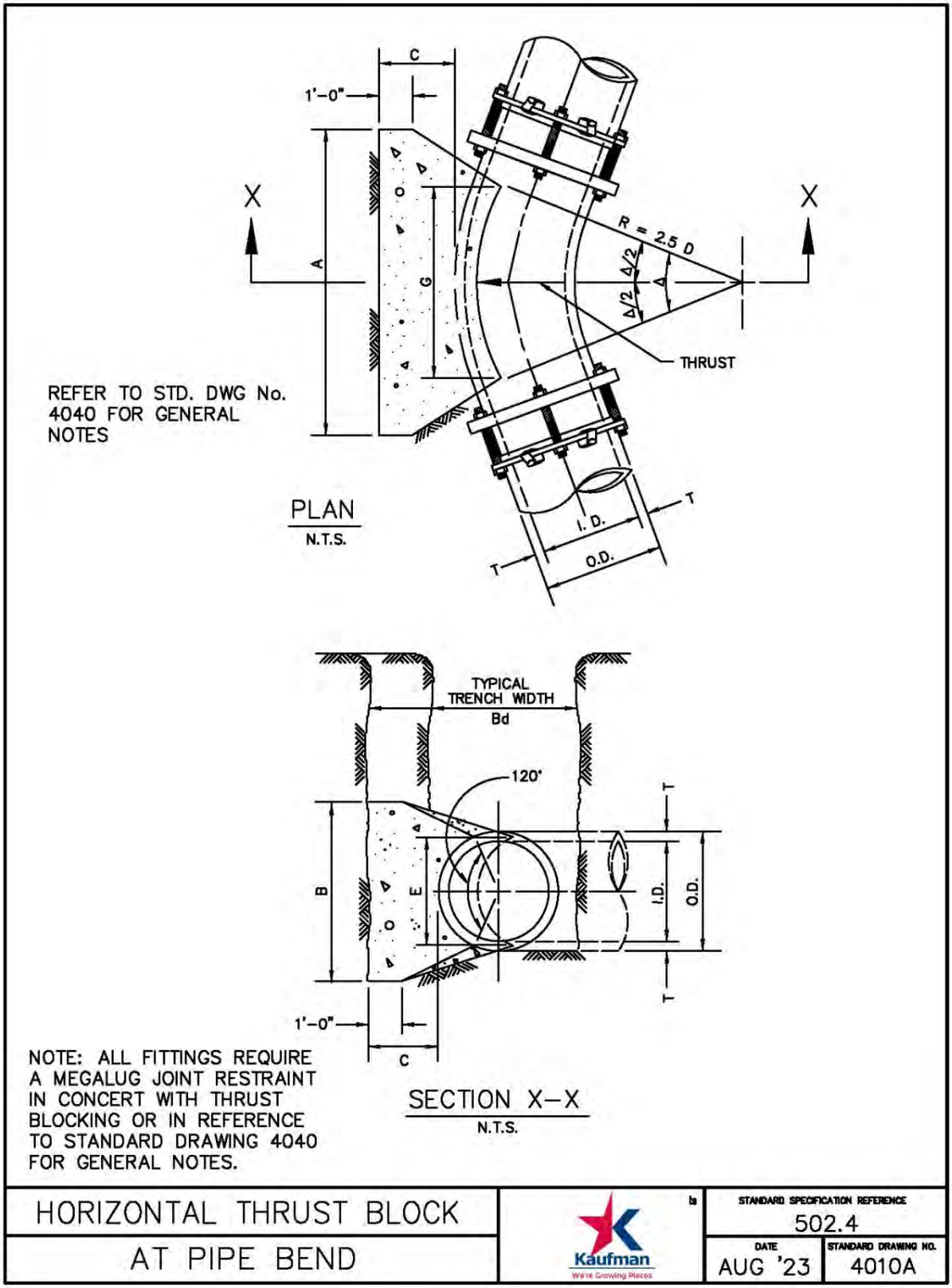
ENCASED ROAD BORE

NO SCALE

NOTES:

1) ALL BORES BY CONTRACTOR SHALL BE DRY BORES.
2) PREFABRICATED PLASTIC SPACERS SHALL BE RACI NORTH AMERICA OR APPROVED EQUAL, FOR THE SPECIFIC APPLICATION AS RECOMMENDED BY THE MANUFACTURER.
3) CONTRACTOR SHALL PROVIDE SUPPORT UNDER CARRIER PIPE TO HAVE A MIN. 1" CLEARANCE BETWEEN PIPE BELL AND ENCASEMENT PIPE.
4) ENDS OF ENCASEMENT PIPE SHALL HAVE END SEALS INSTALLED PER MANUFACTURER'S REQUIREMENTS. END SEALS SHALL BE CCI MODEL ESW WRAP-AROUND BY CCI PIPELINE SYSTEMS OR APPROVED EQUAL.
5) THE DESIGN ENGINEER SHALL DESIGN THE MINIMUM THICKNESS OF THE ENCASEMENT PIPE. DESIGN WILL NEED TO INCLUDE DEAD LOADING BASED ON THE HEIGHT OF COVER AND HS-20 LOADINGS FOR ROADWAY CROSSINGS AND E-80 LOADINGS FOR RAILROAD CROSSINGS.
6) STEEL ENCASEMENT PIPE SHALL CONFORM TO AWWA C-200. PIPE SHALL BE FABRICATED IN ACCORDANCE WITH ASTM A-570 FROM STEEL PLATES HAVING MINIMUM YIELD STRENGTH 36,000 PSI.
7) STEEL ENCASEMENT PIPE SHALL BE PAINTED INSIDE AND OUTSIDE WITH TWO COATS OF TNEMEC. HB TNEMECOL, SERIES 46+465 COAL TAR, OR CITY APPROVED EQUIVALENT PRIOR TO DELIVERY TO THE JOB SITE. MINIMUM COATING INSIDE AND OUTSIDE SHALL BE 12+MILS DRY FILM THICKNESS (DFT) PER EACH COAT.
8) ENCASEMENT PIPE SHALL BE FEILD WELDED IN ACCORDANCE WITH AWWA C-206. WELDED JOINTS SHALL BE WIRE BRUSHED AND PAINTED WITH ONE COAT OF TNEMEC, OMNITHANE SERIES 530, 2.5-MILS DRY FILM THICKNESS 9DFT) OR CITY APPROVED EQUIVALENT.

UNDERGROUND CONDUIT			
STEEL ENCASED BORE		DATE: AUG '23	STANDARD DRAWING NO.: 3090


C
1'-0"
X
X
A
G
R = 2.5 D
Δ/2
Δ/2
Δ
THRUST
REFER TO STD. DWG No. 4040 FOR GENERAL NOTES
PLAN
N.T.S.
T
I. D.
O.D.
T
TYPICAL TRENCH WIDTH
Bd
120°
T
B
E
I.D.
O.D.
T
1'-0"
C
NOTE: ALL FITTINGS REQUIRE A MEGALUG JOINT RESTRAINT IN CONCERT WITH THRUST BLOCKING OR IN REFERENCE TO STANDARD DRAWING 4040 FOR GENERAL NOTES.
SECTION X–X
N.T.S.
HORIZONTAL THRUST BLOCK
AT PIPE BEND
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
502.4
DATE
AUG '23
STANDARD DRAWING NO.
4010A

I.D. (IN.)	T (IN.)	$\Delta =$ 11.25° C (FT.)	$\Delta \geq$ 22.50° C (FT.)	E (FT.)
4,6,8	0.4	1.5	1.5	0.9
10,12	0.5	1.5	1.5	1.2
16,18	0.6	1.5	1.5	1.6
20	0.7	1.5	1.5	1.8
24	0.9	1.5	1.5	2.1
30	2.9	1.5	1.9	2.6
36	4.5	1.5	2.3	3.3
42	5.0	1.8	2.6	3.8
48	5.5	2.0	3.0	4.3
54	6.0	2.3	3.4	4.8
60	6.5	2.5	3.8	5.3
66	6.8	2.8	4.1	5.7
72	7.5	3.0	4.5	6.3
78	7.5	3.3	4.9	6.7
84	8.0	3.5	5.3	7.2
90	8.5	3.8	5.6	7.7
96	9.0	4.0	6.0	8.2

	$\Delta = 11.25°$									$\Delta = 22.50°$							
			EARTH			ROCK						EARTH			ROCK		
I.D. (IN.)	G (FT.)	THRUST (TONS)	A (FT.)	B (FT.)	VOL. (C.Y.)	A (FT.)	B (FT.)	VOL. (C.Y.)	I.D. (IN.)	G (FT.)	THRUST (TONS)	A (FT.)	B (FT.)	VOL. (C.Y.)	A (FT.)	B (FT.)	VOL. (C.Y.)
4,6,8	0.4	1.0	1.0	1.5	0.1	1.0	1.0	0.1	4,6,8	0.8	2.0	1.5	1.5	0.1	1.0	1.0	0.1
10,12	0.6	2.2	1.5	1.5	0.1	1.0	1.5	0.1	10,12	1.1	4.4	2.0	2.5	0.3	1.5	1.5	0.1
16,18	0.8	5.0	2.0	2.5	0.3	1.5	2.0	0.2	16,18	1.6	9.9	3.0	3.5	0.6	2.0	2.5	0.3
20	0.9	6.2	2.0	3.5	0.4	1.5	3.0	0.3	20	1.8	12.3	3.5	3.5	0.7	2.0	3.0	0.4
24	1.1	8.9	3.0	3.5	0.5	1.5	3.0	0.3	24	2.2	17.7	4.0	4.5	1.0	3.0	3.5	0.5
30	1.4	10.4	3.0	3.5	0.6	2.0	3.5	0.4	30	2.7	20.7	5.0	4.5	1.5	3.0	4.0	0.8
36	1.7	15.0	3.5	4.5	0.9	2.0	4.0	0.5	36	3.3	29.8	5.5	5.5	2.3	4.0	4.0	1.3
42	1.9	20.4	4.5	5.0	1.5	2.5	5.0	0.8	42	3.8	40.5	7.0	6.0	3.9	4.5	5.0	2.1
48	2.2	26.6	4.5	6.0	2.0	2.5	6.0	1.1	48	4.4	52.9	8.0	7.0	5.7	4.5	6.0	2.8
54	2.5	33.7	6.0	6.0	3.0	3.0	6.0	1.4	54	4.9	67.0	9.0	8.0	8.0	6.0	6.0	4.1
60	2.7	41.6	6.0	7.0	3.8	3.0	7.0	1.8	60	5.5	82.7	9.5	9.0	10.6	6.0	7.0	5.3
66	3.0	50.3	6.5	8.0	5.1	3.5	8.0	2.7	66	6.0	100.1	10.5	10.0	14.1	6.5	8.0	7.2
72	3.3	59.9	7.5	8.0	6.3	4.0	8.0	3.3	72	6.6	119.1	11.0	11.0	17.6	7.5	8.0	9.1
78	3.6	70.2	8.0	9.0	8.1	4.0	9.0	3.9	78	7.1	139.8	12.0	12.0	22.5	8.0	9.0	11.7
84	3.8	81.5	8.5	10.0	10.3	4.5	10.0	5.3	84	7.6	162.1	13.0	12.5	27.2	8.5	10.0	14.8
90	4.1	93.5	9.5	10.0	12.2	5.0	10.0	6.3	90	8.2	186.1	14.0	13.5	33.7	9.5	10.0	17.7
96	4.4	106.4	10.0	11.0	15.0	5.0	11.0	7.4	96	8.7	211.7	15.0	14.5	41.2	10.0	11.0	21.8

TABLES OF DIMENSIONS AND QUANTITIES

HORIZONTAL THRUST BLOCK AT PIPE BEND		STANDARD SPECIFICATION REFERENCE 502.4	
		DATE AUG '23	STANDARD DRAWING NO. 4010B

I.D. (IN.)	Δ = 30° G (FT.)	THRUST (TONS)	EARTH A (FT.)	EARTH B (FT.)	EARTH VOL. (C.Y.)	ROCK A (FT.)	ROCK B (FT.)	ROCK VOL. (C.Y.)	I.D. (IN.)	Δ = 45° G (FT.)	THRUST (TONS)	EARTH A (FT.)	EARTH B (FT.)	EARTH VOL. (C.Y.)	ROCK A (FT.)	ROCK B (FT.)	ROCK VOL. (C.Y.)
4,6,8	1.0	2.6	2.0	1.5	0.2	1.0	1.5	0.1	4,6,8	1.5	3.9	2.0	2.0	0.2	1.5	1.5	0.1
10,12	1.5	5.9	2.5	2.5	0.3	2.0	1.5	0.2	10,12	2.2	8.7	3.5	2.5	0.5	2.0	2.5	0.3
16,18	2.2	13.2	3.5	4.0	0.8	2.5	3.0	0.4	16,18	3.2	19.5	4.5	4.5	1.2	3.0	3.5	0.6
20	2.4	16.3	4.5	4.0	1.0	3.0	3.0	0.5	20	3.6	24.1	5.5	4.5	1.5	3.5	3.5	0.7
24	2.9	23.4	6.0	4.0	1.4	3.5	3.5	0.7	24	4.3	34.6	8.0	4.5	2.3	4.5	4.0	1.1
30	3.6	27.5	6.5	5.0	1.9	3.5	4.0	0.9	30	5.4	40.6	8.5	5.0	3.2	5.5	4.0	1.6
36	4.4	39.5	7.0	6.0	3.4	4.5	4.5	1.6	36	6.5	58.5	10.0	6.0	5.3	6.5	4.5	2.6
42	5.1	53.8	8.0	7.0	5.1	5.5	5.0	2.5	42	7.5	79.6	11.5	7.0	8.1	8.0	5.0	4.2
48	5.8	70.3	9.0	8.0	7.4	6.0	6.0	3.7	48	8.6	104.0	13.0	8.0	11.9	9.0	6.0	6.3
54	6.5	89.0	10.0	9.0	10.3	7.0	6.5	5.3	54	9.7	131.5	15.0	9.0	17.1	10.5	6.5	8.9
60	7.3	110.0	11.0	10.0	13.9	7.5	7.5	7.3	60	10.7	162.4	16.5	10.0	23.1	11.0	7.5	12.0
66	8.0	132.9	12.5	11.0	18.9	8.5	8.0	9.6	66	11.8	196.5	18.0	11.0	30.1	12.0	8.5	16.2
72	8.7	158.2	13.5	12.0	24.0	9.0	9.0	12.3	72	12.9	233.9	19.5	12.0	38.6	14.0	8.5	20.7
78	9.4	185.6	14.5	13.0	30.0	10.0	9.5	15.6	78	13.9	274.5	21.5	13.0	49.8	14.5	9.5	25.9
84	10.1	215.3	15.5	14.0	37.1	10.5	10.5	19.5	84	15.0	318.4	23.0	14.0	61.2	15.5	10.5	32.6
90	10.9	247.1	16.5	15.0	45.0	11.5	11.0	23.9	90	16.1	365.5	24.5	15.0	74.5	17.5	10.5	39.6
96	11.6	281.2	18.0	16.0	55.5	12.5	11.5	28.9	96	17.1	415.6	26.0	16.0	89.5	18.5	11.5	48.5

I.D. (IN.)	Δ = 67.50° G (FT.)	THRUST (TONS)	EARTH A (FT.)	EARTH B (FT.)	EARTH VOL. (C.Y.)	ROCK A (FT.)	ROCK B (FT.)	ROCK VOL. (C.Y.)	I.D. (IN.)	Δ = 90° G (FT.)	THRUST (TONS)	EARTH A (FT.)	EARTH B (FT.)	EARTH VOL. (C.Y.)	ROCK A (FT.)	ROCK B (FT.)	ROCK VOL. (C.Y.)
4,6,8	2.1	5.6	3.0	2.0	0.3	2.0	1.5	0.2	4,6,8	2.7	7.1	5.0	1.5	0.4	2.0	2.0	0.2
10,12	3.1	12.6	5.5	2.5	0.8	3.5	2.0	0.4	10,12	4.0	16.0	6.5	2.5	1.0	3.5	2.5	0.5
16,18	4.7	28.3	7.5	4.0	1.9	5.5	3.0	0.9	16,18	6.0	36.0	9.0	4.0	2.4	4.5	4.0	1.0
20	5.2	34.9	9.0	4.0	2.3	5.5	3.5	1.2	20	6.6	44.4	10.0	4.5	3.1	6.0	4.0	1.5
24	6.2	50.3	11.5	4.5	3.5	6.5	4.0	1.6	24	7.9	64.0	14.5	4.5	5.0	8.0	4.0	2.1
30	7.8	58.9	12.0	5.0	4.8	7.5	4.0	2.2	30	9.9	75.0	15.0	5.0	6.7	10.0	4.0	3.3
36	9.4	84.9	14.5	6.0	8.2	9.5	4.5	3.8	36	11.9	108.0	18.0	6.0	11.4	12.0	4.5	5.3
42	10.9	115.5	17.0	7.0	12.8	11.0	5.5	6.3	42	13.9	147.0	21.0	7.0	17.8	14.0	5.5	8.7
48	12.5	150.9	19.0	8.0	18.4	13.0	6.0	9.2	48	15.9	192.0	24.0	8.0	26.2	16.0	6.0	12.4
54	14.0	191.0	21.5	9.0	26.0	15.0	6.5	12.9	54	17.9	243.0	27.0	9.0	36.9	18.0	7.0	18.1
60	15.6	235.8	24.0	10.0	35.6	16.0	7.5	17.6	60	19.9	299.8	30.0	10.0	50.3	20.0	7.5	24.0
66	17.1	285.3	26.0	11.0	46.0	18.0	8.0	23.0	66	21.8	362.8	33.0	11.0	66.2	22.0	8.5	32.5
72	18.7	339.5	28.5	12.0	57.8	19.0	9.0	28.4	72	23.8	431.8	36.0	12.0	85.6	24.0	9.0	41.0
78	20.2	398.5	31.0	13.0	75.7	21.0	9.5	37.4	78	25.7	506.7	39.0	13.0	108.2	26.0	10.0	53.2
84	21.8	462.1	33.5	14.0	94.7	22.0	10.5	46.5	84	27.7	587.7	42.0	14.0	134.4	28.0	10.5	64.8
90	23.3	530.5	35.5	15.0	114.4	24.5	11.0	58.2	90	29.0	674.6	45.0	15.0	164.9	30.0	11.5	81.2
96	24.9	603.6	38.0	16.0	138.9	25.5	12.0	70.0	96	31.6	767.5	48.0	16.0	199 0	32.0	12.0	95.1

TABLE OF DIMENSIONS AND QUANTITIES

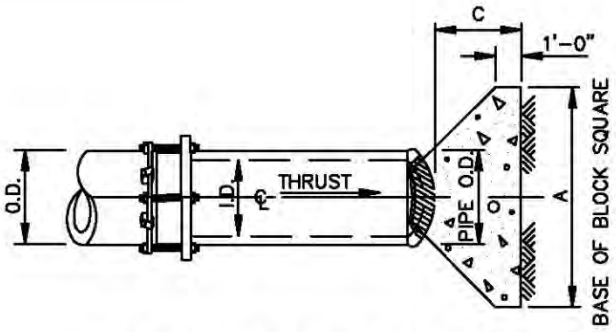
HORIZONTAL THRUST BLOCK AT PIPE BEND

Kaufman
We're Growing Places

STANDARD SPECIFICATION REFERENCE
502.4

DATE
AUG '23

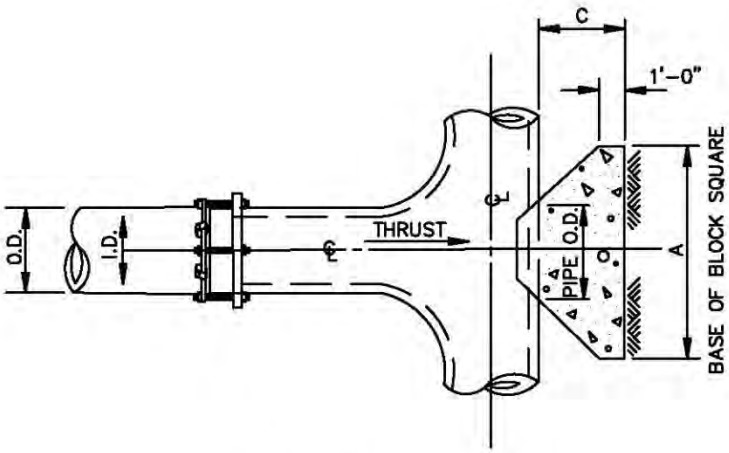
STANDARD DRAWING NO.
4010C



PLAN OF PLUG THRUST BLOCK

N.T.S.

REFER TO
STD. DWG. No. 4040
FOR GENERAL NOTES.



PLAN OF TEE THRUST BLOCK

N.T.S.

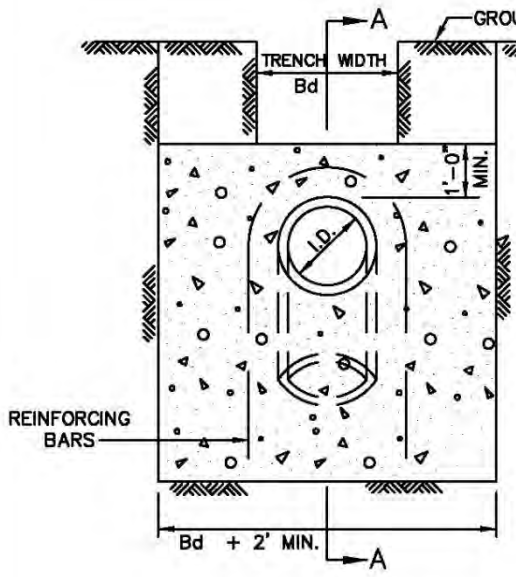
			EARTH		ROCK	
I.D. (IN.)	THRUST (TONS)	C (FT.)	A (FT.)	VOL. (C.Y.)	A (FT.)	VOL. (C.Y.)
4,6,8	5.1	1.5	2.5	0.3	2.0	0.2
10,12	11.3	1.5	3.5	0.6	2.5	0.3
16,18	25.5	2.0	5.5	1.6	4.0	0.9
20	31.5	2.0	6.0	1.9	4.0	0.9
24	45.2	2.5	7.0	3.1	5.0	1.7
30	53.0	3.0	7.5	4.1	5.5	2.4
36	76.3	4.0	9.0	7.3	6.5	4.2
42	104.0	4.5	10.5	11.0	7.5	6.2
48	136.0	5.0	12.0	15.6	8.5	8.7
54	172.0	5.5	13.5	21.4	9.5	11.9
60	212.0	6.0	15.0	28.4	10.5	15.7
66	257.0	6.5	16.5	36.8	11.5	20.5
72	305.0	7.5	17.5	47.2	12.5	27.2
78	358.0	8.0	19.0	58.9	13.5	33.7
84	416.0	8.5	20.5	72.3	14.5	41.2
90	477.0	9.0	22.0	87.7	15.5	49.7
96	543.0	9.5	23.5	104.8	16.5	61.0

HORIZONTAL THRUST BLOCK AT TEES AND PLUGS

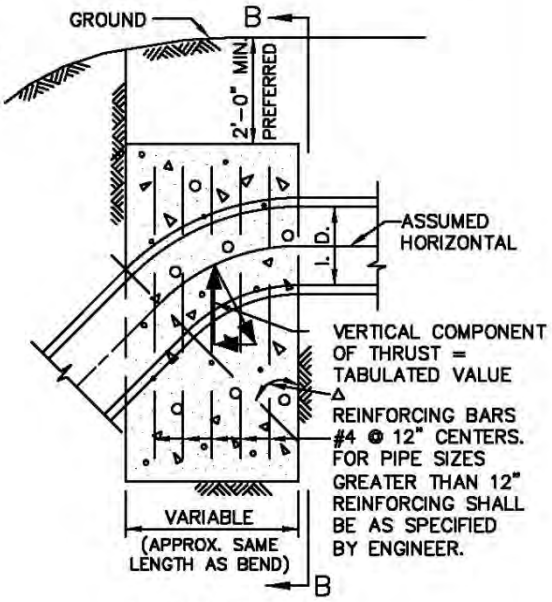
STANDARD SPECIFICATION REFERENCE
502.4

DATE
AUG '23

STANDARD DRAWING NO.
4020



ELEVATION "B–B"
N.T.S.



SECTION "A–A"
N.T.S.

REFER TO
STD. DWG. No. 4040
FOR GENERAL NOTES.

Δ →	11.25°		22.50°		30°		45°		67.50°		90°		← Δ
I.D. (IN.)	THRUST (TONS)	VOL. (C.Y.)	THRUST (TONS)	VOL. (C.Y.)	THRUST (TONS)	VOL. (C.Y.)	THRUST (TONS)	VOL. (C.Y.)	THRUST (TONS)	VOL. (C.Y.)	THRUST (TONS)	VOL. (C.Y.)	I.D. (IN.)
4,6,8	1.0	0.5	2.0	1.0	2.5	1.3	3.6	1.8	4.6	2.3	5.0	2.5	4,6,8
10,12	2.2	1.1	4.3	2.2	5.7	2.8	8.0	4.0	10.5	5.2	11.3	5.7	10,12
16,18	5.0	2.5	9.7	4.9	12.7	6.4	18.0	9.0	23.5	11.8	25.5	12.7	16,18
20	6.1	3.1	12.0	6.0	15.7	7.9	22.2	11.1	29.2	14.5	31.4	15.7	20
24	8.2	4.4	17.3	8.7	22.6	11.3	32.0	16.0	41.8	20.9	45.2	22.6	24
30	10.5	5.2	20.3	10.1	26.5	13.3	37.5	18.8	49.0	24.5	53.1	26.5	30
36	14.9	7.5	29.2	14.6	38.2	19.1	54.0	27.0	70.5	35.3	76.4	38.2	36
42	20.3	10.1	39.8	19.9	52.0	26.0	73.5	36.7	96.0	48.0	104.0	52.0	42
48	26.5	13.2	51.9	26.0	67.9	33.9	96.0	48.0	126.0	62.7	136.0	67.9	48
54	33.5	16.8	65.7	32.9	85.9	42.9	122.0	60.7	159.0	79.4	172.0	85.9	54
60	41.4	20.7	81.2	40.6	106.0	53.0	150.0	75.0	196.0	98.0	212.0	106.0	60
66	50.1	25.0	98.2	49.1	128.0	64.2	182.0	90.7	237.0	119.0	257.0	128.0	66
72	59.6	29.8	117.0	58.4	153.0	76.3	216.0	108.0	282.0	141.0	305.0	153.0	72
78	69.9	35.0	137.0	68.6	179.0	90.0	254.0	127.0	331.0	166.0	358.0	179.0	78
84	81.1	40.5	159.0	79.5	208.0	104.0	294.0	147.0	384.0	192.0	416.0	208.0	84
90	93.1	46.5	183.0	91.3	239.0	119.0	337.0	169.0	441.0	221.0	477.0	239.0	90
96	106.0	53.0	208.0	104.0	272.0	136.0	384.0	192.0	502.0	251.0	543.0	272.0	96

VERTICAL THRUST BLOCK
AT PIPE BEND

Kaufman
We're Growing Places

STANDARD SPECIFICATION REFERENCE
502.4

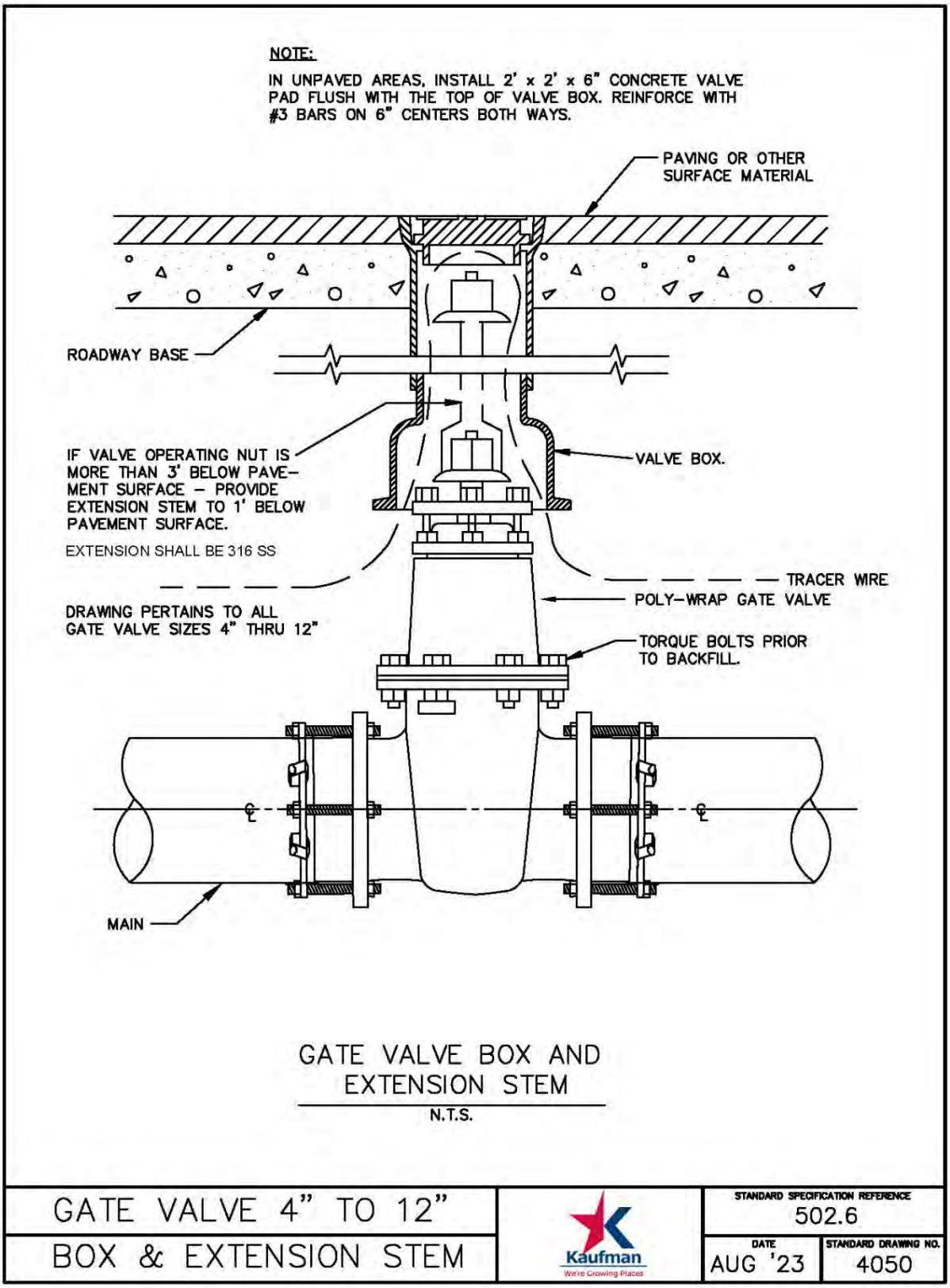
DATE
AUG '23

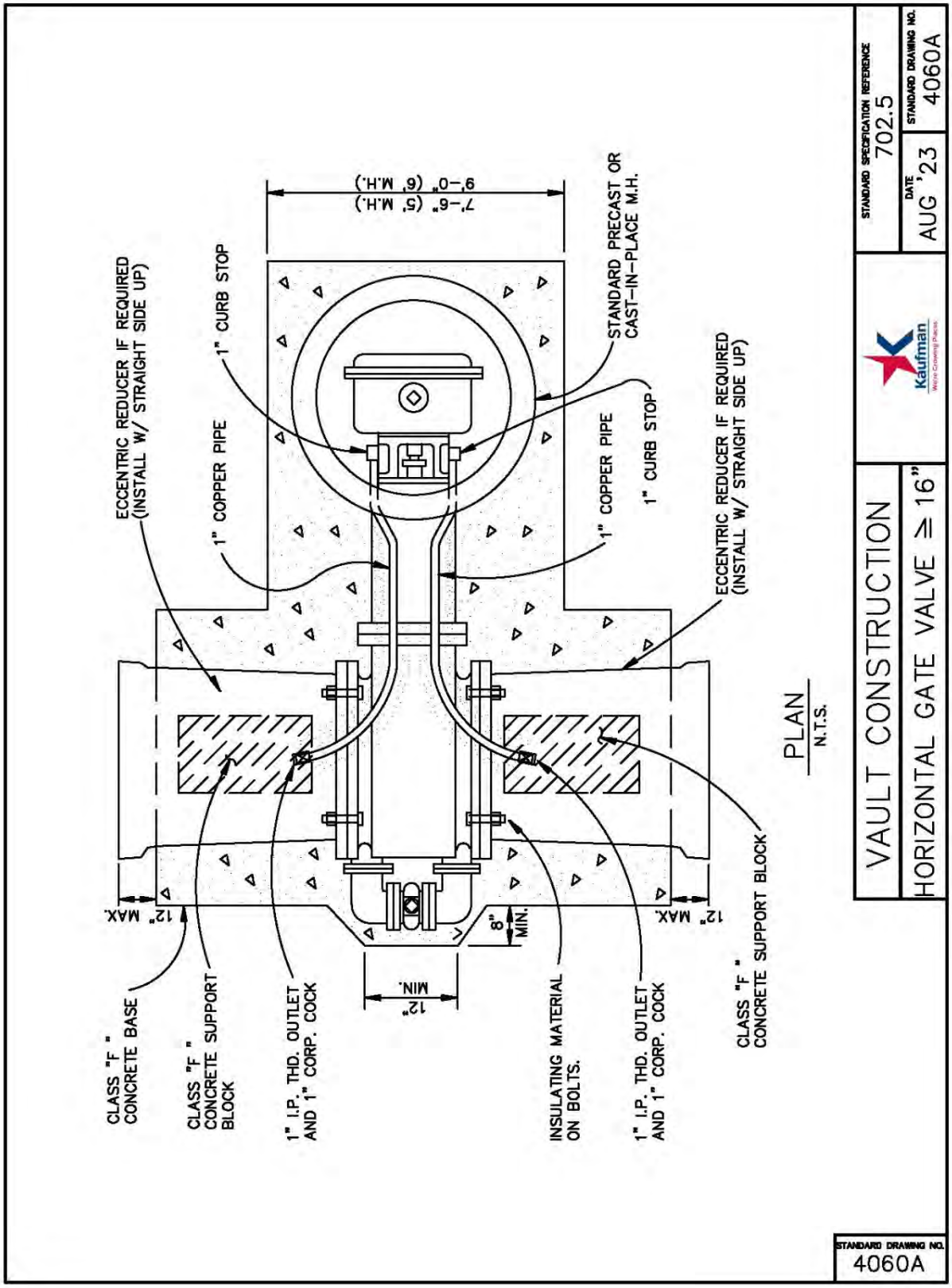
STANDARD DRAWING NO.
4030

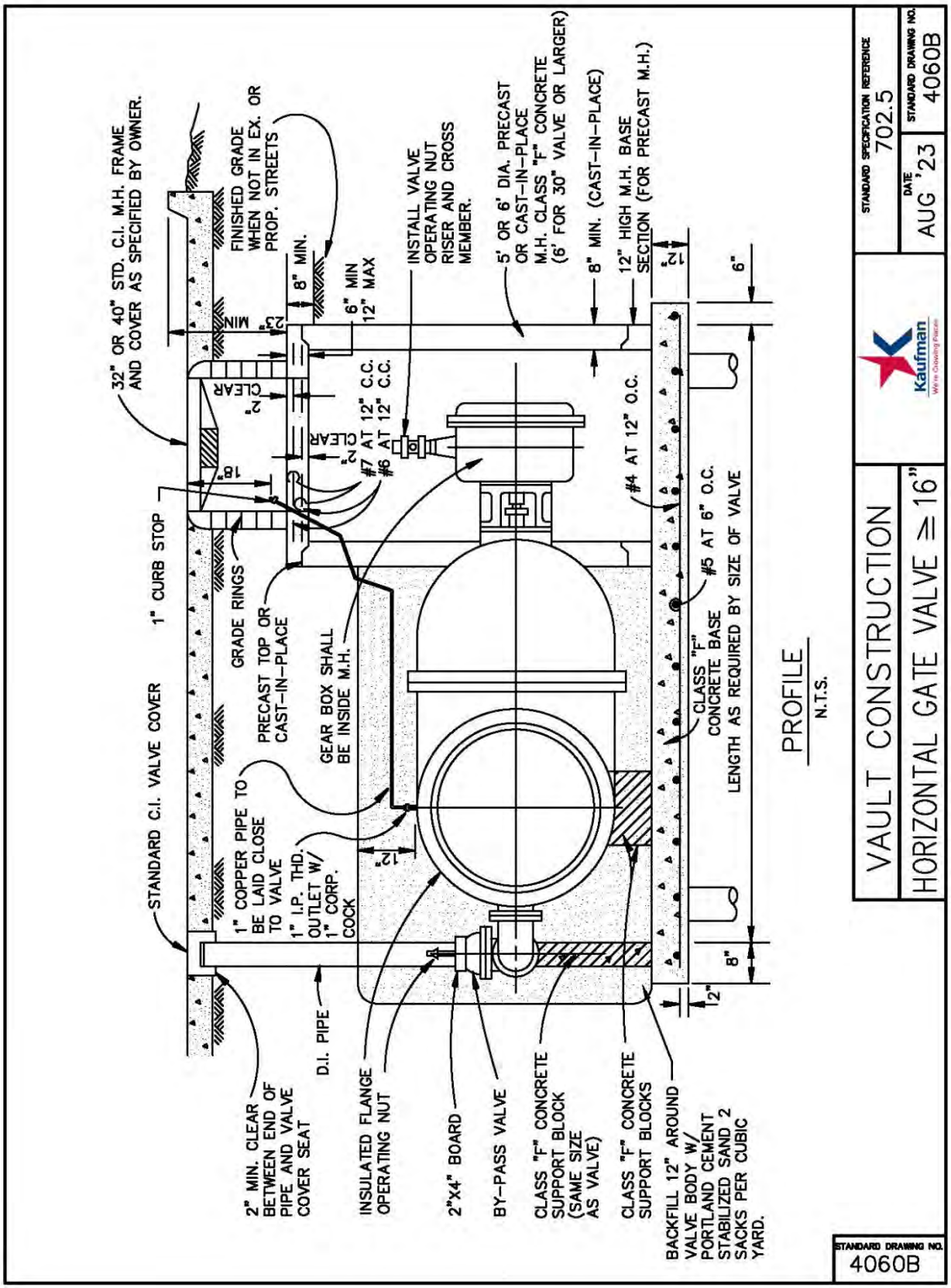
GENERAL NOTES FOR ALL THRUST BLOCKS:

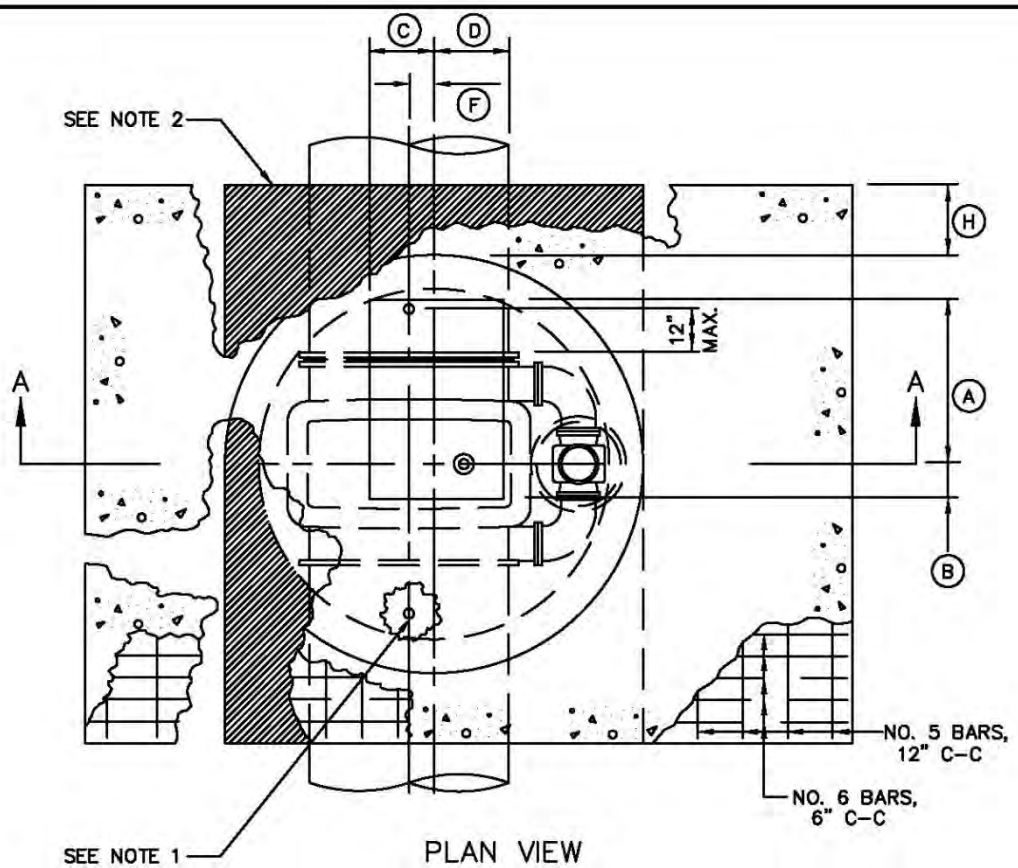
1. CONCRETE FOR BLOCKING SHALL BE CLASS "B".
2. ALL CALCULATIONS ARE BASED ON INTERNAL PRESSURE OF 200 PSI FOR DUCTILE IRON, P.V.V, AND 150 PSI FOR CONCRETE PIPE.
3. VOLUMES OF THRUST BLOCKS ARE NET VOLUMES OF CONCRETE TO BE FURNISHED. THE CORRESPONDING WEIGHT OF THE CONCRETE (CLASS "B") IS EQUAL TO OR GREATER THAN THE VERTICAL COMPONENT OF THE THRUST ON THE VERTICAL BEND.
4. WALL THICKNESS (T) ASSUMED HERE FOR ESTIMATING PURPOSES ONLY.
5. POUR CONCRETE FOR BLOCKS AGAINST UNDISTURBED EARTH.
6. DIMENSIONS MAY BE VARIED AS REQUIRED BY FIELD CONDITIONS WHRE AND AS DIRECTED BY THE ENGINEER. THE VOLUME OF CONCRETE BLOCKING SHALL NOT BE LESS THAN SHOWN HERE.
7. THE SOIL BEARING PRESSURES ARE BASED ON 1000 LBS./S.F. IN SOIL AND 2000 LBS./S.F. IN ROCK.
8. USE POLYETHYLENE WRAP OR EQUAL BETWEEN CONCRETE AND BEND, TEE, OR PLUG TO PREVENT THE CONCRETE FROM STICKING TO IT.
9. CONCRETE SHALL NOT EXPAND BEYOND JOINTS.
10. RESTRAINED JOINTS AND/OR THRUST BLOCKING SHALL BE USED TO RESIST THRUST FORCES AT ALL FITTINGS. IF USED IN LIEU OF THRUST BLOCKING, RESTRAINING LENGTH SHALL BE CALCULATED IN ACCORDANCE WITH AWWA M41 FOR DUCTILE IRON PIPES AND AWWA M23 FOR PVC PIPES.
11. IF ADDING ADDITIONAL SACRIFICIAL ANODE DETAIL: SACRIFICIAL ANODES CAN BE ADDED TO FITTINGS AS DIRECTED BY OWNER AND/OR ENGINEER.

THRUST BLOCK		STANDARD SPECIFICATION REFERENCE 502.4	
GENERAL NOTES		DATE AUG '23	STANDARD DRAWING NO. 4040


NOTE:
IN UNPAVED AREAS, INSTALL 2' x 2' x 6" CONCRETE VALVE PAD FLUSH WITH THE TOP OF VALVE BOX. REINFORCE WITH #3 BARS ON 6" CENTERS BOTH WAYS.
PAVING OR OTHER SURFACE MATERIAL
ROADWAY BASE
IF VALVE OPERATING NUT IS MORE THAN 3' BELOW PAVEMENT SURFACE – PROVIDE EXTENSION STEM TO 1' BELOW PAVEMENT SURFACE.
EXTENSION SHALL BE 316 SS
VALVE BOX.
TRACER WIRE
POLY-WRAP GATE VALVE
DRAWING PERTAINS TO ALL GATE VALVE SIZES 4" THRU 12"
TORQUE BOLTS PRIOR TO BACKFILL.
MAIN
GATE VALVE BOX AND EXTENSION STEM
N.T.S.
GATE VALVE 4" TO 12"
BOX & EXTENSION STEM
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
502.6
DATE
AUG '23
STANDARD DRAWING NO.
4050


VAULT CONSTRUCTION
HORIZONTAL GATE VALVE ≧ 16"
STANDARD SPECIFICATION REFERENCE
702.5
DATE
AUG '23
STANDARD DRAWING NO.
4060A
PLAN
N.T.S.
7'-6" (5' M.H.)
9'-0" (6' M.H.)
ECCENTRIC REDUCER IF REQUIRED (INSTALL W/ STRAIGHT SIDE UP)
1" COPPER PIPE
1" CURB STOP
STANDARD PRECAST OR CAST-IN-PLACE M.H.
1" COPPER PIPE
1" CURB STOP
ECCENTRIC REDUCER IF REQUIRED (INSTALL W/ STRAIGHT SIDE UP)
12" MAX.
12" MAX.
8" MIN.
12" MIN.
CLASS "F" CONCRETE BASE
CLASS "F" CONCRETE SUPPORT BLOCK
1" I.P. THD. OUTLET AND 1" CORP. COCK
INSULATING MATERIAL ON BOLTS.
1" I.P. THD. OUTLET AND 1" CORP. COCK
CLASS "F" CONCRETE SUPPORT BLOCK
STANDARD DRAWING NO.
4060A


VAULT CONSTRUCTION
HORIZONTAL GATE VALVE ≧ 16"
PROFILE
N.T.S.
STANDARD SPECIFICATION REFERENCE
702.5
DATE
AUG '23
STANDARD DRAWING NO.
4060B
STANDARD DRAWING NO.
4060B
32" OR 40" STD. C.I. M.H. FRAME AND COVER AS SPECIFIED BY OWNER.
FINISHED GRADE WHEN NOT IN EX. OR PROP. STREETS
8" MIN.
6" MIN 12" MAX
INSTALL VALVE OPERATING NUT RISER AND CROSS MEMBER.
5' OR 6' DIA. PRECAST OR CAST-IN-PLACE M.H. CLASS "F" CONCRETE (6' FOR 30" VALVE OR LARGER)
8" MIN. (CAST-IN-PLACE)
12" HIGH M.H. BASE SECTION (FOR PRECAST M.H.)
23" MIN
CLEAR 2"
#7 AT 12" C.C.
#6 AT 12" C.C.
#4 AT 12" O.C.
#5 AT 6" O.C.
CLASS "F" CONCRETE BASE
LENGTH AS REQUIRED BY SIZE OF VALVE
6"
8"
12"
18"
STANDARD C.I. VALVE COVER
1" CURB STOP
GRADE RINGS
PRECAST TOP OR CAST-IN-PLACE
GEAR BOX SHALL BE INSIDE M.H.
1" COPPER PIPE TO BE LAID CLOSE TO VALVE
1" I.P. THD. OUTLET W/ 1" CORP. COCK
12"
D.I. PIPE
2" MIN. CLEAR BETWEEN END OF PIPE AND VALVE COVER SEAT
INSULATED FLANGE OPERATING NUT
2"X4" BOARD
BY-PASS VALVE
CLASS "F" CONCRETE SUPPORT BLOCK (SAME SIZE AS VALVE)
CLASS "F" CONCRETE SUPPORT BLOCKS
BACKFILL 12" AROUND VALVE BODY W/ PORTLAND CEMENT STABILIZED SAND 2 SACKS PER CUBIC YARD.



PLAN VIEW

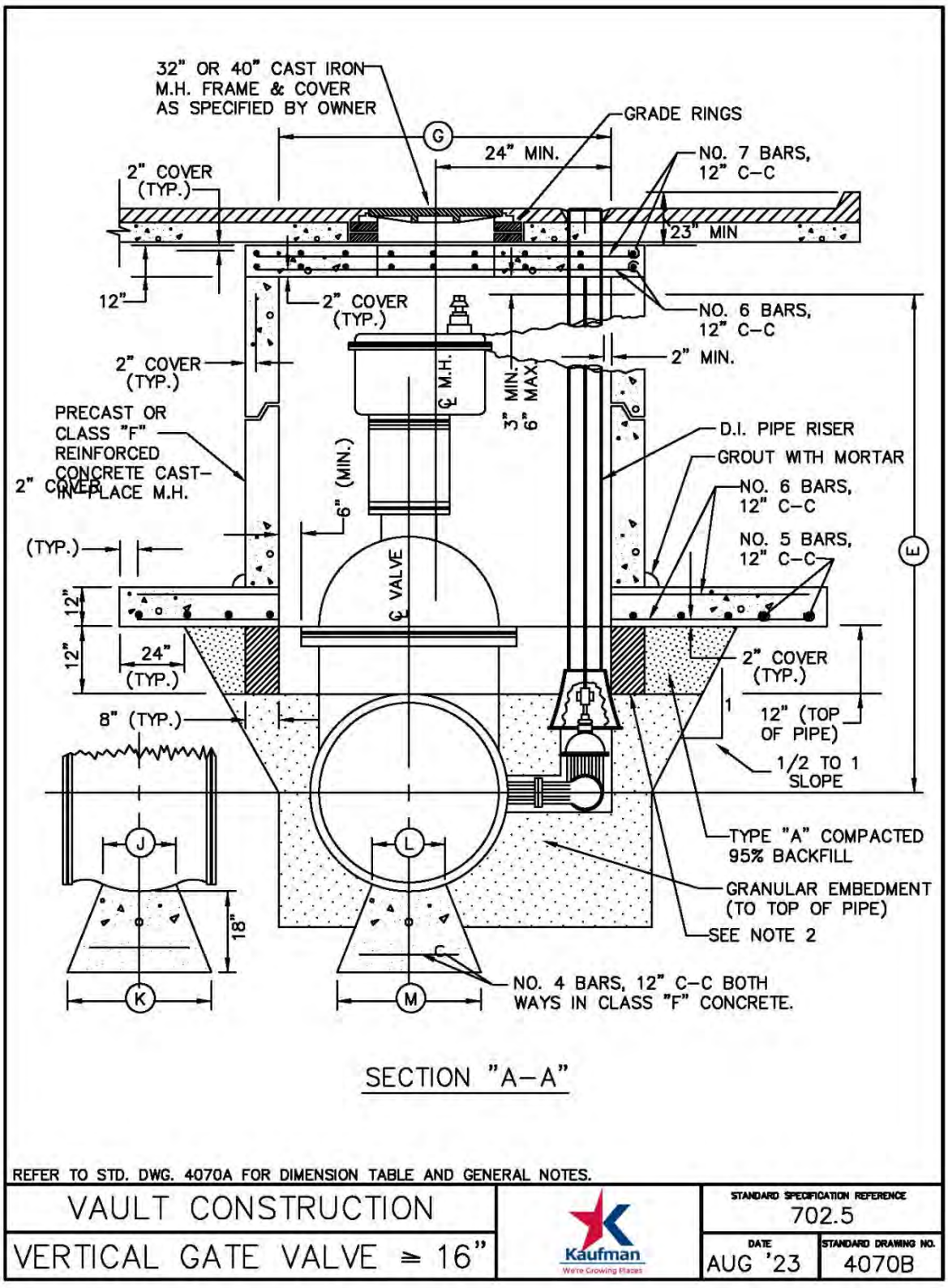
(LESS MANHOLE FRAME & COVER INSTALLATION)
N.T.S.

GATE VALVE SIZE	DIMENSION TABLE											
	A	B	C	D	E	F	G	H	J	K	L	M
16"	20"	20"	12"	12"	44 1/2"	1"	48"	12"	10"	24"	12"	16"
18"	20"	20"	12"	12"	51 3/8"	2"	48"	12"	12"	24"	12"	18"
20"	22"	18"	12"	12"	56 5/8"	1"	48"	12"	12"	24"	16"	20"
24"	26"	14"	12"	12"	64 3/8"	1"	60"	18"	14"	30"	18"	24"
30"	28"	12"	12"	12"	80 5/8"	3"	60"	18"	18"	30"	20"	30"
36"	32"	8"	12"	12"	90 1/16"	4"	72"	18"	18"	36"	24"	36"
42"	34"	6"	15"	9"	107 3/4"	5"	84"	24"	20"	36"	30"	42"
48"	36"	4"	14"	10"	121 5/8"	4"	96"	24"	26"	42"	36"	48"
54"	36"	4"	9"	15"	142 1/2"	3"	120"	24"	32"	46"	40"	54"

NOTES:

1. PROVIDE CORPORATION AND CURB STOPS A MAXIMUM OF 12" FROM EACH END OF GATE VALVE, AS SHOWN. CORPORATION AND CURB STOP SIZES SHALL BE 1" FOR 16", 20", AND 24" NOMINAL PIPE DIAMETERS; 2" FOR 30" AND LARGER DIAMETERS. 2" TAPS SHALL BE MADE AS A 2" FLANGED OUTLET WITH INSULATED ADAPTOR KIT. COPPER RISERS SHALL BE PROVIDED BETWEEN THE CORPORATION AND CURB STOPS. CURB STOPS SHALL BE INSTALLED AT AN ELEVATION 12" ABOVE THE TOP SURFACE OF VAULT BOTTOM SLAB.
2. POLYURETHANE CUSHION PAD.
3. STANDARD PRECAST DIMENSIONS MAY BE USED WITH APPROVAL OF THE OWNER AND MAY REQUIRE AN INCREASE IN SIZE TO THE NEXT READILY AVAILABLE PRECAST DIMENSION.

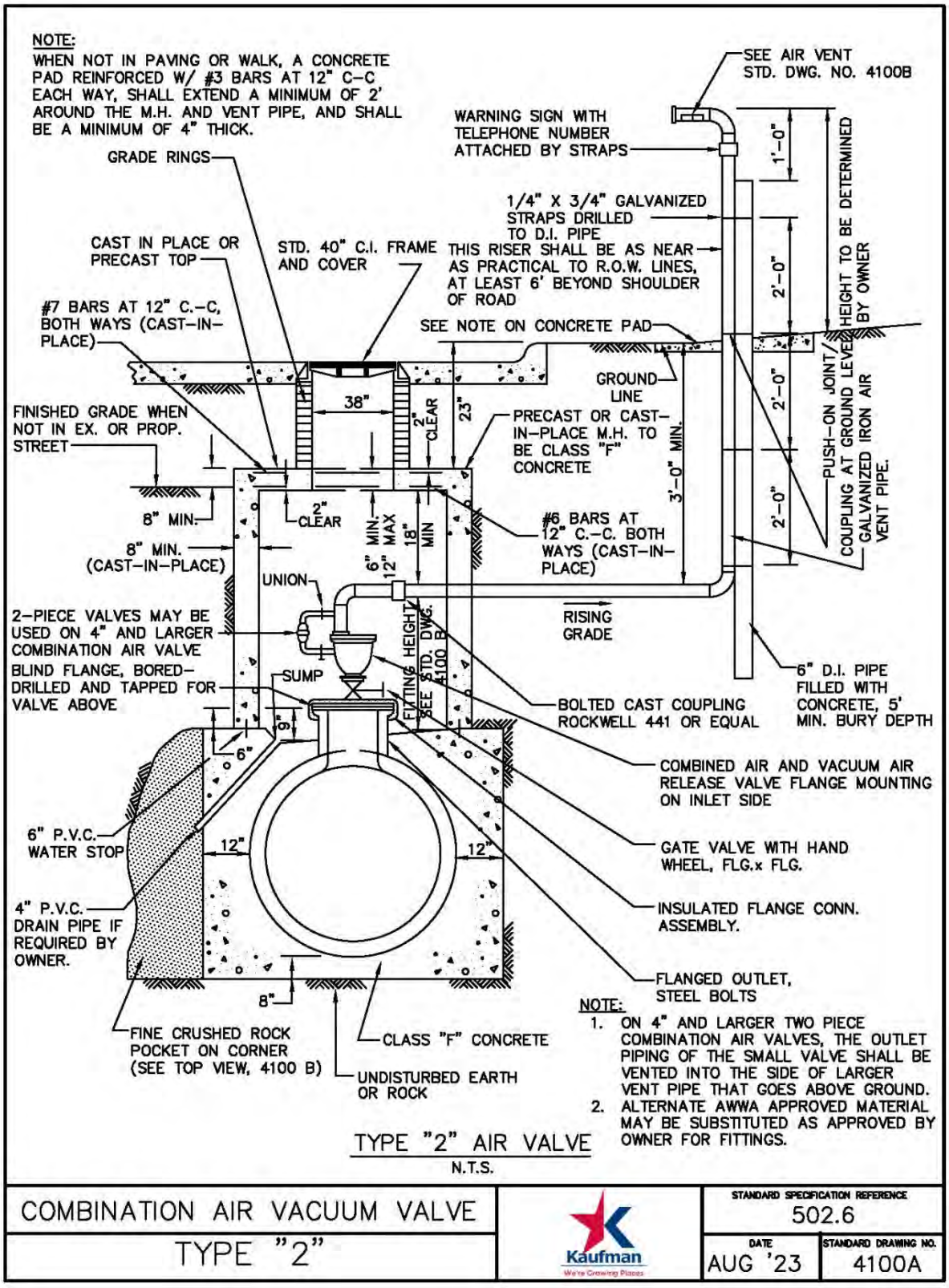
VAULT CONSTRUCTION		STANDARD SPECIFICATION REFERENCE 702.5	
VERTICAL GATE VALVE ≥ 16"		DATE AUG '23	STANDARD DRAWING NO. 4070A

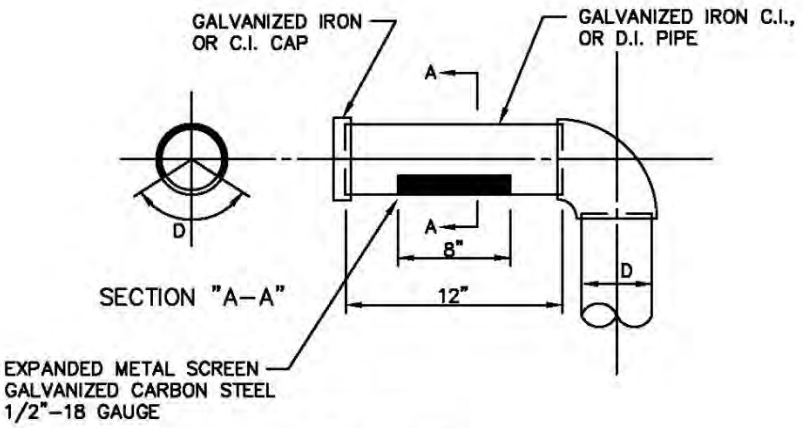


SECTION "A-A"

REFER TO STD. DWG. 4070A FOR DIMENSION TABLE AND GENERAL NOTES.

VAULT CONSTRUCTION		STANDARD SPECIFICATION REFERENCE 702.5	
VERTICAL GATE VALVE ≥ 16"		DATE AUG '23	STANDARD DRAWING NO. 4070B

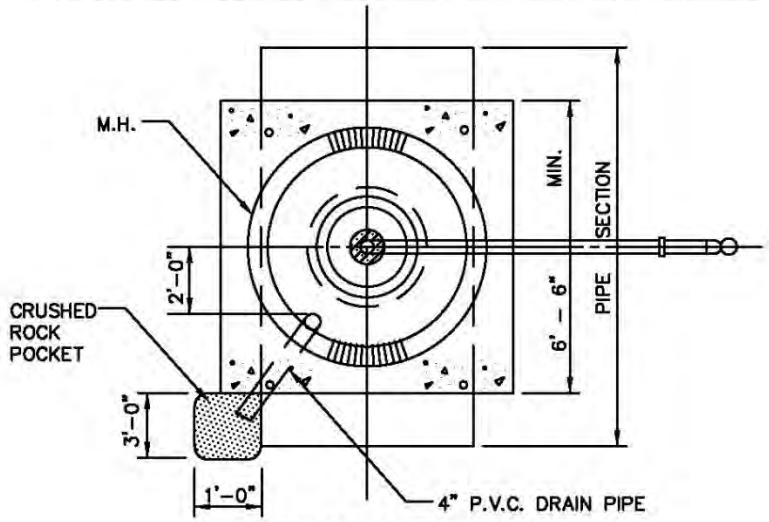

NOTE:
WHEN NOT IN PAVING OR WALK, A CONCRETE PAD REINFORCED W/ #3 BARS AT 12" C-C EACH WAY, SHALL EXTEND A MINIMUM OF 2' AROUND THE M.H. AND VENT PIPE, AND SHALL BE A MINIMUM OF 4" THICK.
GRADE RINGS
CAST IN PLACE OR PRECAST TOP
STD. 40" C.I. FRAME AND COVER
#7 BARS AT 12" C.-C, BOTH WAYS (CAST-IN-PLACE)
FINISHED GRADE WHEN NOT IN EX. OR PROP. STREET
8" MIN.
8" MIN. (CAST-IN-PLACE)
38"
2" CLEAR
23"
2" CLEAR
6" MIN. 12" MAX
18" MIN
UNION
2-PIECE VALVES MAY BE USED ON 4" AND LARGER COMBINATION AIR VALVE
BLIND FLANGE, BORED-DRILLED AND TAPPED FOR VALVE ABOVE
SUMP
FITTING HEIGHT SEE STD. DWG. 4100 B
9"
6"
6" P.V.C. WATER STOP
12"
12"
4" P.V.C. DRAIN PIPE IF REQUIRED BY OWNER.
8"
FINE CRUSHED ROCK POCKET ON CORNER (SEE TOP VIEW, 4100 B)
CLASS "F" CONCRETE
UNDISTURBED EARTH OR ROCK
SEE AIR VENT STD. DWG. NO. 4100B
WARNING SIGN WITH TELEPHONE NUMBER ATTACHED BY STRAPS
1/4" X 3/4" GALVANIZED STRAPS DRILLED TO D.I. PIPE
THIS RISER SHALL BE AS NEAR AS PRACTICAL TO R.O.W. LINES, AT LEAST 6' BEYOND SHOULDER OF ROAD
SEE NOTE ON CONCRETE PAD
GROUND LINE
PRECAST OR CAST-IN-PLACE M.H. TO BE CLASS "F" CONCRETE
3'-0" MIN.
#6 BARS AT 12" C.-C. BOTH WAYS (CAST-IN-PLACE)
RISING GRADE
1'-0"
2'-0"
2'-0"
2'-0"
HEIGHT TO BE DETERMINED BY OWNER
PUSH-ON JOINT COUPLING AT GROUND LEVEL
GALVANIZED IRON AIR VENT PIPE.
6" D.I. PIPE FILLED WITH CONCRETE, 5' MIN. BURY DEPTH
BOLTED CAST COUPLING ROCKWELL 441 OR EQUAL
COMBINED AIR AND VACUUM AIR RELEASE VALVE FLANGE MOUNTING ON INLET SIDE
GATE VALVE WITH HAND WHEEL, FLG.x FLG.
INSULATED FLANGE CONN. ASSEMBLY.
FLANGED OUTLET, STEEL BOLTS
NOTE:
1. ON 4" AND LARGER TWO PIECE COMBINATION AIR VALVES, THE OUTLET PIPING OF THE SMALL VALVE SHALL BE VENTED INTO THE SIDE OF LARGER VENT PIPE THAT GOES ABOVE GROUND.
2. ALTERNATE AWWA APPROVED MATERIAL MAY BE SUBSTITUTED AS APPROVED BY OWNER FOR FITTINGS.
TYPE "2" AIR VALVE
N.T.S.
COMBINATION AIR VACUUM VALVE
TYPE "2"
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
502.6
DATE
AUG '23
STANDARD DRAWING NO.
4100A



AIR VENT

N.T.S.

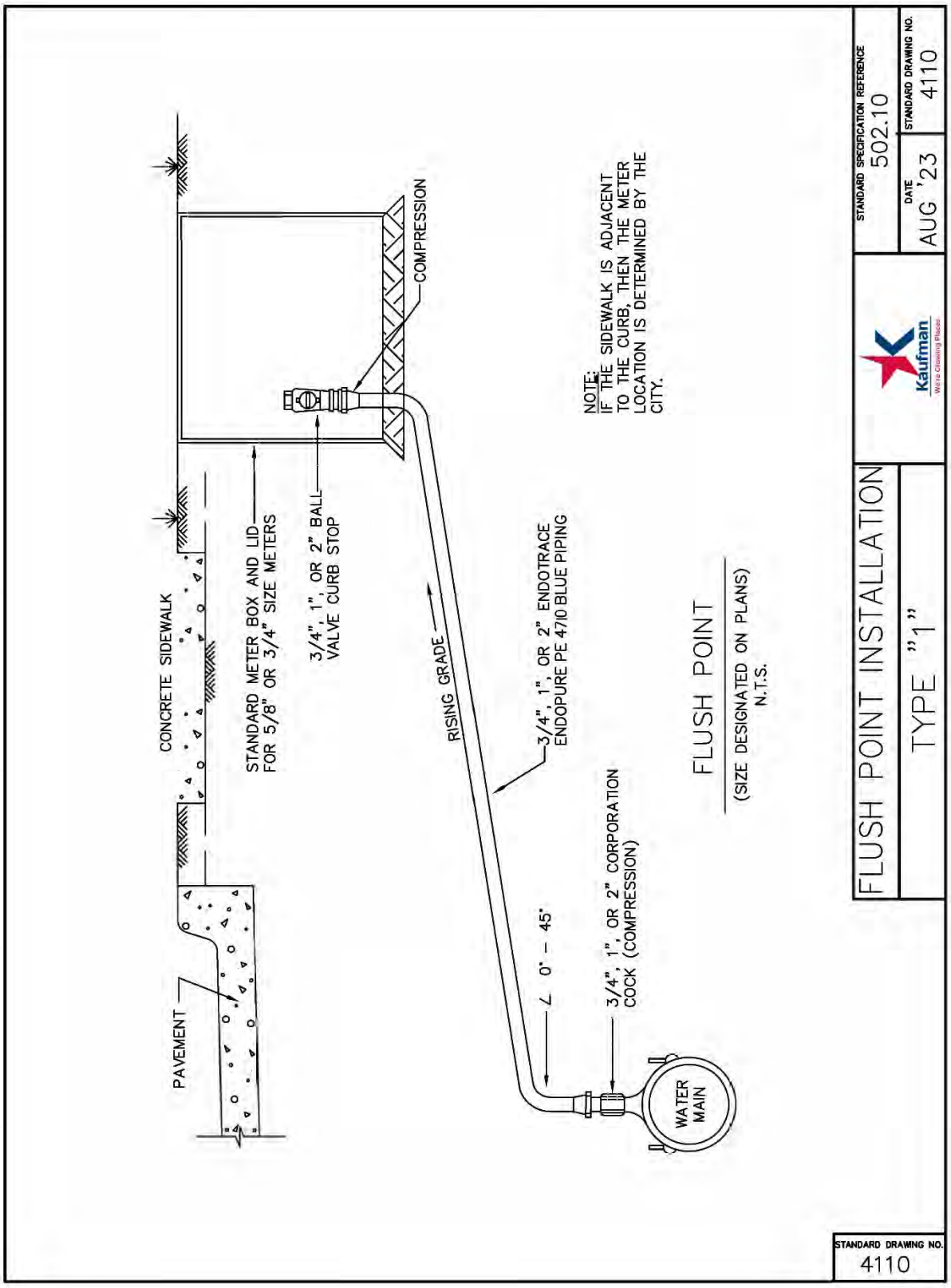
AIR VALVE	GATE VALVE	FLG. OUTLET	MIN. FITTING HEIGHT	VENT PIPE D	M.H. DIA.
2"	2"	8"	26"	2"	5'
3"	3"	18"	31"	3"	5'
4"	4"	18"	38"	4"	5'
6"	6"	18"	46"	6"	5'
8"	8"	18"	53"	8"	6'
10"	10"	20"	62"	10"	6'
12"	12"	24"	72"	12"	6'

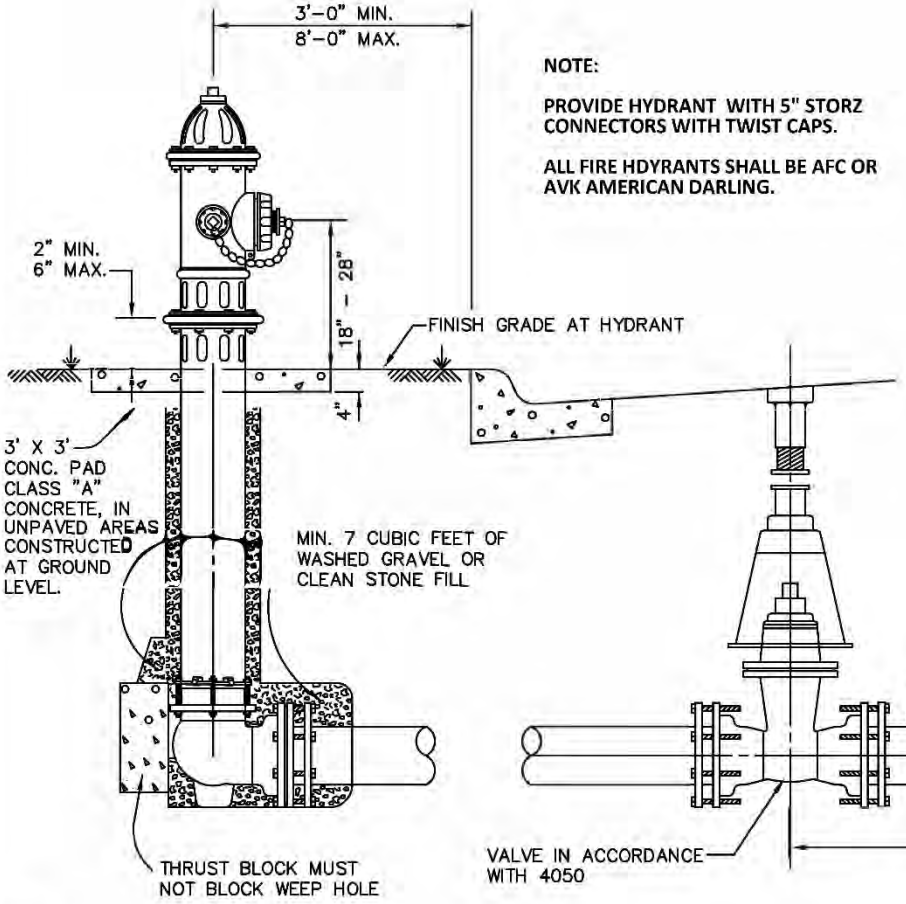


PLAN VIEW

N.T.S.

AIR VENT STANDARD DIMENSION AND DETAIL		STANDARD SPECIFICATION REFERENCE 502.6	
		DATE AUG '23	STANDARD DRAWING NO. 4100B


FLUSH POINT INSTALLATION
TYPE "1"
STANDARD SPECIFICATION REFERENCE
502.10
DATE
AUG '23
STANDARD DRAWING NO.
4110
Kaufman
We're Growing Places
NOTE:
IF THE SIDEWALK IS ADJACENT TO THE CURB, THEN THE METER LOCATION IS DETERMINED BY THE CITY.
FLUSH POINT
(SIZE DESIGNATED ON PLANS)
N.T.S.
CONCRETE SIDEWALK
STANDARD METER BOX AND LID FOR 5/8" OR 3/4" SIZE METERS
3/4", 1", OR 2" BALL VALVE CURB STOP
COMPRESSION
RISING GRADE
3/4", 1", OR 2" ENDOTRACE ENDOPURE PE 4710 BLUE PIPING
∠ 0° - 45°
3/4", 1", OR 2" CORPORATION COCK (COMPRESSION)
PAVEMENT
WATER MAIN
STANDARD DRAWING NO.
4110



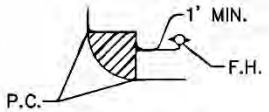
NOTE:

PROVIDE HYDRANT WITH 5" STORZ CONNECTORS WITH TWIST CAPS.

ALL FIRE HDYRANTS SHALL BE AFC OR AVK AMERICAN DARLING.

NOTES:

1. IN GENERAL, ALL FIRE HYDRANTS SHALL CONFORM TO AWWA STANDARD SPECIFICATIONS FOR FIRE HYDRANTS FOR ORDINARY WATER WORKS SERVICE, C-502. FIRE HYDRANTS SHALL HAVE A 5 1/4" MIN. VALVE OPENING AND A BARREL APPROXIMATELY 7" INSIDE DIAMETER. ALL HYDRANTS SHALL BE EQUIPPED WITH A BREAKAWAY FLANGE.
2. ALL JOINTS TO BE RESTRAINED JOINTS. MEGA-LUGS OR APPROVED EQUAL.
3. TYPICAL VALVE: ACTUAL VALVE LOCATION WILL DEPEND ON LOCATION OF WATER MAIN.
4. F.H. NO CLOSER THAN 18" TO EXISTING OR PROPOSED SIDEWALKS. (USUAL)
5. STANDARD BURY DEPTH 4' FEET
6. SET FIRE HYDRANT ON THE LOT LINE EXTENDED WHEN POSSIBLE.
7. F.H. SHALL BE LOCATED MINIMUM 1 FT. OUTSIDE OF THE AREA BETWEEN THE P.C.'S OF THE CORNER TURNING RADII AT INTERSECTIONS. (SEE PLAN VIEW)
8. PLACEMENT OF F.H. SHALL BE WHERE PUMPER NOZZLE IS PERPENDICULAR TO AND FACING THE NEAREST CURB.



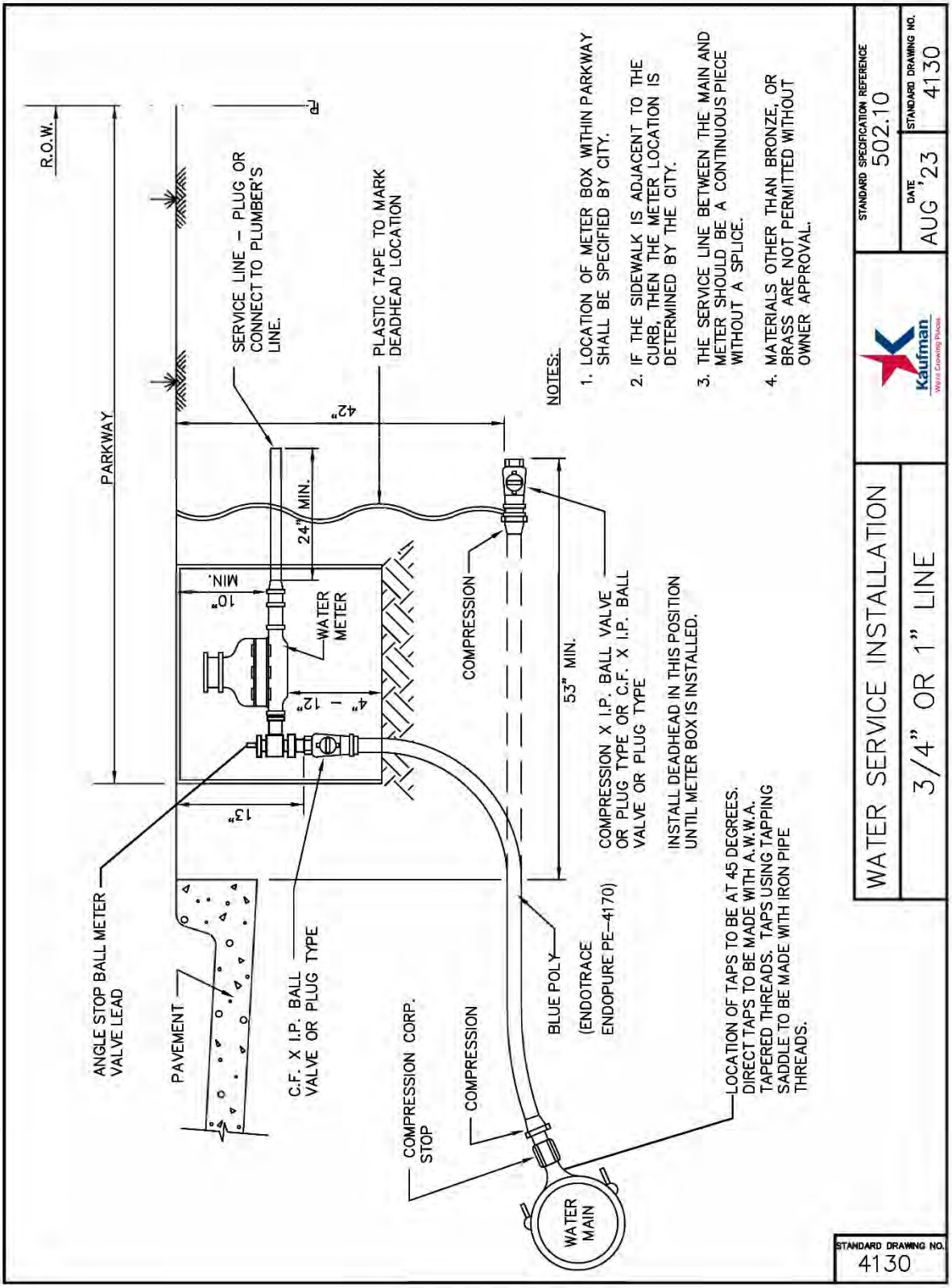
PLAN VIEW
N.T.S.

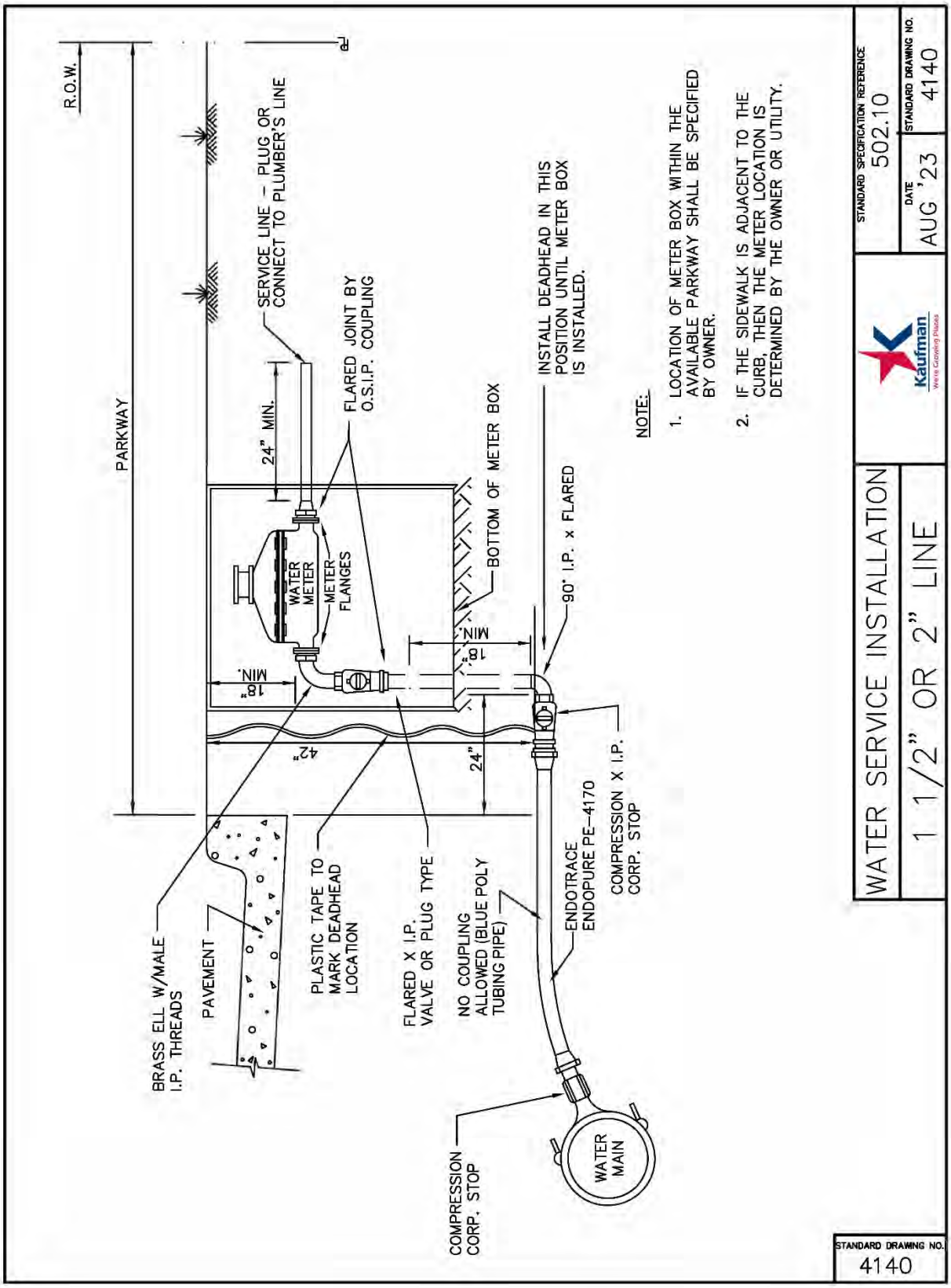
STANDARD DRAWING NO. 4120

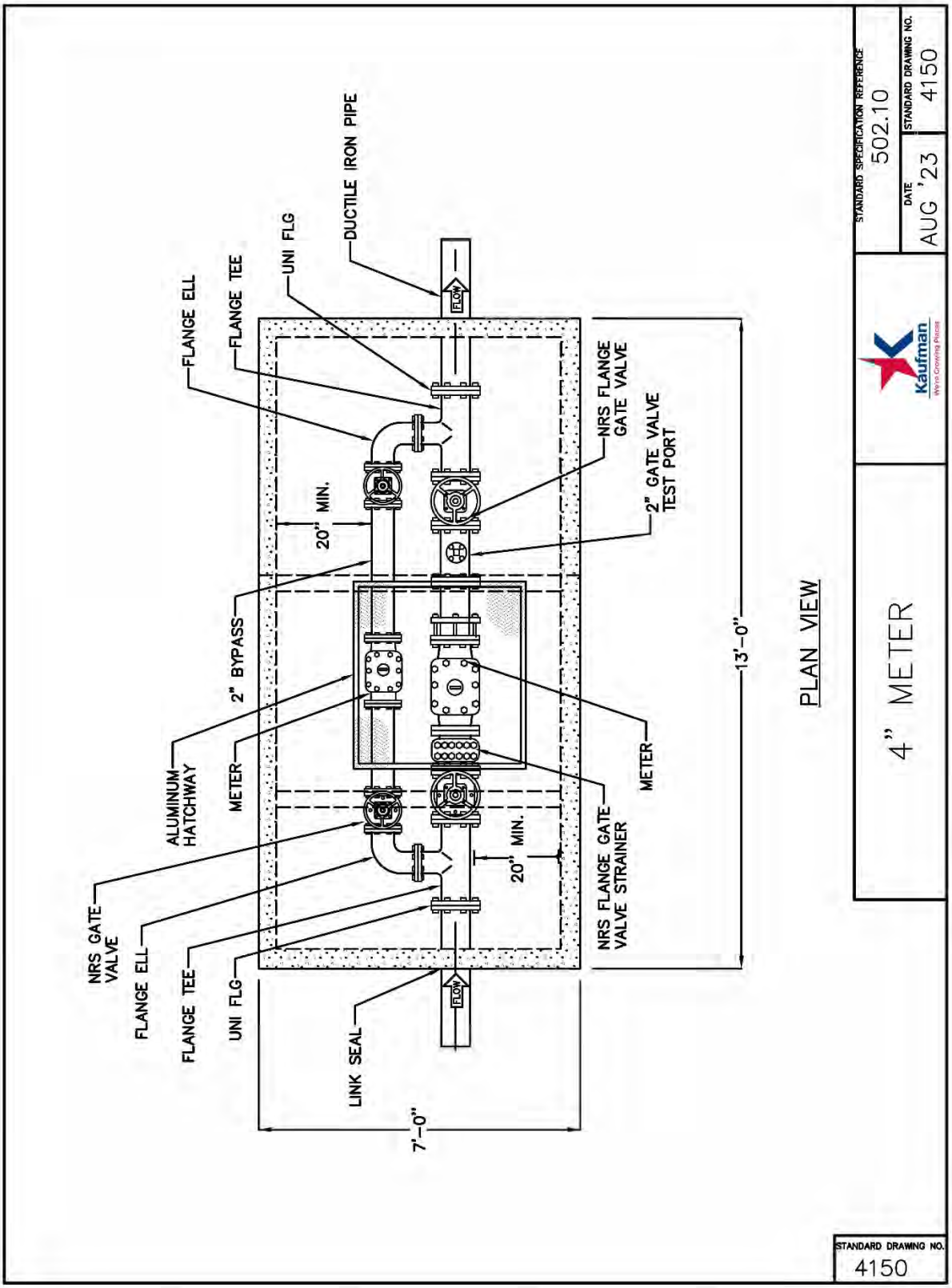
FIRE HYDRANT INSTALLATION

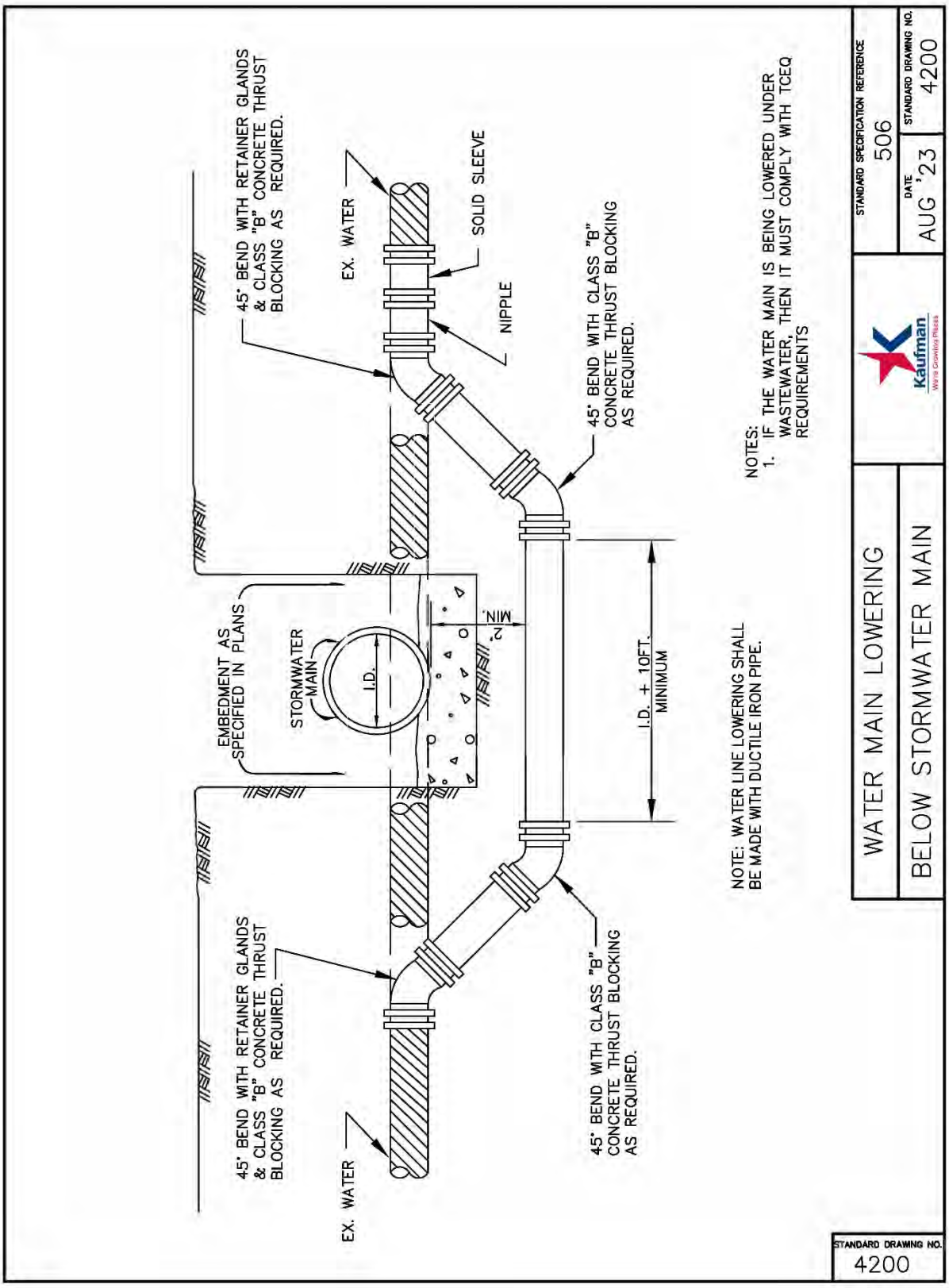
Kaufman
We're Growing Places

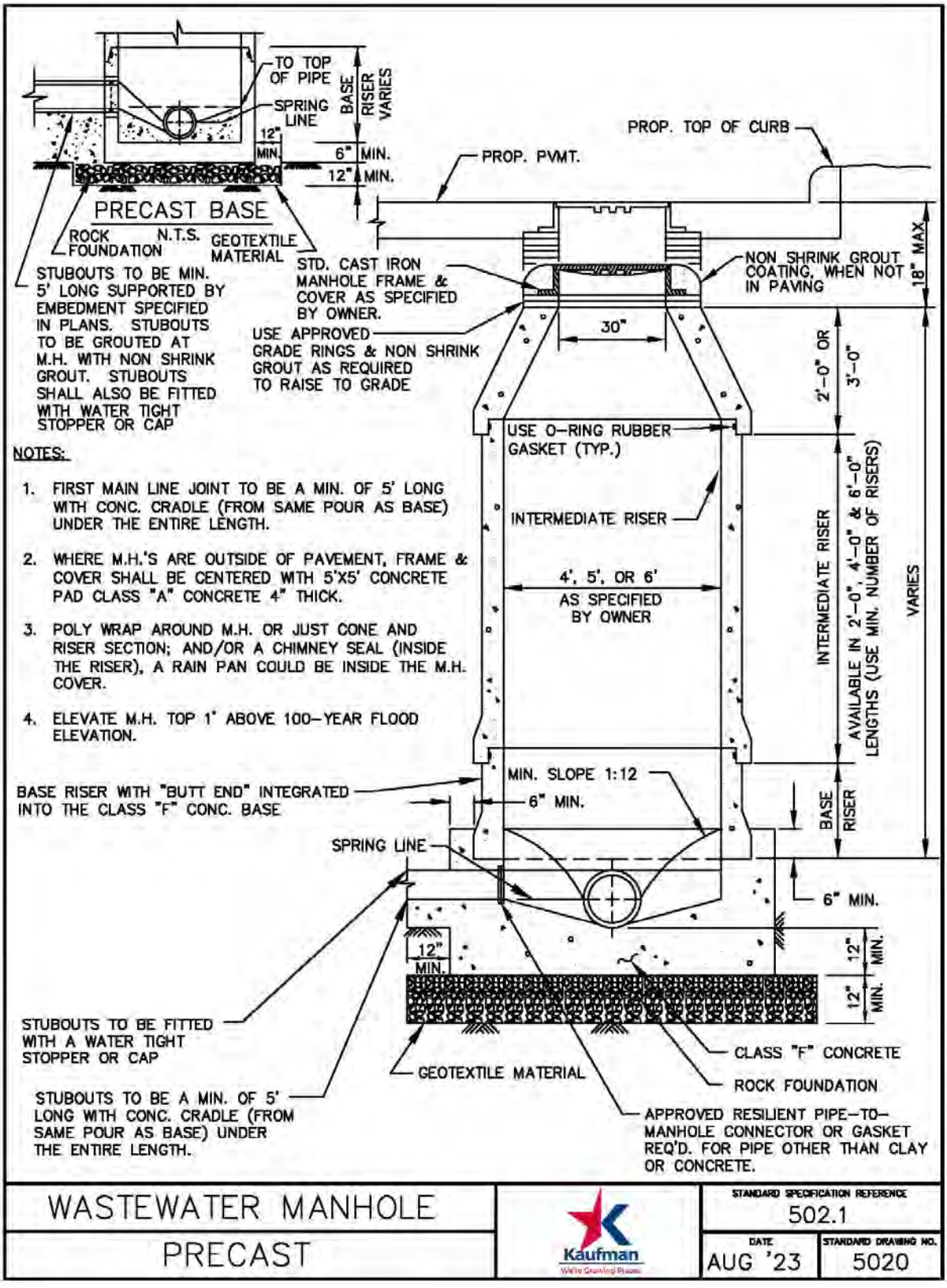
STANDARD SPECIFICATION REFERENCE	
502.3	
DATE	STANDARD DRAWING NO.
AUG '23	4120

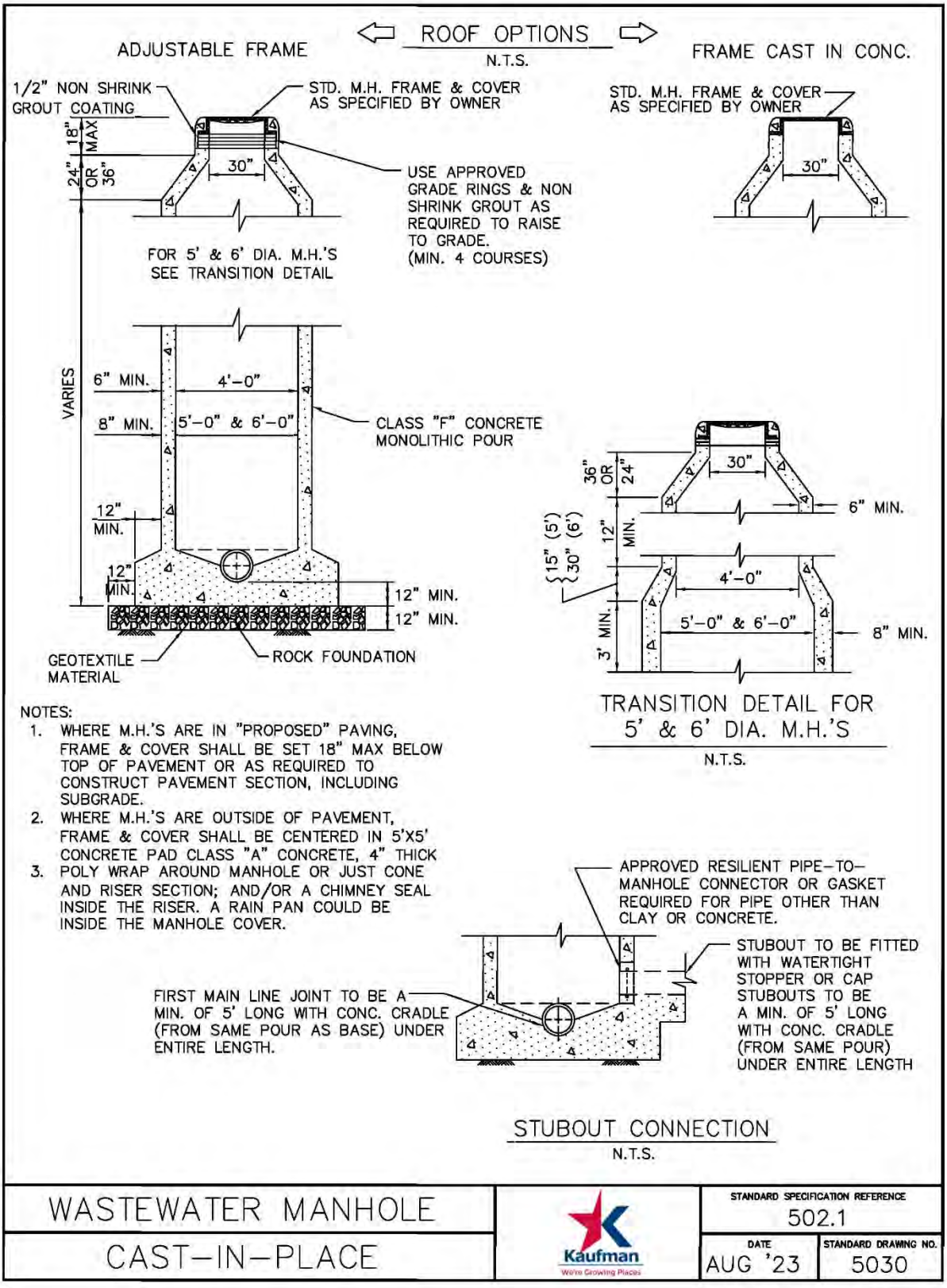

WATER SERVICE INSTALLATION
3/4" OR 1" LINE
STANDARD SPECIFICATION REFERENCE
502.10
DATE
AUG '23
STANDARD DRAWING NO.
4130
R.O.W.
PARKWAY
SERVICE LINE – PLUG OR CONNECT TO PLUMBER'S LINE.
PLASTIC TAPE TO MARK DEADHEAD LOCATION
42"
24" MIN.
10" MIN.
WATER METER
12"
4"
13"
COMPRESSION
53" MIN.
NOTES:
1. LOCATION OF METER BOX WITHIN PARKWAY SHALL BE SPECIFIED BY CITY.
2. IF THE SIDEWALK IS ADJACENT TO THE CURB, THEN THE METER LOCATION IS DETERMINED BY THE CITY.
3. THE SERVICE LINE BETWEEN THE MAIN AND METER SHOULD BE A CONTINUOUS PIECE WITHOUT A SPLICE.
4. MATERIALS OTHER THAN BRONZE, OR BRASS ARE NOT PERMITTED WITHOUT OWNER APPROVAL.
ANGLE STOP BALL METER VALVE LEAD
PAVEMENT
C.F. X I.P. BALL VALVE OR PLUG TYPE
COMPRESSION CORP. STOP
COMPRESSION
BLUE POLY
(ENDOTRACE ENDOPURE PE-4170)
COMPRESSION X I.P. BALL VALVE OR PLUG TYPE OR C.F. X I.P. BALL VALVE OR PLUG TYPE
INSTALL DEADHEAD IN THIS POSITION UNTIL METER BOX IS INSTALLED.
LOCATION OF TAPS TO BE AT 45 DEGREES. DIRECT TAPS TO BE MADE WITH A.W.W.A. TAPERED THREADS. TAPS USING TAPPING SADDLE TO BE MADE WITH IRON PIPE THREADS.
WATER MAIN
STANDARD DRAWING NO.
4130

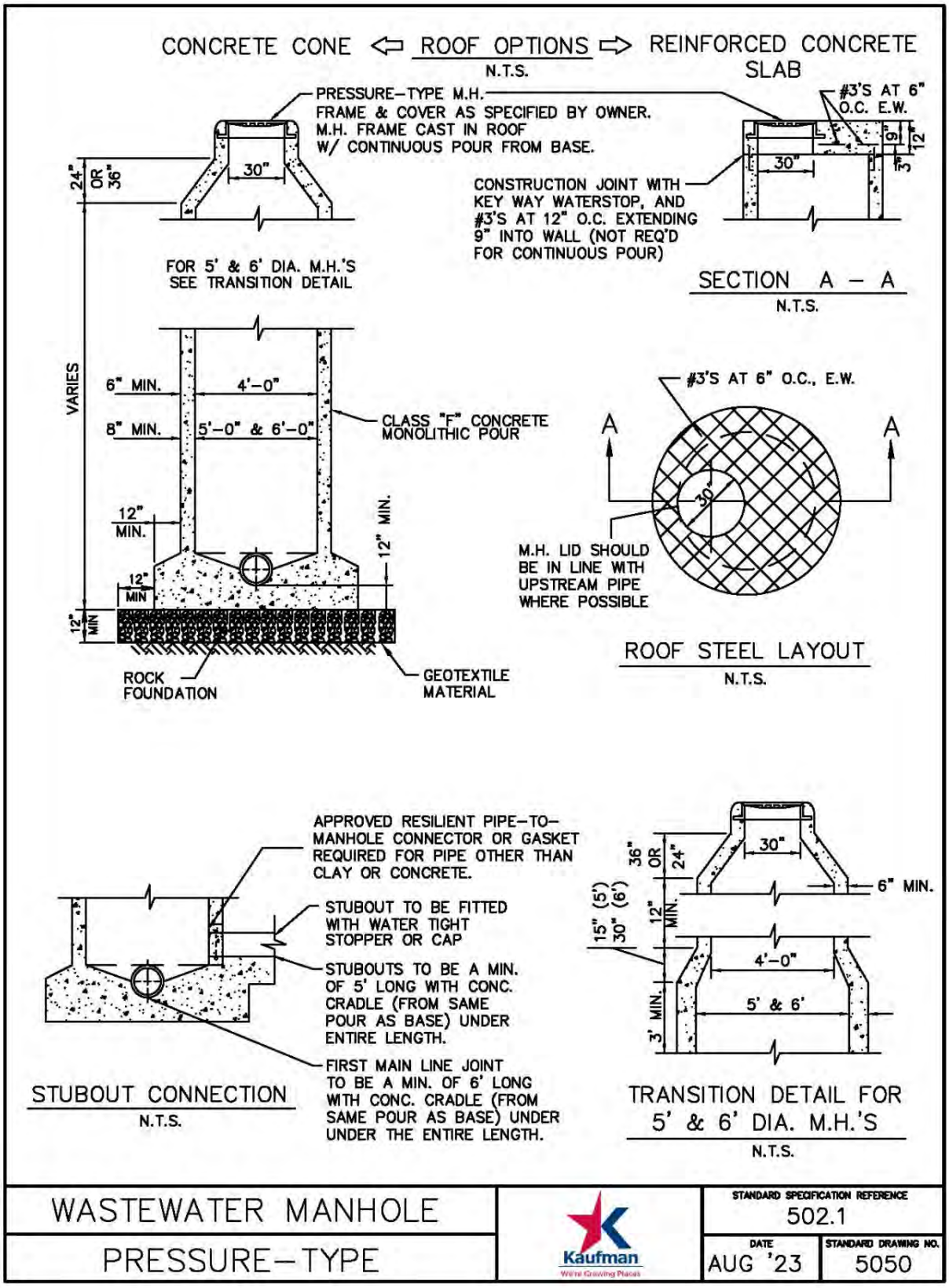

R.O.W.
PARKWAY
SERVICE LINE – PLUG OR CONNECT TO PLUMBER'S LINE
24" MIN.
FLARED JOINT BY O.S.I.P. COUPLING
WATER METER
METER FLANGES
BOTTOM OF METER BOX
INSTALL DEADHEAD IN THIS POSITION UNTIL METER BOX IS INSTALLED.
90° I.P. x FLARED
18" MIN.
18" MIN.
42"
24"
NOTE:
1. LOCATION OF METER BOX WITHIN THE AVAILABLE PARKWAY SHALL BE SPECIFIED BY OWNER.
2. IF THE SIDEWALK IS ADJACENT TO THE CURB, THEN THE METER LOCATION IS DETERMINED BY THE OWNER OR UTILITY.
BRASS ELL W/MALE I.P. THREADS
PAVEMENT
PLASTIC TAPE TO MARK DEADHEAD LOCATION
FLARED X I.P. VALVE OR PLUG TYPE
NO COUPLING ALLOWED (BLUE POLY TUBING PIPE)
ENDOTRACE ENDOPURE PE-4170
COMPRESSION X I.P. CORP. STOP
COMPRESSION CORP. STOP
WATER MAIN
WATER SERVICE INSTALLATION
1 1/2" OR 2" LINE
STANDARD SPECIFICATION REFERENCE
502.10
DATE
AUG '23
STANDARD DRAWING NO.
4140
STANDARD DRAWING NO.
4140

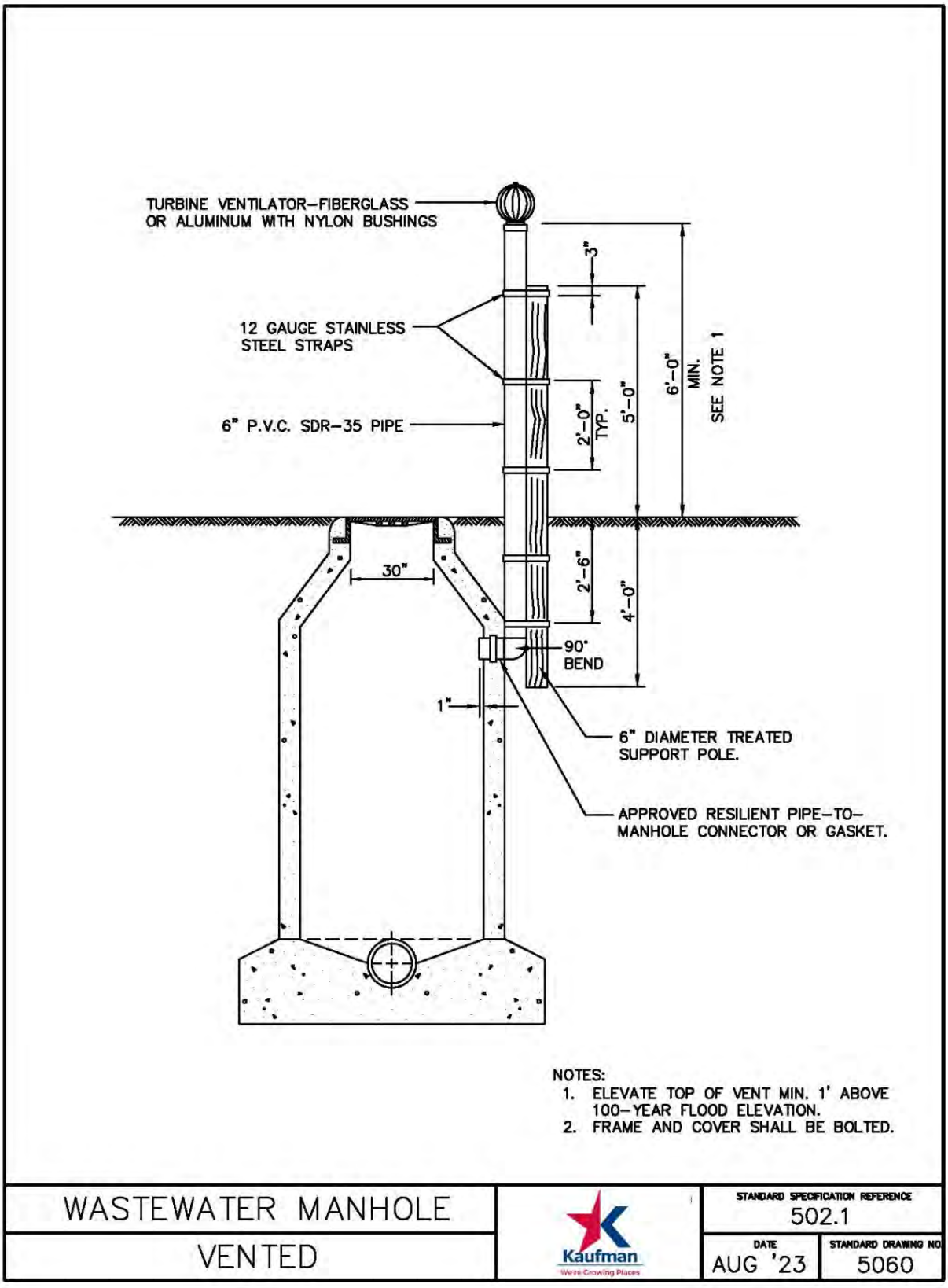

DUCTILE IRON PIPE
UNI FLG
FLANGE TEE
FLANGE ELL
NRS FLANGE GATE VALVE
2" GATE VALVE TEST PORT
20" MIN.
2" BYPASS
METER
ALUMINUM HATCHWAY
NRS GATE VALVE
FLANGE ELL
FLANGE TEE
UNI FLG
LINK SEAL
7'-0"
20" MIN.
NRS FLANGE GATE VALVE STRAINER
METER
13'-0"
PLAN VIEW
4" METER
STANDARD SPECIFICATION REFERENCE
502.10
DATE
AUG '23
STANDARD DRAWING NO.
4150
STANDARD DRAWING NO.
4150

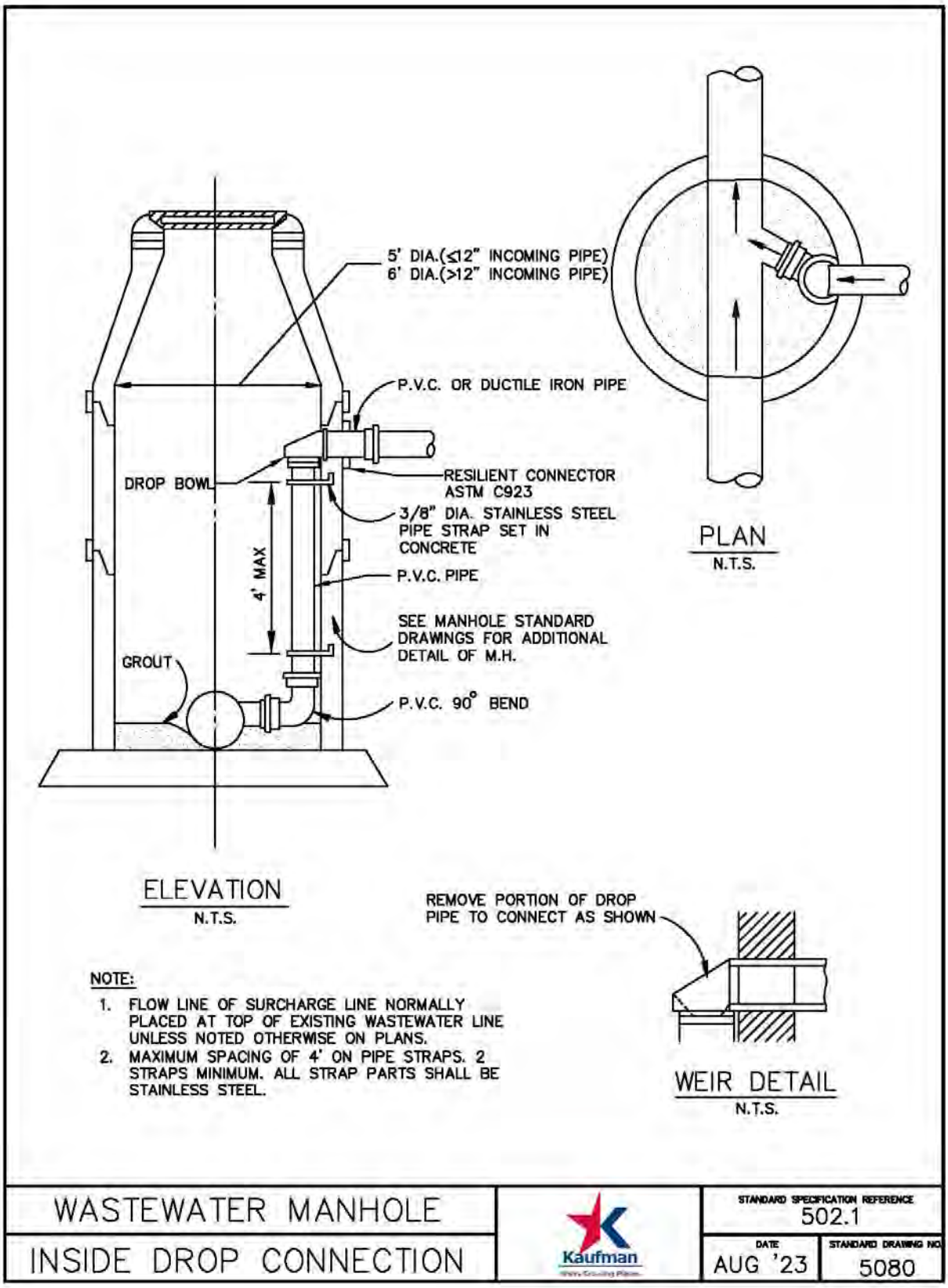

WATER MAIN LOWERING
BELOW STORMWATER MAIN
STANDARD SPECIFICATION REFERENCE
506
DATE
AUG '23
STANDARD DRAWING NO.
4200
STANDARD DRAWING NO.
4200
NOTES:
1. IF THE WATER MAIN IS BEING LOWERED UNDER WASTEWATER, THEN IT MUST COMPLY WITH TCEQ REQUIREMENTS
NOTE: WATER LINE LOWERING SHALL BE MADE WITH DUCTILE IRON PIPE.
EX. WATER
45° BEND WITH RETAINER GLANDS & CLASS "B" CONCRETE THRUST BLOCKING AS REQUIRED.
EMBEDMENT AS SPECIFIED IN PLANS
STORMWATER MAIN
I.D.
MIN.
I.D. + 10FT. MINIMUM
45° BEND WITH CLASS "B" CONCRETE THRUST BLOCKING AS REQUIRED.
SOLID SLEEVE
NIPPLE
EX. WATER
45° BEND WITH RETAINER GLANDS & CLASS "B" CONCRETE THRUST BLOCKING AS REQUIRED.
45° BEND WITH CLASS "B" CONCRETE THRUST BLOCKING AS REQUIRED.

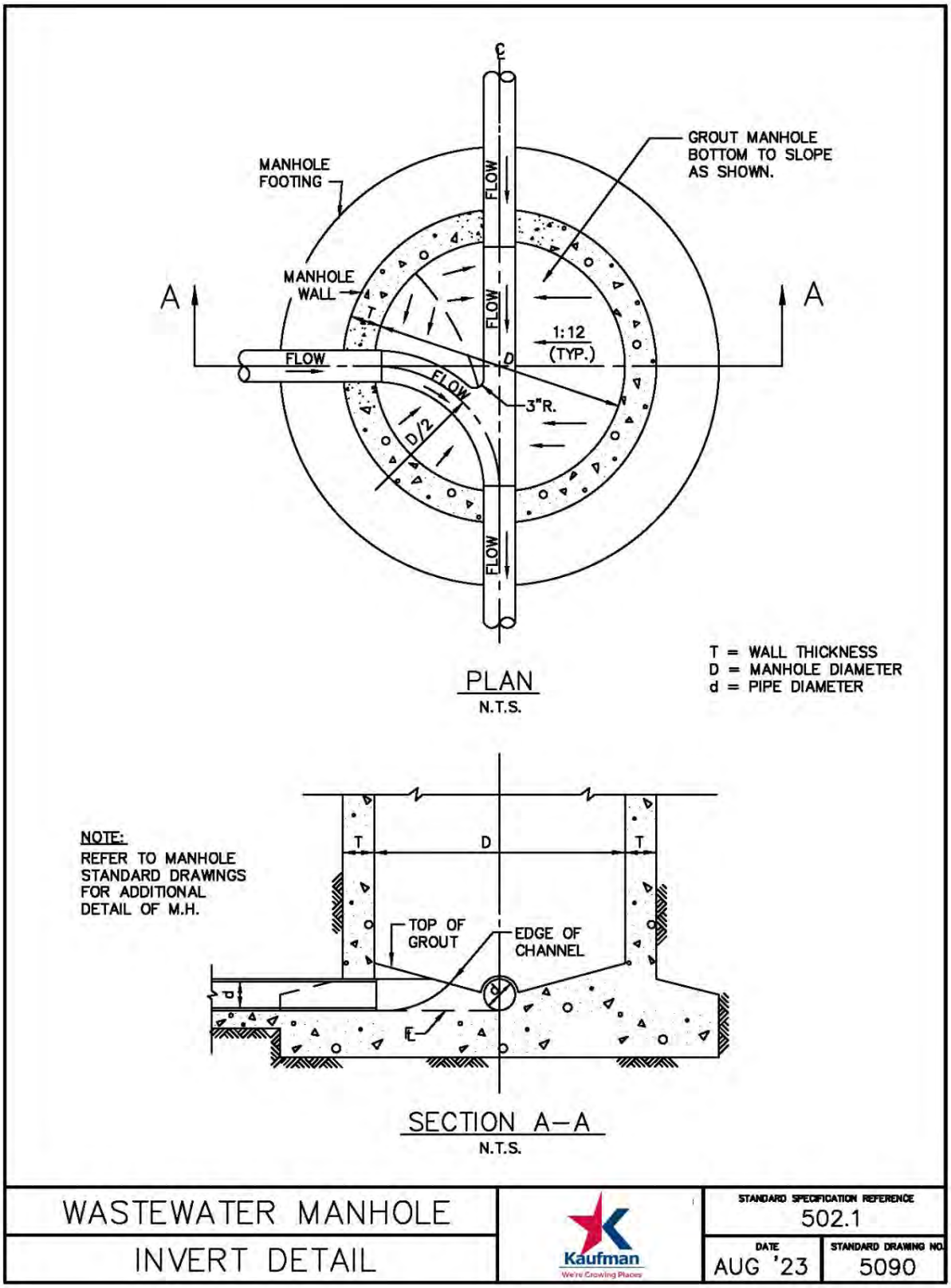

TO TOP OF PIPE
SPRING LINE
BASE RISER VARIES
12" MIN.
6" MIN.
12" MIN.
PRECAST BASE
ROCK FOUNDATION
N.T.S.
GEOTEXTILE MATERIAL
STUBOUTS TO BE MIN. 5' LONG SUPPORTED BY EMBEDMENT SPECIFIED IN PLANS. STUBOUTS TO BE GROUTED AT M.H. WITH NON SHRINK GROUT. STUBOUTS SHALL ALSO BE FITTED WITH WATER TIGHT STOPPER OR CAP
PROP. TOP OF CURB
PROP. PVMT.
STD. CAST IRON MANHOLE FRAME & COVER AS SPECIFIED BY OWNER.
USE APPROVED GRADE RINGS & NON SHRINK GROUT AS REQUIRED TO RAISE TO GRADE
NON SHRINK GROUT COATING, WHEN NOT IN PAVING
18" MAX
30"
2'-0" OR 3'-0"
USE O-RING RUBBER GASKET (TYP.)
INTERMEDIATE RISER
4', 5', OR 6' AS SPECIFIED BY OWNER
INTERMEDIATE RISER AVAILABLE IN 2'-0", 4'-0" & 6'-0" LENGTHS (USE MIN. NUMBER OF RISERS)
VARIES
NOTES:
1. FIRST MAIN LINE JOINT TO BE A MIN. OF 5' LONG WITH CONC. CRADLE (FROM SAME POUR AS BASE) UNDER THE ENTIRE LENGTH.
2. WHERE M.H.'S ARE OUTSIDE OF PAVEMENT, FRAME & COVER SHALL BE CENTERED WITH 5'X5' CONCRETE PAD CLASS "A" CONCRETE 4" THICK.
3. POLY WRAP AROUND M.H. OR JUST CONE AND RISER SECTION; AND/OR A CHIMNEY SEAL (INSIDE THE RISER), A RAIN PAN COULD BE INSIDE THE M.H. COVER.
4. ELEVATE M.H. TOP 1' ABOVE 100-YEAR FLOOD ELEVATION.
MIN. SLOPE 1:12
BASE RISER WITH "BUTT END" INTEGRATED INTO THE CLASS "F" CONC. BASE
6" MIN.
BASE RISER
SPRING LINE
6" MIN.
12" MIN.
12" MIN.
12" MIN.
STUBOUTS TO BE FITTED WITH A WATER TIGHT STOPPER OR CAP
GEOTEXTILE MATERIAL
CLASS "F" CONCRETE
ROCK FOUNDATION
STUBOUTS TO BE A MIN. OF 5' LONG WITH CONC. CRADLE (FROM SAME POUR AS BASE) UNDER THE ENTIRE LENGTH.
APPROVED RESILIENT PIPE-TO-MANHOLE CONNECTOR OR GASKET REQ'D. FOR PIPE OTHER THAN CLAY OR CONCRETE.
WASTEWATER MANHOLE
PRECAST
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
502.1
DATE
AUG '23
STANDARD DRAWING NO.
5020

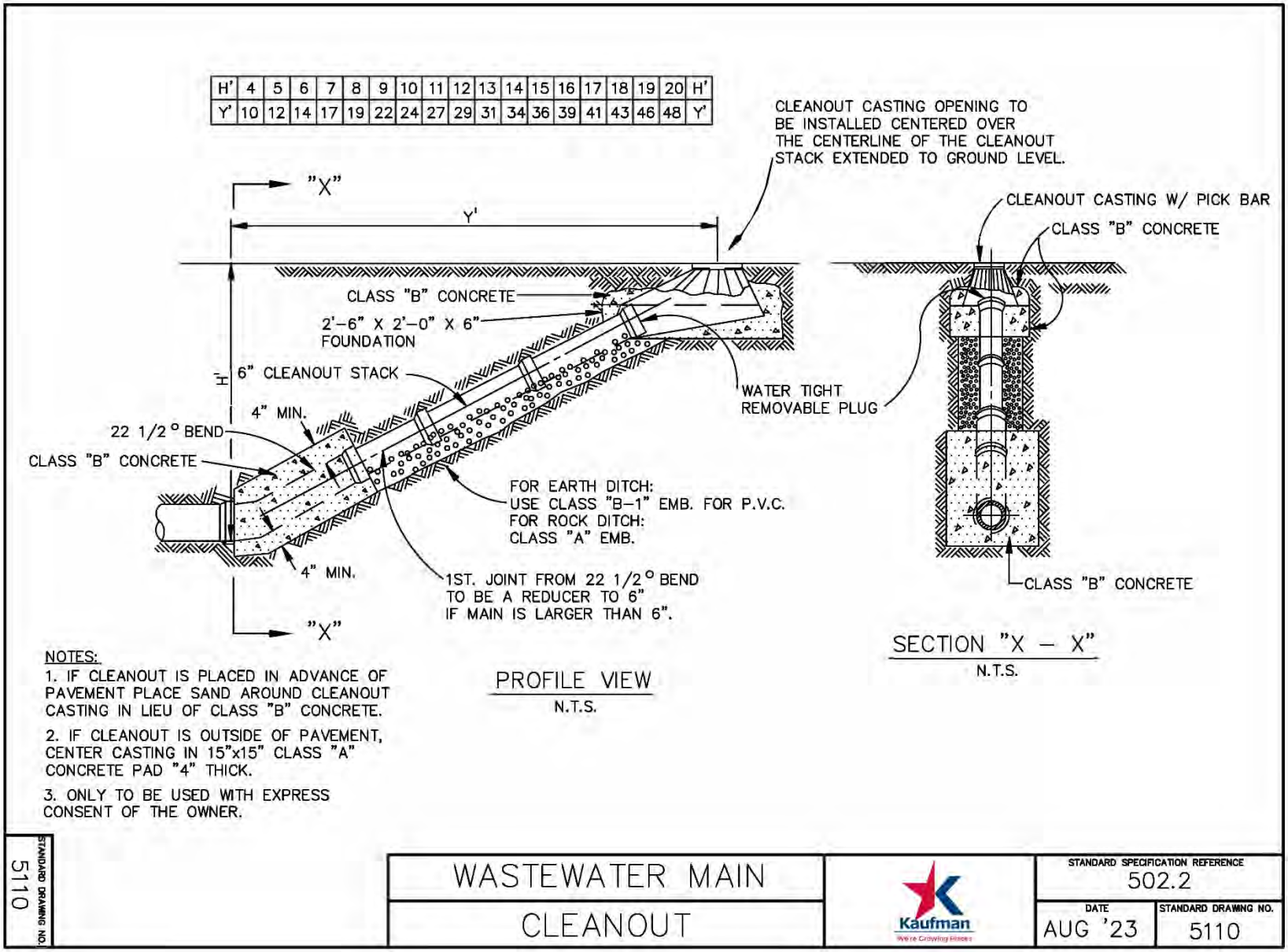

ROOF OPTIONS
N.T.S.
ADJUSTABLE FRAME
FRAME CAST IN CONC.
1/2" NON SHRINK GROUT COATING
STD. M.H. FRAME & COVER AS SPECIFIED BY OWNER
18" MAX
24" OR 36"
30"
USE APPROVED GRADE RINGS & NON SHRINK GROUT AS REQUIRED TO RAISE TO GRADE. (MIN. 4 COURSES)
FOR 5' & 6' DIA. M.H.'S SEE TRANSITION DETAIL
VARIES
6" MIN.
4'-0"
8" MIN.
5'-0" & 6'-0"
CLASS "F" CONCRETE MONOLITHIC POUR
12" MIN.
12" MIN.
12" MIN.
12" MIN.
GEOTEXTILE MATERIAL
ROCK FOUNDATION
36" OR 24"
30"
6" MIN.
12" MIN.
(15" (5') 30" (6')
4'-0"
5'-0" & 6'-0"
8" MIN.
3' MIN.
TRANSITION DETAIL FOR 5' & 6' DIA. M.H.'S
N.T.S.
NOTES:
1. WHERE M.H.'S ARE IN "PROPOSED" PAVING, FRAME & COVER SHALL BE SET 18" MAX BELOW TOP OF PAVEMENT OR AS REQUIRED TO CONSTRUCT PAVEMENT SECTION, INCLUDING SUBGRADE.
2. WHERE M.H.'S ARE OUTSIDE OF PAVEMENT, FRAME & COVER SHALL BE CENTERED IN 5'X5' CONCRETE PAD CLASS "A" CONCRETE, 4" THICK
3. POLY WRAP AROUND MANHOLE OR JUST CONE AND RISER SECTION; AND/OR A CHIMNEY SEAL INSIDE THE RISER. A RAIN PAN COULD BE INSIDE THE MANHOLE COVER.
APPROVED RESILIENT PIPE-TO-MANHOLE CONNECTOR OR GASKET REQUIRED FOR PIPE OTHER THAN CLAY OR CONCRETE.
STUBOUT TO BE FITTED WITH WATERTIGHT STOPPER OR CAP
STUBOUTS TO BE A MIN. OF 5' LONG WITH CONC. CRADLE (FROM SAME POUR) UNDER ENTIRE LENGTH
FIRST MAIN LINE JOINT TO BE A MIN. OF 5' LONG WITH CONC. CRADLE (FROM SAME POUR AS BASE) UNDER ENTIRE LENGTH.
STUBOUT CONNECTION
N.T.S.
WASTEWATER MANHOLE
CAST-IN-PLACE
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
502.1
DATE
AUG '23
STANDARD DRAWING NO.
5030


CONCRETE CONE ⇦ ROOF OPTIONS ⇨ REINFORCED CONCRETE SLAB
N.T.S.
PRESSURE-TYPE M.H. FRAME & COVER AS SPECIFIED BY OWNER. M.H. FRAME CAST IN ROOF W/ CONTINUOUS POUR FROM BASE.
#3'S AT 6" O.C. E.W.
24" OR 36"
30"
CONSTRUCTION JOINT WITH KEY WAY WATERSTOP, AND #3'S AT 12" O.C. EXTENDING 9" INTO WALL (NOT REQ'D FOR CONTINUOUS POUR)
FOR 5' & 6' DIA. M.H.'S SEE TRANSITION DETAIL
SECTION A - A
N.T.S.
VARIES
6" MIN.
8" MIN.
4'-0"
5'-0" & 6'-0"
CLASS "F" CONCRETE MONOLITHIC POUR
12" MIN.
12" MIN
12" MIN
#3'S AT 6" O.C., E.W.
A
A
30"
M.H. LID SHOULD BE IN LINE WITH UPSTREAM PIPE WHERE POSSIBLE
ROOF STEEL LAYOUT
N.T.S.
ROCK FOUNDATION
GEOTEXTILE MATERIAL
APPROVED RESILIENT PIPE-TO-MANHOLE CONNECTOR OR GASKET REQUIRED FOR PIPE OTHER THAN CLAY OR CONCRETE.
STUBOUT TO BE FITTED WITH WATER TIGHT STOPPER OR CAP
STUBOUTS TO BE A MIN. OF 5' LONG WITH CONC. CRADLE (FROM SAME POUR AS BASE) UNDER ENTIRE LENGTH.
FIRST MAIN LINE JOINT TO BE A MIN. OF 6' LONG WITH CONC. CRADLE (FROM SAME POUR AS BASE) UNDER UNDER THE ENTIRE LENGTH.
STUBOUT CONNECTION
N.T.S.
36" OR 24"
30"
6" MIN.
15" (5') 30" (6')
12" MIN.
4'-0"
5' & 6'
3' MIN.
TRANSITION DETAIL FOR 5' & 6' DIA. M.H.'S
N.T.S.
WASTEWATER MANHOLE
PRESSURE-TYPE
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
502.1
DATE
AUG '23
STANDARD DRAWING NO.
5050


TURBINE VENTILATOR–FIBERGLASS OR ALUMINUM WITH NYLON BUSHINGS
12 GAUGE STAINLESS STEEL STRAPS
6" P.V.C. SDR–35 PIPE
3"
2'–0" TYP.
5'–0"
6'–0" MIN. SEE NOTE 1
30"
2'–6"
4'–0"
90° BEND
1"
6" DIAMETER TREATED SUPPORT POLE.
APPROVED RESILIENT PIPE–TO–MANHOLE CONNECTOR OR GASKET.
NOTES:
1. ELEVATE TOP OF VENT MIN. 1' ABOVE 100–YEAR FLOOD ELEVATION.
2. FRAME AND COVER SHALL BE BOLTED.
WASTEWATER MANHOLE
VENTED
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
502.1
DATE
AUG '23
STANDARD DRAWING NO
5060


5' DIA.(≤12" INCOMING PIPE)
6' DIA.(>12" INCOMING PIPE)
P.V.C. OR DUCTILE IRON PIPE
DROP BOWL
RESILIENT CONNECTOR ASTM C923
3/8" DIA. STAINLESS STEEL PIPE STRAP SET IN CONCRETE
4' MAX
P.V.C. PIPE
SEE MANHOLE STANDARD DRAWINGS FOR ADDITIONAL DETAIL OF M.H.
GROUT
P.V.C. 90° BEND
PLAN
N.T.S.
ELEVATION
N.T.S.
REMOVE PORTION OF DROP PIPE TO CONNECT AS SHOWN
WEIR DETAIL
N.T.S.
NOTE:
1. FLOW LINE OF SURCHARGE LINE NORMALLY PLACED AT TOP OF EXISTING WASTEWATER LINE UNLESS NOTED OTHERWISE ON PLANS.
2. MAXIMUM SPACING OF 4' ON PIPE STRAPS. 2 STRAPS MINIMUM. ALL STRAP PARTS SHALL BE STAINLESS STEEL.
WASTEWATER MANHOLE
INSIDE DROP CONNECTION
STANDARD SPECIFICATION REFERENCE
502.1
DATE
AUG '23
STANDARD DRAWING NO.
5080

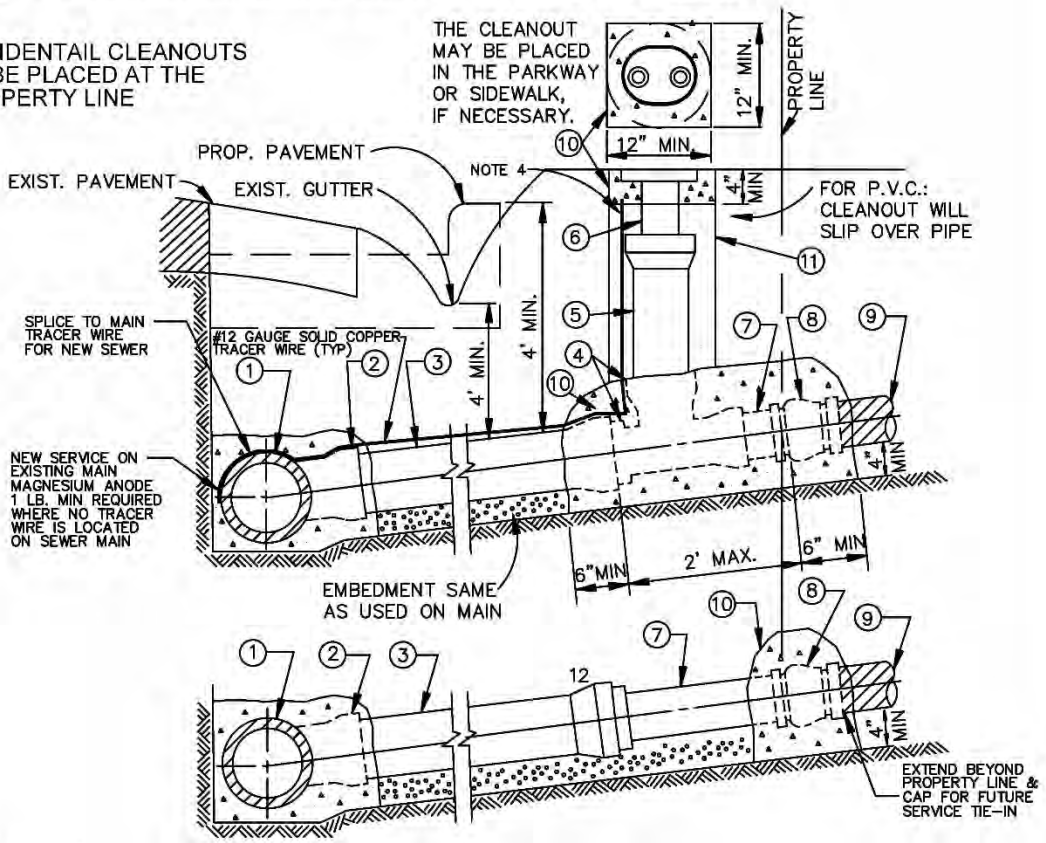

℄
MANHOLE FOOTING
GROUT MANHOLE BOTTOM TO SLOPE AS SHOWN.
MANHOLE WALL
A
A
T
FLOW
FLOW
FLOW
FLOW
FLOW
D
1:12 (TYP.)
3"R.
D/2
T = WALL THICKNESS
D = MANHOLE DIAMETER
d = PIPE DIAMETER
PLAN
N.T.S.
NOTE:
REFER TO MANHOLE STANDARD DRAWINGS FOR ADDITIONAL DETAIL OF M.H.
T
D
T
TOP OF GROUT
EDGE OF CHANNEL
d
℄
SECTION A–A
N.T.S.
WASTEWATER MANHOLE
INVERT DETAIL
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
502.1
DATE
AUG '23
STANDARD DRAWING NO.
5090


H' 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 H'
Y' 10 12 14 17 19 22 24 27 29 31 34 36 39 41 43 46 48 Y'
"X"
Y'
H
CLEANOUT CASTING OPENING TO BE INSTALLED CENTERED OVER THE CENTERLINE OF THE CLEANOUT STACK EXTENDED TO GROUND LEVEL.
CLASS "B" CONCRETE
2'-6" X 2'-0" X 6" FOUNDATION
6" CLEANOUT STACK
4" MIN.
22 1/2° BEND
CLASS "B" CONCRETE
4" MIN.
FOR EARTH DITCH: USE CLASS "B-1" EMB. FOR P.V.C. FOR ROCK DITCH: CLASS "A" EMB.
1ST. JOINT FROM 22 1/2° BEND TO BE A REDUCER TO 6" IF MAIN IS LARGER THAN 6".
WATER TIGHT REMOVABLE PLUG
CLEANOUT CASTING W/ PICK BAR
CLASS "B" CONCRETE
CLASS "B" CONCRETE
"X"
PROFILE VIEW
N.T.S.
SECTION "X - X"
N.T.S.
NOTES:
1. IF CLEANOUT IS PLACED IN ADVANCE OF PAVEMENT PLACE SAND AROUND CLEANOUT CASTING IN LIEU OF CLASS "B" CONCRETE.
2. IF CLEANOUT IS OUTSIDE OF PAVEMENT, CENTER CASTING IN 15"x15" CLASS "A" CONCRETE PAD "4" THICK.
3. ONLY TO BE USED WITH EXPRESS CONSENT OF THE OWNER.
STANDARD DRAWING NO. 5110
WASTEWATER MAIN
CLEANOUT
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE 502.2
DATE AUG '23
STANDARD DRAWING NO. 5110

KEY:

1. WASTEWATER MAIN
2. 4" WYE
3. 4" WASTEWATER LAT. (LENGTH VARIES)
4. 4" X 4" WYE AS REQ'D. BY OWNER.
5. 4" STACK (LENGTH VARIES)
6. 4" WASTEWATER LAT. CLEANOUT CASTING
7. 4" WASTEWATER PIPE (LENGTH VARIES)
8. ADAPTOR
9. BUILDING SEWER LAT.
10. CLASS "B" CONCRETE
11. COMPACTED AS SPECIFIED, OR INUNDATED SAND
12. 6" x 4" REDUCER

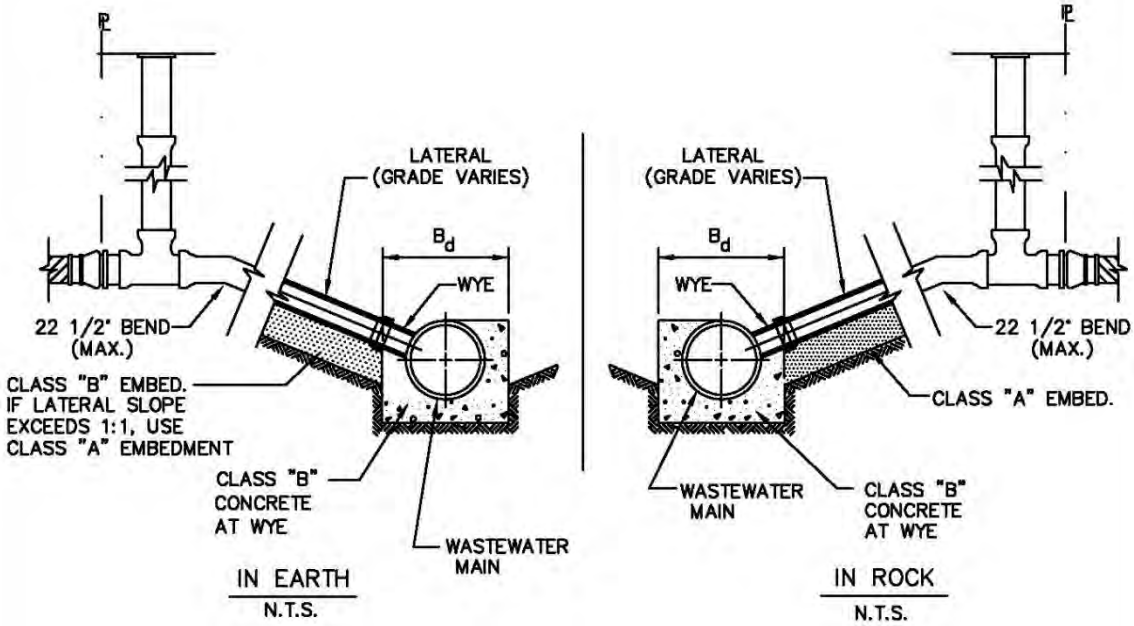
RESIDENTAIL CLEANOUTS TO BE PLACED AT THE PROPERTY LINE



NOTES:

1. CLEANOUT CASTING TO BE FURNISHED AND PLACED PER SPECIAL CONDITIONS, IN VEHICLE TRAFFIC AREAS AND FOR COMMERCIAL MAINLINE LATERALS, WASTEWATER CLEANOUT SHALL BE OF CAST IRON.
2. SLOPE OF LATERAL TO BE 2% MIN., UNLESS INSTRUCTED OTHERWISE BY OWNER.
3. THE WASTEWATER LATERAL SHALL BE CONNECTED TO BUILDING LATERAL AND CONSTRUCTED IN SUCH MANNER AS TO CLEAR EXISTING UTILITIES AND PROPOSED FACILITIES SUCH AS STORM SEWER MAINS, PAVING, SIDEWALKS, RETAINING WALLS, ETC. VERTICAL BENDS (22.5° MAX.) MAY BE USED IF APPROVED BY OWNER.
4. EXTEND TRACER WIRE TO JUST ABOVE CLEANOUT PLUG, PROVIDE 24' NEATLY COILED WIRE IN BOX
5. THE MAINLINE LATERAL CONNECTION TO THE PRIVATE BUILDING LATERAL SHALL BE AS CLOSE TO THE PROPERTY LINE AS POSSIBLE.
6. INSTALL 4" STOPPER OR CAP AT PROPERTY LINE IF BUILDING LATERAL DOES NOT EXIST.
7. SUBSTITUTE 4" FOR 6" FITTINGS IF PLANS OR SPEC. COND. CALL FOR 4" LATERAL DOES NOT EXIST.
8. THE CLEANOUT STACK & CASTING MAY BE PLACED IN THE PARKWAY, VEHICLE TRAFFIC AREAS, OR SIDEWALK, IF NECESSARY.
9. FOR 6" SERVICES OR LARGER, INSTALL A MANHOLE.
10. MINIMUM 9' SEPARATION FROM WATER SERVICE.

WASTEWATER LATERALS WITH CLEANOUT		STANDARD SPECIFICATION REFERENCE 502.10	
		DATE AUG '23	STANDARD DRAWING NO. 5120

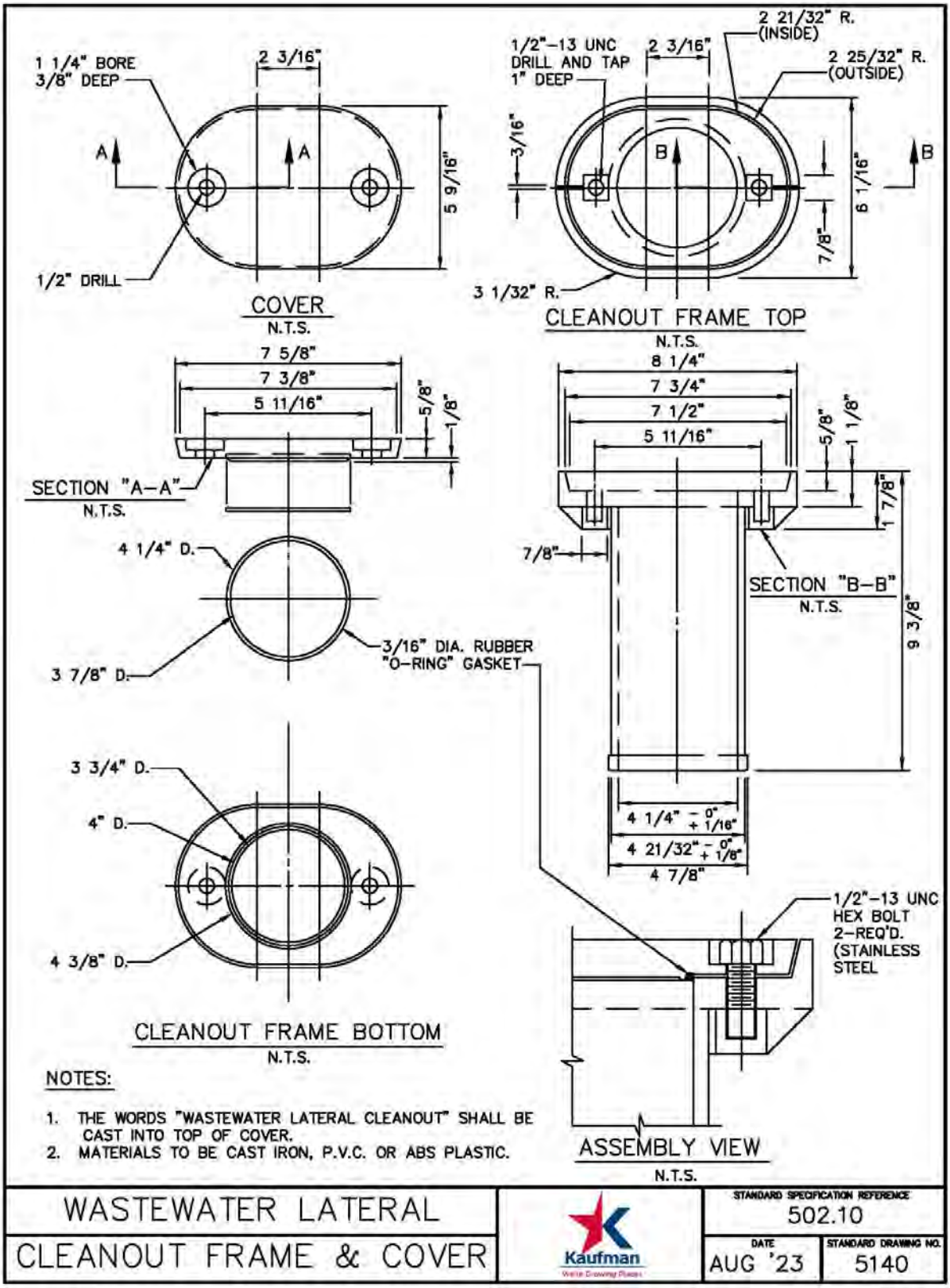


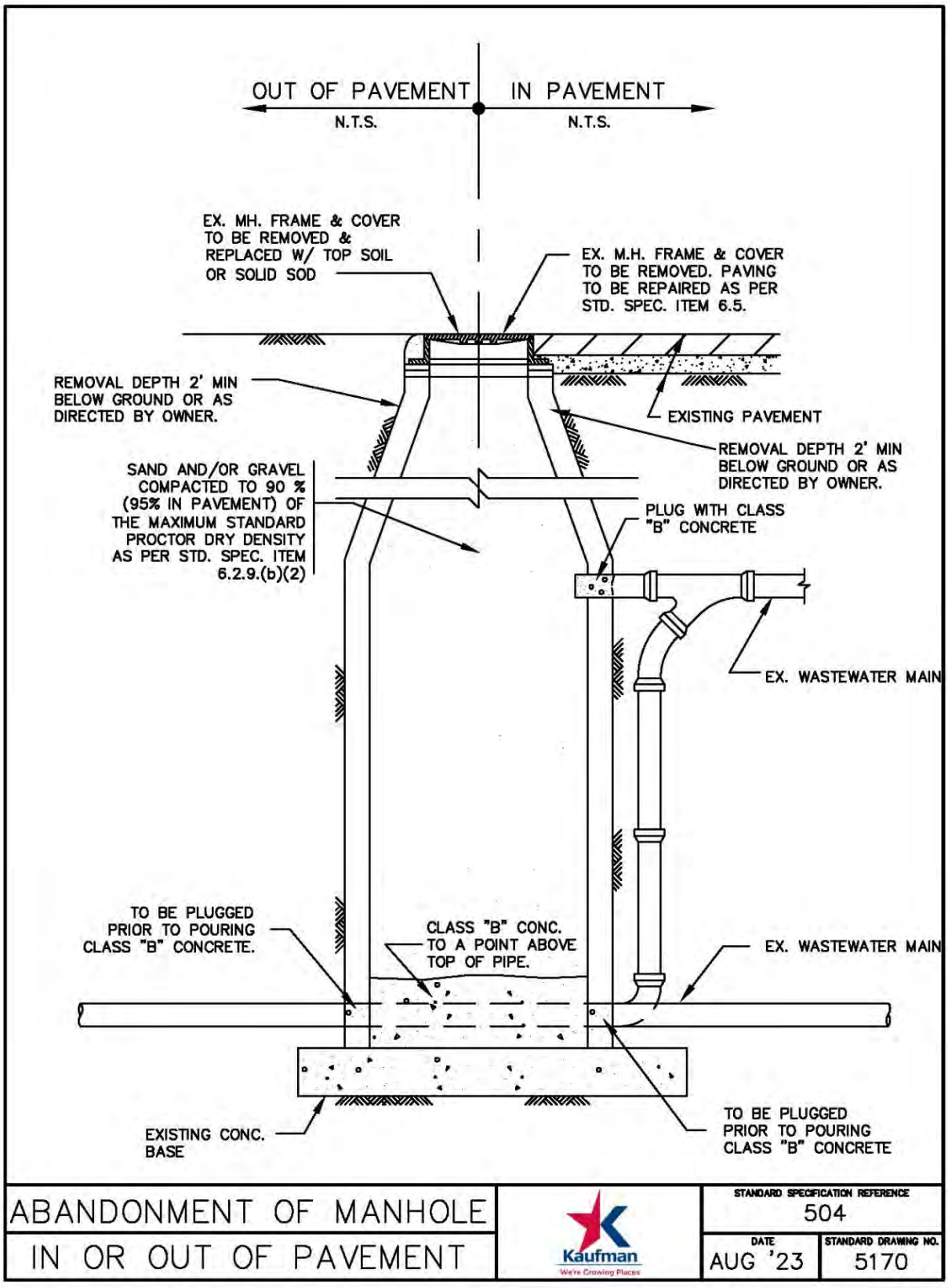
TRENCH WITH SLOPING SIDES
N.T.S.

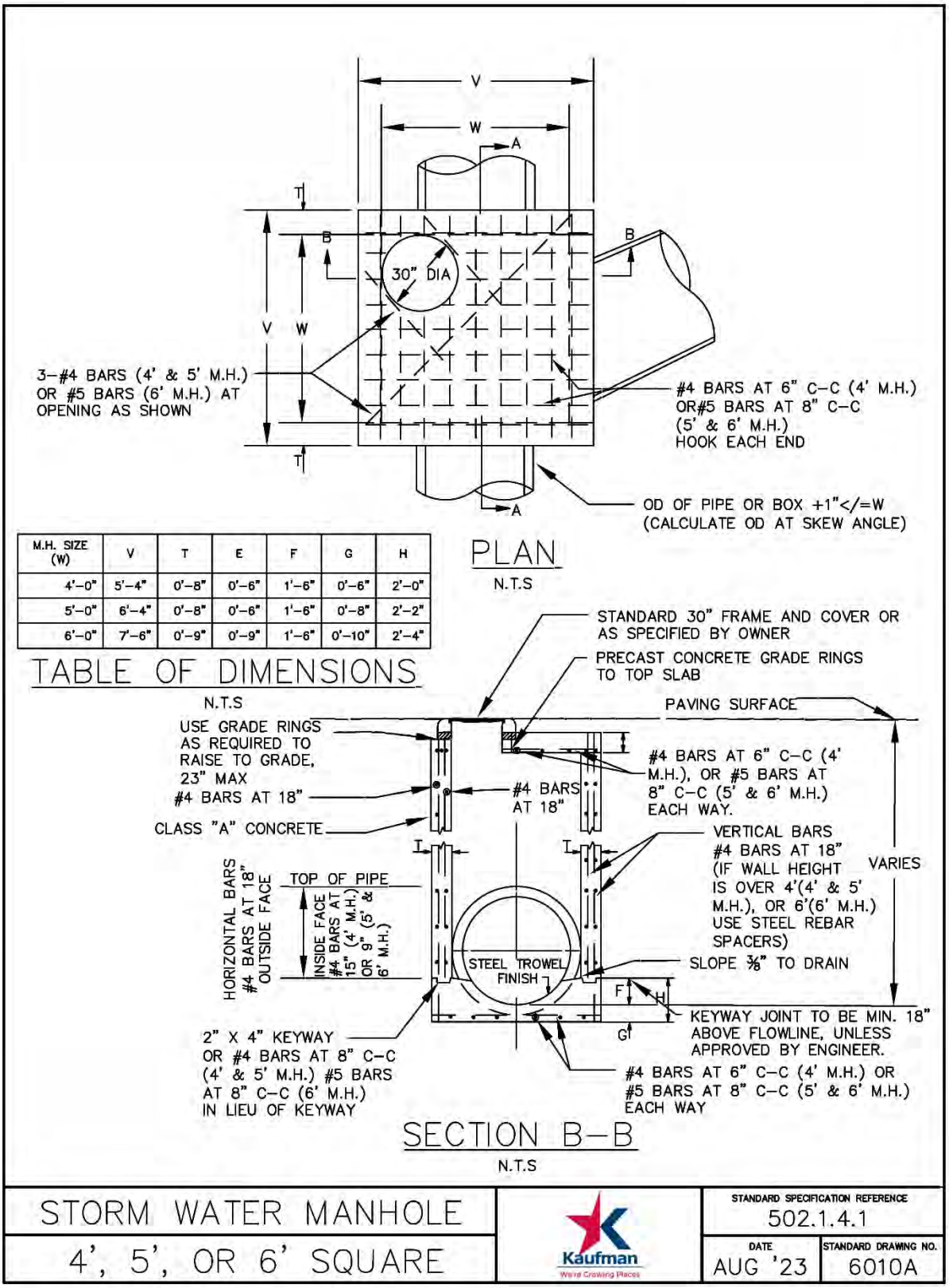
NOTES:

1. WYE SHALL BE SUPPORTED AS SHOWN FOR WYE CONNECTION SUPPORT.
2. LATERALS ARE TO CLEAR ALL EXISTING UTILITIES. 11 1/4" OR 22 1/2" BEND, ONLY, MAY BE REQUIRED.

WASTEWATER LATERAL CONNECTIONS IN EARTH & IN ROCK		STANDARD SPECIFICATION REFERENCE 502.10	
		DATE AUG '23	STANDARD DRAWING NO. 5130


1 1/4" BORE
3/8" DEEP
2 3/16"
A
A
5 9/16"
1/2" DRILL
COVER
N.T.S.
1/2"-13 UNC
DRILL AND TAP
1" DEEP
2 3/16"
2 21/32" R.
(INSIDE)
2 25/32" R.
(OUTSIDE)
3/16"
B
B
6 1/16"
7/8"
3 1/32" R.
CLEANOUT FRAME TOP
N.T.S.
7 5/8"
7 3/8"
5 11/16"
5/8"
1/8"
SECTION "A-A"
N.T.S.
8 1/4"
7 3/4"
7 1/2"
5 11/16"
5/8"
1 1/8"
1 7/8"
7/8"
SECTION "B-B"
N.T.S.
9 3/8"
4 1/4" D.
3 7/8" D.
3/16" DIA. RUBBER
"O-RING" GASKET
4 1/4" - 0" + 1/16"
4 21/32" - 0" + 1/8"
4 7/8"
3 3/4" D.
4" D.
4 3/8" D.
CLEANOUT FRAME BOTTOM
N.T.S.
1/2"-13 UNC
HEX BOLT
2-REQ'D.
(STAINLESS
STEEL
ASSEMBLY VIEW
N.T.S.
NOTES:
1. THE WORDS "WASTEWATER LATERAL CLEANOUT" SHALL BE CAST INTO TOP OF COVER.
2. MATERIALS TO BE CAST IRON, P.V.C. OR ABS PLASTIC.
WASTEWATER LATERAL
CLEANOUT FRAME & COVER
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
502.10
DATE
AUG '23
STANDARD DRAWING NO.
5140


OUT OF PAVEMENT
N.T.S.
IN PAVEMENT
N.T.S.
EX. MH. FRAME & COVER TO BE REMOVED & REPLACED W/ TOP SOIL OR SOLID SOD
EX. M.H. FRAME & COVER TO BE REMOVED. PAVING TO BE REPAIRED AS PER STD. SPEC. ITEM 6.5.
REMOVAL DEPTH 2' MIN BELOW GROUND OR AS DIRECTED BY OWNER.
EXISTING PAVEMENT
REMOVAL DEPTH 2' MIN BELOW GROUND OR AS DIRECTED BY OWNER.
SAND AND/OR GRAVEL COMPACTED TO 90 % (95% IN PAVEMENT) OF THE MAXIMUM STANDARD PROCTOR DRY DENSITY AS PER STD. SPEC. ITEM 6.2.9.(b)(2)
PLUG WITH CLASS "B" CONCRETE
EX. WASTEWATER MAIN
TO BE PLUGGED PRIOR TO POURING CLASS "B" CONCRETE.
CLASS "B" CONC. TO A POINT ABOVE TOP OF PIPE.
EX. WASTEWATER MAIN
EXISTING CONC. BASE
TO BE PLUGGED PRIOR TO POURING CLASS "B" CONCRETE
ABANDONMENT OF MANHOLE IN OR OUT OF PAVEMENT
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
504
DATE
AUG '23
STANDARD DRAWING NO.
5170



M.H. SIZE (W)	V	T	E	F	G	H
4'–0"	5'–4"	0'–8"	0'–6"	1'–6"	0'–6"	2'–0"
5'–0"	6'–4"	0'–8"	0'–6"	1'–6"	0'–8"	2'–2"
6'–0"	7'–6"	0'–9"	0'–9"	1'–6"	0'–10"	2'–4"

TABLE OF DIMENSIONS

N.T.S

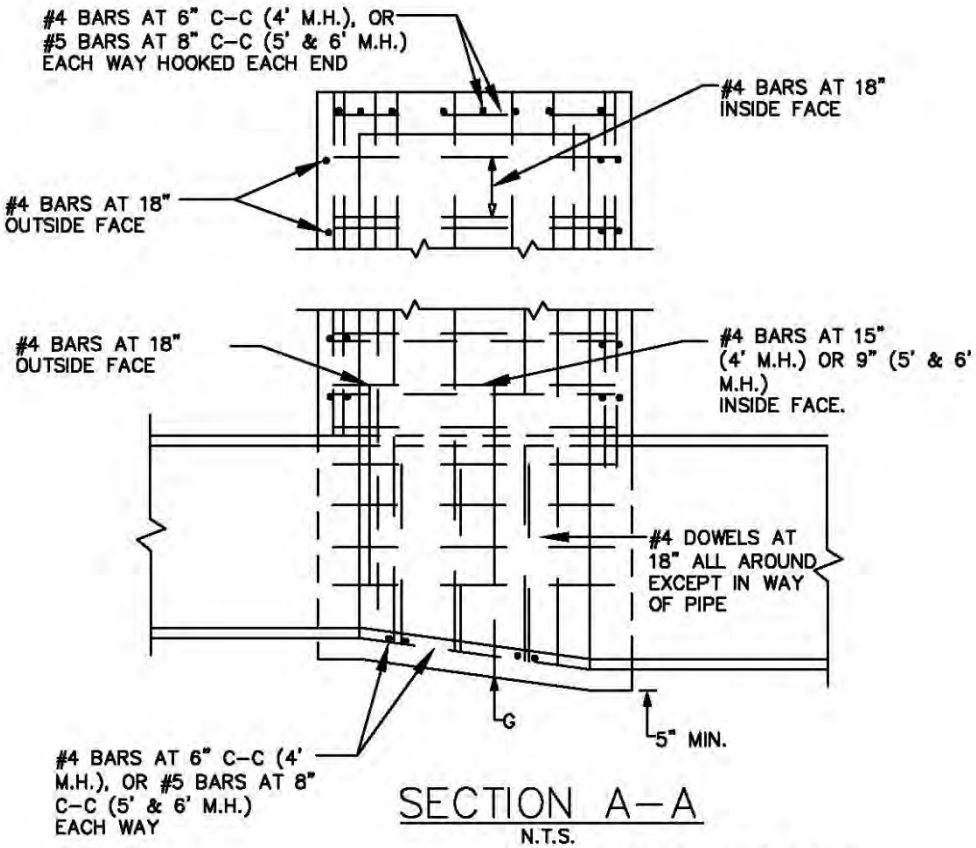
STORM WATER MANHOLE

4', 5', OR 6' SQUARE

STANDARD SPECIFICATION REFERENCE
502.1.4.1

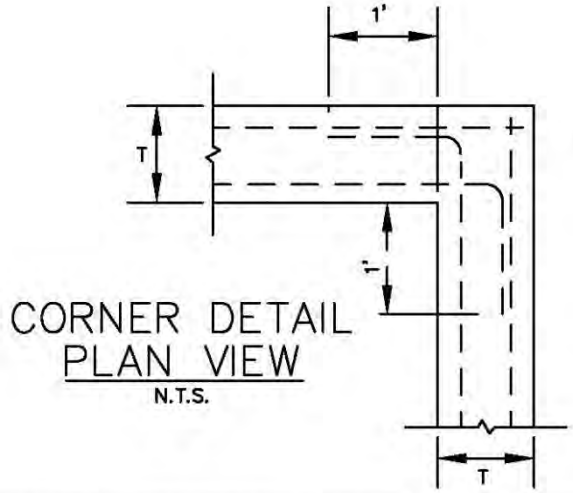
DATE
AUG '23

STANDARD DRAWING NO.
6010A



SECTION A–A
N.T.S.

*REFERENCE TABLE 6010A

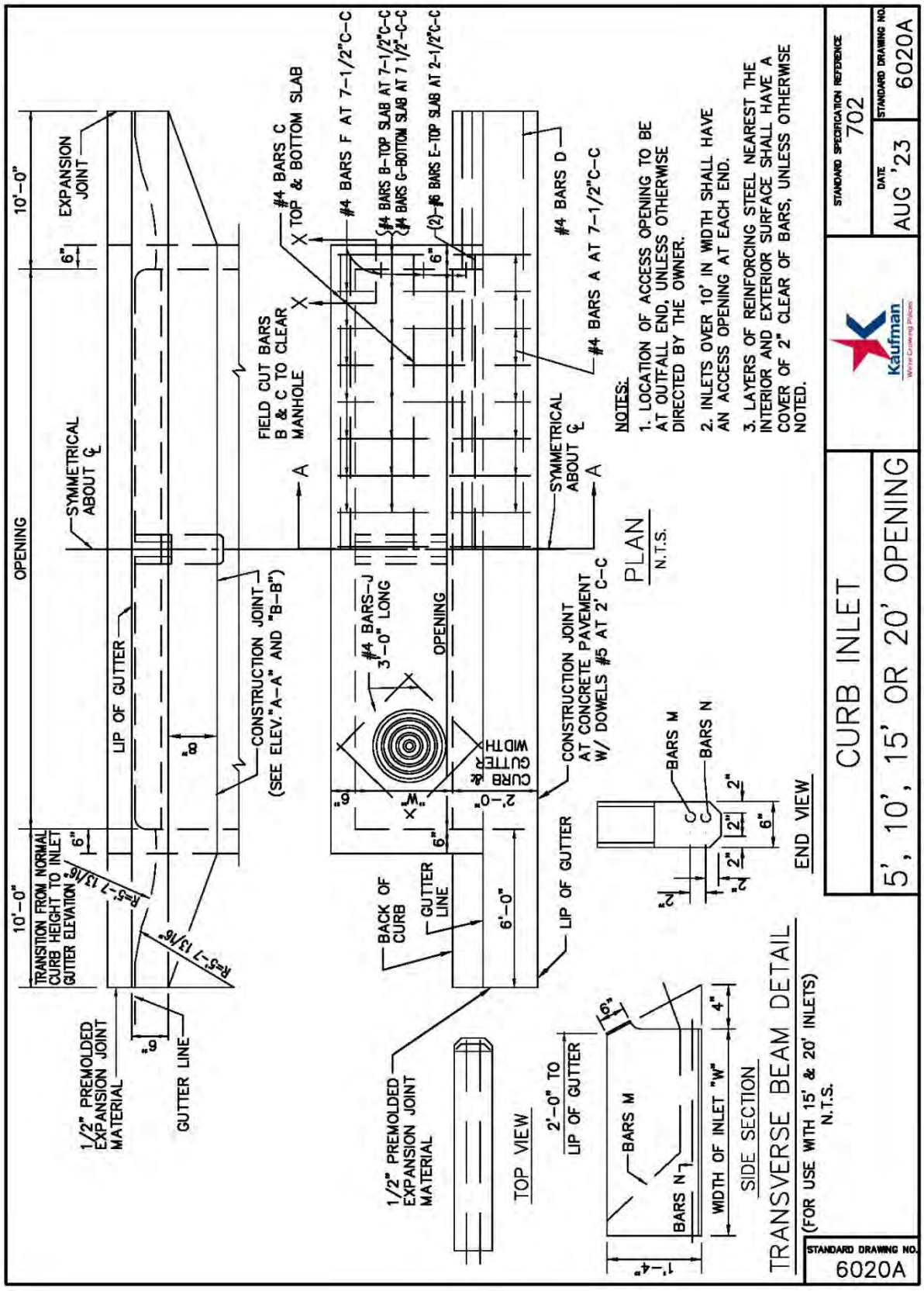


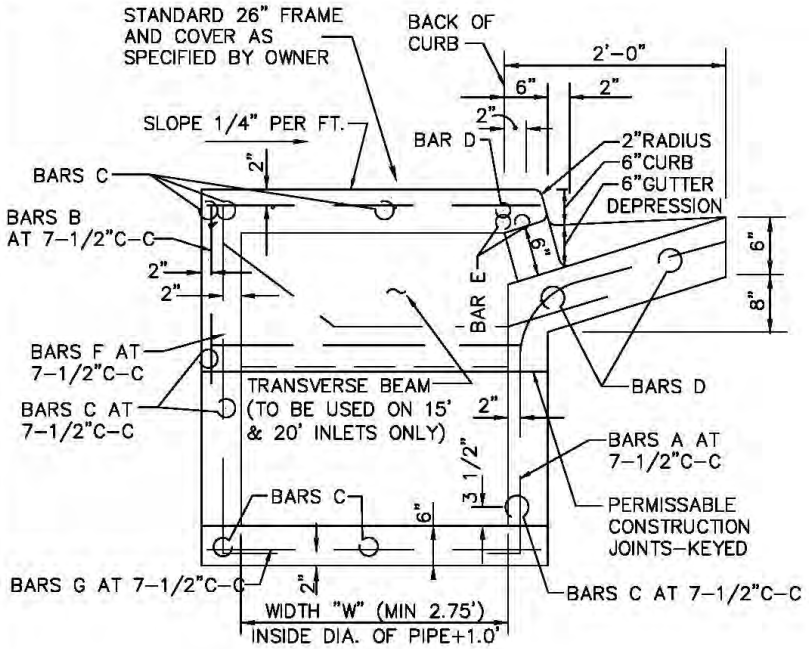
CORNER DETAIL
PLAN VIEW
N.T.S.

NOTES:

1. SLOPE INVERT OF MANHOLE AS INDICATED ON PLAN–PROFILE SHEET.
2. LAYERS OF REINFORCING STEEL NEAREST THE INTERIOR AND EXTERIOR SURFACE SHALL HAVE A COVER OF 2" CLEAR OF BARS, UNLESS OTHERWISE NOTED.
3. CONCRETE SHALL BE CLASS "C".
4. PRECAST PRODUCTS MAY BE USED AT THE APPROVAL OF THE OWNER.

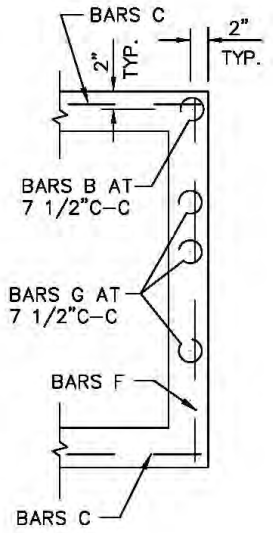
STORM WATER MANHOLE		STANDARD SPECIFICATION REFERENCE 502.1.4.1	
4', 5', OR 6' SQUARE	Kaufman We're Growing Places	DATE AUG '23	STANDARD DRAWING NO. 6010B


CURB INLET
5', 10', 15' OR 20' OPENING
STANDARD SPECIFICATION REFERENCE 702
DATE AUG '23
STANDARD DRAWING NO. 6020A
NOTES:
1. LOCATION OF ACCESS OPENING TO BE AT OUTFALL END, UNLESS OTHERWISE DIRECTED BY THE OWNER.
2. INLETS OVER 10' IN WIDTH SHALL HAVE AN ACCESS OPENING AT EACH END.
3. LAYERS OF REINFORCING STEEL NEAREST THE INTERIOR AND EXTERIOR SURFACE SHALL HAVE A COVER OF 2" CLEAR OF BARS, UNLESS OTHERWISE NOTED.
PLAN
N.T.S.
END VIEW
TOP VIEW
SIDE SECTION
TRANSVERSE BEAM DETAIL
(FOR USE WITH 15' & 20' INLETS)
N.T.S.
STANDARD DRAWING NO. 6020A
OPENING
10'-0"
EXPANSION JOINT
SYMMETRICAL ABOUT ℄
LIP OF GUTTER
CONSTRUCTION JOINT (SEE ELEV. "A-A" AND "B-B")
FIELD CUT BARS B & C TO CLEAR MANHOLE
#4 BARS C TOP & BOTTOM SLAB
#4 BARS F AT 7-1/2"C-C
#4 BARS B-TOP SLAB AT 7-1/2"C-C
#4 BARS G-BOTTOM SLAB AT 7 1/2"-C-C
(2)-#6 BARS E-TOP SLAB AT 2-1/2"C-C
#4 BARS D
#4 BARS A AT 7-1/2"C-C
#4 BARS J 3'-0" LONG
CURB & GUTTER WIDTH
CONSTRUCTION JOINT AT CONCRETE PAVEMENT W/ DOWELS #5 AT 2' C-C
BACK OF CURB
GUTTER LINE
6'-0"
1/2" PREMOLDED EXPANSION JOINT MATERIAL
TRANSITION FROM NORMAL CURB HEIGHT TO INLET GUTTER ELEVATION
R=5'-7 15/16"
BARS M
BARS N
WIDTH OF INLET "W"
2'-0" TO LIP OF GUTTER



SECTION "A-A"

N.T.S.



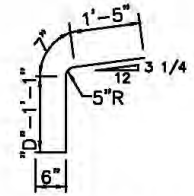
SECTION "X-X"

N.T.S.

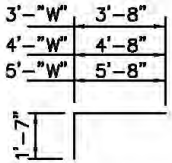
GENERAL NOTES:

1. ALL CONCRETE SHALL BE CLASS "C" CONCRETE.
2. REINFORCING BARS SHALL BE STANDARD GRADE STEEL, DEFORMED REINFORCING BARS OF A DIAMETER AND LENGTH AS SHOWN.
3. CHAMFER ALL EXPOSED CORNERS 3/4" EXCEPT WHERE OTHERWISE NOTED.
4. DIMENSIONS RELATING TO REINFORCING STEEL ARE TO OUTSIDE EDGE OF BARS.
5. FIELD CUT AND BEND BARS AS NECESSARY TO ACCOMODATE STORM SEWER PIPE.
6. RING AND COVER SHALL BE APPROVED BY THE OWNER AND INSTALLED BY THE CONTRACTOR.
7. INLET OPENING SHALL BE 6" MIN. OR 8" MAX.
8. PRECAST PRODUCT MAY BE USED AT THE APPROVAL OF THE OWNER.
9. ALLOW 1" MIN. CLEAR SPACE BETWEEN OD OF PIPE OR BOX AND INSIDE WALL OF INLET (OD OF PIPE OR BOX SHOULD ACCOUNT FOR SKEWED CONDITIONS).
10. DEPTHS GREATER THAN 10' NEED TO BE STRUCTURALLY ENGINEERED.
11. KEYWAY JOINT TO BE MIN. 18" ABOVE FLOWLINE, UNLESS APPROVED BY ENGINEER.

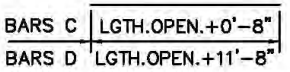
STANDARD DRAWING NO.				
6020B	CURB INLET CROSS SECTION & INLET THROAT	Kaufman We're Growing Places	STANDARD SPECIFICATION REFERENCE 702 DATE AUG '23	STANDARD DRAWING NO. 6020B



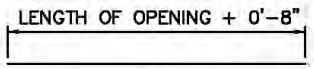
#4 BARS A
N.T.S.



#4 BARS B
N.T.S.

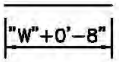


#4 BARS C & D
N.T.S.

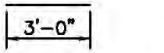


#4 BARS E
N.T.S.

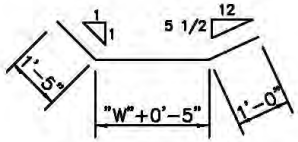
#4 BARS F
N.T.S.



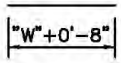
#4 BARS G
N.T.S.



#4 BARS J
N.T.S.



#3 BARS M
N.T.S.



#5 BARS N
N.T.S.

STANDARD DRAWING NO. 6020C

CURB INLET	STANDARD SPECIFICATION REFERENCE 702	
REBAR	DATE AUG '23	STANDARD DRAWING NO. 6020C

BILL OF REINFORCING STEEL

DEPTH "D"	ALL WIDTHS AND LENGTHS				OPENING LENGTH "L" = 5ft Widths "W" 3ft 4ft 5ft						OPENING LENGTH "L" = 10ft Widths "W" 3ft 4ft 5ft						OPENING LENGTH "L" = 15 ft Widths "W" 3ft 4ft 5ft								OPENING LENGTH "L" = 20 ft Widths "W" 3ft 4ft 5ft							
	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS
	C	D	E	J	F	F	F	A	B	G	F	F	F	A	B	G	F	F	F	A	B	G	M	N	F	F	F	A	B	G	M	N
3'-6"	17	3	2	4	20	24	28	10	10	20	28	32	36	18	18	28	36	40	44	26	26	36	2	2	44	48	52	34	34	44	2	2
3'-9"	18	"	"	"	"	"	"	"	"	20	"	"	"	"	"	28	"	"	"	"	"	36	"	"	"	"	"	"	"	44	"	"
4'-0"	19	"	"	"	"	"	"	"	"	24	"	"	"	"	"	32	"	"	"	"	"	40	"	"	"	"	"	"	"	48	"	"
4'-3"	19	"	"	"	"	"	"	"	"	24	"	"	"	"	"	32	"	"	"	"	"	40	"	"	"	"	"	"	"	48	"	"
4'-6"	21	"	"	"	"	"	"	"	"	26	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	"	"	50	"	"
4'-9"	21	"	"	"	"	"	"	"	"	26	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	"	"	50	"	"
5'-0"	21	"	"	"	"	"	"	"	"	26	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	"	"	50	"	"
5'-3"	23	"	"	"	"	"	"	"	"	28	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	"	"	52	"	"
5'-6"	23	"	"	"	"	"	"	"	"	28	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	"	"	52	"	"
5'-9"	25	"	"	"	"	"	"	"	"	30	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	"	"	54	"	"
6'-0"	25	"	"	"	"	"	"	"	"	30	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	"	"	54	"	"
6'-3"	26	"	"	"	"	"	"	"	"	30	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	"	"	54	"	"
6'-6"	27	"	"	"	"	"	"	"	"	32	"	"	"	"	"	40	"	"	"	"	"	48	"	"	"	"	"	"	"	56	"	"
6'-9"	27	"	"	"	"	"	"	"	"	32	"	"	"	"	"	40	"	"	"	"	"	48	"	"	"	"	"	"	"	56	"	"
7'-0"	29	"	"	"	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	"	"	58	"	"
7'-3"	29	"	"	"	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	"	"	58	"	"
7'-6"	30	"	"	"	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	"	"	58	"	"
7'-9"	31	"	"	"	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	52	"	"	"	"	"	"	"	60	"	"
8'-0"	31	"	"	"	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	52	"	"	"	"	"	"	"	60	"	"
8'-3"	32	"	"	"	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	52	"	"	"	"	"	"	"	60	"	"
8'-6"	33	"	"	"	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	54	"	"	"	"	"	"	"	62	"	"
8'-9"	34	"	"	"	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	54	"	"	"	"	"	"	"	62	"	"
9'-0"	35	"	"	"	"	"	"	"	"	40	"	"	"	"	"	48	"	"	"	"	"	56	"	"	"	"	"	"	"	64	"	"
9'-3"	36	"	"	"	"	"	"	"	"	40	"	"	"	"	"	48	"	"	"	"	"	56	"	"	"	"	"	"	"	64	"	"
9'-6"	37	"	"	"	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	58	"	"	"	"	"	"	"	66	"	"
10'-0"	38	"	"	"	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	58	"	"	"	"	"	"	"	66	"	"

NOTES:

- FOR CONVENIENCE, DEPTHS OF INLETS SHOWN IN ABOVE TABLES ARE IN INCREMENTS OF 3 INCHES BUT ANY DEPTHS OTHER THAN THOSE SHOWN ABOVE MAY BE USED WHEREVER DEEMED NECESSARY. QUANTITIES FOR OTHER DEPTHS FALLING WITHIN THE LIMITS OF THE TABLE MAY BE FOUND BY INTERPOLATION.
- DEPTHS GREATER THAN 10' NEED TO BE STRUCTURALLY ENGINEERED.

STANDARD DRAWING NO. 6020D

CURB INLET

BILL OF REINFORCING STEEL

Kaufman
We're Growing Places

STANDARD SPECIFICATION REFERENCE 702

DATE AUG '23

STANDARD DRAWING NO. 6020D

SUMMARY OF QUANTITIES FOR CURB INLETS

DEPTH "D"	5'–0" OPENING						10'–0" OPENING						15'–0" OPENING						20'–0" OPENING					
	WIDTH 3'–0"		WIDTH 4'–0"		WIDTH 5'–0"		WIDTH 3'–0"		WIDTH 4'–0"		WIDTH 5'–0"		WIDTH 3'–0"		WIDTH 4'–0"		WIDTH 5'–0"		WIDTH 3'–0"		WIDTH 4'–0"		WIDTH 5'–0"	
	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.
3'–6"	2.62	306	2.95	332	3.28	373	4.12	479	4.64	521	5.20	564	5.69	667	6.40	721	7.10	775	7.20	846	8.11	909	9.03	976
3'–9"	2.70	309	3.04	341	3.39	373	4.25	494	4.78	536	5.34	579	5.87	687	6.58	741	7.30	796	7.42	874	8.34	937	9.27	1010
4'–0"	2.78	328	3.14	364	3.49	399	4.38	518	4.92	565	5.49	610	6.05	718	6.77	776	7.49	835	7.64	909	8.58	976	9.51	1046
4'–3"	2.87	334	3.23	370	3.59	406	4.51	526	5.06	573	5.64	619	6.22	729	6.95	787	7.69	847	7.87	922	8.81	990	9.75	1061
4'–6"	2.95	356	3.32	394	3.69	431	4.64	558	5.20	607	5.79	656	6.40	770	7.14	830	7.88	891	8.09	973	9.04	1043	9.99	1115
4'–9"	3.03	361	3.41	410	3.79	438	4.77	566	5.34	616	5.94	665	6.57	780	7.32	841	8.07	903	8.31	986	9.27	1056	10.23	1129
5'–0"	3.12	367	3.51	416	3.90	445	4.90	574	5.47	624	6.09	674	6.75	791	7.51	853	8.27	915	8.53	999	9.50	1070	10.47	1144
5'–3"	3.20	383	3.60	424	4.00	465	5.03	600	5.61	652	6.23	704	6.93	827	7.69	890	8.46	955	8.76	1044	9.73	1118	10.71	1194
5'–6"	3.28	389	3.69	430	4.10	472	5.16	608	5.75	681	6.38	713	7.11	837	7.88	901	8.66	967	8.98	1057	9.97	1131	10.95	1208
5'–9"	3.37	405	3.78	451	4.20	495	5.29	635	5.89	690	6.53	744	7.28	874	8.07	940	8.85	1007	9.20	1102	10.20	1178	11.19	1258
6'–0"	3.45	415	3.88	460	4.30	504	5.42	646	6.03	702	6.68	757	7.45	888	8.25	954	9.05	1022	9.42	1119	10.43	1196	11.43	1276
6'–3"	3.53	425	3.97	470	4.41	515	5.55	661	6.17	718	6.83	773	7.63	908	8.44	975	9.24	1044	9.64	1147	10.66	1223	11.67	1305
6'–6"	3.62	437	4.06	486	4.51	532	5.68	681	6.31	739	6.97	797	7.81	935	8.62	1005	9.43	1057	9.87	1178	10.89	1258	11.92	1340
6'–9"	3.70	441	4.15	490	4.61	537	5.81	688	6.45	747	7.12	806	7.98	945	8.81	1015	9.63	1066	10.09	1191	11.12	1272	12.15	1355
7'–0"	3.78	460	4.25	510	4.71	560	5.94	716	6.59	777	7.27	837	8.16	981	8.99	1053	9.82	1126	10.31	1237	11.35	1319	12.40	1404
7'–3"	3.86	465	4.34	516	4.81	567	6.07	724	6.72	785	7.42	846	8.33	992	9.18	1065	10.02	1138	10.53	1249	11.59	1333	12.64	1418
7'–6"	3.95	477	4.43	529	4.91	570	6.20	742	6.86	804	7.57	866	8.51	1016	9.36	1089	10.21	1163	10.75	1290	11.82	1365	12.88	1451
7'–9"	4.03	491	4.53	544	5.02	597	6.33	762	7.00	826	7.71	890	8.67	1040	9.55	1116	10.41	1193	10.98	1313	12.05	1399	13.12	1498
8'–0"	4.12	496	4.62	550	5.12	604	6.46	770	7.14	834	7.86	899	8.86	1051	9.73	1129	10.60	1205	11.20	1325	12.28	1412	13.36	1510
8'–3"	4.20	504	4.71	559	5.22	613	6.59	784	7.28	849	8.01	915	9.04	1069	9.92	1149	10.80	1228	11.42	1353	12.51	1440	13.60	1529
8'–6"	4.28	519	4.80	576	5.32	632	6.71	804	7.42	871	8.16	938	9.21	1107	10.10	1176	10.99	1257	11.64	1385	12.74	1474	13.84	1565
8'–9"	4.37	528	4.90	586	5.42	643	6.84	819	7.56	886	8.31	954	9.39	1119	10.29	1199	11.18	1280	11.87	1410	12.97	1500	14.08	1592
9'–0"	4.45	545	4.99	605	5.53	664	6.97	842	7.70	912	8.46	982	9.56	1148	10.47	1231	11.38	1313	12.09	1447	13.21	1539	14.32	1631
9'–3"	4.53	554	5.08	614	5.63	674	7.10	858	7.84	929	8.60	999	9.74	1169	10.66	1252	11.57	1335	12.31	1474	13.44	1563	14.56	1660
9'–6"	4.62	568	5.17	630	5.73	692	7.23	878	7.97	950	8.75	1022	9.92	1195	10.84	1280	11.77	1365	12.53	1505	13.67	1600	14.80	1696
10'–0"	4.78	582	5.36	645	5.93	708	7.49	900	8.11	974	9.05	1048	10.27	1227	11.21	1312	12.16	1399	12.98	1546	14.13	1642	15.29	1739

NOTE:

- FOR CONVENIENCE, DEPTHS OF INLETS SHOWN IN ABOVE TABLES ARE IN INCREMENTS OF 3 INCHES BUT ANY DEPTHS OTHER THAN THOSE SHOWN ABOVE MAY BE USED WHEREVER DEEMED NECESSARY. QUANTITIES FOR OTHER DEPTHS FALLING WITHIN THE LIMITS OF THE TABLE MAY BE FOUND BY INTERPOLATION.
- DEPTHS GREATER THAN 10' NEED TO BE STRUCTURALLY ENGINEERED.

STANDARD DRAWING NO. 6020E

CURB INLET

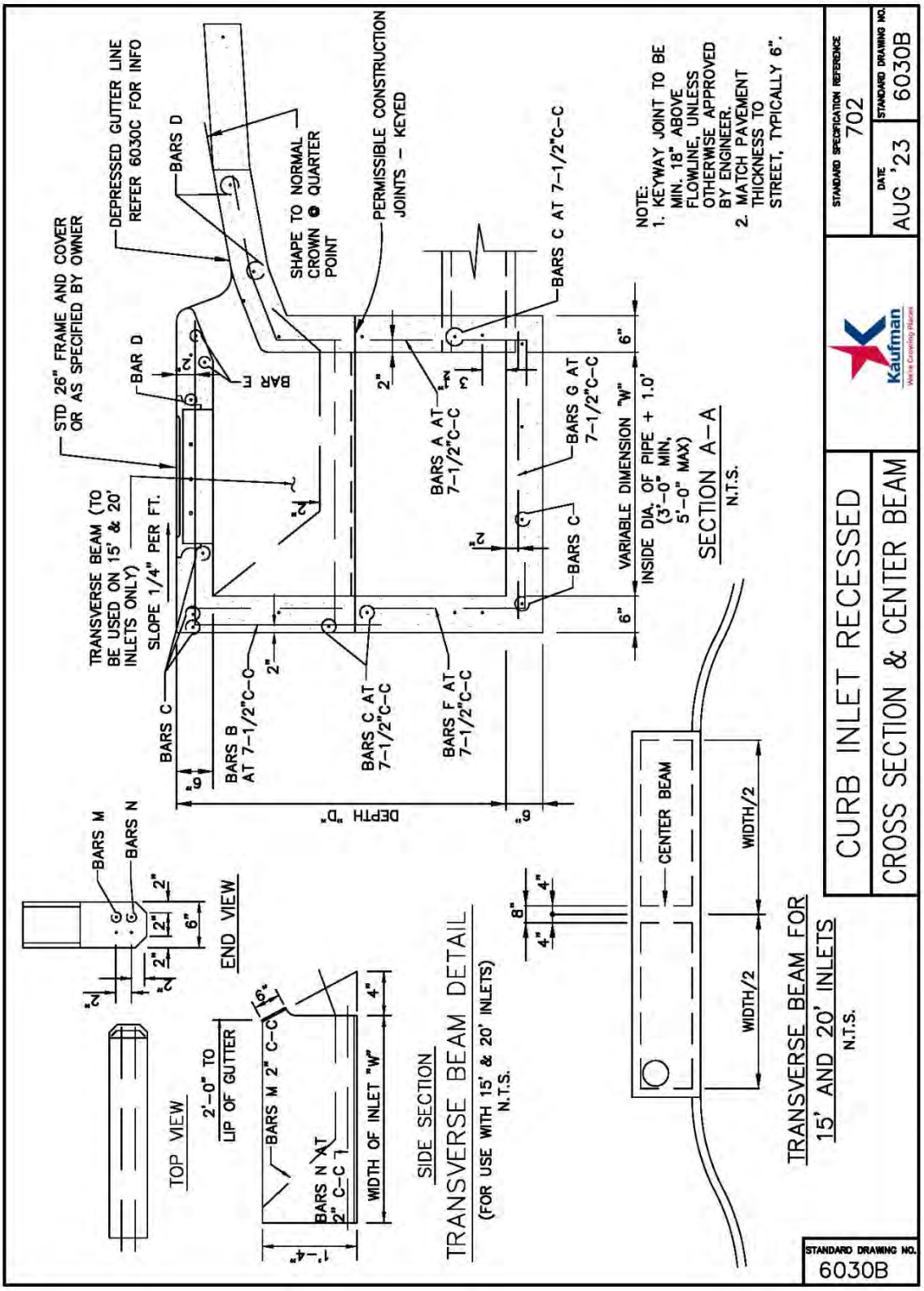
SUMMARY OF QUANTITIES

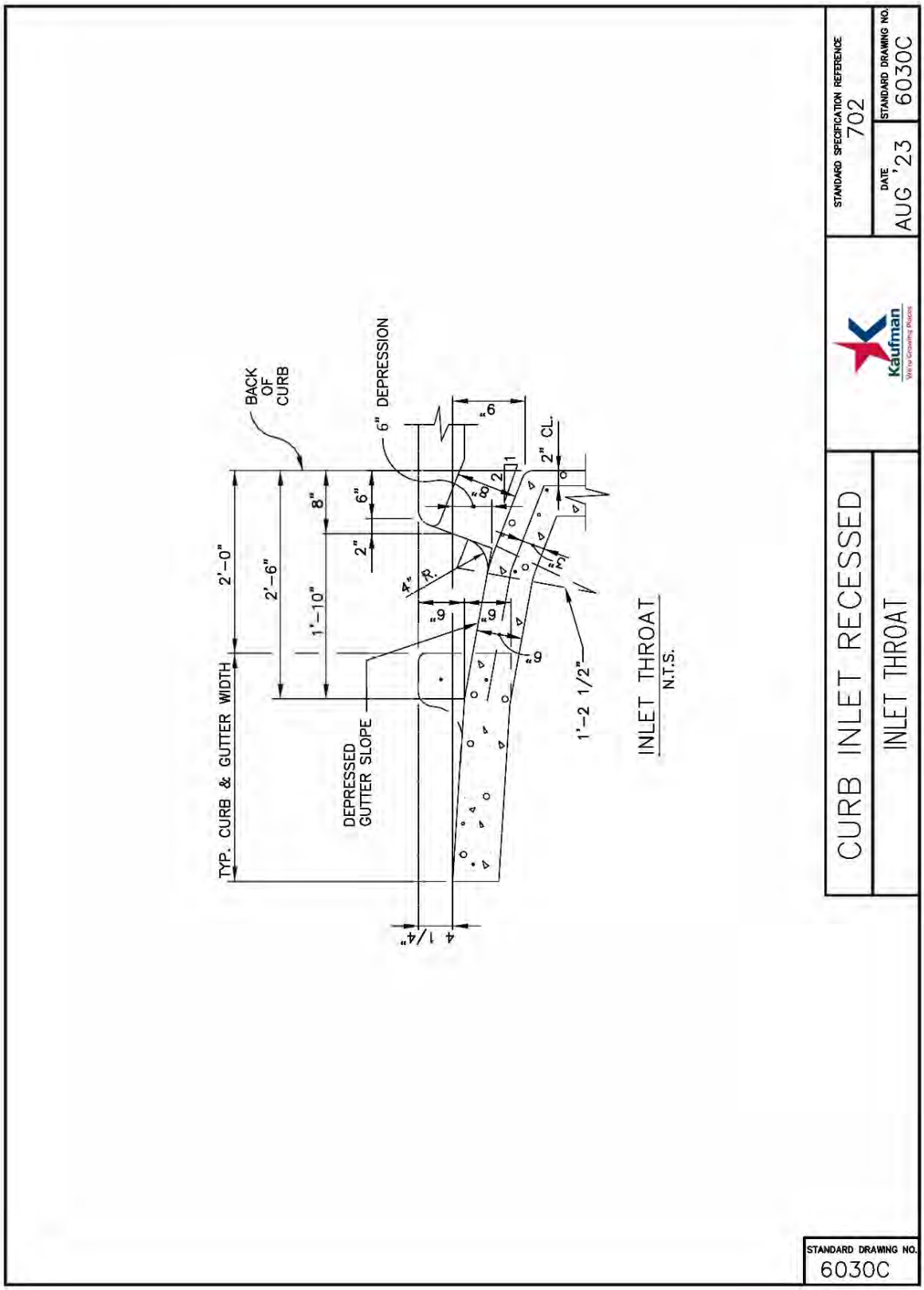
Kaufman We're Growing Places

STANDARD SPECIFICATION REFERENCE 702

DATE AUG '23

STANDARD DRAWING NO. 6020E

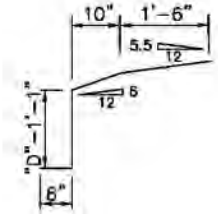

CURB INLET RECESSED
CROSS SECTION & CENTER BEAM
STANDARD SPECIFICATION REFERENCE
702
DATE
AUG '23
STANDARD DRAWING NO.
6030B
NOTE:
1. KEYWAY JOINT TO BE MIN. 18" ABOVE FLOWLINE, UNLESS OTHERWISE APPROVED BY ENGINEER.
2. MATCH PAVEMENT THICKNESS TO STREET, TYPICALLY 6".
STD 26" FRAME AND COVER OR AS SPECIFIED BY OWNER
DEPRESSED GUTTER LINE REFER 6030C FOR INFO
BARS D
SHAPE TO NORMAL CROWN @ QUARTER POINT
PERMISSIBLE CONSTRUCTION JOINTS - KEYED
BAR D
BAR E
TRANSVERSE BEAM (TO BE USED ON 15' & 20' INLETS ONLY)
SLOPE 1/4" PER FT.
BARS C
BARS B AT 7-1/2"C-C
BARS C AT 7-1/2"C-C
BARS A AT 7-1/2"C-C
BARS F AT 7-1/2"C-C
BARS G AT 7-1/2"C-C
BARS C AT 7-1/2"C-C
VARIABLE DIMENSION "W"
INSIDE DIA. OF PIPE + 1.0'
(3'-0" MIN, 5'-0" MAX)
DEPTH "D"
SECTION A-A
N.T.S.
BARS M
BARS N
END VIEW
TOP VIEW
2'-0" TO LIP OF GUTTER
BARS M 2" C-C
BARS N AT 2" C-C
WIDTH OF INLET "W"
SIDE SECTION
TRANSVERSE BEAM DETAIL
(FOR USE WITH 15' & 20' INLETS)
N.T.S.
CENTER BEAM
WIDTH/2
WIDTH/2
TRANSVERSE BEAM FOR 15' AND 20' INLETS
N.T.S.
STANDARD DRAWING NO.
6030B


CURB INLET RECESSED
INLET THROAT
STANDARD SPECIFICATION REFERENCE
702
DATE
AUG '23
STANDARD DRAWING NO.
6030C
BACK OF CURB
6" DEPRESSION
2'-0"
2'-6"
1'-10"
8"
6"
2"
TYP. CURB & GUTTER WIDTH
DEPRESSED GUTTER SLOPE
2" CL.
1'-2 1/2"
INLET THROAT
N.T.S.
STANDARD DRAWING NO.
6030C

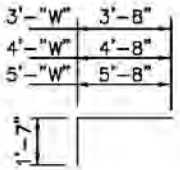
GENERAL NOTES:

1. ALL REINFORCING STEEL SHALL BE GRADE 60. DEFORMED REINFORCING BARS AT A DIAMETER & LENGTH AS SHOWN.
2. ALL CONCRETE SHALL BE CLASS "C". ALL EXPOSED CORNERS SHALL BE CHAMFERED 3/4".
3. ALL REINFORCING STEEL SHALL HAVE A MINIMUM COVER OF 2" CLEAR OF THE BARS.
4. 10'-0" OF EXISTING CURB AND GUTTER UPSTREAM AND 10'-0" OF EXISTING CURB AND GUTTER DOWNSTREAM SHALL BE REMOVED AND REPOURED INTEGRALLY WITH EACH INLET.
5. ALL BACK FILLING SHALL BE PERFORMED BY MECHANICAL TAMPING TO 95% STANDARD PROCTOR DENSITY.
6. PRECAST PRODUCTS MAY BE USED AT THE APPROVAL OF THE OWNER.
7. ALLOW 1" MIN. CLEAR SPACE BETWEEN OD OF PIPE OR BOX AND INSIDE WALL OF INLET (OD OF PIPE OR BOX SHOULD ACCOUNT FOR SKEWED CONDITIONS).
8. FIELD CUT & BEND BARS AS NECESSARY TO ACCOMODATE STORM SEWER PIPE.
9. RING & COVER SHALL BE APPROVED BY THE OWNER AND INSTALLED BT CONTRACTOR.
10. WHEN POURING INVERTS, THE BOTTOM SHALL BE SLOPED NO MORE THAN 1/4"/FT TOWARD PIPE.
11. INLET OPENING SHALL BE 6" MIN OR 8" MAX.
12. 10 FT. MAX DEPTH.

STANDARD DRAWING NO.				
6030D	CURB INLET RECESSED GENERAL NOTES	Kaufman We're Growing Places	STANDARD SPECIFICATION REFERENCE 702	
			DATE AUG '23	STANDARD DRAWING NO. 6030D



#4 BARS A
N.T.S.



#4 BARS B
N.T.S.

BARS C | LGTH.OPEN.+0'-8"
BARS D | LGTH.OPEN.+19'-8"

#4 BARS C & D
N.T.S.

FIELD CUT D BARS AS NECESSARY AT TRANSITIONS

LENGTH OF OPENING + 0'-8"

#4 BARS E
N.T.S.

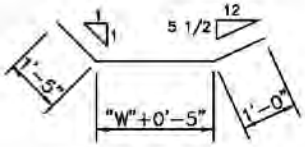
#4 BARS F
N.T.S.

"W"+0'-8"

#4 BARS G
N.T.S.

3'-0"

#4 BARS J
N.T.S.



#3 BARS M
N.T.S.

"W"+0'-8"

#5 BARS N
N.T.S.

STANDARD DRAWING NO. 6030E

CURB INLET RECESSED
REBAR

STANDARD SPECIFICATION REFERENCE 702

DATE AUG '23

STANDARD DRAWING NO. 6030E

BILL OF REINFORCING STEEL

DEPTH "D"	ALL AND WIDTHS LENGTHS				OPENING LENGTH "L" = 5ft						OPENING LENGTH "L" = 10ft						OPENING LENGTH "L" = 15 ft								OPENING LENGTH "L" = 20 ft							
					Widths "W"						Widths "W"						Widths "W"								Widths "W"							
					3ft	4ft	5ft				3ft	4ft	5ft				3ft	4ft	5ft						3ft	4ft	5ft					
	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS
	C	D	E	J	F	F	F	A	B	G	F	F	F	A	B	G	F	F	F	A	B	G	M	N	F	F	F	A	B	G	M	N
3'–6"	17	3	2	4	20	24	28	10	10	20	28	32	36	18	18	28	36	40	44	26	26	36	2	2	44	48	52	34	34	44	2	2
3'–9"	18	"	"	"	"	"	"	"	"	20	"	"	"	"	"	28	"	"	"	"	"	36	"	"	"	"	"	"	"	"	44	"	"
4'–0"	19	"	"	"	"	"	"	"	"	24	"	"	"	"	"	32	"	"	"	"	"	40	"	"	"	"	"	"	"	"	48	"	"
4'–3"	19	"	"	"	"	"	"	"	"	24	"	"	"	"	"	32	"	"	"	"	"	40	"	"	"	"	"	"	"	"	48	"	"
4'–6"	21	"	"	"	"	"	"	"	"	26	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	"	"	"	50	"	"
4'–9"	21	"	"	"	"	"	"	"	"	26	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	"	"	"	50	"	"
5'–0"	21	"	"	"	"	"	"	"	"	26	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	"	"	"	50	"	"
5'–3"	23	"	"	"	"	"	"	"	"	28	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	"	"	"	52	"	"
5'–6"	23	"	"	"	"	"	"	"	"	28	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	"	"	"	52	"	"
5'–9"	25	"	"	"	"	"	"	"	"	30	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	"	"	"	54	"	"
6'–0"	25	"	"	"	"	"	"	"	"	30	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	"	"	"	54	"	"
6'–3"	26	"	"	"	"	"	"	"	"	30	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	"	"	"	54	"	"
6'–6"	27	"	"	"	"	"	"	"	"	32	"	"	"	"	"	40	"	"	"	"	"	48	"	"	"	"	"	"	"	"	56	"	"
6'–9"	27	"	"	"	"	"	"	"	"	32	"	"	"	"	"	40	"	"	"	"	"	48	"	"	"	"	"	"	"	"	56	"	"
7'–0"	29	"	"	"	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	"	"	"	58	"	"
7'–3"	29	"	"	"	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	"	"	"	58	"	"
7'–6"	30	"	"	"	"	"	"	"	"	34	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	"	"	"	58	"	"
7'–9"	31	"	"	"	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	52	"	"	"	"	"	"	"	"	60	"	"
8'–0"	31	"	"	"	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	52	"	"	"	"	"	"	"	"	60	"	"
8'–3"	32	"	"	"	"	"	"	"	"	36	"	"	"	"	"	44	"	"	"	"	"	52	"	"	"	"	"	"	"	"	60	"	"
8'–6"	33	"	"	"	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	54	"	"	"	"	"	"	"	"	62	"	"
8'–9"	34	"	"	"	"	"	"	"	"	38	"	"	"	"	"	46	"	"	"	"	"	54	"	"	"	"	"	"	"	"	62	"	"
9'–0"	35	"	"	"	"	"	"	"	"	40	"	"	"	"	"	48	"	"	"	"	"	56	"	"	"	"	"	"	"	"	64	"	"
9'–3"	36	"	"	"	"	"	"	"	"	40	"	"	"	"	"	48	"	"	"	"	"	56	"	"	"	"	"	"	"	"	64	"	"
9'–6"	37	"	"	"	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	58	"	"	"	"	"	"	"	"	66	"	"
10'–0"	38	"	"	"	"	"	"	"	"	42	"	"	"	"	"	50	"	"	"	"	"	58	"	"	"	"	"	"	"	"	66	"	"

NOTE:

- FOR CONVENIENCE, DEPTHS OF INLETS SHOWN IN ABOVE TABLES ARE IN INCREMENTS OF 3 INCHES BUT ANY DEPTHS OTHER THAN THOSE SHOWN ABOVE MAY BE USED WHEREVER DEEMED NECESSARY. QUANTITIES FOR OTHER DEPTHS FALLING WITHIN THE LIMITS OF THE TABLE MAY BE FOUND BY INTERPOLATION.
- DEPTHS GREATER THAN 10' NEED TO BE STRUCTURALLY ENGINEERED.

STANDARD DRAWING NO. 6030F

CURB INLET RECESSED

BILL OF REINFORCING STEEL

Kaufman
We're Growing Places

STANDARD SPECIFICATION REFERENCE 702

DATE AUG '23

STANDARD DRAWING NO. 6030F

SUMMARY OF QUANTITIES FOR CURB INLETS

DEPTH "D"	5'–0" OPENING						10'–0" OPENING						15'–0" OPENING						20'–0" OPENING					
	WIDTH 3'–0"		WIDTH 4'–0"		WIDTH 5'–0"		WIDTH 3'–0"		WIDTH 4'–0"		WIDTH 5'–0"		WIDTH 3'–0"		WIDTH 4'–0"		WIDTH 5'–0"		WIDTH 3'–0"		WIDTH 4'–0"		WIDTH 5'–0"	
	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.	CONC C.Y.	STEEL LBS.
3'–6"	2.87	324	3.23	357	3.59	390	4.41	496	4.95	540	5.50	584	5.94	684	6.67	742	7.40	799	7.48	858	8.40	926	9.31	995
3'–9"	2.96	333	3.32	367	3.69	401	4.54	512	5.09	556	5.64	601	6.12	706	6.86	764	7.60	822	7.70	886	8.63	955	9.55	1024
4'–0"	3.04	353	3.42	390	3.79	428	4.66	537	5.23	585	5.79	633	6.29	737	7.04	799	7.79	861	7.92	923	8.86	996	9.79	1068
4'–3"	3.12	358	3.51	396	3.89	434	4.79	545	5.37	594	5.94	643	6.47	748	7.23	811	7.99	873	8.14	937	9.09	1010	10.03	1083
4'–6"	3.21	376	3.60	417	4.00	457	4.92	573	5.51	624	6.09	675	6.64	786	7.41	850	8.18	915	8.36	984	9.32	1059	10.27	1134
4'–9"	3.29	382	3.69	423	4.10	464	5.05	581	5.65	633	6.24	684	6.82	796	7.60	862	8.37	927	8.59	997	9.55	1073	10.51	1149
5'–0"	3.37	387	3.79	429	4.20	471	5.18	589	5.79	641	6.38	693	7.00	807	7.78	873	8.57	939	8.81	1011	9.78	1087	10.75	1164
5'–3"	3.46	406	3.88	450	4.30	493	5.31	617	5.92	671	6.53	725	7.17	845	7.97	912	8.76	980	9.03	1057	10.02	1136	10.99	1215
5'–6"	3.54	411	3.97	456	4.40	500	5.44	625	6.06	680	6.68	735	7.35	855	8.15	924	8.96	992	9.25	1071	10.25	1150	11.23	1229
5'–9"	3.62	429	4.06	476	4.50	523	5.57	653	6.20	710	6.83	767	7.52	893	8.34	963	9.15	1034	9.48	1118	10.48	1199	11.48	1280
6'–0"	3.71	435	4.16	482	4.61	530	5.70	661	6.34	719	6.98	776	7.70	903	8.53	975	9.35	1046	9.70	1131	10.71	1213	11.72	1295
6'–3"	3.79	444	4.25	492	4.71	540	5.83	676	6.48	735	7.12	793	7.88	925	8.71	997	9.54	1069	9.92	1159	10.94	1242	11.96	1324
6'–6"	3.87	459	4.34	509	4.81	559	5.96	697	6.62	757	7.27	818	8.05	952	8.90	1026	9.74	1100	10.14	1191	11.17	1276	12.20	1361
6'–9"	3.96	464	4.43	515	4.91	566	6.09	705	6.76	766	7.42	827	8.23	962	9.08	1037	9.93	1112	10.36	1205	11.40	1290	12.44	1376
7'–0"	4.04	482	4.53	536	5.01	589	6.22	733	6.90	796	7.57	859	8.40	1000	9.27	1077	10.12	1154	10.59	1252	11.64	1339	12.68	1427
7'–3"	4.12	488	4.62	542	5.12	595	6.35	741	7.04	805	7.72	869	8.58	1010	9.45	1088	10.32	1166	10.81	1265	11.87	1353	12.92	1442
7'–6"	4.21	497	4.71	552	5.22	606	6.48	756	7.17	821	7.87	885	8.76	1032	9.64	1110	10.51	1189	11.03	1293	12.10	1382	13.16	1471
7'–9"	4.29	512	4.80	568	5.32	625	6.61	777	7.31	843	8.01	910	8.93	1059	9.82	1139	10.71	1219	11.25	1326	12.33	1417	13.40	1508
8'–0"	4.37	517	4.90	574	5.42	632	6.74	785	7.45	852	8.16	919	9.11	1069	10.01	1150	10.90	1231	11.48	1339	12.56	1431	13.64	1522
8'–3"	4.46	526	4.99	584	5.52	642	6.87	800	7.59	868	8.31	936	9.28	1091	10.19	1173	11.10	1254	11.70	1367	12.79	1459	13.88	1551
8'–6"	4.54	541	5.08	601	5.63	661	7.00	820	7.73	891	8.46	961	9.46	1118	10.38	1201	11.29	1285	11.92	1399	13.02	1494	14.12	1588
8'–9"	4.62	550	5.17	611	5.73	672	7.13	836	7.87	907	8.61	978	9.64	1139	10.56	1224	11.49	1308	12.14	1427	13.26	1522	14.36	1617
9'–0"	4.71	565	5.27	628	5.83	691	7.26	856	8.01	929	8.75	1002	9.81	1166	10.75	1252	11.68	1339	12.36	1460	13.49	1557	14.60	1654
9'–3"	4.79	574	5.36	638	5.93	701	7.39	872	8.15	945	8.90	1019	9.99	1187	10.93	1275	11.87	1362	12.59	1487	13.72	1585	14.85	1683
9'–6"	4.87	588	5.45	654	6.03	720	7.52	892	8.29	968	9.05	1044	10.16	1214	11.12	1303	12.07	1393	12.81	1520	13.95	1620	15.09	1720
10'–0"	5.04	603	5.64	670	6.24	738	7.78	916	8.56	993	9.35	1070	10.51	1246	11.49	1337	12.46	1428	13.25	1561	14.41	1662	15.57	1764

NOTE:

— FOR CONVENIENCE, DEPTHS OF INLETS SHOWN IN ABOVE TABLES ARE IN INCREMENTS OF 3 INCHES BUT ANY DEPTHS OTHER THAN THOSE SHOWN ABOVE MAY BE USED WHEREVER DEEMED NECESSARY. QUANTITIES FOR OTHER DEPTHS FALLING WITHIN THE LIMITS OF THE TABLE MAY BE FOUND BY INTERPOLATION.

— DEPTHS GREATER THAN 10' NEED TO BE STRUCTURALLY ENGINEERED.

STANDARD DRAWING NO. 6030G

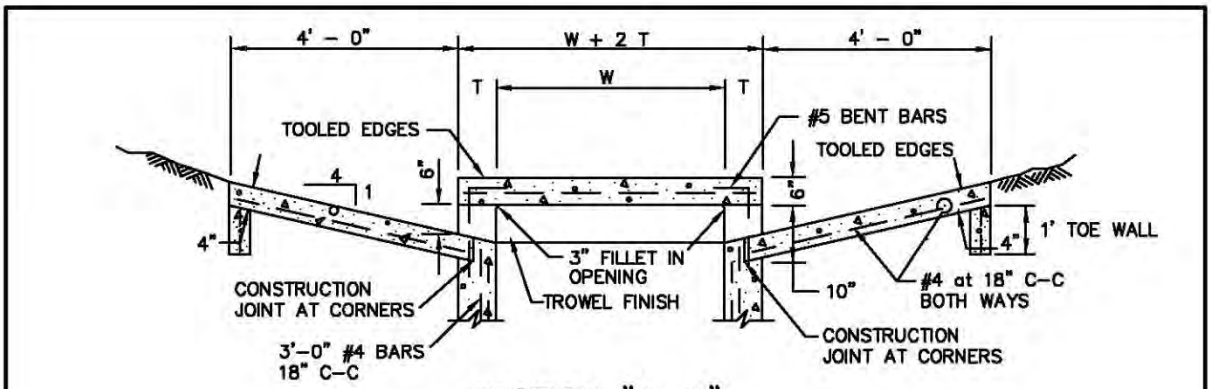
CURB INLET RECESSED
SUMMARY OF QUANTITIES

Kaufman
We're Growing Places

STANDARD SPECIFICATION REFERENCE: 702

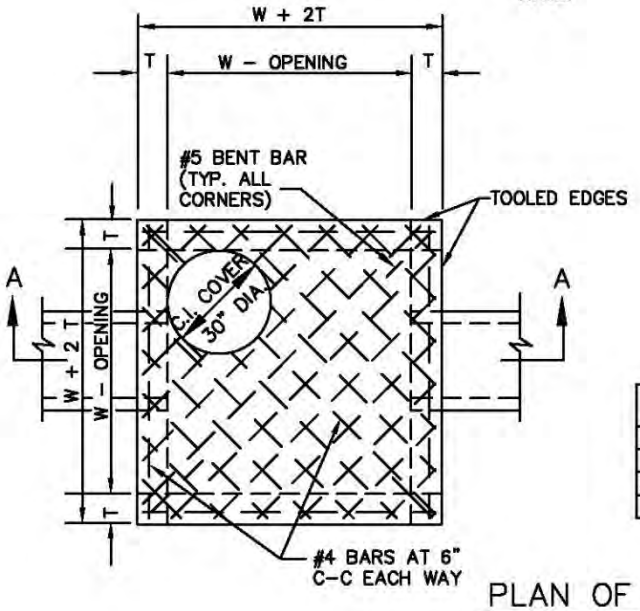
DATE: AUG '23

STANDARD DRAWING NO.: 6030G



SECTION "A–A"

N.T.S.



INLET SIZE	T	W
2' SQUARE	7"	2'–0"
4' SQUARE	7"	4'–0"
5' SQUARE	8"	5'–0"
6' SQUARE	9"	6'–0"

PLAN OF TOP SLAB

N.T.S.

NOTES:

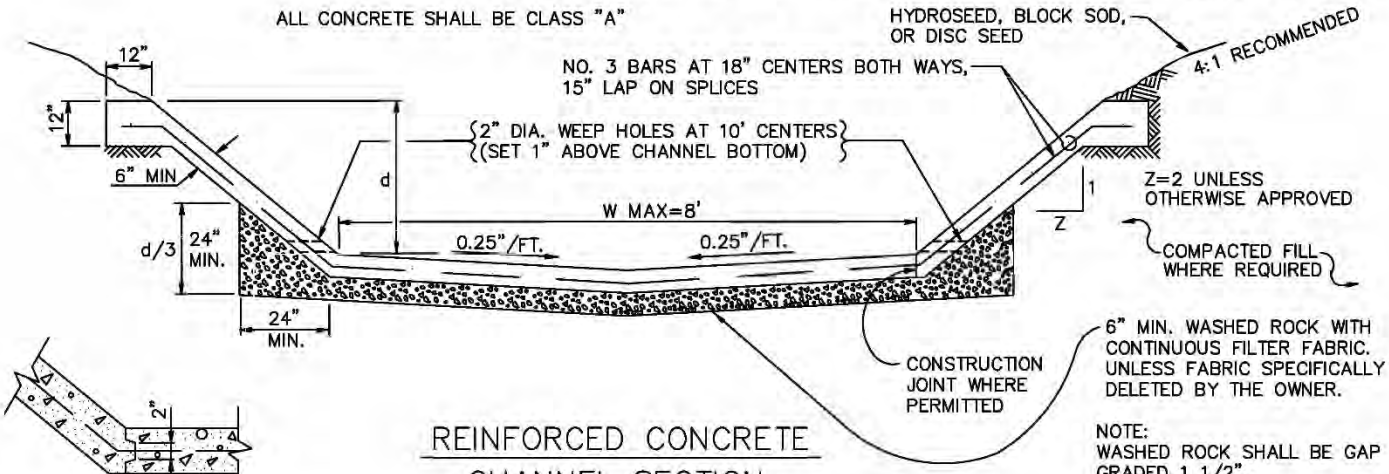
1. MATERIAL AND WORKMANSHIP SHALL CONFORM WITH THE REQUIREMENTS OF NCTCOG STANDARD SPECIFICATIONS FOR STANDARD CONCRETE MANHOLES. MINIMUM CLASS "C" CONCRETE.
2. LAYERS OF REINFORCING STEEL NEAREST THE INTERIOR AND EXTERIOR SURFACES SHALL HAVE A COVER OF 2" CLEAR OF BARS, UNLESS OTHERWISE NOTED.
3. FOR DETAILS OF REINFORCING OF LOWER PORTION OF INLET SEE APPROPRIATE SQUARE MANHOLE DETAILS.
4. DEPTH OF DROP INLET FROM FINISHED GRADE TO FLOW LINE OF INLET IS VARIABLE. APPROXIMATE DEPTH WILL BE SHOWN ON PLANS AT LOCATION OF INLET.
5. ALL STANDARD DROP INLETS SHALL HAVE ONE OPENING ON EACH SIDE UNLESS OTHERWISE SHOWN ON PLANS.
6. TOP SLAB MAY BE REINFORCED SAME AS 4' SQUARE MANHOLE.
7. PRECAST PRODUCTS MAY BE USED AT THE APPROVAL OF THE OWNER.
8. ALLOW 1" MIN CLEAR SPACE BETWEEN OD OF PIPE OR BOX AND INSIDE WALL OF INLET (OD OF PIPE OR BOX SHOULD ACCOUNT FOR SKEWED CONDITIONS).
9. DEPTHS OF GREATER THAN 10' NEED TO BE STRUCTURALLY ENGINEERED.

DROP INLET		STANDARD SPECIFICATION REFERENCE 702	
2', 4', 5', OR 6' SQUARE		DATE AUG '23	STANDARD DRAWING NO. 6040

FILL AREAS SHALL BE COMPACTED TO 95% STD. PROCTOR DENSITY AT OPTIMUM MOISTURE CONTENT PRIOR TO CHANNEL EXCAVATION.

* GEO TEXTILE RECOMMENDED AT CONNECTION OF TOP OF SLOPE TO EARTHEN MATERIAL.

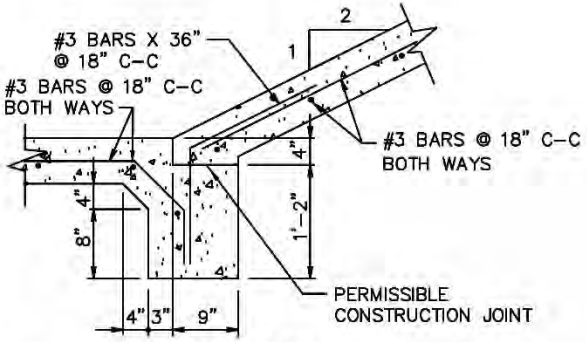
ALL CONCRETE SHALL BE CLASS "A"



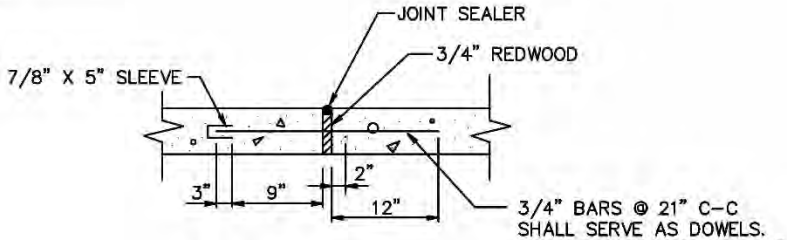
NOTE:
WASHED ROCK SHALL BE GAP GRADED 1 1/2".

REINFORCED CONCRETE CHANNEL SECTION
N.T.S.

CONSTRUCTION JOINT
N.T.S.



ALTERNATE CONSTRUCTION JOINT
N.T.S.



TRANSVERSE EXPANSION JOINT
SPACE 100' C-C AND USE AT ENDS OF CURVES – P.C. AND P.T.
N.T.S.

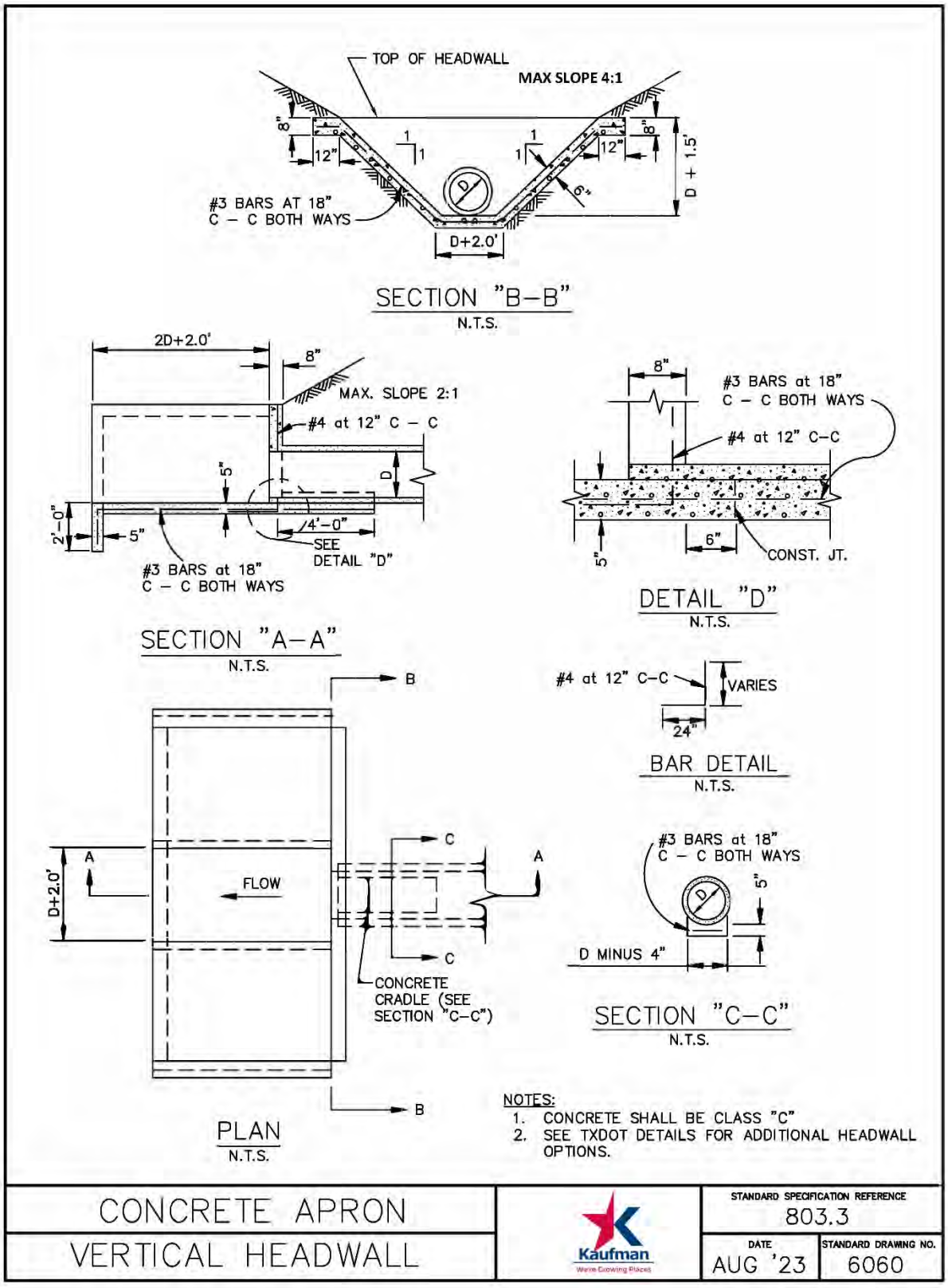
STANDARD DRAWING NO. 6050

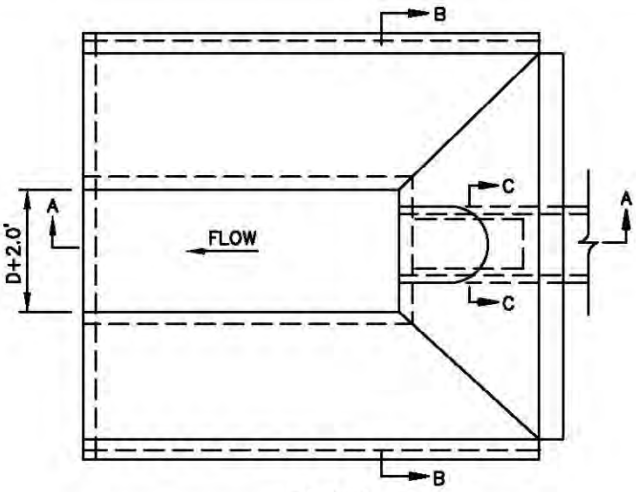
FULL CHANNEL LINING
CONCRETE REINFORCED

STANDARD SPECIFICATION REFERENCE: 803.3

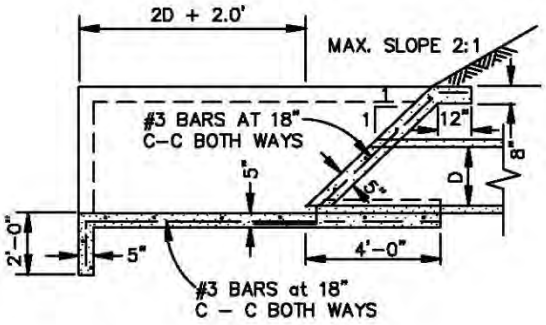
DATE: AUG '23

STANDARD DRAWING NO.: 6050

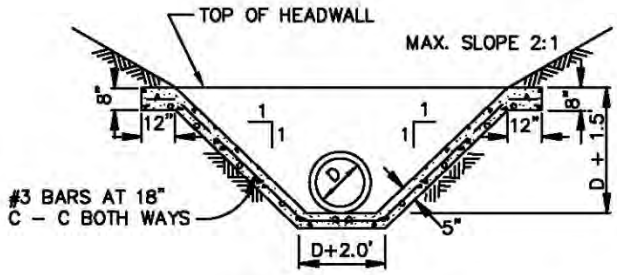

TOP OF HEADWALL
MAX SLOPE 4:1
8"
12"
1
1
1
1
12"
8"
D + 1.5'
6"
#3 BARS AT 18"
C – C BOTH WAYS
D
D+2.0'
SECTION "B–B"
N.T.S.
2D+2.0'
8"
MAX. SLOPE 2:1
#4 at 12" C – C
5"
D
2'–0"
5"
4'–0"
SEE
DETAIL "D"
#3 BARS at 18"
C – C BOTH WAYS
SECTION "A–A"
N.T.S.
8"
#3 BARS at 18"
C – C BOTH WAYS
#4 at 12" C–C
5"
6"
CONST. JT.
DETAIL "D"
N.T.S.
#4 at 12" C–C
VARIES
24"
BAR DETAIL
N.T.S.
B
A
D+2.0'
FLOW
C
A
C
CONCRETE
CRADLE (SEE
SECTION "C–C")
B
PLAN
N.T.S.
#3 BARS at 18"
C – C BOTH WAYS
D
5"
D MINUS 4"
SECTION "C–C"
N.T.S.
NOTES:
1. CONCRETE SHALL BE CLASS "C"
2. SEE TXDOT DETAILS FOR ADDITIONAL HEADWALL OPTIONS.
CONCRETE APRON
VERTICAL HEADWALL
Kaufman
We're Growing Places
STANDARD SPECIFICATION REFERENCE
803.3
DATE
AUG '23
STANDARD DRAWING NO.
6060



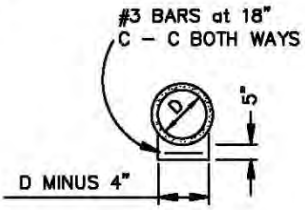
PLAN
N.T.S.



SECTION A–A
N.T.S.



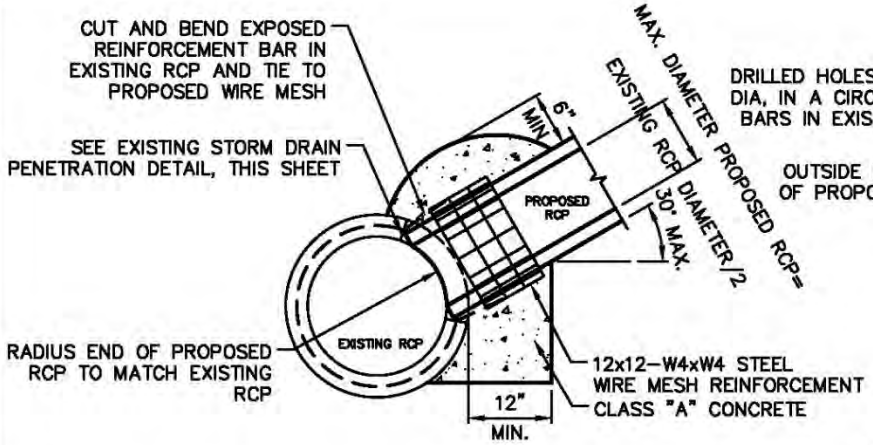
SECTION B–B
N.T.S.



SECTION C–C
N.T.S.

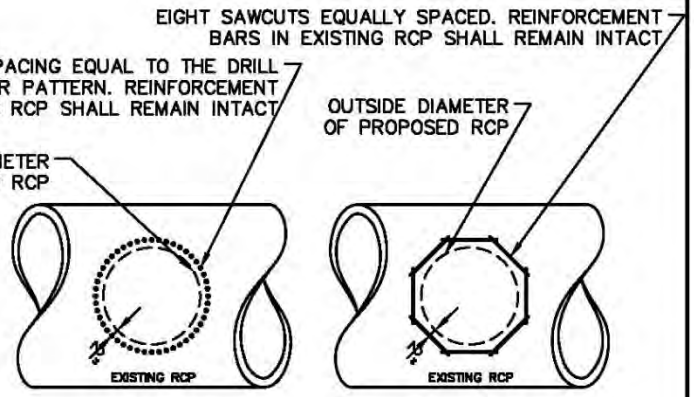
NOTES:
1. CONCRETE SHALL BE CLASS "A".
2. WHEN SITE IT NOT APPLICABLE, SEE TXDOT

CONCRETE APRON		STANDARD SPECIFICATION REFERENCE 803.3	
SLOPING HEADWALL		DATE AUG '23	STANDARD DRAWING NO. 6070



CONNECTION OF PROPOSED TO EXISTING RCP STORM DRAIN

N.T.S.

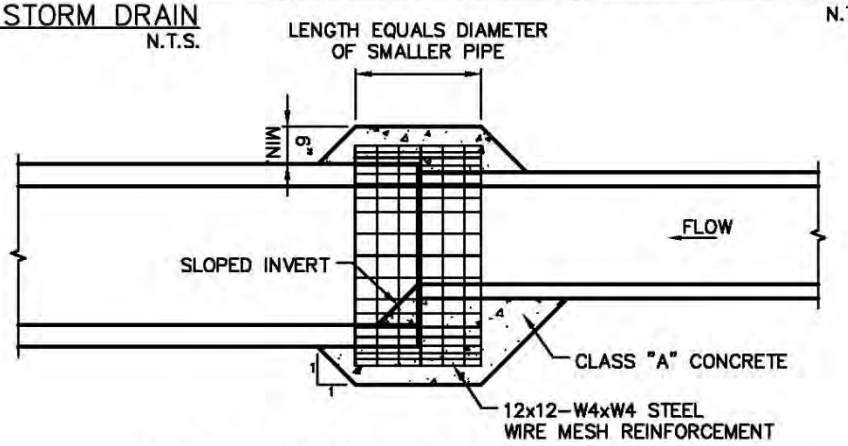


EXISTING STORM DRAIN PENETRATION METHODS

N.T.S.

NOTES:

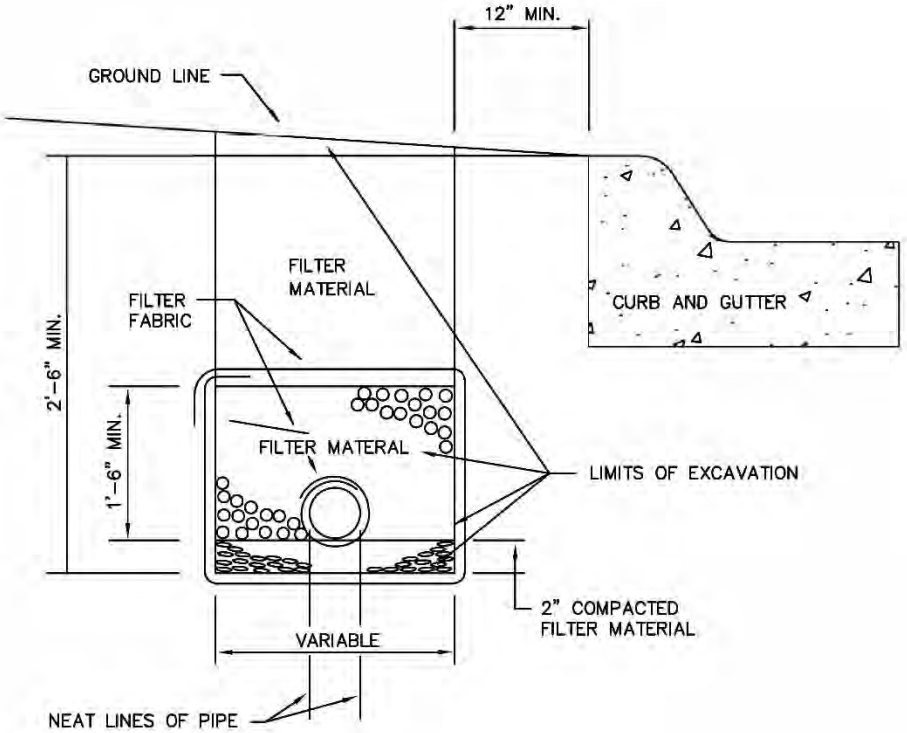
1. THE CONNECTION METHODS SHOWN ON THIS DETAIL SHALL ONLY BE EMPLOYED WHEN THE USE OF A PREFABRICATED RCP CONNECTION IS NOT POSSIBLE, AND WITH THE APPROVAL OF THE OWNER.
2. NO. 3 BARS ON 6" CTRS. MAY BE USED IN PLACE OF WIRE MESH REINFORCEMENT.
3. FOR OTHER PIPE MATERIALS, REFER TO MANUFACTURER'S DETAILS.



PIPE COLLAR FOR FIELD CONNECTION

N.T.S.

STANDARD DRAWING NO. 6080	STORM DRAIN PIPE COLLAR FOR FIELD CONNECTION	Kaufman We're Growing Places	STANDARD SPECIFICATION REFERENCE 501, 702	
			DATE AUG '23	STANDARD DRAWING NO. 6080



SECTION
N.T.S.

LIMITS OF EXCAVATION

DEPTH OF TRENCH (FT.)	DIST. IN FT. OUTSIDE NEAT LINES OF PIPE SUBDRAIN
0 TO 6	1.00
6 TO 10	1.50
10 TO 15	2.00
OVER 15	2.50

FILTER MATERIAL SPECIFICATIONS

SIEVE SIZE	PERCENTAGE RETAINED ON SIEVE TYPE A	TYPE B
1 1/2	——	0 – 10
3/4	0 – 10	20 – 40
3/8	15 – 35	——
NO. 4	35 – 55	40 – 60

MATERIAL FINER THAN NO. 4 SIEVE	
4	——
20	35 – 65
50	75 – 100

TYPES OF PIPE ACCEPTABLE FOR USE AS SUBDRAIN

1. PERFORATED PVC PIPE.
2. PERFORATED POLYETHYLENE PIPE.

SUBDRAINS PAVEMENT SUBGRADE		STANDARD SPECIFICATION REFERENCE 301
		DATE AUG '23 / STANDARD DRAWING NO. 6090