City of BRENHAM

Website: cityofbrenham.org
Phone - Main Line: 979-337-7200
Development 979-337-7220 | Utilities 979-337-7401
200 W. Vulcan, Brenham, Texas 77834

PUBLIC INFRASTRUCTURE DESIGN MANUAL

Version 2021-1

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

PURPOSE

This *Public Infrastructure Design Manual* is intended to set a standard of design for public infrastructure in the City of Brenham and the City of Brenham's extraterritorial jurisdiction that is consistent, cost-effective, efficient, maintainable, and protects public safety. These standards are a guide for design, but not a substitute for good engineering. It is the obligation of the designer to use these standards responsibly and professionally to produce designs conforming to commonly accepted engineering practices. It may at times be desirable or necessary to vary from the standards in this manual to produce a product in accordance with these goals. When the need arises, please refer to the section on exceptions.

Any reference by this manual to any law, regulation, rule, publication, or any other source shall refer to the most recently adopted, promulgated, or otherwise effective version applicable as such may be amended from time to time.

ADOPTION

ORDINANCE NO. 0-22-021

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF BRENHAM, TEXAS, ADOPTING THE PUBLIC INFRASTRUCTURE DESIGN MANUAL AS APPENDIX "F" OF THE CODE OF ORDINANCES OF THE CITY OF BRENHAM, TEXAS; REPEALING ALL ORDINANCES IN CONFLICT HEREWITH; PROVIDING FOR A SEVERABILITY AND SAVINGS CLAUSE; AND PROVIDING FOR AN EFFECTIVE DATE.

PASSED and APPROVED on its first reading this the 1st day of September 2022.

PASSED and APPROVED on its second reading this the 15th day of September 2022.

CITY OF BRENHAM TEXAS

Milton Y. Tate, Jr.
Mayor

ATTEST:

Jeana Bellinger, TRC, CMC
City Secretar

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

TABLE OF CONTENTS

City of BRENHAM
200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

Chapter 5 – Stormwater System Design Requirements

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

Chapter 6 – Paving

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

City of BRENHAM

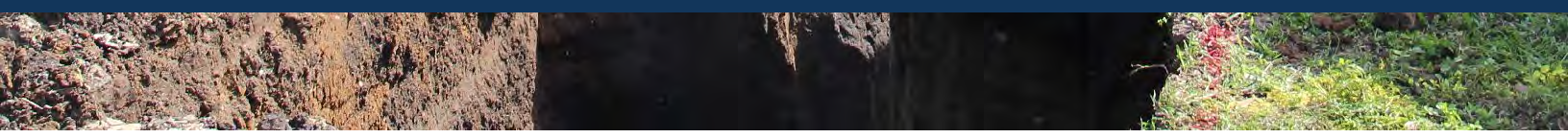
Website: cityofbrenham.org
Phone - Main Line: 979-337-7200

Development	Utilities
979-337-7220	979-337-7401

200 W. Vulcan, Brenham, Texas 77834

PUBLIC INFRASTRUCTURE DESIGN MANUAL

CHAPTER 1 - GENERAL



Version 2021-1

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

CHAPTER 1
GENERAL

1.01 GENERAL

A. This chapter describes the general requirements of the construction process, the preparation of construction drawings, the supporting documents required within the City limits, and the extraterritorial jurisdiction of the City of Brenham (City). This chapter also describes procedural requirements for the construction process.

B. The City of Brenham Development Services Department shall approve construction drawings for public improvements within the City limits or applicable properties in the extraterritorial jurisdiction. Applicable properties located in the extraterritorial jurisdiction shall mean properties receiving City services including but not limited to water, sanitary sewer, gas, electric and/or discharging into the public storm sewer system.

C. Construction drawings for private improvements within public right-of-way and public easements that connect to or affect the public infrastructure shall be approved by the City subject to the requirements of this Design Manual (Manual) and are subject to review and approval using the process defined in this manual.

D. City staff and or their designee will be available for preliminary meetings to discuss a proposed project with the Project Engineer.

E. Materials and manufactured items used in construction of an infrastructure project shall be approved by the City before installation. Water, wastewater, and drainage system appurtenances shall be subject to the approved items as listed in the Approved Products List, (which is included in Appendix A of this manual). Items not appearing on the approved list shall not be used for construction of public infrastructure in the City.

F. It may at times be desirable or necessary to vary from the standards in this manual to produce a product in accordance with these goals. Exceptions to these standards are authorized only if approved in writing by the City. Exception request must be submitted at the time of the original construction drawing submittal. Persons seeking an exception to these standards shall submit to the Development Services Department a request explaining what exception is being requested, why the exception is being requested, and an explanation of how or why the resulting product will be equivalent or superior to the product that would result from constructing the improvement in strict accordance with these standards.

G. Upon receipt of an exception request, the City shall approve or disapprove such request within 30 business days. Construction work related to the request should not begin before approval. Any construction work related to the request that proceeds without approval shall be subject to removal and replacement at the cost of the party who performs such construction work.

1.02 References

All projects that are required to conform to these standards shall also be in compliance with all applicable City ordinances. All construction drawings and supporting documentation shall conform to the requirements of these standards and all applicable regulations of all federal, state, county, and local entities having jurisdiction.

Relevant related laws and regulations include, but are not limited to, the following:

A. City of Brenham

1. Utilities, Chapter 26 of the City Code.
2. Flood Damage Prevention, Chapter 8 1/2 of the City Code.
3. Subdivisions, Chapter 23 of the City Code.
4. Zoning, Appendix A of the City Code.
5. Building and Structure, Chapter 6 of the City Code.
6. Fire Protection and Prevention, Chapter 8 of the City Code.

B. State of Texas

1. Texas Accessibility Standards (TAS), pursuant and subject to the Texas Government Code, Chapter 469, and the Texas Administrative Code, Title 16, Chapter 68.
2. Rules and Regulations published by the Texas Commission on Environmental Quality (TCEQ):
    a. Rules and Regulations for Public Water Systems, Texas Administrative Code, Title 30, Chapter 290, Subchapter D.
    b. Design Criteria for Domestic Wastewater Systems, Texas Administrative Code, Title 30, Chapter 217.
    c. TCEQ storm water pollution prevention protection standards.
3. State of Texas Engineering Practice Act, Texas Occupational Code, Chapter 1001.
4. Professional Land Surveying Practices Act, Texas Occupational Code, Chapter 1071.
5. Texas Manual on Uniform Traffic Control Devices.

C. National

1. Americans with Disabilities Act, 42 U.S.C § 12101 et seq and regulations, 28 CFR Part 36.
2. American Association of Highway and Transportation Officials, A policy on Geometric Design of Highways and Streets.
3. Institute of Transportation Engineers, Traffic Engineering Handbook.
4. Highway Capacity Manual, National Research Council, Transportation Research Board.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

1.03 Definitions

For the purpose of this Manual, the following words and phrases shall have the meanings respectively ascribed to them by this section.

Approved Products List – List of approved products that can be used for construction in the City. This list is included in Appendix A of this manual and may be updated periodically.

City Code – The code or ordinances of the City of Brenham, Texas.

Collector Streets – Street routes that have short travel distances and collect traffic from intra-city streets and funnel it into major thoroughfares or other collector streets.

Commercial Driveway Approach – The portion of a driveway within the public right-of-way that provides access to property on which an office, retail commercial center, or a building having more than three dwelling units is located or any driveway approach that accesses property primarily used for nonresidential purpose.

County – The applicable political subdivision of the State of Texas in which a subject tract is located in; Brenham, Texas city limits and its extraterritorial jurisdiction is within Washington County.

Design Analysis – Narrative and calculation necessary to support design of a project.

Director of Public Works – The Director of Public Works or his designee.

Drawings – Plan, profile, detail and other graphic sheets to be used in a construction contract, which define character and scope of the project.

Driveway – Entrance to and exit from premises where it is possible to park completely off the street, and which is not open for vehicular traffic except by permission of the owner of said private property.

Driveway Approach – A way or place including paving and curb returns between the street travel lanes and private property that provides vehicular access between the roadway and said private property.

Dwelling Unit – A building or portion thereof designed exclusively for residential occupancy.

Highway, Street, or Roadway – A general term denoting a public or private way for the purpose of vehicular travel.

Infrastructure – Any facility or structure proposed to be constructed, reconstructed, repaired, or regraded wholly or partially within right-of-way public easements or connecting to right-of-way, including, but not limited to, streets, driveways, sidewalks, curbs, gutters, culverts, open ditches, storm drains, and irrigation facilities owned or maintained by a public entity.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

Intersection – The area embraced within the prolongation or connection of the lateral curb lines, or, if none, then the lateral boundary lines of two or more roadways. This includes public street, private street, commercial driveway, residential driveway, driveway approach, alley or combination thereof that join one another at, or approximately at, right angles, or the area within which vehicles traveling upon different roadways joining at any other angle may come into conflict.

Major Thoroughfare – Highways, streets, and roadways devoted to moving large volumes of traffic over long distances. Major thoroughfares shall be set forth in the Major Thoroughfare Plan adopted by the City Council and may be amended, periodically.

Professional Engineer – An engineer currently licensed by, and in good standing with the Texas Board of Professional Engineers.

Professional Land Surveying – A surveyor currently registered with and in good standing with the State of Texas Board of Professional Land Surveying.

Project Engineer Representative – A representative of the design engineer who possesses the knowledge, skills and abilities to carry out inspection duties to insure compliance with the approved drawings and specifications.

Private Projects or Private Improvements – All projects involving construction, reconstruction, modification or maintenance of privately owned or maintained facilities including, but not limited to, buildings, parking lots, utility systems, private shared-access drives, and any facility supporting functions within private property boundaries.

Public Improvements, or Public Projects – All projects involving construction, reconstruction, modification or maintenance of public infrastructure, including, but not limited to, streets, drainage facilities, water and wastewater systems, construction in public right-of-way or easements. Any project that will be accepted for permanent maintenance by a public agency or political subdivisions of the State of Texas. Any project subject to review and approval by the terms of Section 1.01 of this chapter.

Residential Developments – Residential developments shall mean all areas identified as residential under the Brenham Zoning Ordinances or otherwise zoned or devoted primarily to residential use.

Residential Driveway Approach – The portion of a driveway within the public right-of-way that provides access to property on which a single-family residence, duplex, or multi-family building containing three or fewer dwelling units is located.

Residential Streets – Street routes that provide access to local property owners and which connect property to major thoroughfares or collector street networks.

Residential Structure – A single-family home, apartment house, townhouse, condominium or any other type of dwelling unit.

Revegetation – Restoration of existing ground cover for all areas disturbed by construction activities. Revegetation may include applying hydro-mulch or sod to the disturbed area. In accordance with TCEQ Stormwater Control requirements, vegetative cover must be restored to 70% of its original condition prior to removal of erosion or sediment controls (ESC's).

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

Review Authorities – The authorized representatives of City departments, divisions, or sections responsible for reviewing and approving calculations and drawings for privately funded projects, and for design and construction contracts with the City.

Right-of-way – Property that is publicly owned or upon which a governmental entity has an express or implied property interest (e.g., fee title and easements) held for a public purpose. Examples of such public purpose include by way of example and not limitation, highways, streets, sidewalks, drainage facilities, sewerage and water facilities.

Sidewalk – The section of pavement between the curb lines of a roadway and the adjacent property lines or located within an easement intended for the use of pedestrians.

Specification – City of Brenham Standard Specification plus project-specific narrative descriptions of procedures, requirements, and materials for particular project.

Standard Construction Details – This is a separate document that contains the City construction details and may be updated periodically.

Standards – The requirements of this Manual.

Subdivision Ordinance – Chapter 23 of the City code as it may be amended from time to time.

Traffic Impact Analysis – A study performed by engineers with expertise in traffic engineering principles and practice that reviews development of a specific property and how it integrates into the existing City Street network. The analysis uses data and conclusions developed in previous studies and identifies improvements needed to mitigate the impact of traffic generated by a development on the street network system.

1.04 CONSTRUCTION DRAWING REVIEW PROCESS

A. A recorded plat shall be on file with the Washington County Clerk prior to final approval of the construction plans. A copy of the final, recorded plat is required in all plan sets, before approval for permitting or as permitted in accordance with Chapter 23 – Subdivision of the Code of Ordinances. All separate or special easements that may be required for construction shall be recorded in Washington County Official Records prior to final approval of the construction drawings.

B. The applicant shall submit complete drawings for each review phase in accordance with the Development Services Application Procedures and Standard Forms. A project number will be assigned to all projects and this number will be stated on the returned plan review. Please reference the number in all correspondence relating to that project. Drawings will be reviewed, and typed comments will be returned to the submitting design professional in a timely manner.

C. If a project has begun the review process but becomes inactive for a period of 12 months from the date of the last correspondence, the project will be considered stopped. Projects reactivated after 12 months of inactivity will be treated as new submittals, subject to all current requirements and changes in codes or ordinances.

D. Submit an indexed listing of all expectation or deviations from the requirements of the Manual or the Standard Construction Details with the original drawing submittal.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

E. Signature of the Director of Development Services or his/her designee on approved construction drawings for utilities that are intended to remain private, does not infer acceptance of the City for ownership or maintenance or operation of facilities indicated on the drawings.

1.05 QUALITY ASSURANCE

A. Surveying and platting shall be accomplished under direction of a Professional Land Surveyor. Recording documents shall be sealed, signed, and dated by a Professional Land Surveyor.

B. Engineering calculations shall be prepared by or under direct supervision of a Professional Engineer trained and licensed in disciplines required by the project scope and sealed by the Professional Engineer. Final engineering design drawings shall be sealed, signed, and dated by the Professional Engineer responsible for development of the drawings.

C. Final architect design drawings shall be sealed, signed, and dated by the licensed Architect responsible for development of the drawings.

D. Final irrigation design drawings shall be sealed, signed, and dated by either a Texas Professional Engineer, a licensed irrigator, or a licensed Landscape Architect.

1.06 CAPACITY ALLOCATIONS

A. Construction drawing approval shall not infer that capacity is committed for service to the property. A capacity allocation for service to the development and approval of the connection design shall be secured separately prior to connection to water and wastewater facilities.

B. Prior to beginning construction on a project, a current commitment of drainage capacity for the proposed development, including the status of any drainage fees that may be due or have been paid, will be required. The commitment shall be issued by the relevant agencies such as Washington County or the City, as applicable.

1.07 CONSTRUCTION PROCEDURE REUIREMENTS

A. Construction on Public Projects and within public rights-of-way and easements shall not begin until construction drawings are approved by the City, and a Construction Permit has been issued. A schedule of fees is on file in the Development Services Department. Construction shall not begin within an existing easement of right-of-way until all permits, or any right-of-way use agreements are negotiated between the affected parties.

B. Schedule a preconstruction meeting with the City at least 48 hours prior to the desired start of construction for the project.

C. The City will make periodic inspections. The City shall be notified at least 24 hours prior to each time concrete is placed on the project. The City shall be notified at least 24 hours prior to all pipe inspection tests and other tests that may be required. All Saturday construction shall be scheduled with the City at least 48 hours in advance. There will be no construction or inspections made on Sundays except in the event of an emergency. Request for Sunday or holiday construction or inspections shall be made in writing and submitted to the City for approval not later than 72 hours prior to the intent. All Saturday, Sunday, or holiday inspections will be on fee basis paid directly to the City prior to final approval of the project. A schedule of fees is on file in the Development Services Department.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

D. Notify the City staff at least 48 hours prior to a final inspection. The City staff and representative of all entities having jurisdiction shall be present during all final inspections (i.e., TCEQ, TxDOT, etc.).

E. For all projects, upon request, all delivery tickets for material (e.g., concrete, cement stabilized sand) shall be submitted to the Development Services Department. These delivery tickets shall be maintained by the Engineer of Record for a minimum of one year from the completion of the project.

F. Significant changes from approved construction drawings shall be approved by the Development Services Department prior to construction. The Project Engineer will submit revised plans to the Development Services Department for re-approval. The Development Services Department will respond in writing within ten working days.

G. Competent, full-time resident inspection by the Project Engineer's representative shall be provided at all critical points of construction and as deemed necessary by the City. Critical points of construction include, but are not limited to, operations involving inspection of bedding and pipe prior to backfilling, placing and compaction of backfill, placement of structural concrete and paving, sidewalk placement, and all on-site testing activities.

H. A certified testing laboratory shall be on site to perform applicable test required so that construction practices and material conform to drawing and specification requirements.

I. All disturbed areas must be properly revegetated prior to demobilization and acceptance of project.

1.08 APPROVAL AND ACCEPTANCE

A. Public projects shall have the final approval of the Development Services Department prior to placing the facilities in service.

B. Infrastructure projects within the City and extraterritorial jurisdiction will be subject to a one-year maintenance period. An inspection before the end of the maintenance period of an infrastructure project shall be conducted by the Public Projects staff and all other entities having jurisdiction and a punch list of items to correct shall be issued. If the punch list items are not corrected and accepted by the City within 30 days from the generation of the punch list, the project shall be subject to re-inspection and the generation of a new punch list.

C. The Engineer of Record or Developer shall contact the City to schedule the one-year maintenance inspections. Maintenance bonds are required to be in force until final acceptance by the City. Before final acceptance by the City, Owner shall be responsible for all maintenance. All facilities, including street lighting and electricity in lift stations, shall be operational and in good condition before final acceptance of a project.

D. Acceptance into the one-year maintenance period shall be granted by the City when the items listed in Section 23-31 of the City of Brenham Code of Ordinances are complete.

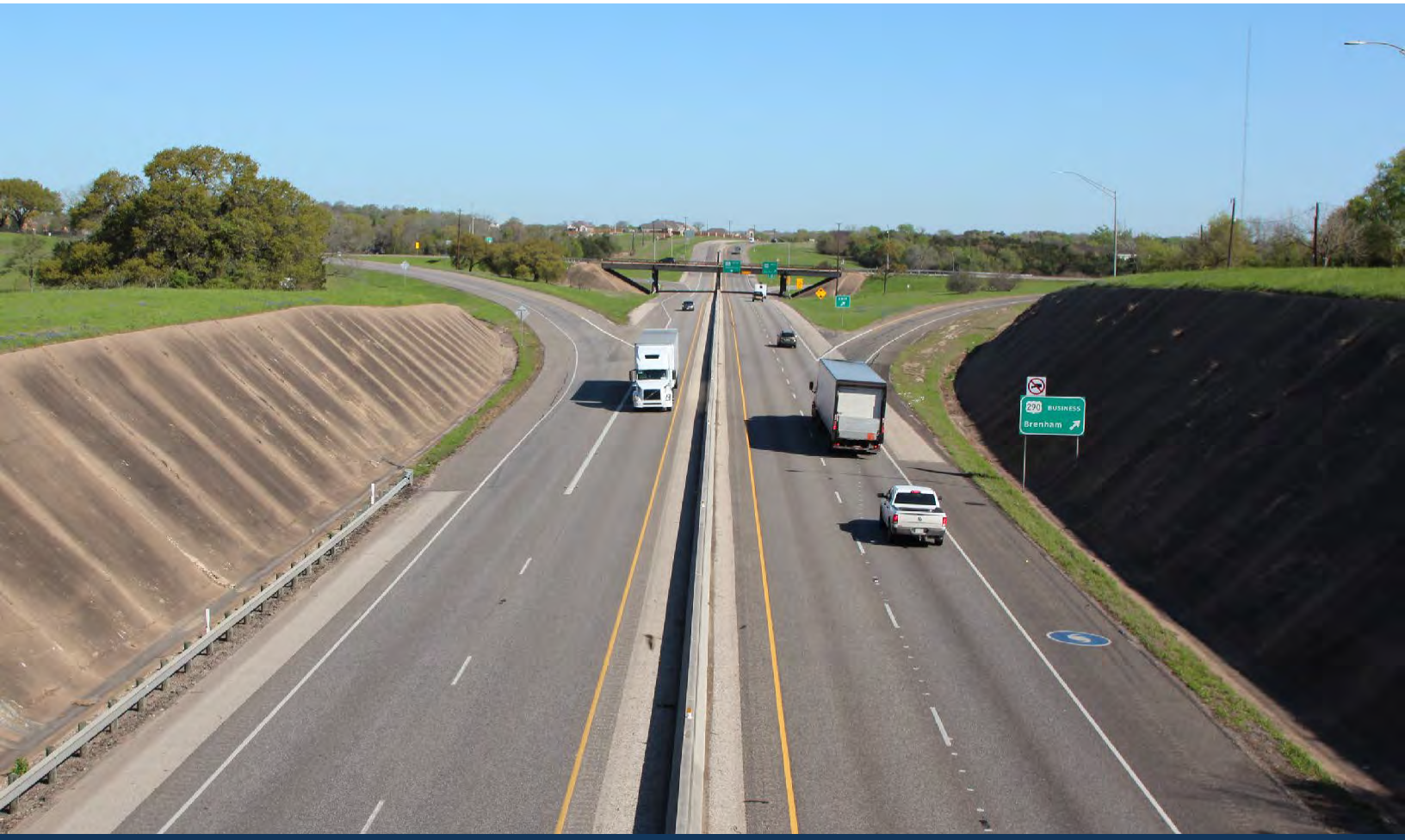
200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

E. The project can be considered complete when the project closeout documents listed in Section 23-31 of the City of Brenham Code of Ordinances are properly submitted and accepted by resolution by the City of Brenham City Council.

F. Until such time as the project is complete, in accordance with 1.08E above, all infrastructure shall remain the property of the developer and the sole responsibility for any and all line marking, maintenance, and/or repair shall remain that of the developer.

END OF CHAPTER

Website: cityofbrenham.org
Phone - Main Line: 979-337-7200
Development | Utilities
979-337-7220 | 979-337-7401
200 W. Vulcan, Brenham, Texas 77834



PUBLIC INFRASTRUCTURE DESIGN MANUAL

CHAPTER 2 - RIGHT-OF-WAY USE

Version 2021-1

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

CHAPTER 2
RIGHT-OF-WAY USE

2.01 GENERAL

A. These standards describe the general requirements for the use of public rights-of-way and public easements and the supporting documents required for permit approval by the City. These standards also address the location requirements for franchise utilities.

B. The City Development Services Department shall approve and permit all activity within the public rights-of-way and public easements within the City.

C. Construction drawings for private improvements within public rights-of-way and public easements, or that connect to or affect the public infrastructure, shall be approved by the City subject to the requirements of this Manual and are subject to review and approval using the process defined in this Manual.

D. Permit fees shall be assessed in accordance with the latest Fee Schedule adopted by the City Council and applicable state and federal law.

E. In exercising its police powers as necessary to protect the health, safety, and welfare of the public, the City has first priority over all other uses of the public right-of-way and public utility easements. The City reserves the right to, among other things, lay water, sewer, drainage, and other pipelines, cables, or conduits; complete underground and overhead work; add improvements such as attachments, restructuring, or changes in street facilities across, along, over, or under a public street, alley or right-of-way occupied by an agency or right-of-way user; and to change the curb, sidewalks, or the grade of streets.

F. All transmission, distribution, and collection structures, lines, equipment, trees, and other facilities erected by a right-of-way user within the City shall be so located as to cause minimum interference with the proper use of the right-of-way, and to cause minimum interference with the rights and reasonable convenience of property owners who join any of said streets. The City reserves the right (in permit or otherwise) to restrict or determine the route (pathway) or spatial location, whether horizontal, vertical, or depth, of any facility or structure or improvement in the public right-of-way or public utility easements. The City reserves the right to reserve space for future utilities.

G. The right-of-way user shall be responsible for stormwater management, erosion control, and excavation safety measures that comply with City, state, and federal guidelines. Requirements shall include, but not limited to, construction fencing around any excavation that will be left overnight, silt fencing in erosion areas until reasonable vegetation is established, and barricade fencing around open holes.

H. The City shall take reasonable precautions, but is under no obligation, to protect non-City-owned facilities during the course of roadway maintenance and improvements. The City will make reasonable efforts to notify known users within 2 feet of back-of-curb of planned roadway maintenance or improvements that may impact their facilities. It is the responsibility of the installer or owner of the facilities to protect their facilities and to remove or adjust the location of their facilities as appropriate.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

2.02 DEFINITIONS

For the purpose of this chapter, the following words and phrases shall have the meanings respectively ascribed to them by this section.

Emergency Operations – Those operations and repairs necessary to prevent damage or injury, maintain the health or safety of the public or any person, and the work necessary to address or prevent an immediate service interruption. Upgrading of facilities, new service installation, and neighborhood improvement project are not emergency operations.

Excavation – Any activity that removes or otherwise disturbs soil, pavement, driveways, curbs, or sidewalks in the right-of-way.

Facilities – The equipment and property including, but not limited to, lines, poles, mains, pipes, conduits, ducts, cables, valves, manholes, handholes, and wires located under, on, or above the surface of the ground within the right-of-way, and related facilities and equipment used or useful for the provision of utility services.

Pavement – Refers to the surface of streets containing Portland cement or asphalt that covers the underlying subgrade and base.

Permit – A permit issued by the City authorizing work in the right-of-way.

Permittee – Any person or right-of-way user to whom a permit is issued to excavate a right-of-way.

Repair – The temporary or permanent construction work necessary to make the right-of-way useable.

Repair area – The area around an excavation where the pavement and subgrade are impacted by the excavation.

Restoration – The process by which an excavation right-of-way and surrounding area, including, but not limited to, pavement and foundation structures, ground cover, landscaping, and monuments are returned to the same condition, or better than that which existed before the commencement of the work.

Right-Of-Way or Public Right-of-Way (ROW) – The area on, below, adjacent to, or above a public roadway, street, public sidewalk, alley, waterway, or utility easement in which the municipality has an interest, and shall include, but not limited to, all easements now held, or hereafter held, by the City, but shall specifically exclude private property.

ROW User – A person, its successors, and assigns, that uses the ROW for purpose of work, excavation, provision of services, or installing constructing, maintaining, or repairing facilities thereon including, but not limited to, landowner and service providers.

Routine Service Operation – A work activity that makes no material change to the facilities and does not disrupt traffic.

Street – The paved portion of the ROW that has been constructed or resurfaced with concrete asphalt, or some other surface.

TMUTCD – The Texas Manual on Uniform Traffic Control Devices, latest edition.

Utility – Any private or publicly owned entity that uses ROW to furnish the public any general public service including (without limitations) sanitary sewer, gas, electricity, water, telephone, petroleum products, telegraph, heat, stream, or chilled water, together with the equipment, structures, and appurtenances belonging to such entity and located within and near the ROW.

2.03 ROW PERMITS

A. Any disturbance within the roads, streets, and easements of the City requires a ROW use permit. Such disturbances include digging or excavating anywhere within the ROW, installation, replacement, or repair of lines, conduits, and franchise utilities, erection of utility poles, installation of lights, transformers, switches, and other appurtenances, installing, removing, or repairing curbs, gutters, sidewalks, driveway aprons, irrigation systems, planting trees, or other improvements. Excavations for telecommunication service drops that are completed within 48 hours are excluded from the need to obtain a ROW use permit.

B. A ROW use permit is not required for street construction projects undertaken by the City pursuant to a contract between the City and its Contractor for projects permitted under other City permits or for those uses that the Public Projects staff finds to be minor in nature.

C. A ROW use permit is not required for routine maintenance of existing utilities within the ROW that does not require a lane closure in excess of two hours and will be completed in the same calendar day. However, maintenance activity that involves an excavation or boring within the ROW or a lane closure in excess of two hours does require a ROW permit describing the type and location of work to the City.

D. In the event of an emergency that demands immediate action to protect the public health, safety, or welfare, when a permit cannot be reasonably or practically obtained beforehand, emergency actions may proceed provided that notification be provided to the public utilities dispatcher at (979) 337-7400.

E. Before the issuance of a ROW use permit the applicant, his agent, or Contractor shall:

1. Furnish evidence of insurance or self-insurance or public liability and property damage issued by an insurance company, authorized to transact business in the State of Texas. If a valid certificate is on file with the City, subsequent applications may reference the certificate on file.

2. Issue a statement holding the City harmless and free of liability, to the extent allowed in Chapter 283 of Texas Local Government Code, from work performed under the authority of the permit. If a valid certificate is on file with the City, subsequent applications may reference the certificate on file.

3. Post an assurance bond or other method of guarantee acceptance to the City to ensure that the work covered by the permit will be completed in accordance with the latest edition of this Manual.

4. Submit a Traffic Control Plan for review if the work involves a lane closure of more than four hours; however, all lane closures require traffic control in accordance with the TMUTCD.

5. Prepare drawings and specifications for the for the proposed work to be performed. If required, these drawings should show the subject area and adjacent areas, the existing conditions, the proposed work, and any changed to the existing conditions.

6. Adhere to the State of Texas, Underground Facility Damage Prevention, and Safety Act. Before any excavation work, the Dig Safely guidelines shall be followed, including calling a notification center in advanced of excavation (Call-Before-You-Dig (800) 545-6005).

F. The applicant for the permit, his agent, or the Contractor shall protect from damage, utility conduits, sewer conduits, water conduits, lawns, shrubbery, trees, fences, structures, or other property encountered in its work. The applicant shall not trespass upon private property. It is the applicant's responsibility to determine the boundary between public ROW and private property. Prior to entering upon private property, the applicant shall secure written permission from the property owner or owners affected.

G. The applicant, his agent, or the Contractor shall, at all times, ensure the safety of the traveling public. It shall provide, install, and maintain traffic control devices as described by the TMUTCD and, when required, will also take such other measures of precaution as directed by the City. The City has the authority to stop work if the traffic control does not conform to the requirements of the TMUTCD.

H. The City shall inspect all work within the ROW of dedicated streets, dedicated drainage ways, or public easements. The City shall have the authority to revoke the permit whenever it is clear that the drawings, details, and specifications are not being followed. All work and materials used shall be in accordance with the requirements of the manual and the City Standard Construction Details.

I. All lane closures require 24-hour notification of the police and fire department before closing.

J. Permittee shall dispose of all material removed from the ROW and any waste created by permittee in compliance with all state, federal, and local laws and requirements.

K. Except in the case of an emergency, whenever excavation is required in the ROW adjacent to an occupied property, the ROW user shall notify the property owner of the activity through use of a door hangar, which shall include the following information:

1. Permit number.

2. Identity of the Contractor and the ROW user, including a 24-hour emergency contact name and phone number, and a phone number to obtain more information regarding the project.

3. The anticipated duration of the construction work.

L. Every permittee and ROW user shall prosecute its work diligently and in a good, safe, and workmanlike manner, and shall safeguard and protect the public, using the street or ROW where the work is being performed, from accidents or damage by placing barriers, lights, and other sufficient safeguards around all cuts, openings, an excavation. All material, implements, and tools stored upon the premises and used in connection with the excavation shall be stored in a safe and nonhazardous manner.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

M. The City reserves its right, as provided herein, to revoke or suspend any permit, without refund of the permit fee, in the event of a breach by the permittee of the terms or conditions of the permit, this Manual or any other City ordinance. A breach of the terms of the permit shall include, but not be limited to, any of the following:

1. The violation of any provision of the permit.
2. The failure to meet insurance, surety bond, or indemnification requirements.
3. The failure to complete the work as specified in the permit.
4. The failure to correct a condition indicated on an order issued pursuant to City ordinances.
5. Repeated traffic control violation.
6. Failure to protect facilities or repair facilities damaged in the ROW.
7. Any safety violation or other action that threatens the health, welfare, or safety of the public as solely determined by the City.

N. A permit shall only be valid for the area of the ROW specified within the permit. No permittee may cause any work to be done outside the area specified in the permit, expect as provided herein. Any permittee who determines that an area is greater than that which is specified in the permit must apply for and receive a new ROW permit.

O. No work shall commence until erosion control measures (e.g., silt fence) and advance warning signs, marker, cones, and barricades are in place.

P. Any request for a permit to excavate street pavement shall include a description of the proposed restoration of the area, as well as a statement of clear and convincing evidence as to why alternate procedures cannot or should not be used in lieu of excavating a street. All pavement cuts and repairs shall be performed by a contractor with experience in street repair work and performed in accordance with the City Repair Details and City specifications or, if unusual conditions are encountered, the City may require new standards for compaction, backfill, and pavement restoration. Any damage to pavement outside the removal area shall also be repaired subject to approval of the City staff.

Q. A permittee or ROW user shall maintain its repairs in the ROW for one year from the completion date of any repair. In the case the pavement or the surface of the street, alley, or ROW in, over, or near any excavation should become depressed, cracked, or broken at any time (or fails in any way at any time after the excavation has been made and during the one-year warranty) the ROW user shall be responsible for repair of the failure.

R. Open trenches may be temporarily backfilled for the convenience of the permittee of public safety. Traffic-bearing plates can be used temporarily for pavement areas. Such temporarily measures will only be allowed for a maximum duration of 48 hours.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

S. All excess water and mud shall be removed from the trench before backfilling. Any backfill placed during a rainy period or at other times, where excess water cannot be prevented from entering the trench, will be considered temporary and shall be removed as soon as weather permits. All disturbed base material or any base that has been undermined shall be removed and discarded. All backfill within the right-of-way shall be installed and tested in accordance with the applicable section of the standards provided in this manual.

T. All earth, materials, sidewalks, pavement, utilities, conduits, crossing, irrigation, landscaping, monuments, manhole covers, valve covers, meter box lids, or improvements or any kind owned or possessed by the City, and damaged, disturbed, or removed by a ROW user shall be fully repaired promptly by the ROW user, at its sole expense, to the reasonable satisfaction of the City.

U. After any excavation, the ROW user shall, at its expense, restore the ROW, trench envelope, pavement structure, and the surrounding area to at least the same condition it was prior to the excavation. The restoration shall be made in accordance with specifications set forth herein, and the repair shall endure without failure for one year from the completion date of any repair.

V. In the event the ROW user fails to restore the ROW in the manner and to the condition required herein, or fails to satisfactorily or timely complete all restoration, the City may, at its option, serve written notice upon the ROW user that, unless within 5 business days after serving of such notice a satisfactory arrangement can be made for the proper restoration of the ROW by the ROW user, the City may take over the work and prosecute same to completion, by contract or otherwise, at the sole expense of the ROW user. The ROW use, and its surety, shall be liable to the City for any and all cost incurred by the City by reason of such prosecution and completion. Nothing contained herein shall limit any other remedies available to the City.

W. The ROW user is required to comply with the Storm Water Pollution Protection Plan (SWPPP) developed for the development and for the implementation and maintenance of the Best Management Practices (BMP). Once the project is complete and the final BMPs are installed, ROW user shall maintain the BMPs until revegetation is established to prevent sediment transport and erosion. The ROW user is responsible for the removal of BMPs once the revegetation is established. These BMPs shall be removed within 30 days once the revegetation has been reestablished.

X. If any excavation cannot be backfilled immediately, the ROW user shall securely and adequately cover the excavation and maintain proper barricades, safety fencing or lights as required, from the time of the opening of the excavation until the excavation is surfaced and opened for travel.

Y. No trench shall be open in any paved area of the ROW for the purpose of laying pipes, conduits, or ducts more than 200 feet in advance of the pipe, conduit, or ducts being placed in the trench, other than with the prior written consent of the City. No trench shall be opened in any nonpaved ROW for the purpose of laying pipes, conduits, or ducts more than 500 feet in advance of the pipe, conduit, or ducts being placed in the trench, other than with prior written consent of the City. In all areas of the ROW, all trenches shall be closed prior to the end of the business day.

Z. Before a permit shall be issued, the applicant shall execute and deliver to the City (to be kept on file with the City) a good and sufficient bond of performance or assurance in accordance with the requirements of Section 12.04.

AA. Utility and other street crossings under pavement shall not be installed within 2 feet of the bottom of the subgrade.

BB. The permittee of ROW use shall maintain its equipment or facilities once installed, in perpetuity. Above ground facilities shall be maintained in a neat, organized, and workmanlike appearance in the opinion of the City. This may require that the permittee or ROW holder be required to repair or replace the surface facilities with new equipment or equipment with decorative features. Should the surface area equipment not be maintained in a workmanlike appearance, refer to Section 12.03.V for resolution. Additionally, failure to maintain upkeep of existing facilities may cause future permits to be delayed or revoked until such items are addressed.

CC. The permittee or ROW user facilities that are to be abandoned, and after all facilities are removed and properly abandoned, shall remove all surface features and the surface shall be restored to match the surrounding area. Should the surface area not be restored refer to Section 12.03.V for resolution. Additionally, failure to restore the area may cause future permits to be delayed or revoked until such items are addressed.

2.04 INSURANCE AND BONDING REQUIREMENTS

A. A ROW user shall obtain and maintain insurance in the amounts reasonably prescribed by the City with an insurance company licensed to do business in the State of Texas. A person shall furnish the City with proof of insurance at the time of request for permits. The City reserves the right to review the insurance requirements and to reasonably adjust insurance coverage and limits when the City Manager determines that changes to statutory law, court decisions, or the claims history of the industry or the person require adjustment of the coverage.

B. For purpose of this section, the City will accept certificates of self-insurance issued by the State of Texas or letters written by the person in those instances where the state does not issue such letter, which provide the same coverage as required herein. However, for the City to accept such letters the ROW user must demonstrate by written information that it has adequate financial resources to be self-insured entity as reasonably determined by the City, based on financial information requested by and furnished to the City.

C. The City's current insurance requirements are described in the following. If a certificate of insurance is on file from a previous application and has not expired, the valid certificate may be referenced on subsequent applications.

D. The ROW user shall furnish, at no cost to the City, copies of certificates of insurance evidencing the coverage required by this chapter to the City. A ROW user shall immediately advise the City Attorney of actual or potential litigation that may develop or may affect an existing carrier's obligation to defend and indemnify.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

1. The ROW User shall procure and maintain at its sole cost and expense for the duration of the permit, insurance coverage for injuries to persons or damages to property that may arise from or in connection with the performance of the work hereunder by the ROW User, its agents, representatives, volunteers, employees, or subcontractor. The ROW User's insurance coverage shall be primary insurance with respect to the City, its officials, employees, and volunteers. Any insurance or self-insurance maintained by the City, its officials, employees, or volunteers shall be considered in excess of the ROW User's insurance and shall not contribute to it. Further, the ROW User shall include the City as an additional insured under its policy. All coverage for subcontractor shall be subject to all of the requirements stated herein. Certificates of insurance and endorsements shall be furnished to the City and approved by the City before work commences.

2. Standard insurance Policies Required:

   a. Commercial General Liability Policy

   b. Automobile Liability Policy

   c. Workers' Compensation Policy

3. General Requirements Applicable to all Policies:

   a. General Liability and Automobile Liability insurance shall be written by a carrier with an A: VIII or better rating in accordance with the current Best Key Rating Guide.

   b. Only Insurance Carriers licensed and admitted to do business in the State of Texas will be accepted.

   c. Deductibles shall be listed on the Certificate of Insurance and are acceptable only a per occurrence basis for property damage only.

   d. "Claims Made" policies will not be accepted.

   e. The City of Brenham, its officials, employees, and volunteers, are to be added as "Additional Insure" to the General Liability policy. The coverage shall contain no special limitations on the scope of protection afforded to the City, its officials, employees, or volunteers.

   f. A Waiver of Subrogation in favor of the City with respect to Workers' Compensation Insurance must be included.

   g. Each insurance policy shall be endorsed to state that coverage shall not be suspended, voided, canceled, reduced in coverage or in limits except after thirty (30) days prior to written notice has been given to the City of Brenham.

   h. Upon request, certified copies of all insurance policies shall be furnished to the City of Branham.

4. Commercial General Liability

a. Minimum Combined Single Limit of $100,000 per occurrence for bodily injury and property damage.

b. No coverage shall be deleted from the standard policy without notification of individual exclusions being attached for review and acceptance.

5. Automobile Liability

a. Minimum Combined Single Limit of $100,000 per occurrence for bodily injury and property damage.

6. Worker's Compensation

a. Employer's Liability limits of $100,000 for each accident is required.

7. Certificates of Insurance shall be prepared and executed by the insurance company or its authorized agents. And shall contain the following provisions and warranties:

a. The company is licensed and admitted to do business in the State of Texas.

b. The insurance policies provided by the insurance company are underwritten on forms that have been provided by the Texas Board of Insurance.

c. All endorsements and insurance coverage according to requirements and instructions contained herein.

d. The form of the notice of cancellation, termination, or change in coverage provisions to the City of Brenham.

e. Original endorsements affecting coverage required by this section shall be furnished with the certificates of insurance.

E. Before a permit shall be issued, the applicant shall execute and deliver to the City (to be kept on file with the City) a good sufficient bond of performance or assurance. Said bond should be approved by the City and conditioned that the person making the application shall promptly adjust, pay, and settle all legitimate claims for damages that may result by reason of carelessness or negligence in the manner of performing such work or by reason of any defects therein caused or arising from careless, negligent, or imperfect construction thereof. This also includes holding the City, its council member, officers, employees, volunteers, agents and representative, free and harmless from liability on all such claims for damages to the performance or assurance bond that shall cover the cost of repairs in or upon the street, sidewalk, or other public place where the work is to be done that may become necessary by reason of such cut or excavation having been made. The bond shall be maintained until the City accepts the work after expiration of the one-year maintenance period. With respect to the ROW user's obligation to comply with the requirements for a performance or assurance bond, the City may allow the ROW user to self-insure such obligation upon production of evidence that is satisfactory to the City.

F. The amount of the required performance or assurance bond shall be as follows:

1. Work requiring street, sidewalk, or pavement excavation, or excavation within 5 feet of pavement – 120 percent of the original construction cost.

2. Residential driveways, street tree planting, or other work - $2,000.00.

2.05 PUBLIC AND PRIVATE LOCATIONS

A. New installations of public and private utilities (i.e., community antenna television (CATV) telephone, or gas) within the ROW shall be located in accordance with the alignments shown in Detail ROW-1 that is included in Appendix B of this manual.

B. The minimum horizontal and vertical separation between private utilities and any public utility shall be 18 inches.

C. The location of jack and bore pits shall be shown on permit applications. Jack and bore pits shall be at least 5 feet from the back-of-curb or edge or pavement.

D. Public and private utility depths within the public ROW shall not be less than the utility depths requirements of the Typical Easement Installation Details shown in the following:

E. Public and private utilities along open ditch roadways shall be installed in utility easements adjacent to the public ROW when the easements are available. Franchise utilities along open ditch roadways shall not be less than 2 feet below the flowline of any ditch under any circumstance and, wherever possible, shall be installed between the outside bank of the ditch and the ROW line.

F. Public and private utilities crossing under street pavement shall not be installed within 2 feet from the bottom of the subgrade.

END OF CHAPTER

City of BRENHAM

Website: cityofbrenham.org
Phone - Main Line: 979-337-7200

Development	Utilities
979-337-7220	979-337-7401

200 W. Vulcan, Brenham, Texas 77834

PUBLIC INFRASTRUCTURE DESIGN MANUAL

CHAPTER 3 - WATER SYSTEMS DISTRIBUTION

Version 2021-1

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

CHAPTER 3
WATER DISTRIBUTION SYSTEMS

3.01 GENERAL

A. This chapter includes the design requirements for public water distribution systems within the city limits and the extra-territorial jurisdiction of the City.

B. The City's staff shall approve water distribution drawings for all public improvements within the City limits or extraterritorial jurisdiction. Construction shall conform to the City's Standard Construction Details.

C. Construction drawings for private improvements, within public rights-of-way and public easements, that connect to or affect the public infrastructure shall be approved by the City. These improvements are subject to the requirements of this Manual and are subject to review and approval using the process defined in this Manual.

D. Construction and sizing of all water mains and appurtenances shall meet or exceed the requirements of the Texas Commission on Environmental Quality (TCEQ).

E. The Public Water System shall not extend beyond the water meter. All construction to the meter shall conform to the requirements of this Manual. All construction beyond the meter is considered private and shall conform to the requirements of the City's adopted Plumbing Code.

F. All proposed water distribution systems and interconnects between separate systems or utility districts, shall be approved by the City staff.

G. No interconnect between the City's public water supply system and any separate system, utility district, or private water source will be permitted without the prior written consent and approval by the City.

3.02 DESIGN REQUIREMENTS

A. Public water distribution systems shall be designed to handle the necessary water flow based upon complete development. The necessary water flow shall include applicable residential and nonresidential uses and fire protection flows.

B. The City may require oversizing of proposed infrastructure to serve future development or extension of main lines. If City chooses to require such oversizing, City will participate in the cost of the oversize and will negotiate an oversize agreement with the developer to establish the terms of the participation effort.

C. The water system shall be designed to deliver peak-hour demand flows. The fire flow must be available above the peak-hour demand of the system and for a duration and at the residual pressure as specified by the Fire Marshall.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

D. One hard copy and one electronic copy in Adobe Acrobat (.pdf) format of the system hydraulic calculation, sealed by a Texas Registered Professional Engineer, shall be provided with all water distribution system drawings. These calculations shall show how the water flow rates were computed, design assumptions, and how fire flow requirements are met. If the proposed water distribution system is connecting to an existing system, verification of the flow rates and pressure in the existing system (both before and after inclusion of the new system) shall be provided by the design engineer and approved by the City.

E. Fire flow requirements are based upon International Fire Code, as amended in the Code of Ordinances, latest adopted edition.

F. The overall water system shall be designed to maintain adequate pressure throughout the system. In all cases, specific water pressure and flow analysis and study shall be required. The layout of the water mains should provide maximum circulation of water to prevent future problems of odor, taste, or color as a result of stagnant water.

G. Permanent dead-end mains will not be allowed if looping alternatives are available. This may require extending the water mains beyond the limits of the project.

H. In unavoidable permanent dead-end situations, lines shall be 6” or longer and not exceed 600 feet in length and shall be equipped with a 2” automatic flushing device.

I. The length of a dead-end water main shall be measured from the intersection with a multiple feed (looped) main to the end of the main.

J. Where a water main is stubbed out for future extensions, place a valve to isolate the dead-end and extend a 20’ section of pipe with a cap on the end on the downstream side of the isolation valve. Restrain the water main to prevent line separation. Thrust blocking will not be allowed. No customer services shall be located on the dead-end until it is extended. Provide a 2” automatic flushing device at the end of the dead-end line in advance of the isolation valve.

3.03 SYSTEM LAYOUT AND PLACEMENT

A. Water system layout and placement requirements are established based on land uses, as established in this section. These layouts and placement requirements are intended to be minimum requirements; larger mains, shorter runs, or additional looping may be required based upon fire flow calculations. If a property is not covered within the development types listed, the City staff shall designate the type of development.

1. Type A (Residential) Development shall include all properties and rights-of-way within zoning district R-1 through R-3 and any planned development districts that allows any R-1 through R-3 use developed in accordance with the intent and requirements of these districts and developments similar in density and use.

2. Type B (Commercial) Development shall include all properties and rights-of-way within zoning districts B-1, B-2, B-3, B-4, I, and PD use developed in accordance with the intent and requirements of these districts and developments similar in density and use.

B. Water mains in Type A (Residential) Development shall have a minimum size as follows:

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

1. Two-inch water mains may serve a maximum of two domestic, residential service connections. Two-inch mains shall not exceed 200 feet in length and shall be installed with a 2" automatic flushing device at the end of the line. All 2-inch water mains shall be specifically approved by the City staff.

2. All 4-inch water mains shall be specifically approved by the City Staff.

3. Six-inch water mains shall be maximum of 1,500 feet long when supported on both ends by 8-inch mains or larger. Six-inch water mains shall have no more then two fire hydrants. Dead-end 6-inch mains shall not be more than 600 feet in length and shall be equipped with a 2" automatic flushing device.

4. Eight-inch water mains are required for mains over 1,500 feet long, or when three or more intermediate fire hydrants are required. Eight-inch water mains shall not be dead-end, except as provided in Section 3.02.

5. Twelve-inch and larger water mains will be required at locations established by the City or as determined by the design calculations.

C. Water mains in Type B (Commercial) Developments shall have a minimum sizing as follows:

1. Minimum size of water mains shall be 8-inch. Maximum length of a dead-end 8-inch main shall be 600 feet. A dead-end main shall be terminated with a 2" automatic flushing device.

2. Twelve-inch and larger water mains will be required at locations established by the City staff or as determined by the design calculations.

D. Water main and appurtenances are not allowed in the following sizes: 3-inch, 10-inch, and 14-inch.

3.04 FIRE HYDRANTS (Flushing Valves)

A. Fire hydrants shall have a three-way nozzle arrangement, a 5 and ¼-inch compression type main valve, a mechanical joint (MJ) boot, and conform to the requirements of American Water Works Association (AWWA) C502. Hydrants shall be factory painted red with yellow pumper caps and silver streamer caps. Bonnet shall be painted in accordance with the table shown in 3.04F. Field painting of the hydrants after installation is not allowed, other than as specified in 3.04F or for minor touch-up. Approved fire hydrants shall be listed on the Approved Product List.

B. Fire hydrant spacing shall be measured along the length of the main. Fire hydrants shall be spaced along all mains 6 inches and larger as follows:

1. Type A (Residential) Development – Four hundred feet minimum to 500 feet maximum spacing, or as designated by the Fire Marshal.

2. Type B (Commercial) Development – Two hundred and fifty feet minimum to 300-feet maximum spacing and at all street intersections, or as designated by the Fire Marshal.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

3. If applicable, fire hydrant spacing measurements shall begin from the nearest existing fire hydrant to the new development so as to avoid spacing that exceeds these standards.

C. Location – Fire hydrants or flushing valves shall be located as follows:

1. Fire hydrants shall be located a minimum of 2 feet behind the back of the curb, or projected future curb, and be set at the point of curvature (PC) of the intersection curb radius. To the maximum extend practical, fire hydrants shall be located on lot lines.

2. On all open-ditch roadways, set the fire hydrants or flushing valves within 3 feet of the right-of-way. Fire hydrants shall not be located between the edge-of-pavement and the open ditch.

3. Fire hydrants located between right-of-way intersections should be set at a lot line. However, this location may be adjusted 5 feet either way to miss driveways or other obstructions, in which case the fire hydrants should not be closer than 3 feet from curbed driveways or 5 feet from non-curbed driveways.

D. The depth of bury for all fire hydrants shall be established such that the manufacture's bury line on the fire hydrant is installed at the ground line at each location or at the finished ground after pavement construction.

E. Fire hydrants shall be installed in accordance with all applicable TCEQ rules and regulations.

F. The bonnet of the fire hydrant shall be factory painted white and then shall be field painted in accordance with the table below. Fire hydrants shall be color coded on the fire hydrants bonnet based upon fire flow test administered prior to final walk through. The paint used shall be a polyurethane enamel or approved equal and applied in accordance with the manufacturer's instructions. The color code shall be as follows:

Flow Rate (GPM)	Paint Color
< 500	Red
500-999	Orange
1000-1499	Green
1500+	Light Blue

G. All fire hydrants shall be installed so that the streamer connection will face the fire lane or street, or as directed by the Fire Marshal.

H. Fire hydrants, when placed at intersections or access drives to parking lots, when practical, shall be placed so that no part of the fire truck will block the intersection or parking lot access when connections to the fire hydrant are made.

I. A Blue Stimsonite, Fire-Lite reflector model 88-SSA (or approved equal) shall be placed 12 inches from the centerline of the street, offset toward the fire hydrant. At intersections, reflectors shall be placed on both roadways opposite the fire hydrant.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

J. Fire hydrants that are to be designated as private shall have a factory coated body color of red. The caps and bonnets shall be color coded in accordance with Section 3.04F. These fire hydrants will be owned and maintained by the property owner/entity. The valve for the fire hydrant line shall be located at the public water main.

K. All fire hydrants shall be set on a foundation consisting of either a pre-cast concrete block or a 90-pound sack of premix concrete.

L. All fire hydrants shall have a 3'L x 2'W x 4" thick unreinforced concrete splash pad installed directly in front of the pumper nozzle to reduce or eliminate erosion that might result from flushing the hydrant.

M. All fire hydrants must be equipped with an isolation valve located adjacent to the water main.

3.05 WATER DISTRIBUTIONS SYSTEM MATERIALS

A. All materials used in the construction of public water distribution systems must be in conformance with AWWA and NSF International guidelines.

B. PVC Pressure Pipe, 2-inch through 12-inch, shall conform to the requirements of ANSI/AWWA C900, current revision, Class 150 DR 18. Pipe shall be designed and constructed in conformance with the minimum requirements of the "Manual of Water Supply Practices", AWWA Manual No. M23. PVC pipe with the use of ductile iron fittings is the preferred material for water line construction. The use of DIP is allowed, as necessary.

C. Ductile Iron Pipe, 4-inch through 54-inch, shall conform to the requirements of "Ductile-Iron Pipe, Centrifugally Cast in Metal Molds for Sand-Lined Molds, for Water and Other Liquids," AWWA C151, (ANSI A21.51), current revision. Pipe thickness shall be the minimum specified in C151. Under special conditions, the City may require thickness design in conformance with the minimum requirements of "Thickness Design for Ductile Iron Pipe," AWWA C150 (ANSI A21.51), current revision. Pipe shall be installed in conformance with the minimum requirements of AWWA C600, "Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances." DIP shall be furnished with epoxy or cement mortar lining, AWWA C104 (ANSI A21.4). Polyethylene tube encasement shall be provided as required.

D. Bedding and backfill shall conform to Section 3.09 of this Manual and as shown in the City's Standard Construction Details.

3.06 LOCATION OF WATER MAINS AND EASEMENT REQUIREMENTS

A. All public mains shall be installed within a public utility easement, or right-of-way. A minimum of 4 feet of cover shall be maintained at all times, except as allowed by section 3.08.

B. Water mains shall be placed along a uniform alignment with the right-of-way. When necessary, the water main may be deflected at a fire hydrant location to accommodate proper installation of the fire hydrant. At all locations where a water main changes alignment, the location of the water main shall be clearly shown on the construction drawings. A minimum distance of 2 feet shall be maintained from the right-of-way line to the nearest outside edge of the water line.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

C. For new construction, any water main, except at a fire hydrant, and located less than 5 feet from the dedicated right-of-way line, and within the right-of-way shall have a public utility easement adjoining the right-of-way. Public utility easements adjoining a right-of-way shall be sufficient width to provide a minimum of 12.5 feet of clearance on each side of the centerline of the pipe.

D. Water mains shall be located within the right-of-way as shown in Standard Detail ROW-1.

E. Water mains not within the public right of way shall be centered in a public utility easement the width of which will be determined by City staff.

3.07 CLEARANCE OF WATER LINES FROM OTHER UTILITIES

A. Water mains shall be designed and located to conform to regulations of the TCEQ.

B. For water mains crossing an existing or proposed sanitary sewer or force main, the minimum clearances between the utilities shall comply with the latest edition of “Rules and regulations for Public Water Systems,” of the TCEQ.

3.08 DEPTH OF COVER

A. Minimum depth of cover for water mains shall be as follows:

1. Twelve-inch and smaller mains shall have a minimum cover of 4 feet from the top of curb. At utility conflicts the water main cover may be reduced to 3 feet with the approval of the City. For open ditch roadway section, 12-inch and smaller mains shall be installed at least 3 feet below the ultimate flow line of ditch or 6 feet below natural ground at the right-of-way line. Whichever is deeper.

2. Sixteen-inch and larger mains shall have a minimum cover of 5 feet from the top of curb. For open ditch roadway sections, 16-inch and larger mains shall be installed at least 3 feet below the flow line of ditch of 7 feet below natural ground at the right-of-way line, whichever is deeper.

3. Water mains shall be located in a manner that minimizes the impact on adjacent facilities or infrastructure and allows for ease of maintenance of the water line.

B. Changes in grade to clear other utilities or underground features may be made by deflecting pipe joints. The maximum designed deflection shall be no more than the manufacturers allowable deflection. The vertical realignments shall be restrained in each direction in accordance with restraint requirements and be constructed with MJ fitting and restraints. Any bell joints located in the vertical realignment shall also be restrained.

3.09 TRENCHING, BEDDING, AND BACKFILL REQUIREMENTS

A. The minimum trench width shall be equivalent to the outside diameter of the pipe plus 12”.

B. The maximum trench width shall be equivalent to the outside diameter of the pipe plus 36”.

C. The minimum trench depth shall be equivalent to the desired bury depth of the pipe plus the outside pipe diameter plus 6”.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

D. Pipes should be bedded with bank sand.

E. Sand bedding shall fill the entire width of the trench and shall extend from a depth of 6” below the pipe to 6” above the pipe.

F. Bedding shall be installed in maximum 9” loose lifts and be compacted by vibratory equipment to a 90% standard proctor (ASTM D698).

G. Backfill in non-paved areas and under concrete paved roadways shall consist of select backfill from the excavation.

H. All backfill within public rights-of-way and public easements shall be installed in maximum 9” loose lifts and be compacted to a minimum of 95 percent of Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78), without additional moisture control, cured and tested in accordance with ASTM C31.

I. In non-paved areas the backfill shall fill the entire trench width of the trench and shall extend from the top of the sand bedding to a depth of 6” below the elevation of the finished surface.

J. In non-paved areas, the uppermost 6” of backfill shall consist of topsoil. If the trench extends through an existing vegetated landscape, any excavated or disturbed area adjacent to the trench shall be re-sodded with grass that is similar to the exiting landscaping.

K. Under concrete roadways, the backfill shall fill the entire width of the trench and shall extend from the top of the sand bedding to the elevation of the bottom of the concrete paving. All water lines located underneath and within 1 foot of any asphalt paving be backfilled with cement stabilized sand.

L. Under asphalt paving, the cement stabilized sand shall fill the entire trench width and shall extend from the top of the sand bedding to the elevation of the bottom of the base section.

M. The cement stabilized sand shall be in accordance with the following requirements.

1. The cement shall be Portland Cement, Type I, ASTM C150.

2. The sand shall be clean, durable sand, with less than 0.5 percent clay clumps, ASTM C142: with less than 0.5 percent lightweight pieces, ASTM C123; with organic impurities, ASTM C40, not showing a color darker than standard color, and a plasticity index of less than 6 when tested in accordance with ASTM D423 and ASTM D424.

3. Compact to 95 percent Standard Proctor Density (ASTM D2922-78 and ASMT D3017-78) in maximum loose lifts of 8-inches thick. Actual testing shall be required as specified in Section 3.13 of this Manual.

4. The cement-sand mixture shall consist of at least 2.5 bags of cement per cubic yard of mixture. The cement-sand mixture shall have a minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours, when compacted to a minimum of 95 percent of Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78), without additional moisture control, cured and tested in accordance with ASTM C31.

5. Cement stabilized sand shall be placed and compacted within 3 hours of batching.

3.10 PIPE LOCATION MARKING

A. Adequate markings on site as specified below and accurate as-built locations shall be provided so that the water lines and services can be easily located by the City in the future.

B. A continuous tracer wire, such as a solid 14-guage cooper clad wire with blue shielding or approved equal, shall be affixed to the top of the new water main prior to bury and shall have a snake pit tracer station installed at a maximum of 500 feet. The tracer station shall have a 2' x 2' concrete pad around it and shall be shown on the plans. Tracer wire shall be connected to all water meter angle stops, fire hydrants, and valve box risers. Wire splices shall be completed using approved, underground connector. Soldered connections are not permitted. A continuity test shall be completed prior to acceptance.

C. The location of water services shall be marked on the curb by etching or casting a "W" into the face of the curb directly over the water service location

3.11 INSTALLATION BY BORE AND JACK

A. Bore and jack sections shall be specifically approved by the City and clearly shown on the drawings by location and footage.

B. The following criteria are generally used as a basis for setting bore and jack sections.

1. Bore pits shall be at least 3 feet from the back of curb and 5 feet from back of curb on a major thoroughfare. Bore pits in highways, county roads, or railroad right-of-way shall conform to these requirements and to the requirements of the crossing permit or use agreement. All bore pits shall be shored in accordance with Occupational Safety and Health Administration (OSHA) requirements. Bore pits or receiving pits to be located in street or driveway paving, shall be shown on drawings.

2. All existing developed areas shall be restored to original condition after construction.

3.12 VALVES

A. All water systems valves shall conform with AWWA standards and shall be designed as follows:

1. Four-inch through 18-inch valves shall be resilient seated gate valves, AWWA C509, counterclockwise opening with MJ fittings. Valves shall have a complete epoxy coating on all iron parts in the valve interior to eliminate corrosion.

2. Twenty-inch and larger valves may be resilient gate valves, AWWA C509 or butterfly valves, AWWA G504, with complete epoxy coating to avoid corrosion of all iron parts, as approved by the City. All valves shall be counterclockwise opening. All valves shall be direct-bury type.

3. Cast-iron valve boxes are required on all valves.

4. All valves shall be sized equal to the size of the main upon which it is located.

5. Valves shall be approved by the City and shall be listed on the Approved Product List.

B. Valves shall be set at a maximum distance of 1,000 feet along the main.

1. The total number of valves at any water line intersection shall equal the total number of main lines extending out from the intersection, i.e., three (3) for a tee and four (4) for a cross.

2. All valves shall be equipped with a Snake Pit tracer wire station installed adjacent to the valve in a 2' x 2' concrete pad that is located around the valve box.

C. Valves shall be located as follows:

1. All mains shall be valved within the street right-of-way. Valves shall not be placed within 4 feet of ultimate pavement, except as specifically approved by the City.

2. Valves are normally located on the projection of intersection street right-of-way lines or at the curb return adjoining a paved street across the main. Tapping sleeves and valves are excluded from this requirement.

3. All fire hydrants shall be isolated from the service main with a valve located on the fitting at the main line.

4. Intermediate valves not located on the projection of intersection street right-of-way lines may be located at a lot line projection or 5 feet from the fire hydrant.

5. Valves shall be placed at the end of all mains that are to be extended in the future and extend the main a minimum of 20 feet past the valve. Valve and piping shall be restrained using MJ fittings, restraints, and pipe joint restraints. Thrust blocks are not allowed.

3.13 FITTINGS AND APPURTENANCES

A. Fittings shall be Ductile-Iron Compact Fittings 4-inch to 12-inch, AWWA C153/A21.53.84, conforming to the minimum requirements of "Gray-Iron and Ductile-Iron Fittings, 12-inch through 48-inch, for Water and Other Liquids", AWWA C153 (ANSI 21.10), current revision. Fittings shall be furnished with epoxy or cement mortar lined, AWWA C104 (ANSI A21.4).

B. All fittings shall be identified and described on the construction drawings.

C. Water main fittings shall be MJ fittings.

D. Polyethylene tube encasement shall conform with the minimum requirements of "Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids," ANSI/AWWA C105, current revision. Soils within the project shall be tested in accordance with Appendix A of ANSI/AWWA C105 to adequately determine the requirements for encasement.

E. Concrete thrust blocking or mechanical restraints shall be required on all bends, tees, plugs, and combinations thereof. Refer to the City's Standard Construction Details for specifications.

F. The maximum allowable size of a tapping sleeve and valve on an existing pipe is equal to the pipe diameter of the main to be tapped.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

3.14 DUCTILE IRON WATER PIPE

A. All transitions from DIP to approved water main materials shall be constructed using MJ fittings.

B. All DIP shall be constructed of materials as specified in Section 3.05.

3.15 TESTING

A. It is the responsibility of the contractor to deliver a finished product in compliance with the contract documents and applicable federal, state, and local requirements. An independent testing laboratory shall be used to verify contract document compliance.

B. The contractor is responsible for notification of the City and the independent testing laboratory in accordance with the City's notification requirements. In the event construction activity occurs without proper notification to the City, the work in question is subject to removal and replacement in accordance with the standards at the discretion of the City.

C. Water lines shall be tested in accordance with the following:

1. A hydrostatic exfiltration test shall be performed on all water lines in accordance with the requirements of the TCEQ and AWWA C600-10 (DIP) or C605-13 (PVC pipe) prior to being placed in service.

2. New water lines shall be thoroughly disinfected in accordance with AWWA Standard C651 and TCEQ requirements, and then flushed and sampled prior to being placed in service.

3. Copies of all test results shall be given to the City.

D. Cement Stabilized Sand Testing

1. A minimum of two random samples for compressive strength shall be taken each week. For smaller projects, one sample may suffice with City approval. The City reserves the right to require additional tests, at the Contractor's expense, if it is deemed necessary.

2. In the event of a change in supplier, samples shall be drawn on the first day of delivery from the new supplier, regardless of previous samples taken.

3. Cement stabilized sand samples shall be taken at the point of placement of the cement stabilized sand and identified as to the location of the sample.

4. Cement stabilized sand densities shall be taken a minimum of every 150 linear feet of trench, with a minimum of two test (one per direction of travel) at each road crossings. When used as subgrade on roadway repairs, density test shall be taken every 100 square feet of subgrade, with a minimum of one test per repair.

E. Bedding, Backfill, Testing

1. Bedding and density test shall be performed a minimum of every 300 linear feet of trench in each lift. Density test shall be offset on altering lifts and test locations shall be identified by station number.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

3.16 EXISTING FACILITY CROSSINGS

A. Installation of water main across a proposed or existing public street, driveway, sidewalk, railroad, pipeline, or drainage way shall conform to the requirements of this section.

1. Public Street – All existing public streets are to be bored and jack regardless of surface. Bore and jack length shall be computed as roadway width at proposed bore plus 5 feet to either side.

2. Driveways – Concrete and asphalt driveways in good condition shall be bored and jacked. Bore and jack length shall be computed as driveway width at bore plus 5 feet to either side. Where driveways cross culvert pipe sections along open ditch streets and the proposed water main is in proximity and parallel to the culvert pipe, the length of bore shall be the same as the length of culvert pipe.

3. Sidewalks – When the water line crossed under a sidewalk in good condition, the sidewalk shall either be bored and jacked or removed and replaced to the City criteria, whichever is most cost-effective. Bore and jack length shall be at least the width of the sidewalk. The proposed type of construction shall be noted on the drawings.

4. Railroad Crossings – All railroad crossings require a pipeline crossing permit to be issued by the corresponding railroad company and shall be bored and jacked in accordance with the requirement of that permit and the standards provided in this Manual.

5. Drainage Way – When a water line cross under an existing drainage way, the water conveying portion of the drainage way shall be bored and jacked in accordance with the standards provided in this Manual.

6. Trees – When saving trees is a consideration, all trees 6 inches or larger in diameter and within 10 feet of the centerline of the water main must be noted on all drawings. The water main shall be bored and jacked within the drip line of any tree larger than 6 inches in diameter.

3.17 BARRICADING AND SIGNAGE

A. Proper barricading and signage, conforming to the Texas Manual of Uniform Traffic Control Devices' latest edition, shall be required on all projects.

B. Adequate signage for vehicular and pedestrian traffic shall be installed.

C. A traffic control plan shall be submitted to the City and approved by the City for all streets open to travel by the public.

3.18 WATER SERVICES

A. Water services 2" and smaller must be single lot connections.

B. The minimum size for a single lot service shall be 1".

C. Water services shall be located within the public utility easement as close to the lot line as possible.

D. Single lot services shall consist of the following components:

1. An epoxy coated double strap tapping saddle with stainless steel straps at the main line.
2. A brass ball-type corporation stop with cc threads.
3. Polyethylene service line.
4. A brass, angle, ball-type lockable curb stop with 360-degree operating T-head.
5. A concrete meter box with a cast iron or concrete lid having a 2” plug in it.

E. Water services 4” and larger shall be installed using pipe and fittings that comply with the applicable sections of these design standards and shall be located in vaults.

F. The City of Brenham to supply the water meter in all instances upon payment of the applicableservice connection fee.

G. Water service in Type A (Residential) Development

1. Water services from the main to the meter curb stop shall be installed using materials from the Approved Products List.
2. Water services lines shall be placed at a minimum depth of 36 inches below final paving elevation.
3. Meter boxes shall be located just outside the public right-of-way in a public utility easement along the projection of a lot line. Location of meters on open ditch streets shall be specifically approved by the City.
4. Public system maintenance shall end at the water meter. The water meter box or vault shall be constructed to meet the City’s requirements and will be maintained by the City.

H. Water Service in Type B (Commercial) Developments

1. Backflow prevention (i.e., detector check valves) shall be required on all fire lines.
2. The location of the service line tee, valve, valve box, and temporary plug shall be designated on the construction drawings in the appropriate location to serve the “future meter”.
3. Location of water distribution appliances necessary for the fire protection (i.e., vault, “PIE”, post indicator valves, and “FDC” fire department connections) shall be determined by the Fire Marshal.

3.19 AIR RELEASE VALVES

A. Two-inch (2”) air release valves shall be installed at all high points in the proposed distribution system piping.

B. A high point in the distribution system is defined as a point having an elevation change of 20’ or more.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

C. Air release valve assembles shall be constructed from materials on the City's Approved Product List and shall be installed in accordance with the City's Standard Details.

END OF CHAPTER

Website: cityofbrenham.org
Phone - Main Line: 979-337-7200
Development | Utilities
979-337-7220 | 979-337-7401
200 W. Vulcan, Brenham, Texas 77834

PUBLIC INFRASTRUCTURE DESIGN MANUAL

CHAPTER 4 - SANITARY SEWER SYSTEMS

Version 2021-1

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

CHAPTER 4
SANITARY SEWER SYSTEMS

4.01 GENERAL

A. This chapter includes the design requirements for sanitary sewer collection systems within the City limits and the extraterritorial jurisdiction of the City.

B. The City's staff shall approve sanitary sewer collection drawings for all public improvements within the City limits or extraterritorial jurisdiction. Construction shall conform to the City Standard Construction Details.

C. Construction drawings for private improvements, within public rights-of-way and public easements, that connect to or affect the public infrastructure shall be approved by the City subject to the requirements of this Manual and are subject to review and approval using the process defined in this Manual.

D. Construction and sizing of all sanitary sewer mains and appurtenances shall meet or exceed the requirements of the TCEQ.

E. The public sanitary sewer system shall be defined as all sewers, and services leads located in public easements or street rights-of-way and that are installed in accordance with these standards. The public sanitary sewer system shall not extend beyond the service connection. All public construction shall conform to the requirements of this Manual. All private construction beyond the service connection shall conform to the requirements of the City's adopted Plumbing Code.

F. No Interconnects between the City's sanitary sewer system and any separate system, utility district, or private sanitary sewer collection system will be permitted without the prior written consent and approval by the City.

G. Sanitary sewer service shall be extended to all building sites prior to development. Septic systems are not allowed, except as specifically approved by the City.

4.02 DESIGN REQUIREMENTS

A. Sanitary sewer systems shall be designed to handle the necessary flow based upon complete development. The necessary flow shall include applicable residential and non-residential average daily flows and shall include a minimum peak design flow of four times the average daily flows.

B. The average daily flow for the design of sanitary sewers shall be based on a minimum set by the TCEQ in gallons per day per single-family connection for residential areas. Commercial, industrial and office areas shall be designed for an average day flow that can be anticipated from the contributing area.

C. One copy of the system hydraulic calculations, sealed by a Texas Registered Professional Engineer, shall be provided electronically (PDF format) with all sanitary sewer system drawings. These calculations shall show how the sanitary flow rates were computed, design assumptions, and that TCEQ requirements are met. If the proposed sanitary sewer system is connecting to an existing system, verification of the availability of capacity in the existing system, after inclusion of the new system, shall be provided by the design engineer and approved by the City.

D. All gravity sewers will be designed to accommodate the peak flow from the contributing service area. The peak flow will be computed using a peaking factor of four multiplied by the average daily flow for the contributing area. For non-residential areas, the peak flow should include consideration of flow characteristics from the anticipated development.

E. Additional consideration of peak flow shall be given for design of pumping stations. The impact of pumping stations on the upstream and downstream sanitary sewer system shall be evaluated. The peak flow for design of a pumping station shall be based on the actual flow into the station.

F. The minimum size allowable public sanitary sewer main shall be six inches. Public sanitary sewers are not allowed in back lot or rear yard easements.

G. The minimum size residential double sanitary sewer service lead shall be six inches and shall not serve more than two residential services.

H. Commercial sewer service leads shall be six-inch pipe or larger and shall not serve more than one commercial connection.

I. All elevations shall be shown to the nearest 0.01 of a foot.

J. All mains to be installed under an existing roadway should be installed by bore unless otherwise approved by the City.

4.03 SYSTEM LAYOUT AND PLACEMENT

A. All sanitary sewer systems shall be designed in conformance with the requirements of the TCEQ and other applicable standards.

B. All stationing shall be based on centerline of street right-of-way stations.

C. The minimum depth of a sewer main along a curb and gutter street shall be four feet below finished grade or top of curb to the top of pipe, whichever is lower. Sanitary sewers laid along open ditch streets shall have a minimum cover of six feet from the average ground line at the adjacent street right-of-way or two feet below the flow line of the open ditch to the top of the pipe, whichever is lower. In situations where sewer main must be shallower than the depths reference above, the shallower sewer main must be constructed of C900 PVC pressure rated pipe.

D. The maximum allowed depth for sanitary sewer collection lines is 16 feet from top of curb to invert of pipe. Sanitary sewers greater than 10 feet in depth to invert of pipe require public utility easements as stated in Section 4.06.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

E. Sanitary sewers shall be laid in a straight alignment, manhole-to-manhole. No curvilinear bends in excess of the pipe manufacturer's recommended pipe deflection amounts are allowed.

F. Vertical Alignment should avoid high or low points between connections.

G. Sanitary sewer hydraulic requirements include:

1. Design velocity in a gravity sewer flowing full shall be a minimum of 2.0 feet per second (fps) and a maximum of 10 fps. In both cases, the Manning Formula has been used with an n coefficient of 0.013. The use of different pipe materials will not alter the use of n=0.013 for the purposes of design.

2. Minimum acceptable slopes in sewers shall be as follows:

Size of Pipe (inches)	**Minimum Slope (%)**	**Maximum Slope (%)**
6	0.50	12.35
8	0.335	8.40
10	0.25	6.23
12	0.20	4.88
15	0.15	3.62
18	0.115	2.83
21	0.095	2.30
24	0.08	1.93
27	0.07	1.65
30	0.06	1.43
33	0.055	1.26
36	0.045	1.12
39	0.04	1.01
>39	*	*
*For pipes larger than 29 inches in diameter, the slope shall be determined by Manning's formula to maintain a velocity greater than 2.0 feet per second and less than 10.0 feet per second when flowing full.		

H. Unequal size sewers shall be designed so that the inverts of the pipes are matched at manholes. When this is not possible, the upstream sewer may be designed so that the flow line of the upstream sewer is higher than the flow line of the downstream sewer. When the flow line of the upstream sewer is raised more than 24-inches above the flow line of the downstream sewer, a drop manhole connection is required, except as specifically approved by the City.

I. Sanitary sewer service leads shall be laid at a minimum of 0.50 percent slope.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

4.04 MANHOLES

A. Manhole requirements include:

1. Manholes shall be placed at points of changes in alignment, grade, or size of sewers, at all four-way and three-way connections, and at the end of all sewers. Cleanout boots will, however, be allowed on the dead end of a sanitary sewer line that is less than 150 feet long with specific approval from the City.

    a. Manholes placed at the end of a collection system pipe that may be extended in the future must include pipe stub-outs with plugs.

    b. Manholes in a straight-run pipe shall be spaced at a maximum distance of 500 feet apart.

    c. The maximum allowable manhole spacing for collection systems with horizontal curvature is 300 feet. In such cases, a manhole must be at the point of curvature and the point of termination of a curve.

    d. Manholes shall have a traffic bearing frame and cover. Manholes shall have a design strength of 4,500 pounds per square inch (psi) and be in compliance with ASTM C478 reinforcement.

    e. Sewers laid in easements shall have a manhole at each side of a street crossing.

    f. Manholes should be located to eliminate the inflow of stormwater into the sanitary sewer. The top of the manhole rim elevation shall be shown on the drawings for all sanitary manholes. Manholes shall not be located within the street pavement. Manholes shall have inflow protection inserts, a minimum thickness of 1/8-inch, made of high-density polyethylene (HDPE) meeting ASTM D 1248 Class A, Category 5, Type 111. Insert shall include a lift strap and vent hole with a vent disk. Manholes may be sealed with gaskets and bolts when specifically approved by the City. Where gasketed manhole covers are required for more than three manholes in sequence, an alternate means of venting shall be provided at less than 1,500-foot intervals.

    g. Manholes shall be constructed in accordance with the City Standard Construction Details. The diameter of a manhole constructed over the center of a sewer shall vary with the size of the sewer, as follows:

Sewer Size	Manhole Diameter
8- through 12-inch	4-foot minimum
15- through 27-inch	5-foot minimum
30-inch	6-foot minimum
36-inch	6-foot minimum

B. Manholes deeper than 12 feet shall be a minimum of 5-foot diameter, depending on pipe size. If a drop structure is required, the manhole shall be a minimum of 5-foot in diameter.

1. A drop manhole is required for pipes that have a change in elevation of greater than 24 inches. The manhole will be a minimum of 5 feet in diameter. The use of an interior drop is required.

2. Steps in manholes will not be permitted.

3. Manhole covers shall be 32 inches in diameter or larger, cast-iron, shall include a traffic bearing type ring and cover with the words “Sanitary Sewer,” and the City logo cast into the cover. All manhole covers shall be made impermeable to surface drainage by providing a solid cover in accordance with City Standard Construction Details. Whenever a manhole is placed in a low-lying area, an additional impermeable lining shall be provided underneath the cover to present flow.

4. All manhole adjustments shall be made with 3-inch precast concrete rings or traffic-related HDPE adjustment rings. A maximum of five adjustment rings are permitted.

5. Manhole cones shall be concentric cast.

6. All new manholes shall have an interior surface coated with an approved epoxy coating a minimum of 100 millimeters thick. If the project requires a rehabilitation of an existing manhole, the epoxy coating thickness shall be 125 millimeters thick.

7. Bituminous coatings are not allowed.

8. Coatings shall be tested with a Holiday tester.

9. Testing shall be in accordance with latest edition of the National Association of Corrosion Engineers (NACE) “Standard Recommended Practice Discontinuity Testing of Protective Coatings.”

10. All holidays shall be marked, repaired, and retested. All joints shall be grounded smooth prior to installation of the interior coating. Should the manhole be pre-coated at the place of manufacturing, the joint shall be grouted smooth, and the grouted area shall be coated in accordance with this section.

11. Interior coating is not required, however, if polymer concrete, corrosion-resistant manholes are used that are manufactured using the additive XYPEX.

12. Fiberglass manholes are not allowed as part of public sanitary sewer systems. All manholes within public rights-of-way and public easements shall be pre-cast of cast-in-place manholes.

13. Where unequal size pipes enter a manhole, inverts of pipes are required to be at the same elevation, unless due to an elevation drop connection.

4.05 SANITARY SEWER SYSTEM MATERIALS

A. All materials used in the construction of sanitary sewer systems shall be in conformance with the City’s Approved Products List and the requirements of the TCEQ. Sewers shall be designed to meet or exceed the pipe manufacturer's recommendations for depth.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

B. Solvent welded sanitary sewer joints are not an acceptable joining method for PVC piping materials. Use of rubber gasketed bell and spigot sanitary sewer joints shall be mandatory.

C. Sanitary sewers 15 inches or less in diameter and installed at depths of 16 feet or less to invert shall be constructed conforming to ASTM specification D 3034 SDR-26 (115 psi). The color shall be green and shall meet ASTM specifications D 3212 for pipe joined with rubber gaskets conforming to ASTM F477. Bell (female) ends of pipe shall be installed on the upstream side with spigot (male) ends oriented downstream.

D. All sanitary sewers greater than 18 inches in diameter and less than 27 inches in diameter and installed at depths of 18 feet or less to invert shall be constructed conforming to ASTM specification F679 SDR-26 (115psi). The color shall be green and shall meet ASTM specifications D 3212 for pipe joined with rubber gaskets conforming to ASTM F477. Bell (female) ends of pipe shall be installed on upstream side with spigot (male) ends oriented downstream.

E. Sanitary sewers exceeding 27 inches in diameter shall be constructed of PVC pipe approved by the City. Bell (female) ends of pipe shall be installed on the upstream side with spigot (male) ends oriented downstream.

F. A 2-inch wide green marker tape with the words "Sanitary Sewer" shall be installed 12 inches above the top of pipe during installation. All sanitary sewer mains shall be equipped with a 14-gauge, copper clad tracer wire and shall have a snake pit tracer station installed at a maximum of 500 feet. These should be shown on plans.

G. All force mains 12 inches or less in diameter shall be constructed of PVC and shall be AWWA specification C 900, Class 150, DR 18. The color shall be green and shall meet ASTM specifications D 3139 for pipe joined with rubber gaskets conforming to ASTM F 477, or DIP shall conform to the requirements of "Ductile-Iron Pipe, Centrifugally Cast in Metal Molds for Sand- Lined Molds, for Water and Other Liquids," AWWA C151, (ANSI A21.51), current revision. Pipe shall be lined with Protecto 401 ceramic epoxy lining or approved equal. Pipe thickness shall be the minimum specified in C151. Bell (female) ends of pipe shall be installed on upstream side with spigot (male) ends oriented downstream. All ductile iron fittings shall be MJ and restrained with Ebba "Meg-a-lugs," or approved equal. The fittings shall be lined with Protecto 401 ceramic epoxy lining or approved equal. A 2-inch wide green marker tape with the words "Sanitary Sewer Forcemain" shall be installed 12 inches above the top of pipe during installation. Force mains shall be equipped with a 14-gauge, copper clad tracer wire and shall have a snake pit tracer station installed at a maximum of 500 feet. These should be shown on plans.

H. All force mains greater than 12 inches shall be AWWA specification C 905, Class 235, DR 18. The color shall be green and shall meet ASTM specifications D 3139 for pipe joined with rubber gaskets conforming to ASTM F 477, or DIP shall conform to the requirements of "Ductile-Iron Pipe, Centrifugally Cast in Metal Molds for Sand-Lined Molds, for Water and Other Liquids," AWWA C151, (ANSI A21.51), current revision. Pipe shall be lined with Protecto 401 ceramic epoxy lining or approved equal. Pipe thickness shall be the minimum specified in C151. Bell (female) ends of pipe shall be installed on upstream side with spigot (male) ends oriented downstream. All ductile iron fittings shall be Ductile-Iron Compact Fittings AWWA C153/A21.53.84 MJ and restrained with Ebba "Meg-a-lugs" or approved equal. The fittings shall be lined with Protecto 401 ceramic epoxy lining or approved equal. A 2-inch- wide green marker tape with the words "Sanitary Sewer Forcemain" shall be installed 12 inches above the top of pipe during installation. Force mains shall be equipped with a 14-gauge, copper clad tracer wire and shall have a snake pit tracer station installed at a maximum of 500 feet.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

These should be shown on plans. Bedding and backfill shall conform to Section 6.04 and to the City's Standard Construction Details.

4.06 LOCATION OF SANITARY SEWERS AND EASEMENT REQUIREMENTS

A. Sanitary sewers shall be designed and located to conform to regulations of the TCEQ.

B. Sanitary sewers shall be placed within the right-of-way at least 4 feet from the back of curb. Sanitary sewers shall be placed along a uniform alignment within the right-of-way.

C. Where required, additional easements shall be provided adjoining the right-of-way to provide required clearances. A public utility easement adjoining a public right-of- way shall be of sufficient width to provide a minimum of 12.5 feet of clearance on each side of the centerline of the pipe.

D. The minimum width of a public utility easement not located adjacent to a public right-of-way shall be 20 feet.

E. Where sanitary sewers or force mains are installed in easements separated from public rights-of-way by other private or utility company easements, the sanitary sewer easement should be extended along or across the private utility company easement to provide access for maintenance of the sewer or force main.

4.07 CLEARANCE OF WATER LINES FROM SANITARY SEWER LINES

A. Sanitary sewers shall be designed and located to conform to regulations of the TCEQ. The latest edition of "Rules and Regulations for Public Water Systems," of the TCEQ, shall be followed for minimum criteria and instructions for water line crossings.

4.08 TRENCHING, BEDDING, AND BACKFILL REQUIREMENTS

A. All bedding and backfill shall be in accordance with the City Standard Construction Details. All backfill within public rights-of-way and public easements shall be compacted to a minimum of 95 percent of Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78), without additional moisture control, cured and tested in accordance with ASTM C31.

B. The minimum trench width shall be equivalent to the outside diameter of the pipe plus 12".

C. The maximum trench width shall be equivalent to the outside diameter of the pipe plus 36".

D. The minimum trench depth shall be equivalent to the desired bury depth of the pipe plus the outside pipe diameter plus 6".

E. Pipes shall be bedded with bank sand.

F. Sand bedding shall fill the entire width of the trench and shall extend from a depth of 6" below the pipe to 6" above the pipe.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

G. Bedding shall be installed in maximum 9” loose lifts and be compacted by vibratory equipment.

H. In water bearing sand, washed shell, or other approved, granular material will be required with geo-textile fabric wrap as shown in the City Standard Construction Details. When water-bearing sands are encountered, the City shall be notified immediately.

I. Backfill in non-paved areas and under concrete paved roadways shall consist of select backfill from the excavation.

J. In non-paved areas the backfill shall fill the entire trench width of the trench and shall extend from the top of the sand bedding to a depth of 6” below the elevation of the finished surface.

K. In non-paved areas, the uppermost 6” of backfill shall consist of topsoil. If the trench extends through an existing vegetated landscape, any excavated or disturbed area adjacent to the trench shall be re-sodded with grass that is similar to the existing landscaping.

L. All sanitary sewer lines located underneath and within 1 foot of any asphalt paving shall be bedded in cement stabilized sand in accordance with the Standard Construction Details. The cement stabilized sand shall be in accordance with the following requirements.

1. The cement shall be Portland Cement, Type I, ASTM C150.

2. The sand shall be clean, durable sand, with less than 0.5 percent clay lumps, ASTM C142: with less than 0.5 percent lightweight pieces, ASTM C123; with organic impurities, ASTM C40, not showing a color darker than standard color, and a plasticity index of less than six when tested in accordance with ASTM D423 and ASTM D424.

3. Compact to 95 percent Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78) in maximum loose lifts of 8 inches thick. Actual testing shall be required as deemed necessary by the City.

4. The cement-sand mixture shall consist of at least 1.5 sacks of cement per ton of sand. The cement-sand mixture shall have a minimum unconfined compressive strength of 100 psi in 48 hours, when compacted to a minimum of 95 percent of Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78), without additional moisture control, cured and tested in accordance with ASTM C31.

5. Under asphalt paving, the cement stabilized sand shall fill the entire trench width and shall extend from the top of the sand bedding to the elevation of the bottom of the base section.

M. Under concrete roadways, the backfill shall fill the entire width of the trench and shall extend from the top of the sand bedding to the elevation of the bottom of the concrete paving.

4.09 PIPE LOCATION MARKING

A. Adequate markings on site as specified below and accurate as-built locations shall be provided so that the wastewater lines and services can be easily located by the City in the future.

B. A continuous tracer wire, such as a solid 14-guage copper clad wire with blue shielding or approved equal, shall be affixed to the top of the new wastewater main prior to bury and shall have a snake pit tracer station installed at a maximum of 500 feet. The tracer station shall have a 2' x 2' concrete pad around it and shall be shown on the plans. Wire splices shall be completed using approved, underground connectors. Soldered connections are not permitted. A continuity test shall be completed prior to acceptance.

C. The location of sanitary sewer services shall be marked on the curb by etching or casting a "Y" into the face of the curb directly over the sanitary sewer service location.

4.10 INSTALLATION BY BORE AND JACK

A. Bore and jack sections shall be specifically approved by the City and clearly shown on the drawings by location and footage.

B. The following criteria are generally used as a basis for setting bore and jack sections.

1. Bore pits shall be at least 3 feet from the back of curb and 5 feet from back of curb on a major thoroughfare. Bore pits in highways, county roads, or railroad rights-of-way shall conform to these requirements and to the requirements of the crossing permit or use agreement. All bore pits shall be shored in accordance with Occupational Safety and Health Administration (OSHA) requirements. Bore pits or receiving pits to be located in street or driveway paving, shall be shown on drawings.

2. All existing developed areas shall be restored to original condition after construction.

4.11 TESTING OF INSTALLED PIPE AND MANHOLES

A. It is the responsibility of the contractor to deliver a finished product in compliance with the contract documents and applicable federal, state, and local requirements. An independent testing laboratory shall be used to verify contract document compliance.

B. The Contractor is responsible for notification of the City and the independent testing laboratory in accordance with the City's notification requirements. In the event construction activity occurs without proper notification to the City, the work in question is subject to removal and replacement in accordance with the standards at the discretion of the City.

C. For a collection system pipe that will transport wastewater by gravity, the following TCEQ testing methods are required:

§217.57 Testing Requirements for Installation of Gravity Collection System Pipes:

(a) For a collection system pipe that will transport wastewater by gravity flow, the design must specify an infiltration and exfiltration test or a low-pressure air test. The test must conform to the following requirements:

(1) Low Pressure Air Test.

(A) A low pressure air test must follow the procedures described in American Society for Testing and Materials (ASTM) C 828, ASTM C 924, or ASTM F 1417 or other procedure approved in writing by the executive director. The testing times listed in Table C.4. in Figure: 30 TAC §217.57(a)(1)(B)(ii) must

be used, regardless of the testing procedure.

(B) For sections of collection system pipe with an average inside diameter less than 36 inches, the following procedure applies, unless a pipe is to be tested as required by paragraph (2) of this subsection.

(i) A pipe must be pressurized to 3.5 pounds per square inch (psi) gauge. If groundwater is present, then a pipe must be pressurized to 3.5 psi gauge greater than the pressure exerted by groundwater above the pipe.

(ii) Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 psi gauge to 2.5 psi gauge is computed from the following equation:

Figure: 30 TAC §217.57(a)(1)(B)(ii)

Equation C.3.

$$T = \frac{(0.085 \times D \times K)}{Q}$$

Where:

T = time for pressure to drop 1.0 pound per square inch gauge in seconds

K = 0.000419×D×L, but not less than 1.0

D = average inside pipe diameter in inches

L = length of pipe line, in feet

Q = rate of loss, 0.0015 cubic feet per minute per square foot internal surface

(C) Since a K value of less then 1.0 may not be used, the minimum testing time for each pipe diameter is shown in the following table:

Figure: 30 TAC §217.57(a)(1)(C)

Table C.4. - Minimum Testing Times for Low-Pressure Air Test

Pipe Diameter *(inches)*	Minimum Time *(seconds)*	Maximum Length for Minimum Time *(feet)*	Time for Longer Length *(seconds/foot)*
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1,020	133	7.693
21	1,190	114	10.471
24	1,360	100	13.676
27	1,530	88	17.309
30	1,700	80	21.369
33	1,870	72	25.856

(D) An owner may stop a test if no pressure loss has occurred during the first 25% of the calculated testing time.

(E) If any pressure loss or leakage has occurred during the first 25% of a testing period, then the test must continue for the entire test duration as outlined above or until failure of the test.

(F) Collection system pipes with a 27 inch or larger average inside diameter may be air tested at each joint instead of following the procedure outlined in this section.

(G) A testing procedure for a pipe with an inside diameter greater than 33 inches must be approved in writing by the executive director.

(2) Infiltration/Exfiltration Test.

(A) The total exfiltration, as determined by a hydrostatic head test, must not exceed 10 gallons per inch of diameter per mile of pipe per 24 hours at a minimum test head of 2.0 feet above the crown of a pipe at an upstream manhole, or at least two feet above the existing groundwater level, whichever is greater.

(B) An owner shall use an infiltration test in lieu of an exfiltration test when pipes are installed below the groundwater level.

(C) If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, an owner shall take remedial action in order to reduce the infiltration or exfiltration to an amount within the limits specified by Equation C.3. in Figure: 30 TAC §217.57(a)(1)(B)(ii) before putting the system into service. An owner shall retest a pipe following a remedial action according to the requirements of this chapter.

Deflection testing of gravity sewer lines shall be conducted after completion of final backfill and grading for piping installed in areas that will not be paved. In areas where gravity sewer piping is installed beneath paving, deflection testing shall be conducted after subgrade preparation is completed. Such initial testing shall be conducted 30 days or longer after piping has been inspected and backfilled. In the event of a failed test, the line will be repaired and retested 30 days after the backfill has been replaced. No pipe shall exceed a deflection of 5 percent. The deflection test shall be conducted using a rigid ball or mandrel having an inside diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices and shall be in accordance with the requirements of the TCEQ.

D. The following TCEQ testing methods are required for sanitary sewer force mains:

§217.68 Force Main Testing:

(a) The final plans and specifications must include the pressure testing procedures.

(b) A pressure test must use 50 pounds per square inch above the normal operating pressure of a force main.

(c) A temporary valve for pressure testing may be installed near the discharge point of a force main and must be removed after a test is successfully completed.

(d) A pump isolation valve may be used as an opposite termination point.

(e) A test must involve filling a force main with water.

(f) A pipe must hold the designated test pressure for a minimum of 4.0 hours.

(g) The leakage rate must not exceed 10.0 gallons per inch of diameter per mile of pipe per day. The following equation must be used to calculate the acceptable leakage rate in gallons per hour per 1,000 feet of pipe.

Figure: 30 TAC §217.68(g)

Equation C.5.

$$L = \frac{SD\sqrt{P}}{155{,}400}$$

Where:

L = Acceptable leakage rate (gallons/hour/1,000 feet of pipe, based on a leakage rate of 10.0 gallons per inch of diameter per mile of pipe per day)

S = Length of pipe (feet)

D = Nominal diameter of pipe (inches)

P = Average test pressure (ponds/square inch)

E. The following TCEQ testing methods are required for sanitary sewer manholes:

§217.58 Testing Requirements for Manholes:

(a) All manholes must pass a leakage test.

(b) An owner shall test each manhole, after assembly and before backfilling, for leakage using hydrostatic exfiltration testing, vacuum testing, or any other method approved in writing by the executive director. A manhole must be tested separately and independently from the collection system pipes.

(1) Hydrostatic Testing.

(A) The maximum leakage rate for hydrostatic testing or any alternative test methods is 0.025 gallons per foot diameter per foot of manhole depth per hour.

(B) To perform a hydrostatic test, an owner shall seal all wastewater pipes coming into the manhole with an internal pipe plug, fill the manhole with water, and maintain the test for at least one hour.

(C) A test for concrete manholes may use a 24-hour wetting period before testing to allow saturation of the concrete.

(2) Vacuum Testing. An owner must perform vacuum testing according to either subparagraph (A) or (B) of this paragraph. If a manhole fails the vacuum test, the

owner must apply grout to the exterior of the excavated manhole before retesting the manhole.

(A) Texas Test.

(i) To perform a vacuum test, an owner shall plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering a manhole.

(ii) Grout may not be placed in horizontal joints before testing.

(iii) Stub-outs, manhole boots, and pipe plugs must be secured to prevent movement while a vacuum is drawn.

(iv) An owner shall use a minimum 60 inch/lb torque wrench to tighten the external clamps that secure a test cover to the top of a manhole.

(v) A test head must be placed at the inside of the top of a cone section, and the seal must be inflated in accordance with the manufacturer's recommendations.

(vi) There must be a vacuum of 10 inches of mercury inside a manhole to perform a valid test.

(vii) A test does not begin until after the vacuum pump is off.

(viii) A manhole passes the test if after 2.0 minutes and with all valves closed, the vacuum is at least 9.0 inches of mercury.

(B) American Society for Testing and Materials (ASTM) Test. The owner may require manhole testing that meets the requirements of ASTM D1244-11.

F. In addition to deflection and pressure testing, the City may require that certain sewer installations be videoed after completion of construction, if necessary, to ensure that City requirements are met.

G. Cement Stabilized Sand Testing:

1. A minimum of two random samples for compressive strength shall be taken each week. For Smaller projects, one sample may suffice with City approval. The City reserves the right to require additional tests, at the Contractor's expense, if it is deemed necessary. In the event of a change in supplier, samples shall be drawn on the first day of delivery from the new supplier, regardless of previous samples taken.

2. Cement stabilized sand samples shall be taken at the point of placement of the cement stabilized sand and identified as to the location of the sample.

3. Cement stabilized sand densities shall be taken a minimum of every 150 linear feet of trench, with a minimum of two tests (one per direction of travel) at each road crossing. When used as subgrade on roadway repairs, density tests shall be taken every 100 square feet of subgrade, with a minimum of one test per repair.

H. Bedding, Backfill, Testing:

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

1. Bedding and density tests shall be performed a minimum of every 300 linear feet of trench in each lift. Density tests shall be offset on alternating lifts and test locations shall be identified by station number.

I. Copies of all test results shall be given to the City with the project closeout documents.

4.12 EXISTING FACILITY CROSSINGS

A. Installation of a sanitary sewer main across a proposed or existing public street, driveway, sidewalk, railroad, pipeline, or drainage way shall conform to the requirements of this section.

1. Public Streets - All existing public streets are to be bored and jacked regardless of surface. Bore and jack length shall be computed as roadway width at proposed bore plus 5 feet to either side.

2. Driveways – Concrete and asphalt driveways in good condition shall be bored and jacked. Bore and jack length shall be computed as driveway width at bore plus 5 foot to either side. Where driveways cross culvert pipe sections along open ditch streets and the proposed wastewater main is in close proximity and parallel to the culvert pipe, the length of bore shall be the same as the length of culvert pipe.

3. Sidewalks – When the wastewater line crosses under a sidewalk in good condition, the sidewalk shall either be bored and jacked or removed and replaced to the City's criteria, whichever is most cost-effective. Bore and jack length shall be at least the width of the sidewalk. The proposed type of construction shall be noted on the drawings.

4. Railroad Crossings – All railroad crossings require a pipeline crossing permit to be issued by the corresponding railroad company and shall be bored and jacked in accordance with the requirements of that permit and the standards provided in this manual.

5. Drainage Way – When a wastewater line crosses under an existing drainage way, the water conveying portion of the drainage way shall be bored and jacked in accordance with the standards provided in this manual.

B. Trees – When saving trees is a consideration, all trees 6 inches or larger in diameter and within 10 feet of the centerline of the water main must be noted on the drawings. The wastewater main shall be bored and jacked within the drip line of any tree larger than 6 inches in diameter.

4.13 BARRICADING AND SIGNAGE

A. Proper barricading and signage, conforming to the Texas Manual of Uniform Traffic Control Devices' latest edition, shall be required on all projects.

B. Adequate signage for vehicular and pedestrian traffic shall be installed.

C. A traffic control plan shall be submitted to the City and approved by the City for all streets open to travel by the public.

4.14 SANITARY SEWER SERVICES

A. Two-way cleanouts shall be installed at the end of each service and be terminated 6 inches below grade with a threaded cap and a concrete box. The downstream cleanout shall have a

section of pipe stubbed out and capped to facilitate connection. Services shall be terminated within the public utility easement as close to the lot line as possible.

B. Sewer service leads shall not exceed 125 feet in length, unless approved by the City. Near-side double sewer service leads shall not exceed 20 feet in length and may extend across a public right-of-way or easement. All leads shall not be deeper than 8 feet.

C. For Single-Family Residential Lots:

1. Far-side service connections shall be installed at the time of construction of the sewer. Double sewer service leads shall be located within a public right-of-way or easement.

2. Service connections shall be constructed of materials on the City's approved Product List.

3. Service connections should be installed at a manhole, when possible.

D. For Multi-Family Residential, Commercial, and Office Development.

1. Service connections shall be made at a manhole. Long service connections should be installed at the time of construction of the sewer.

2. Service connections shall be constructed of materials on the City's approved Product List and in accordance with 6.03 I above.

E. General requirements for service connections at manholes include the following:

1. Service connections shall be made at manholes whenever possible. When a service connection stub-out is not provided, an opening shall be cored out of the manhole at the required elevation. The service connection shall be extended into the manhole and the opening secured and grouted, and the manhole coating shall be repaired in accordance with the coating manufacturer's recommendations.

2. A service connection at a concrete manhole shall have a rubber boot that is cast into the manhole, or the service location shall be cored. The rubber boot shall be secured and then grouted. The manhole interior coating shall be repaired in accordance with the manufacturer's recommendations. When a hole for a service connection in an existing brick manhole exceeds 8 inches, the manhole shall be replaced.

3. Service connections entering a manhole 24 inches or more above the flow line of the manhole shall include an internal drop pipe with fittings. The cored opening for the pipe shall be secured and grouted, and the manhole coating shall be repaired in accordance with the coating manufacturer's recommendations.

F. The location of sewer services shall be marked on the curb by etching or casting a "Y" into the face of the curb directly over the sewer service location.

G. Service connections that are installed after initial construction of a sewer shall be constructed using a PVC saddle with gasket and stainless-steel straps as included on the City's Approved Product List.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

4.15 LIFT STATIONS AND FORCE MAINS

A. Lift stations shall be designed in conformance with the “TCEQ Design Criteria for Sewerage Systems" (latest edition). Lift stations should be considered only when a gravity system cannot be achieved. All lift stations shall be specifically approved by the City. The Design Engineer shall provide design requirements and pertinent data with construction drawings for review. A preliminary design meeting with the City staff is recommended. Lift stations shall be designed as follows:

1. The lift station site shall be conveyed in fee to the City. The site may be part of a larger site that includes a public wastewater treatment facility or other facility. The site shall have a minimum size of 50 feet by 50 feet.

2. Site access shall be provided by a 15-foot-wide public right-of-way with an approved, all-weather access road of a minimum of 12 feet in width. Wet well structures shall be a minimum of 12 feet from the outside walls of the structure to the site boundary fencing. Fencing shall be in conformance with the City Zoning Ordinance.

3. Use drainage swales, sidewalls and driveways, culverts, storm sewers, or a combination thereof for internal site drainage. Site drainage may sheet flow to a public right-of-way. Storm sewer systems, if provided, shall be sized in accordance with applicable design guidelines.

4. The top of the wet well and all electrical controls shall be located 3-feet above the 100-year floodplain Entry to the site must be accessible during a 25-year flood.

5. Locate the wet well, and specifically, the pumps in the wet well such that a crane truck can back up to (or beside) the hatch to facilitate removal of the pumps without leaving the pavement. Provide sufficient room for construction access as well as on-going maintenance.

6. Include an on-site manhole no farther than 80’ upstream of the lift station wet well. Ideally, the on-site manhole shall be located within the fenced in area and shall be located so as not to block vehicle access to the facilities and shall be located in an area that does not receive vehicle traffic.

7. The design of the lift station shall include a potable water connection in accordance with the design standards for water services. In addition to the service connection requirements specified in the design standards for water connections, the potable water connection must include a ¾” Reduced Pressure Zone Backflow Device (RPZ) conforming to AWWA’s Manual M14, a hose bibb (self-draining and freeze resistant, installed 12” above the 100-year flood plain), hose-bibb vacuum breaker, and freeze protection.

8. All gravity sanitary sewers discharging to the wet well shall be located where the invert elevation is at or above the liquid level of the pump's "ON" setting to achieve the firm pumping capacity. Valves and check valves shall not be located in the wet well but may be located in a valve vault or on a concrete slab. Piping shall be spaced to maintain the pump manufacturer's minimum clearances between pumps.

9. Size the diameter of the wet well, hatches, and hatch spacing to accommodate the selected pumping equipment. Consideration should be given to the dimensions of the ultimate pump in a multi-phased lift station to ensure adequate clearances. Provide a minimum of 18 inches of clearance from the inside wet well wall to all flanges to enable removal of all bolts. Pre-cast concrete wet wells may be used in any diameter provided calculations demonstrate that wet well thickness and material weight will resist imposed up-lift pressure. Provide hatch

safety nets with aluminum sliding rails or Flygt Safe-hatch access cover.

10. The wet well volume shall be based on the minimum cycle time of the largest pump planned for the lift station plus additional depth to prevent motor overheating and vortexing. Wet well working volume should be sized to allow for the recommended pump cycle for each pump.

    The cycle time shall not be less than those listed in the following:

Motor Horsepower	Cycle Time (Minutes)
<50	6
50-100	10
>100	15

11. The "OFF" elevation of the submersible pumps shall be deep enough to prevent vortexing and motor overheating. The Design Engineer shall verify with all pump manufacturers on the City's Approved Product List that each pump is capable of operating continuously at the "OFF" elevation shown on the drawings.

12. The wet well floors shall have a minimum of 10 percent slope to the pump intakes and have a smooth finish. There shall be no wet well projections, which will allow deposition of solids under normal operating conditions. The inlet structure shall be designed to minimize turbulence.

13. The wet well shall have a vent sized such that the maximum velocity of air through the vent is 600 feet per minute at the firm pumping capacity. Vents shall have a stainless-steel insect screen that is easily replaceable and will prevent the entrance of rainwater. Vent pipes shall be corrosion resistant.

14. Access shall be provided to underground valve vaults. Stairways shall have corrosion-resistant, non-slip steps and conform to OSHA regulations with respect to rise and run. Where ladders are utilized in lieu of stairways, ladders shall conform to OSHA requirements.

15. Floor drains from valve vaults to wet wells shall be designed to prevent gas and raw sewer water from entering the valve vault. Such designs shall include "P" traps and floating ball type backwater valves.

16. All walls shall be a minimum of 18 inches from the outermost edge of all flanges to enable removal of all bolts. Pipes shall have a minimum spacing greater than that required by the pump manufacturer for minimum pump spacing. Swing check valves shall be positioned such that the shafts may be removed without removing the valve body.

17. Design shall follow the latest version of ACI 350 with the exception that the minimum concrete cover over steel reinforcing shall be at least 4 inches where in contact with raw sanitary sewer.

18. Wet wells shall be designed to resist the effects of buoyancy assuming full saturation of the surrounding soils to the finished grade or the 100-year floodplain, whichever is greater. Surface friction shall not be included in the design unless a friction factor is provided in a geotechnical report signed and sealed by a licensed professional engineer. A safety factor of 1.1 shall be used for buoyancy resistance. Wet well walls shall be designed to withstand

lateral earth pressures and static water levels at finished grade as outlined in ACI 350. At a minimum, 3,500 psi concrete shall be used. Top slabs shall be designed for a uniform loading of 100 pounds per square foot and a point load equal to the weight of the largest pump planned for the lift station at any location.

19. Hatches shall be constructed entirely of aluminum and designed for a minimum of 150-pound-per-square-foot load. The underside of the hatch shall have the following stenciled in red paint: "Warning! Confined Space Entry." Where individual hatches are incorporated into the top slab, the separation distance from inside face to inside face shall be a minimum of 12 inches.

20. Where riser pipes pass through the top slab, offsets or two 45-degree bends shall be used to provide clearance between the outside diameter of the pipe and the inside face of the hatches. The amount of clearance will be determined by the diameter of the slab reinforcing and the maximum aggregate diameter.

21. Use of vault-type or aboveground valves and piping is permitted. Valves shall be mounted in a concrete vault, or on an aboveground concrete foundation. Isolation and check valves shall not be located in the wet well.

22. If a valve vault is not used, the valves must be a minimum of 18” above ground with pipe supports every 5 feet. A minimum 6-inch-thick concrete slab must be placed below the piping gallery and valves. The slab must extend 3-feet beyond all valves and piping to allow for access to and maintenance of the piping and valves.

23. Pumps shall be Flyght, non-clog, submersible pumps capable of passing a 3-inch diameter or greater incompressible sphere and shall have suction and discharge openings a minimum of 4 inches in diameter. Pump seals shall be silicon carbide or tungsten carbide.

24. Pumps shall be sized to operate at optimum efficiency. Minimum acceptable efficiency at the operating point shall be 60 percent, unless specifically approved by the City. Leak detection sensors shall be provided in the motor housing of submersible pumps. Pumps shall be securely supported, in accordance with manufacturer recommendations, so as to prevent movement or vibration during operation. Rail-type pump support systems shall be provided for submersible pump installations so that pump removal and installation can be performed without requiring dewatering of or entry into the wet well. Rails, lifting chains, and hardware shall be constructed of Series 300 stainless steel.

25. Electric motors shall be sized so as to operate at a maximum design load without use of the service factor. Electric motors shall be 120-volt single-phase, 240-volt single-phase, 240-volt three-phase, or 480-volt three-phase. Motor service factor shall be a minimum of 1.15. Thermal protection shall be provided in the motor housing.

26. The following electrical power sources shall be considered for serving lift stations:

    a. For stations where total pump motor sizes do not exceed 30 horsepower (hp), and where any individual pump motor size does not exceed 20 hp, 120/240-volt, three-phase service is recommended.

    b. For stations where individual pump motor sizes do not exceed 5 hp and motor ratings are available as single-phase, and where three-phase service is not available, 120/240-volt, single-phase service may be used.

c. For stations where total pump motor sizes exceed 30 hp and where individual motor sizes exceed 20 hp, 480/277-volt, three-phase service is recommended.

27. Emergency power connections shall require a manual transfer switch and a 200-amp, 3 pole, 4 wire generator receptacle equivalent to a Hubbell HBL4200RS2W the pump controller shall include magnetic starters utilizing melting alloy overloads, and be equipped with a pump alternator, an ultrasonic level controller, backup floats, alarm contacts, and a power supply. The use of variable frequency drive is acceptable. Lightning and surge protection shall be installed on the main power bus.

28. All panels and controls shall be covered by a constructed overhang to shield the equipment from sun and rain.

29. Panel area shall be lit by an outside, overhead light fixture.

30. The following controls and indicators shall be provided:
    a. Pump HOA Selector Switch (for each pump).
    b. Alarm Reset Switch.
    c. Seal-Fail and Over-Temp Reset Switch (for each pump protection module supplied by pump manufacturer).
    d. Phase-Fail Light.
    e. Pump Run Light (for each pump).
    f. Control Power Light On.
    g. Pump Seal-Fail Light (for each pump protection module - supplied by pump manufacturer).
    h. Pump Over-Temp Light (for each pump protection module - supplied by pump manufacturer).
    i. High Level Alarm Indicator.
    j. Alarm Rotating Beacon Light.
    k. Pump Run Elapse Time Meter (for each pump).

31. The following motor protection devices shall be provided:
    a. Motor Circuit Protectors (MCPs) or circuit breakers.
    b. Motor Overload Current Tip Devices or C.T.'s with Relays (for each motor).
    c. Motor Over-Temp and Seal Fail Relays (tor each motor - furnished by pump motor manufacturers).
    d. Phase Fail Relay.

32. Level Controls
    a. Primary: Ultrasonic level controller, rated for wastewater application.
    b. Back-up: PVC ball type float with mercury switch - high and low level.
    c. In the event of fail signal from Ultrasonic level device, controller automatically switches to floats.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

33. Alarm Signals:

    a. Alarms activate local indicator lights and send signals to the City's SCADA system. Communication method shall be approved by the City.

34. Pump Cable Terminal Boxes:

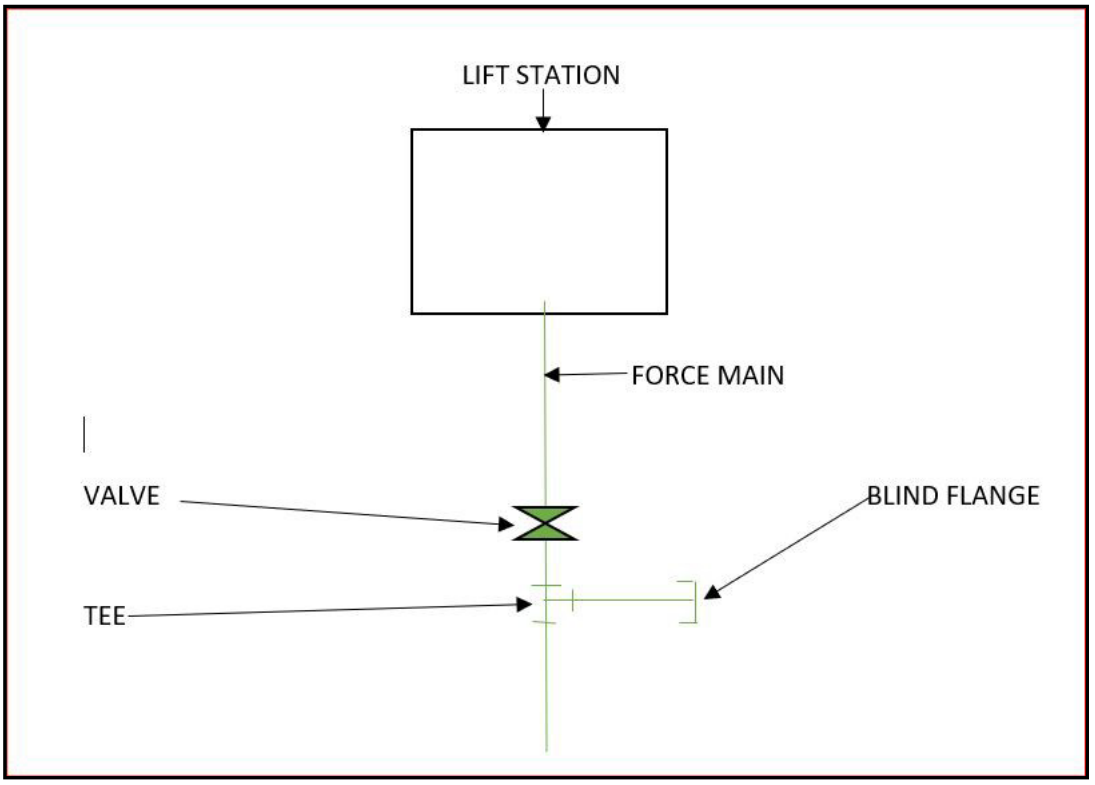
    a. NEMA 4X stainless steel boxes are to be mounted near the pump access hatch for termination of pump power and control cables, and for termination of transducer and float cables.

35. Control Panel Enclosure:

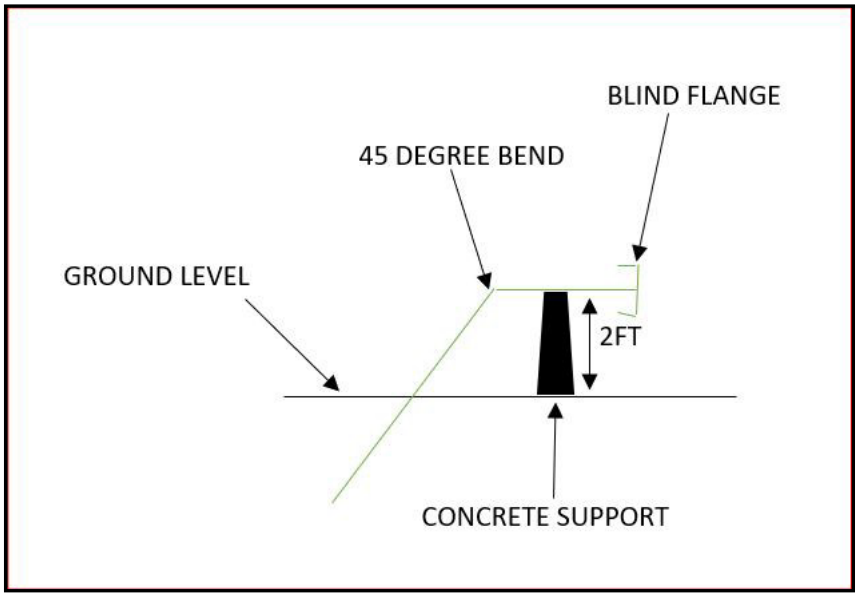
    a. NEMA 4X stainless steel enclosure on factor stainless steel stands with inside swing door, back plate, quick release latches, and hooking clasp.

36. Emergency operations shall be considered.

    a. Provide fittings and a blind flange that will be readily accessible for emergency bypass pumping in accordance with the schematics below:



200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org



b. Provide external hook-up for an emergency generator as specified in 27 above.

37. Force mains shall be a minimum of 4 inches in diameter, unless used in conjunction with grinder pumps. Pump stations with two pumps shall have force main velocities of a minimum of 3 fps with one pump in operation. For pump stations with three or more pumps, the force main velocity shall not be less than 2 fps with the smallest pump only in operation. Force main velocities shall not exceed 6 fps without the engineer performing an analysis for possible high and low negative surge pressures in the event of sudden pump failure.

38. Isolation valves shall be provided on the discharge side of pumps for submersible pumps, positioned such that the pump or check valve can be isolated for removal. Plug valves shall be used. Check valves shall be swing type with an external lever and shall be installed in a horizontal position. Use of butterfly valves, tilting disc check valves, or other valves using a tilting disc in the pipe flow is not permitted.

39. Surge relief valves, air release, or combination air and vacuum valves shall be provided, as required.

40. Lift station piping shall have flanged, grooved (Victaulic) or flexible connections to allow for removal of pipe and check valves without interruption of the lift station operation.

41. Lift stations shall be designed to discharge the peak design flow at the system head required and to operate efficiently during any initial, interim, or ultimate design phase.

42. Firm pumping capacity shall be provided, and is defined as total station, maximum pumping capacity, with the largest pumping unit out of service.

43. Pump selection shall be based on the analysis of the system head and pump capacity curves for the determination of pumping capacities. System losses shall be calculated in accordance with the Hydraulic Institute standards. The selected C coefficient value for use in the calculation of friction head losses per the Hazen-Williams Formula shall be based on the selected pipe material for new and aged (20-year) conditions.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

44. Force main velocities shall be included on the system curve.

45. Design considerations shall include corrosion control and protection of concrete and metallic surfaces located within the wet well or valve vault, or within the immediate vicinity from the effect of hydrogen sulfide (H2S) gas in the wastewater. The effects of H2S gas should be minimized by reducing the production or release of H2S gas from the wastewater discharging to or being contained in the lift station. Design and control methods shall include the following.

    a. Protecting the exposed concrete and steel surfaces with an epoxy lining, refer to the Approved Products List for a list of materials. Exposed piping shall be protected with a 100 percent solids novolac epoxy or approved equal.

    b. The use of Series 300 stainless steel for equipment, piping, or devices exposed to corrosive gases.

    c. Design wet wells that lack interior corners, projections, or areas that can result in the accumulation of solids. Design interior surfaces with smooth finishes that facilitate cleaning.

    d. Provide wash-down water at site when possible.

46. Corrosion protection shall be provided by coating interior concrete surface of the wet well, structural steel, piping and hangers, air systems, electrical, mechanical, and other components subject to a corrosive environment. All metal components subject to a corrosive environment shall be stainless steel or aluminum unless otherwise approved by the City. Surfaces to be protected include the following.

    a. Interior of the wet well: The interior of the wet well shall be coated with an approved epoxy coating. Refer to Approved Products List for the list of materials.

    b. Piping located within the wet well: Exposed piping shall be protected within a 100 percent solids novolac epoxy or approved equal.

    c. Guide rails, lifting chains, hardware, and miscellaneous metal shapes located within the wet well shall be constructed or manufactured of Series 300 stainless steel.

47. Lift station construction drawings shall include drawings that provide the following information:

    a. Site layout.

    b. Plan and profile of pump station and associated site piping.

    c. Profile view of pump operational and control valves and settings.

    d. Hydraulic system curve.

    e. Electrical wiring and control system schematics.

    f. Structural details.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

g. Developer shall provide the City with a complete set of Operations and Maintenance manuals on all equipment to be installed.

END OF CHAPTER

City of BRENHAM

Website: cityofbrenham.org
Phone - Main Line: 979-337-7200
Development 979-337-7220 | Utilities 979-337-7401
200 W. Vulcan, Brenham, Texas 77834

PUBLIC INFRASTRUCTURE DESIGN MANUAL

CHAPTER 5 - STORMWATER SYSTEMS

Version 2021-1

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

CHAPTER 5
STORMWATER SYSTEM DESIGN REQUIREMENTS

5.01 GENERAL

A. This chapter includes the minimum design requirements for public and private stormwater systems within the City limits of the City.

B. The City's staff shall approve stormwater system drawings for all public improvements within the City limits. Construction shall conform to the City Standard Construction Details.

C. Construction drawings for private improvements, within public rights-of-way and public easements, or that connect to or affect the public infrastructure shall be approved by the City subject to the requirements of this Manual and are subject to review and approval using the process defined in this Manual.

D. Design, construction, and sizing of all stormwater systems shall meet or exceed the requirements of the City.

E. All roadway drainage systems that are to become a maintenance responsibility of the City shall be enclosed storm sewers, except as specifically approved by the City.

F. Public storm sewers are defined as sewers and appurtenances that provide drainage for a public right-of-way, or more than one private tract, are located in public rights-of-way or easements and have been accepted by the City. Private storm sewers provide internal drainage for reserves or tracts within the private development. Private storm sewer connections to public storm sewers shall occur at a junction box or at the back of an inlet as approved by the City. All private storm sewers within the public right-of-way shall be constructed in conformance with these standards.

G. All calculations and design drawings shall be prepared under the supervision of a Professional Engineer trained and licensed under the disciplines required by the project scope. The final design drawings and all design calculations must be sealed, signed, and dated by the Professional Engineer responsible for the development of the drawings.

H. All construction drawings shall contain minimum slab elevation, with reference to the most current vertical datum from the most current FEMA flood maps.

5.02 DEFINITIONS

Conduit – Any open or closed device for conveying flowing water.

Drainage Area Map – Area map of watershed that is subdivided to show each area serve by each subsystem.

Hydraulic Grade Line – A line representing the pressure head available at any given point within the drainage system.

Redevelopment – A change in land use that alters the impervious cover from one type of development to either the same type or another type and takes advantage of the existing infrastructure in place as a drainage outlet.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

In-fill Development – Development of open tracts of land in areas where the storm drainage infrastructure is already in place and takes advantage of the existing infrastructure as a drainage outlet.

Rational Method – A method for calculating the peak run-off for a storm drain system using the following equation Q=CiA for run-off, typically used for drainage areas of less than 200 acres.

Design Storm Event – Rainfall intensity upon which the drainage facility will be sized.

Positive Overflow Pathway – The surface flow, through designated route, of the collective sheet flow of stormwater that results when the minor drainage system has reached capacity.

Rainfall Frequency – Probability of a rainfall event of defined characteristics occurring in any given year. The National Oceanic and Atmospheric Administration (NOAA) publishes information on rainfall frequency (NOAA Atlas 14 Point Precipitation Frequency Estimates).

For the purpose of storm drainage design, the following frequencies are applicable:

1. 2-year frequency – a rainfall intensity having a 50 percent probability of occurrence in any given year, or nominally likely to occur once every 2 years.

2. 5-year frequency – a rainfall intensity having a 20 percent probability of occurrence in any given year, or nominally likely to occur once every 5 years.

3. 10-year frequency – a rainfall intensity having a 10 percent probability of occurrence in any given year, or nominally likely to occur once every 10 years.

4. 25-year frequency – a rainfall intensity having a 4 percent probability of occurrence in any given year, or nominally likely to occur once every 25 years.

5. 100-year frequency – a rainfall intensity having a 1 percent probability of occurrence in any given year, or nominally likely to occur once every 100 years.

Sheet Flow – Overland storm run-off that is not conveyed in a defined conduit and is typically in excess of the capacity of the conduit.

Manning's Equation: $V = (Kin)\ R^{2/3}S$, V.

1. Where: K = 1.49 for English units or 1.0 for metric units

2. V = velocity (feet per second).

3. R = hydraulic radius (feet) (area per wetted perimeter).

4. S =friction slope (headless per length).

5. n = 0.013 for concrete pipes.

6. n = 0.024 for CMP pipes.

Continuity Equation: Q = VA

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

1. Where: Q = discharge (cubic feet per second).

2. V =velocity (feet per second).

3. A =cross sectional area of conduit (square feet).

FEMA – Federal Emergency Management Agency.

5.03 DESIGN REQUIREMENTS

A. **Stormwater Goals:** The goal of all drainage design within the City limits of Brenham is the prevention of structure flooding and the maintenance of one lane passable in each direction on major thoroughfares during a 100-year storm event. This is accomplished through application of various drainage enhancements, such as storm sewers, open channels, detention, and overland (sheet) run-off. The combined system is intended to prevent structural flooding from extreme events up to a 100-year storm. Recognizing that each site has unique differences that can enhance the opportunity to provide proper drainage, the intent of these criteria is to specify minimum requirements that can be modified provided that the objective for drainage standards is maintained. Street ponding of short duration is anticipated and designed to contribute to the overall drainage capability of the system. Storm sewers are designed as a balance of capacity and economics. These conduits are designed to convey less intense, more frequent rainfalls with the intent of allowing for traffic movement during these events. When rainfall events exceed the capacity of the storm sewer system, the additional run-off shall be stored or conveyed overland in a manner that reduces the threat of flooding to structures and maintains mobility on major thoroughfares.

B. Drawing sets shall include a drainage area map, which will contain calculations of flow by the rational method or other approved drainage calculation method.

C. Drainage systems for curb-and-gutter pavements shall be underground closed conduits; individual residential lot drainage is exempt.

D. The system hydraulic calculations for the storm sewer design and the 100-year storm, including design storm hydraulic grade line calculations, sealed by a Texas Registered Professional Engineer, shall be provided with all stormwater system drawings. An electronic spreadsheet shall be submitted showing pipe sizes, material, design criteria, and calculations for each section (manhole-to-manhole) of the stormwater system.

E. Private stormwater systems along private streets shall be designed to the standards of public stormwater systems.

F. The lowest chord of all bridges shall be a minimum of 12 inches above the 100-year water surface elevation, or, at or above the level of natural ground, or in accordance with the FEMA regulations latest revisions, whichever is greater.

G. All storm sewer designs and drainage drawings for new developments shall include protection from the 100-year storm event through the use of positive overflow pathways. All positive overflow pathways for extreme events shall be contained within exclusive reserves and shall not be part of a residential lot unless the 100-year event is contained within a below grade conduit. If the 100-year event is contained within a below grade conduit, then the conduit shall be within the right-of-way or an exclusive storm sewer easement.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

H. Design Frequency

1. Newly Developed Areas: The minimum design storm event for sizing storm sewers in newly developing areas will be a five (5) year storm for local streets and a ten (10) year storm for arterials and collectors.

2. Redevelopment, New Development, or In-fill Development: For developments on properties one (1) acre in size or greater, the existing storm drain will be evaluated by conducting a drainage impact study or analysis.

3. If the proposed redevelopment has a lower or equal impervious cover, no modifications to the existing storm drain are required.

4. If the hydraulic gradient of the existing storm drain is one (1) foot below the elevation of the adjacent street gutter, no improvements to the existing storm drain are required.

5. If the hydraulic gradient indicates that structures are threatened by flooding, the applicant has the option of either making improvements to the existing storm drain or providing on-site detention.

I. Storm sewers shall have a minimum vertical clearance of six (6) inches and a minimum horizontal clearance of three (3) feet from all other utilities. The clearance shall be measured from the outside wall of the pipe.

J. Minimum depth of a storm sewer (measured to the top of pipe) shall be 24 inches below top of curb or finished grade, whichever is lower.

K. Minimum size storm sewer for main and inlet lead shall be 24-inch.

L. Pipe Material Considerations

1. Storm sewer and culvert pipe shall be precast reinforced concrete pipe or High-Density Polyethylene (HDPE) with watertight joints, unless specifically approved by the City.

2. Concrete pipe shall be manufactured in conformance with the requirements of ASTM C 76, "Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe," current revision. Reinforced concrete pipe shall be Class Ill or stronger. The design engineer shall provide for increased pipe strength when conditions of the proposed installation exceed the allowable load for Class Ill pipe. All concrete pipe shall have rubber gasket joints meeting the requirements of ANSI/ASTM C 443, “Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets,” current revision. When specifically approved by the City, reinforced concrete arch and elliptical pipe conforming to ASTM C506 and C507, respectively, current revision, may be installed in lieu of circular pipe. Reinforced concrete box culverts shall meet the minimum requirements of ASTM C1433, "Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers," current revision. Box culvert joints may be sealed with rubber gaskets meeting the requirement of ASTM C 1677 “Joints for concrete box culverts using rubber gaskets” or the joint may be sealed with RAM-nek. Pipe joints for arch and elliptical pipe shall be sealed using RAM-nek or approved equal.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

3. Reinforced concrete pipe, as described above shall meet or exceed the following minimum requirements:

Pipe Class	Maximum Cover (Ft)
III	10
IV	20

4. Reinforced concrete pipe shall be designed in accordance with the American Concrete Pipe Association, "Concrete Pipe Design Manual." Maximum cover on the pipe shall be measured from the top of pipe to the ultimate finished grade or natural ground, whichever is greater.

5. HDPE pipe shall be manufactured in conformance with the requirements of ASTM F2306, "Standard Specifications for 12" to 60" Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications. HDPE pipe shall be installed, bedded, and backfilled in accordance with the requirements specified in the Bedding and Backfill section of this Chapter.

6. Storm sewer outfalls shall have slope protection to prevent erosion. Slope protection may be constructed of slope paving. Slope paving shall be 5-inch thick, five sack concrete with 1/2-inch steel rebar on 24-inch centers, each way. Slope protection texturing shall be required where public access is likely.

7. Private storm sewer systems shall be reinforced concrete pipe, high-density polyethylene pipe (HDPE) with water-tight joints meeting ASTM D3212, PVC pipe of minimum SDR 26 rating or A-2000 PVC pipe. Reinforced concrete pipe or HDPE with watertight joints is required within the public right-of-way and public easements.

M. Velocity Considerations

1. Minimum velocities shall not be less than 3 feet per second (fps) with the pipe flowing full, under the design conditions.

2. Maximum velocities shall not exceed 8 fps.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

3. Appropriate energy dissipation measures shall be provided at all outfalls Minimum acceptable slopes in storm sewers shall be:

Size of Pipe (Inches)	Fall in Feet (Per 100 Feet of Sewer)
12	0.38
18	0.24
24	0.18
30	0.13
36	0.10
42	0.08
48	0.07
54	0.06
60	0.05
66	0.045
72	0.040
18	0.036
84	0.033
90	0.030
96	0.028

N. Pipe Sizes and Placement

1. Use storm sewer and inlet leads with at least 12-inch inside diameter or equivalent cross section within the public right-of-way or along private streets.

2. Box culverts shall be at least 2 feet by 2 feet. Closed conduits (circular, elliptical, or box) shall be selected based on hydraulic principals and economy of size and shape.

3. Larger pipes upstream should not flow into smaller pipes downstream unless construction constraints prohibit the use of a larger pipe downstream, or the improvements are outfalling into an existing system, or the upstream system is intended for use in detention.

4. Match crowns of pipe at any size change unless depth constraints or other conditions justify matching flow lines.

5. Locate storm sewers in public street rights-of-way or in approved easements.

6. All storm sewers and inlet leads shall be laid in a straight line. Changes of alignment shall be accomplished at junction boxes only.

O. Consideration of Overland Flow

1. All storm sewer designs shall include provisions for an overland positive overflow pathway to accommodate stormwater that exceeds the capacity of the storm sewer system.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

2. Design Frequency: Design frequency for consideration of overland sheet flow shall consider extreme storm events that exceed the capacity of the underground storm sewer system resulting in pending and overland sheet flow through the development to the primary outlet. The minimum design frequency for overland sheet flow shall be the 100-year design storm.

3. Relationship of structures to street or parking lot ponding: All structures shall be a minimum of 2 feet higher than the highest level of ponding anticipated resulting from the extreme event analysis.

4. Calculation of Flow

    a. Streets shall be designed so that consecutive high points in the street will provide for a gravity flow of drainage to the ultimate outlet.

    b. For non-major thoroughfare streets, the maximum depth of ponding at any point on the gutter line shall be a maximum of 12 inches above the gutter line.

    c. Sheet flow between lots can be provided only through a defined drainage easement. All positive overflow pathways for extreme events shall be contained within exclusive reserves and shall not be part of a residential lot unless the 100-year event is contained within a below grade conduit. If the 100-year event is contained within a below grade conduit, then the conduit shall be within the right-of-way and/or an exclusive storm sewer easement.

    d. A map shall be provided to delineate extreme event flow direction through a proposed development and how this flow is discharged to the primary drainage outlet.

    e. In areas where ponding occurs and no positive overflow pathway exists, a calculation shall be provided showing that run-off from the 100-year event can be conveyed and remain in compliance with all requirements of this section.

P. Consideration of Street Ponding

1. The storm sewer system must convey flows from a 100-year storm event without ponding water in the street at levels that exceed the maximum allowable level. Street ponding elevations shall be shown on the drainage area map and/or the plan and profile sheets in all construction drawings.

2. The maximum allowable ponding level for a minor or collector street is the lowest of the following: (1) one foot above natural ground; (2) twelve inches above the gutter line; or (3) one foot below the lowest slab elevation for a 100-year storm event.

3. The maximum amount of ponding allowed on a major thoroughfare is twelve inches above the outside (non-median) gutter line. For a major thoroughfare, the minimum median top of curb elevation shall be at or above the 100-year flood plain elevation.

4. Drainage calculations, along with water surface or hydraulic grade line profiles shall be submitted to the City for approval.

Q. Starting Water Surface and Hydraulic Gradient

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

1. The hydraulic gradient shall be calculated assuming the greater of the top of the outfall pipe or the 25-year design stormwater surface elevation as the starting water surface.

2. For the Design Storm, the hydraulic gradient, at all times, shall be one foot below the elevation of the adjacent street gutter.

R. Junction Boxes

1. Junction Boxes shall be installed at the following locations:

   a. Size or cross-section changes of storm sewers.

   b. Inlet lead and storm sewer intersections.

   c. Changes in pipe grade or alignment.

   d. Street intersections.

   e. A maximum spacing of 500 feet measured along the conduit run.

2. Junction boxes shall be placed on lot lines to the maximum extent practical. Do not place junction boxes in driveways or in the street in front of, or immediately adjacent to, a driveway.

3. Manhole covers on junction boxes shall be cast iron, traffic bearing, type ring and cover with the words “Storm Sewer" cast into the cover with the City’s emblem in the center (see City Standard Construction Details).

4. Cast-in-place junction boxes shall use 4000 psi minimum concrete with #5 bars @ 12” centers each way.

5. Junction boxes shall be equipped with a 30” opening, cast iron frame and lid with pick holes designed to withstand H20 loading and shall be marked “Storm Sewer”.

6. The top of the frame and lid shall be set flush with the finished surface of the area where the junction box is located.

7. Adjustment rings used to adjust a lid and frame to grade must be constructed of concrete, high density polyethylene and be designed to withstand the anticipated live and static loads.

8. Concrete collars having a minimum width of six inches (6”) shall be installed at the intersection of the storm sewer main and the junction box.

S. Inlets

1. Curb inlets shall be spaced and sized to intercept the calculated runoff for the design storm. The water surface elevation at the inlet shall be less than or equal to the gutter line for the design storm flow.

2. Do not locate inlets adjacent to esplanade openings without prior approval.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

3. Place inlets on side streets intersecting major streets, unless justification based on special conditions can be provided.

4. For all new construction, convey public or private alleyway drainage to an inlet prior to entering the public street drainage system.

5. Locate inlets at low points in the gutter.

6. Valley gutters across intersections are not permitted.

7. Maximum travel distance of water in the street to a curb inlet shall be 300 feet on a major thoroughfare and in a commercial area. The maximum travel distance of water in the street permitted in a single-family residential area shall be 600 feet.

8. Backslope swale interceptors shall be required at locations where sheet drainage enters detention basin or open channels. Backfill around inlets with 1.5 sacks per ton of cement stabilized sand to the bottom of the pavement subgrade.

9. Curb inlets shall have a minimum opening width of five (5) feet.

10. Curb inlets shall be made of either pre-cast concrete or cast-in-place concrete designed to withstand the anticipated live and static loads.

11. Curb inlets shall be equipped with a 30” opening, cast iron frame and lid with pick holes designed to withstand H20 loading and shall be marked “Storm Sewer”.

12. The top of the frame and lid shall be set flush with the finished surface of the area where the junction box is located.

13. Adjustment rings used to adjust a lid and frame to grade must be constructed of concrete, high density polyethylene and be designed to withstand the anticipated live and static loads.

14. Concrete collars having a minimum width of six inches (6”) shall be installed at the intersection of the storm sewer main and the inlet.

T. Public storm sewers shall be located within a public street right-of-way or a public utility easement, dedicated to the public and adjoining a public street right-of-way. Public storm sewers shall not be allowed in back lot easements.

U. Storm sewer alignment within a public street right-of-way.

1. Where required, additional easements shall be provided adjoining the right-of-way to provide required clearances. A public utility easement adjoining a public right-of- way shall be of sufficient width to provide a minimum of 12.5 feet of clearance on each side of the centerline of the pipe.

2. Usable right-of-way is defined as the area located from 2 feet behind curb to the usable right-of-way line.

3. The minimum width of a public utility easement not located adjacent to a public right-of-way shall be 20 feet.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

4. The outside edge of pipe shall be no closer than 2 feet to the edge of right-of-way.

5. Where storm sewers are installed in easements separated from public rights-of-way by other private or utility company easements, the storm sewer easement should be extended along or across the private utility company easement to provide access for maintenance of the sewer or force main.

5.04 TRENCHING, BEDDING AND BACKFILL REQUIREMENTS

A. All bedding and backfill shall be in accordance with the City Standard Construction Details. All backfill within public rights-of-way and public easements shall be compacted to a minimum of 95 percent of Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78), without additional moisture control, cured and tested in accordance with ASTM C31.

B. The minimum trench width shall be equivalent to the outside diameter of the pipe plus 18”.

C. The maximum trench width shall be equivalent to the outside diameter of the pipe plus 24”.

D. The minimum trench depth shall be equivalent to the desired bury depth of the pipe plus the outside pipe diameter plus 6”.

E. Bedding shall fill the entire width of the trench and shall extend from a depth of 6” below the pipe to bottom of the pipe.

F. Initial backfill shall extend from the bottom of the pipe to 6” above the top of the pipe.

G. Final backfill shall extend from the top of the initial backfill to either the finished subgrade for unpaved areas or the pavement subgrade.

H. All Bedding and backfill shall be installed in maximum 6” loose lifts and be compacted by vibratory equipment.

I. In non-paved areas, the uppermost 6” of backfill shall consist of topsoil. If the trench extends through an existing vegetated landscape, any excavated or disturbed area adjacent to the trench shall be re-sodded with grass that is similar to the existing landscaping.

J. All storm sewer lines located underneath and/or within 1 horizontal foot of any asphalt paving shall be bedded in cement stabilized sand in accordance with the Standard Construction Details. The cement stabilized sand shall be in accordance with the following requirements.

K. The cement shall be Portland Cement, Type I, ASTM C150.

L. The sand shall be clean, durable sand, with less than 0.5 percent clay lumps, ASTM C142: with less than 0.5 percent lightweight pieces, ASTM C123; with organic impurities, ASTM C40, not showing a color darker than standard color, and a plasticity index of less than six when tested in accordance with ASTM D423 and ASTM D424.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

M. Compact to 95 percent Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78) in maximum loose lifts of 6 inches thick. Actual testing shall be required as deemed necessary by the City.

N. The cement-sand mixture shall consist of at least 1.5 sacks of cement per ton of sand. The cement-sand mixture shall have a minimum unconfined compressive strength of 100 psi in 48 hours, when compacted to a minimum of 95 percent of Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78), without additional moisture control, cured and tested in accordance with ASTM C31.

O. For Reinforced Concrete Pipe (RCP):

1. RCP Pipes shall be bedded with bank sand.

2. Initial Backfill for RCP Pipe shall consist of select backfill from the excavation.

3. Final backfill for RCP Pipe shall be select backfill from the excavation.

P. For High-Density Polyethylene (HDPE) Pipe:

1. Pipe shall be bedded with Cement Stabilized Sand.

2. Initial Backfill for HDPE Pipe shall consist of Cement Stabilized Sand.

3. Final backfill for HDPE Pipe in concrete paved areas shall be Cement Stabilized Sand.

4. Final Backfill for HDPE Pipe in unpaved areas shall be Select Backfill from the excavation.

5.05 INSTALLATION BY BORE AND JACK

A. Bore and jack sections shall be specifically approved by the City and clearly shown on the drawings by location and footage.

B. The following criteria are generally used as a basis for setting bore and jack sections.

1. Bore pits shall be at least 3 feet from the back of curb and 5 feet from back of curb on a major thoroughfare. Bore pits in highways, county roads, or railroad rights-of-way shall conform to these requirements and to the requirements of the crossing permit or use agreement.

2. All bore pits shall be shored in accordance with Occupational Safety and Health Administration (OSHA) requirements. Bore pits or receiving pits to be located in street or driveway paving, shall be shown on drawings.

3. All existing developed areas shall be restored to original condition after construction.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

5.06 TESTING OF INSTALLED PIPE AND MANHOLES

A. It is the responsibility of the contractor to deliver a finished product in compliance with the contract documents and applicable federal, state, and local requirements. An independent testing laboratory shall be used to verify contract document compliance.

B. The Contractor is responsible for scheduling tests with the City and the independent testing laboratory and for notifying the City of all test results. In the event construction activity occurs without proper notification to the City, the work in question is subject to removal and replacement in accordance with the standards at the discretion of the City.

C. Cement Stabilized Sand Testing:

1. A minimum of two random samples for compressive strength shall be taken each week. For Smaller projects, one sample may suffice with City approval. The City reserves the right to require additional tests, at the Contractor's expense, if it is deemed necessary. In the event of a change in supplier, samples shall be drawn on the first day of delivery from the new supplier, regardless of previous samples taken.

2. Cement stabilized sand samples shall be taken at the point of placement of the cement stabilized sand and identified as to the location of the sample.

3. Cement stabilized sand densities shall be taken a minimum of every 150 linear feet of trench, with a minimum of two tests (one per direction of travel) at each road crossing. When used as subgrade on roadway repairs, density tests shall be taken every 100 square feet of subgrade, with a minimum of one test per repair.

D. Bedding, Backfill, Testing:

1. Bedding and density tests shall be performed a minimum of every 300 linear feet of trench in each lift. Density tests shall be offset on alternating lifts and test locations shall be identified by station number.

E. Copies of all test results shall be given to the City with the project closeout documents.

5.07 EXISTING FACILITY CROSSINGS

A. Installation of a storm sewer main across a proposed or existing public street, driveway, sidewalk, railroad, pipeline, or drainage way shall conform to the requirements of this section.

1. Public Streets - All existing public streets are to be bored and jacked regardless of surface. Bore and jack length shall be computed as roadway width at proposed bore plus 5 feet to either side.

2. Driveways – Concrete and asphalt driveways in good condition shall be bored and jacked. Bore and jack length shall be computed as driveway width at bore plus 5 feet to either side.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

3. Sidewalks – When the storm sewer line crosses under a sidewalk in good condition, the sidewalk shall either be bored and jacked or removed and replaced to the City's criteria, whichever is most cost-effective. Bore and jack length shall be at least the width of the sidewalk. The proposed type of construction shall be noted on the drawings.

4. Railroad Crossings – All railroad crossings require a pipeline crossing permit to be issued by the corresponding railroad company and shall be bored and jacked in accordance with the requirements of that permit and the standards provided in this manual.

5. Drainage Way – When a storm sewer line crosses under an existing drainage way, the water conveying portion of the drainage way shall be bored and jacked in accordance with the standards provided in this manual.

B. Trees – When saving trees is a consideration, all trees 6 inches or larger in diameter and within 10 feet of the centerline of the water main must be noted on the drawings. The storm sewer main shall be bored and jacked within the drip line of any tree larger than 6 inches in diameter.

5.08 BARRICADING AND SIGNAGE

A. Proper barricading and signage, conforming to the Texas Manual of Uniform Traffic Control Devices' latest edition, shall be required on all projects.

B. Adequate signage for vehicular and pedestrian traffic shall be installed.

C. A traffic control plan shall be submitted to the City and approved by the City for all streets open to travel by the public.

5.09 STORMWATER DETENTION REQUIREMENTS

A. The intention of stormwater detention is to mitigate the effect of the new development on an existing drainage system.

B. Application of Detention

1. All development/redevelopment must be designed in a way that mitigates the effects of the development on other properties. In other words, post-development peak runoff for the design storm(s) event must be less than or equal to pre-development peak runoff. This shall be accomplished through the use of on-site stormwater detention facilities designed to mitigate storms up to and including the 100-year (1 percent) event.

2. In some watersheds where mitigation is performed on a regional basis, individual detention sites may not be required. It is the responsibility of the project owner to coordinate with City staff to determine whether regional detention or individual mitigation facilities are necessary for the development.

3. For developments on properties one (1) acre in size or greater, the existing storm drain will be evaluated by conducting a drainage impact study or analysis.

4. The use of on-site detention is required during the following:

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

a. When the drainage impact analysis requires on-site detention to remedy the effects of the proposed development.

b. When reported incidence of structural flooding exists.

c. When in-fill or redevelopment will result in a potential threat to existing structures unless the current infrastructure is improved.

d. When post-development flows result in street ponding levels which exceed City requirements.

e. If, in the opinion of the City, post-development flows will have an adverse impact on adjacent properties.

5. When development occurs within the 100-year floodplain, compensatory storage within the detention pond is required to offset the amount of fill placed within the regulatory floodplain.

6. Detention may not be required if redevelopment occurs without increasing the overall impervious character of the site, then no detention will be required by the City unless the application of detention will prevent existing structure flooding.

C. Detention volume for redevelopment areas is calculated on the basis of the amount of area of the redeveloped impervious cover.

D. Private parking areas, private streets, and private storm sewers may be used for detention with prior approval of the City.

E. Calculation of Outlet Size.

1. Detention pond discharge pipe into an existing storm sewer line or existing City or other public entity facility:

a. Maximum pool elevation at or below the design hydraulic grade at the outfall – The discharge line shall be sized for the Design Storm with the outfall pipe flowing full. The pond will float on the drainage system to provide maximum benefit.

b. Maximum pool elevation at or above the hydraulic grade at the outfall. Provide a reducer or restrictor pipe to be constructed inside the discharge line. The discharge line shall be sized for the Design Storm with the outfall pipe flowing full.

c. Reducer or Restrictor Pipes shall be sized as follows:

(1) The reducer or restrictor will be sized for undeveloped rate of discharge at no greater than 0.5 cubic fps per acre unless capacity for a greater flow rate is verified in the receiving system and approved by the City.

(2) Use the following equations to calculate the required outflow orifice:

$Q = CA\ (2g)1t2\ (h)1t2$

$D = 0^{112}\ I\ (2.25\ h)^{114}$

Where:
Q =outflow discharge (cfs)
C=0.8
A = orifice area (square feet)
g = gravitational factor (32.2)
h =head, water surface differential (feet)
D = orifice diameter (feet)

(3) Restrictor shall be either of the required diameter or of the equivalent cross-sectional area. The orifice diameter D shall be a minimum of 0.5 feet.

d. In addition to a pipe outlet, the detention basin shall be provided with a gravity spillway that will protect structures from flooding should the detention basin be overtopped.

e. Detention ponds shall maintain a minimum freeboard of 1 foot between the top of bank and the 100-year water surface elevation. Trash rack is required at the pond outfall.

f. Pond outfall pipe to an existing roadside ditch system shall be tied to the nearest driveway culvert. No direct outfall to a City-maintained ditch is allowed. All outfall pipe configuration must conform to the slope of the receiving ditch.

g. Side slopes of the proposed detention basin shall not exceed a 4:1 (horizontal to vertical) ratio.

F. Detention Facility Ownership and Easements.

1. Private Facilities:

a. Responsibility for maintenance of the detention facility must be indicated on recorded plat and a maintenance plan shall be submitted to the City for review.

b. All private properties being served have drainage access to the pond. Dedicated easements may be required.

c. No public properties may drain into the detention area.

d. A maintenance agreement shall be provided when multiple tracts are being served.

e. A maintenance work area of 30-foot width surrounding the extent of the detention area shall be provided. Public rights-of-way, drainage reserves or permanent access easements may be included as a portion of this 30-foot width.

G. Proper dedication of public access to the detention pond must be shown on the plat.

5.10 CONSTRUCTION DRAWING REQUIREMENTS

A. Minimum construction drawing submittals include the following.

1. A drainage area map shall be included in the construction drawings. The drainage area map shall include the following:

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

a. Drainage areas, including areas draining from off-site onto or adjoining the project.

b. Design storm runoff.

c. 100-year storm runoff.

d. Route of overland flow including the overflow to a drainage way sized to accommodate the 100-year flow.

e. Elevations for the 25- and 100-year storms in the outfall channel.

f. Flow per inlet.

g. Maximum 100-year ponding elevation.

h. Street ponding elevations for the 100-year event.

i. Geotechnical and Soils Testing Report that substantiates design.

j. Supporting calculations.

2. Copies of any documents that show approval of exceptions to the City design criteria.

3. Design calculations for storm line sizes and grades, and for detention facilities, if any.

4. Design calculations for the hydraulic grade line of each line or ditch, and for detention facilities, if any.

5. Existing contour maps and final grading drawings of the project.

6. Plan and profile sheets showing stormwater design.

7. Projects located within a floodplain boundary or within a floodplain management area shall show the floodplain boundary or floodplain area, as appropriate, on the drainage area map.

8. Stormwater detention maintenance agreement letters.

B. All drainage calculations shall be submitted in an electronic spreadsheet.

C. Upon request, the supporting stormwater model input and output files shall be provided for review.

END OF CHAPTER

Website: cityofbrenham.org
Phone - Main Line: 979-337-7200
Development | Utilities
979-337-7220 | 979-337-7401
200 W. Vulcan, Brenham, Texas 77834

PUBLIC INFRASTRUCTURE DESIGN MANUAL

CHAPTER 6 - PAVING

Version 2021-1

City of Brenham
200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

CHAPTER 6
PAVING

6.01 GENERAL

A. This chapter provides design standards for the construction of streets, paving, sidewalks, and driveway access within the City of Brenham.

B. The standards provided here are primarily for the design of local streets and collector streets. Additional design standards as specified by AASHTO and/or TXDoT shall apply for arterial streets and freeway sections.

C. The City shall approve construction drawings for streets, paving, sidewalks, and driveway access within the City limits. All construction shall conform to the standards referenced in this manual and as shown in the City Standard Construction Details.

D. Construction drawings for private improvements, within public rights-of-way and public easements that connect to or affect the public infrastructure, shall be approved by the City, are subject to the requirements of this Manual, and are subject to review and approval using the process defined in this Manual.

E. Street design should conform to all applicable planning tools, such as the City Subdivision Ordinance, the City Major Thoroughfare Plan, the City bike or pedestrian and parks or trail master plans, the *Texas Manual on Uniform Traffic Control Devices (TMUTCD)*, the AASHTO Policy on Geometric Design of Highways and Streets, and approved master drawings. Other considerations for design should include street function, street capacity, service levels, traffic safety, driver expectancy, pedestrian safety, and utility locations. These additional considerations may affect the minimum requirements set forth herein.

F. A traffic impact study may be required as a part of the approval process for driveways and other roadway access. A traffic impact analysis (TIA), when required, shall be prepared by an individual, group, firm, or corporation having demonstrated professional emphasis and experience in transportation planning, engineering, and in the preparation of similar analyses. The TIA document shall bear the seal and signature of a Texas Registered Professional Engineer.

G. All driveways shall be constructed in accordance with the City Standard Construction Details.

6.02 DEFINITIONS

For the purposes of this chapter, the following words and phrases shall have the meanings respectively ascribed to them by this section.

Collector Streets – Street routes that have short travel distances and collect traffic from intracity streets and funnel it into major thoroughfares or other collector streets.

Development – Identified as the new construction of any building, structure, or improvement, or the enlargement of any exterior dimension of any building, structure, or improvement.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

Commercial Driveway Approach – The portion of a driveway within the public right-of-way that provides access to property on which an office, retail, or commercial center is located to a building having more than five dwelling units or to any driveway approach which accesses property that is primarily used for a nonresidential purpose.

Driveway – Entrance to and exit from premises where it is possible to park completely off the street, and which is not open for vehicular traffic except by permission of the owner of such private property.

Driveway Approach – A way or place including paving and curb returns between the street travel lanes and private property that provides vehicular access between the roadway and said private property.

Driveway Approach Width – As the term is used here, the width of a driveway approach refers to the width of driveway pavement at the point where the property line intersects the driveway pavement.

Intersection – The area embraced within the prolongation or connection of the lateral curb lines, or, if none, then the lateral boundary lines of two or more roadways, including public street, private street, commercial driveway, residential driveway, driveway approach, alley, or combination thereof which join one another at, or approximately at, right angles, or the area within which vehicles traveling upon different roadways joining at any other angle may come into conflict.

Lot – Identified as an undivided tract or parcel of land having frontage on a public or private street, contained within a block, and designated on a subdivision plat by numerical or letter identification.

Major Thoroughfare – Street routes that are identified as major thoroughfares as set forth in the Major Thoroughfare Plan adopted by City Council and as may from time to time be amended.

Multi-family Dwelling – Identified as a structure containing more than two separate units for single-family occupancy.

Nonresidential Driveway Approach – A driveway which provides access to property on which an office, retail, commercial, or industrial center is located, a building having more than five dwelling units is located, or any driveway approach which accesses property that is primarily used for a nonresidential purpose.

Residential Driveway – Identified as a driveway intended to provide access from a public or private street to a single adjacent, detached residential unit or a group of single residential units numbering less than five (5).

Right-of-Way – Property that is publicly owned or upon which a governmental entity has an express or implied property interest (e.g., fee title or easement) held for a public purpose. Examples of such public purpose include by way of example and not limitation, a highway, a street, sidewalks, drainage facilities, sewerage, and water facilities.

Street, Private – Identified as a private roadway, not dedicated to public use, which provides vehicular access from a public street to more than two residential dwelling units, or two or more commercial or industrial buildings or parking areas.

Street, Public – Identified as any public roadway or right-of-way, dedicated for public use, which provides vehicular access to adjacent land.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

Streets

6.03 GENERAL ROADWAY DESIGN

Public Roadways – The standard for public roadways within the City limits is concrete, curb-and-gutter construction, and served by underground storm sewers.

Roadway Classifications – The City recognizes four basic classifications of public roadways that include freeways, arterials, collectors, and local streets. Each class provides a certain degree of continuity, capacity, and accessibility to adjacent land uses. While differentiated by function, there is also a variance in geometric design. Table 6.1 summarizes the general design criteria of roadways within the City.

Roadway Geometries – Geometries of City streets may be defined as the geometry of the pavement and curb areas that govern the movement of traffic within the confines of the rights-of-way. Included in the geometries are pavement width, degree of curvature, width of traffic lanes, median nose radii, curb radii at street intersections, cross fall, crown height, pavement thickness, and geometric shapes of islands separating traffic movements and other features.

Design Speed – The design speed is a primary factor in the horizontal and vertical alignment of roadways. Design features such as curvature, superelevation, turning movement radii, and sight distance affects roadway lane width, pavement width, pavement cross-slope, pavement crown, and clearances. Refer to Table 11.1.

Grades – Roadway grades shall be a minimum of 0.3 percent in order to ensure proper flow of surface drainage toward inlets and a maximum of 6 percent. Steeper grades may be permitted on local residential streets and where required by topographical features, and as approved by the City.

Roadway Centerline – Roadways shall be placed in the center of the right-of-way but may be shifted slightly, with prior City approval, to avoid groupings of trees. The centerline of curves shall be tangent to the centerline of street at each end of curve.

Cross Slope or Crown Height – Thoroughfares shall have a minimum cross-slope of 1/4-inch per foot and a maximum cross-slope of 3/8-inch per foot. Collectors and local streets shall have 6-inch crowns.

Pavement Strength – All concrete pavement and curbs shall be a minimum 3,500 psi.

Sight Distance – All intersections shall be evaluated for adequate sight distances in accordance with AASHTO guidelines. Sight distance triangles shall be shown on the plan view of construction drawings.

Channelization – Channelization shall conform to AASHTO "A Policy on Geometric Design of Highways and Streets," latest edition.

Private Streets – Private streets are streets that are not owned by the City, State of Texas, or the County and are not dedicated for public use. All private streets shall be constructed to the same standards as public streets.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

Requirements for Arterials.

1. The full right-of-way for thoroughfares shown on the adopted City of Brenham Thoroughfare Plan shall be dedicated at the time of platting of the development.

2. When the full section of an arterial is located within the City limits and is dedicated on a final plat, the esplanade and all lanes shall be constructed at the time of development of the adjacent subdivision.

3. In some cases, if approved by the City, one-half of a planned major thoroughfare that is being built as a boulevard section may be constructed at the time of initial construction of the adjacent development.

4. Permanent barricades, conforming to the requirements of the Texas Manual of Uniform Traffic Control Devices, shall be constructed at the termination of lanes on partially constructed thoroughfares.

5. For roadway turnouts placed at an existing cross-street intersection, the turnout should be designed to fit the ultimate pavement width of the intersecting cross street and then transitioned to the existing roadway.

6. Residential driveways shall not access arterial or collector streets without written approval from the City. Subdivision layouts shall be designed to avoid homes requiring collector street access.

TABLE 6.1 – City of Brenham Roadway Requirements

Criteria	Roadway Class				
Classification	**Freeway**	**Arterial**	**Major Collector**	**Minor Collector**	**Local**
Purpose	Designed to move large volumes of traffic through urban areas and provide direct access to local freeways, while also providing controlled access to adjacent businesses.	Designed to provide support and relief to the SH and FM roadways by providing additional routes to accommodate high traffic volumes	Designed to collect traffic from local areas and distribute to the arterial network. Typically accommodates 2 lanes of traffic with turning lanes or median and with limited to no on-street parking.	Designed to collect traffic from local areas and distribute to the arterial network. Typically accommodates 2 lanes of traffic with on-street parallel parking on both sides.	Designed to provide access to abutting property and to collect traffic between parcels of land and collector and arterial streets. Local streets include all other streets that are not included in the higher classifications.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

Right-of-Way	120 feet	100 feet	80 feet	70 feet	55 feet
Typical Pavement Width (back-to-back)	Varies	61 feet	41 feet or 43 feet	39 feet	31 feet
Traffic Lanes	4 - 6	5	2	2	2
Lane Configuration	2-3 Travel Lanes each direction divided	2 Travel Lanes in each direction and 1 Left Turn Lane	2 Travel Lanes and 2 Parking Lanes Or 2 Travel Lanes, One Left Turn Lane, and 1 Parking Lane	2 Travel Lanes and 2 Parking Lanes	2 Travel Lanes and 1 Parking Lane
Minimum Left-turn Lane	11 feet	12 feet	11 feet	---	---
Minimum Right-turn	11 feet	11 feet	11 feet	---	---
Minimum Median Width	24 feet	14 feet	14 feet	---	---
Minimum Travel Lane	12 feet	12 feet	12 feet	11 feet	11 feet
Parking Lane Width	---	---	8 feet	8 feet	8 feet
Minimum Pavement Thickness	8-inch	8-inch	7-inch	6-inch	6-inch
Minimum Grade	0.3 percent	0.3 percent	0.3 percent	0.3 percent	0.3 percent
Maximum Grade	6 percent	6 percent	8 percent	8 percent	10 percent
Minimum Horizontal	2,000 feet	1,000 feet	800 feet	800 feet	300
Minimum Tangent Between	300 feet	300 feet	200 feet	200 feet	100 feet
Vertical Clearance	16 feet	16 feet	16 feet	16 feet	16 feet
Parking	None	None	Permitted	Permitted	Permitted
Typical Volume Range	30,000 to 45,000	7,000 to 30,000	5,000 to 10,000	2,000 – 5,000	500-2,000

6.04 GRADES

A. The minimum longitudinal grade shall be 0.25%.

B. The desired longitudinal grade shall be 0.50%.

C. The minimum cross slope shall be 1%.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

D. The minimum grade for curb returns and cul-de-sacs shall be 0.50% and the design shall show flow lines and/or top of curb grades at all PC and PT of curves.

E. Inverted crown drainage is not allowed.

F. At intersections, the grades of the intersecting streets shall be no more than 2% for the first 25 feet of the intersecting curb line to provide a safe approach sight distance and accessible routes in accordance with the Texas Accessibility Standards.

6.05 GENERAL INTERSECTION REQUIREMENTS

A. Street intersections should be designed at right angles with tangent centerlines whenever possible.

B. Intersections shall have adjacent visibility triangles free of obstacles such as vegetation, entry signage, buildings, structures, and fences. Public use facilities, such as fire hydrants, traffic control signs, and utility structures are exempted.

C. Curb radii, measured from the face of curb, shall be 25-foot minimum on local residential and minor collector streets, and 35-foot minimum on major collectors and arterials. The minimum curb radii shall be 50 feet or more, depending on an evaluation of vehicular types and volumes, in commercial or industrial areas. Minimums shall be increased at skewed intersections.

D. Intersections of major thoroughfares shall maintain a maximum slope of 2 percent along both major thoroughfares for a minimum distance of 200 feet upstream and downstream of the intersection.

E. Intersections of collector streets with major thoroughfares shall maintain a maximum slope of 2 percent along the collector street for a minimum distance of 100 feet upstream and downstream of the intersection.

F. Streets and traffic lanes shall be properly aligned across an intersection. Proposed streets shall be aligned with existing streets.

G. When turnouts are provided at an existing street, the ultimate cross section is required to the end of the curb return. If necessary, a pavement transition is required to reduce the pavement width to the existing cross section.

H. Intersections shall be designed as a high point in the drainage system, whenever possible. Gutter lines shall not extend across traffic lanes.

I. Streets intersecting major thoroughfares shall maintain a minimum of 350 feet of separation from another public street. Separation is defined as the distance from pavement face of curb to pavement face of curb. Streets intersecting collector streets shall maintain a minimum of 250 feet of separation. Local streets shall maintain a minimum separation of 200 feet.

J. Metropolitan joint intersections are not allowed.

K. Pavement width transitions shall meet or exceed requirements of the Texas Manual of Uniform Traffic Control Devices and AASHTO.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

6.06 INTERSECTION RIGHT-OF-WAY REQUIREMENTS

A. Right-of-way width for a 4-lane thoroughfare that intersects a 4-lane thoroughfare shall be 120 feet for a distance of 200 feet and then taper to the standard right-of-way width.

B. Right-of-way width for a collector street that intersects a 4-lane thoroughfare shall be 90 feet for a distance of 200 feet and then taper to the standard right-of-way width, as required in Section 11.05.H, with a 150-foot minimum taper. See Figure 11.5.

6.07 MEDIAN, LEFT-TURN LANE, RIGHT-TURN LANE, DECELERATION LANE, AND ISLAND DESIGN

A. Minimum bay storage lengths may need to be calculated in accordance with a traffic analysis. The referenced standards are minimum requirements. Middle-block left turns may be permitted when specifically approved by the City.

B. Median openings on major thoroughfares, when areas adjoining the right-of-way are not planned for immediate development, may be spaced 1,000 feet apart, measured nose-to- nose, when specifically approved by the City.

C. Required Median Openings and Left-Turn Lanes:

1. Median openings on divided thoroughfares shall be required at all street intersections. Median openings may be constructed to serve nonresidential driveways provided that the minimum spacing requirements listed are met. Left-turn lanes shall be provided at all median openings where a street intersects the divided thoroughfare. Left-turn lanes may be required at nonresidential driveways if warranted by a traffic study.

2. Median openings for street intersections and non-residential driveways may be moved, closed, or modified at the discretion of the City to facilitate traffic flow.

D. Left-Turn Storage

1. All left-turn storage bays on divided thoroughfares shall be a minimum of 11 feet in width.

2. Left-turn lanes will be delineated as shown in the City Standard Construction Details and as approved by the City.

3. Solid stamped, colored concrete pavement shall be used in the median when the median width measured from back-of-curb to back-of-curb is a distance of 4 feet or less.

E. Medians on Public Street Entrances to Developments:

1. Medians installed on undivided roadway entrances to subdivisions for aesthetic or any other purpose shall be a minimum of 13 feet wide and 80 feet long.

2. In areas where a divided subdivision entry is constructed, the transition to the normal residential street width shall begin a minimum of 50 feet upstream or downstream of the first street intersection.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

F. Minimum Right-Turn Storage and Transition Length:

1. Right-Turn Lane Storage:

a. Right-turn lanes shall be provided at the intersection of a divided thoroughfare with another divided thoroughfare. Right-turn lanes may be required at the intersection of collector streets with divided thoroughfares if traffic conditions warrant.

b. All right-turn storage areas shall be 11-foot wide.

c. An additional 10 feet of right-of-way shall be provided with right-turn lanes unless adequate right-of-way to construct and maintain the right-turn lane and adjacent improvements in the right-of-way (i.e., sidewalks) exists.

d. Right-turn lanes shall be delineated in accordance with City Standard Details and this Manual.

6.08 ALLEY AND SERVICE ROAD DESIGN

A. Public alleys are prohibited.

6.09 GATED DEVELOPMENT ENTRANCE REQUIREMENTS

A. Gated developments shall have a median divided street that will allow for a vehicular U-turn prior to the gate in the event that access is denied. The turn-around shall be a minimum of 18 feet in width.

B. Entry gates shall be set back from the right-of-way a minimum of 60 feet to provide stacking. There shall be a minimum of 40 feet to the entry keypad, or first stop, to allow room for the longest queue of vehicles expected to access the gate. Length of queue shall be determined by the development TIA, address the turning movements into and out of the development, and determine if mitigation will be required. Impacts that could cause backups onto the existing roadways because of the gated entrance are not allowed.

C. The hinge point of the gate shall be a minimum of 18 inches behind back of the curb.

D. Gates shall be equipped with a Knox box for emergency access.

E. Vehicular gates shall not encroach on public sidewalks.

6.10 PUBLIC RIGHT-OF-WAY VISIBILITY REQUIREMENTS

A. Adequate sight distance at the intersection of all streets shall be assured. This sight distance is provided through the use of a Corner Visibility Triangle or a Sight Line Triangle. Construction drawings for roadways shall show both the Corner Visibility Triangle and the Sight Line Triangle on the plan view of proposed streets.

B. Landscaping and Obstruction Requirements for Corner Visibility and Site Line Triangles:

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

1. No fence, wall, screen, sign, structure, foliage, hedge, tree, brush, shrub, berm, driveway planting, parking, or any other item, either man-made or natural shall be erected, planted, or maintained in a position that will obstruct or interfere with a driver's clear line of sight within both the corner visibility and sight line triangle (i.e., VAM's).

2. Vision at all intersections shall be clear from obstructions at elevations between 30 inches and 10 feet above the average gutter elevation within each sight line triangle. Existing trees shall have a clear trunk of 8 feet above average gutter elevation within each sight triangle. Traffic control devices shall remain visible at all times in accordance with the requirements of the TMUTCD.

C. Landscape Drawing Requirements:

1. A sitework or landscape drawing is required that shows the plan of the street on both sides, and the median where necessary, of each proposed driveway or street to the proposed development with the grades, curb elevations, proposed street or drive locations, and all items (both natural and man-made) within both the corner visibility and sight line triangles.

2. This sitework or landscape drawing shall show no horizontal or vertical restrictions (either existing or future) within the corner visibility and sight line triangles.

6.11 PAVEMENT STRUCTURE REQUIREMENTS

A. Local residential streets (55-foot right-of-way) and minor collector streets (60-foot right-of-way) shall have a minimum thickness of 6 inches with #4 reinforcing bars spaced at 24 inches measured center to center of the rebar. All transverse paving headers shall be spaced at a maximum of 60 feet. Lap splices will be staggered in adjacent bars. Minimum overlap shall be 10 inches.

B. Major collector streets (70-foot right-of-way) and all streets in multi-family residential, commercial of industrial areas shall have a minimum thickness of 7 inches with #4 reinforcing bars spaced at 24 inches measured center to center of the rebar. All transverse paving headers shall be spaced at a maximum of 60 feet. Lap splices will be staggered in adjacent bars. Minimum overlap shall be 10 inches.

C. Major thoroughfares (greater than 70-foot right-of-way) shall have a minimum thickness of 8 inches with #4 reinforcing bars spaced at 24 inches measured center to center of the rebar. All transverse paving headers shall be spaced at a maximum of 60 feet. Lap splices will be staggered in adjacent bars. Minimum overlap shall be 10 inches.

D. The design engineer is responsible to ensure that the pavement structure is designed to withstand the anticipated loads that are expected on the roadway.

E. Hot mix asphaltic concrete pavement is not permitted for roadways.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

F. Lime determination shall be made using a soil proctor from the site. Subgrade shall be stabilized to a minimum 6 inches thick to reduce Plasticity Index (PI) to fifteen as determined by lime series. If a PI of 15 or less cannot be obtained, then the lime treated soils must obtain a pH of 12.4, subgrade must be increased to 8 inches thick and compacted to 95 percent standard proctor density. Add 1 percent for field variation. Subgrade shall be compacted to 95 percent standard proctor density. Alternative subgrade stabilization may be substituted when the geotechnical engineer for the project makes specific recommendations and when specifically approved by the City; however, the stabilization requirement shall not be waived.

G. Lime shall be applied in accordance with TXDOT 260. Subgrade stabilization and compaction shall extend a minimum of 2 feet beyond the back-of-curb or edge of pavement.

H. Concrete pavement thickness design is required for all pavement within industrial and commercial areas and on major thoroughfares to identify roadways where the minimum pavement thickness may need to be increased. Concrete pavement thickness design shall be based on AASHTO design procedures for rigid pavements.

I. Horizontal dowels or saw cutting full depth are required when making a connection of a proposed street to an existing concrete street. When the existing concrete street has no exposed steel or has been saw cut full depth, the dowels shall be #4 bars, 24 inches long, embedded 12 inches, and epoxied. Dowels shall be 12 inches center-to-center, unless otherwise specified.

J. Dead-end streets or ends of concrete slabs designed to be extended in the future shall have paving headers and 15 inches of reinforcing steel exposed beyond the pavement, coated with asphalt, and wrapped with burlap or paving headers, and dowel type expansion joint for future pavement tie.

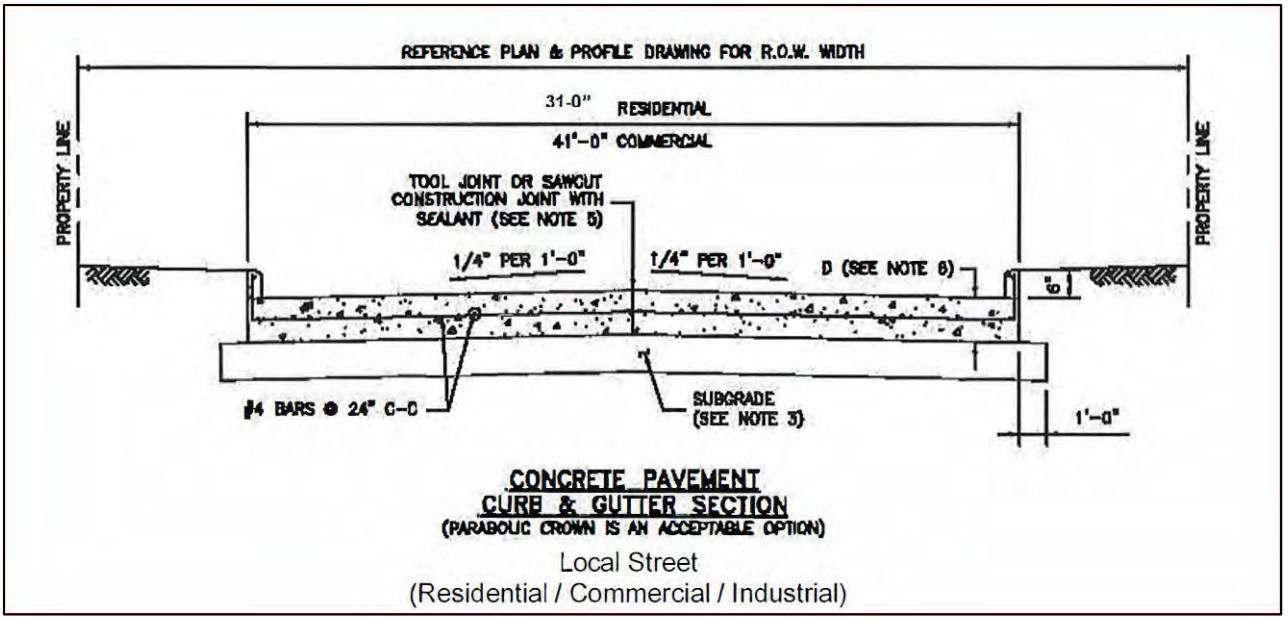
K. Pavement extensions shall connect to the existing pavement with a pavement undercut and a minimum steel overlap of 12 inches. Refer to City Standard Construction Details.

L. All concrete to be removed shall be removed either to an existing joint or a sawed joint. Saw cuts shall be the full depth of the pavement.

M. All concrete pavement should be finished to a light broom finish.

N. Local streets shall be designed and constructed in accordance with the following diagram:

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org



6.12 REINFORCED CONCRETE PAVEMENT MATERIALS

A. Concrete – All concrete shall be a minimum of 5 1/2 sacks of cement per cubic yard of concrete and achieve an unconfined compressive strength of 3,500 psi at 28 days.

A. Reinforcing Steel – Grade 60, ASTM A615, current.

B. Aggregate – Limestone shall be used wherever possible. Granite is permitted only with prior approval by the City. River rock or similar "hard" aggregates are not permitted.

C. All materials and workmanship shall conform to the TxDOT Standard Specifications, 2004, and the *Texas Manual on Uniform Traffic Control Devices, 2011*, and any revisions thereto.

6.13 GRADING AND LAYOUT REQUIREMENTS

A. Minimum gradient on gutter shall be 0.30 percent.

B. Inlet spacing shall be as defined in Chapter 5.

C. Maximum cut measured from finished grade at the right-of-way line to top of curb shall be 1.75 feet. The maximum slope for all driveways shall be 7 percent.

D. Minimum grade shall be 1 percent fall around intersection turnout for a minimum radius of 25 feet. Grade for larger radius shall be determined on an individual basis.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

E. All major collector and major thoroughfare streets and collectors shall have a 6-inch-high barrier concrete curb as shown in the City Standard Construction Details. Local streets may be constructed with a 4-inch by 12-inch lay-down curb as shown in the City Standard Construction Details. All streets within 50 feet of a permanent waterbody must have standard 6-inch curb installed. All streets within 30 feet from curb to the high bank must include a guard rail analysis. At the intersection of a 6-inch barrier curb and a 4-inch by 12-inch lay-down curb, the 6-inch curb shall be continued around the curb return of the lesser street.

F. Minimum slope for the gutter of a cul-de-sac shall be 0.60 percent.

G. The amount of cross slope over the pavement section should be shown on the drawings. The usual cross slope is 3/8-inch per foot from the curb line to quarter point, 1/4-inch per foot from quarter point to centerline, and 1/8-inch per foot for left-turn lanes.

H. When connecting to an existing curbed street, the gutter lines for the proposed and existing streets shall be matched and elevations called out.

I. Proposed top of curb elevations should be designed to match the top of the curb at an existing inlet.

J. Top of curb and bottom of curb elevations shall be shown on the construction drawings.

K. Gutter elevations are required for vertical curves where a railroad track is being crossed.

L. Where railroad crossings are not at right angles to the pavement slab, vertical curves should be calculated for each curb line and should be posted at 10-foot intervals in the profile.

M. When meeting an existing curb-and-gutter street, top-of-curb elevations shall be designed to meet an elevation 6 inches above the existing gutter. At existing inlets, top-of-curb elevations shall be designed to match existing top-of-curb elevations.

N. Adjust existing manhole frames and covers within the limits of the proposed pavement to meet the proposed top-of-slab elevation.

O. Adjust existing manhole frames and covers outside the limits of the pavement to conform to the final grading plan.

6.14 CUL-DE-SAC PAVEMENT

A. Public streets shall not dead-end without a cul-de-sac.

B. Cul-de-sacs are to have a minimum right-of-way radius of fifty (50) feet for a single-family and two-family use and sixty (60) feet for other uses.

C. The minimum right-of-way radius shall be 10 feet greater than the minimum pavement radius. The right-of- way radius shall be clear of permanent obstructions. See Figure 11.19 for minimum cul-de-sac requirements.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

D. The distance from the face of curb of a cul-de-sac to the right-of-way line shall be a minimum of 10 feet.

E. Curb radii at the transition to the cul-de-sac shall have a minimum radius of 25 feet in single-family residential areas and 35 feet in commercial areas, measured at the face of curb.

F. The length of a cul-de-sac is defined as the distance from the centerline of the intersecting pavement to the center of the cul-de-sac bulb measured along the centerline of the street right-of-way. The maximum length of a dead-end street with a permanent turnaround shall be 600 feet, except in conditions of unusual topography or in the event said street accommodates rural lots in the extraterritorial jurisdiction, in which case the maximum length shall be 800 feet.

G. The minimum grade line around a cul-de-sac shall be 0.60 percent.

6.15 Pavement Testing Requirements

A. It is the responsibility of the contractor to deliver a finished product in compliance with the contract documents and applicable federal, state, and local requirements. An independent testing laboratory shall be used to verify contract document compliance.

B. The Contractor is responsible for notification of the City and the independent testing laboratory in accordance with the City's notification requirements. In the event construction activity occurs without proper notification to the City, the work in question is subject to removal and replacement in accordance with the standards at the discretion of the City.

C. The Contractor is responsible for any and all fees and costs associated with the testing requirements.

PAVEMENT SUBGRADE

A. Pavement subgrade shall be a minimum of 6 inches thick, shall be within 0.2 inches of final lines and grade, and shall vary uniformly between points. Subgrade stabilization and compaction shall extend a minimum of 2 feet beyond the back-of-curb or edge of pavement. All subgrade shall be compacted to a minimum of 95 percent of the maximum dry density of the material as determined by Standard Proctor Compaction Test ASTM D-698. Moisture content on all density tests shall be within plus or minus 2 percent of optimum moisture to achieve a passing test.

B. Subgrade density tests are required at a longitudinal spacing of every 150 linear feet, staggered across both lanes of traffic, and on pavement cast full width on undivided roadways. Density tests shall include the entire cross section of the subgrade, including the area 2 feet outside of the form boards. For pavement cast half-width, density tests are required every 300 linear feet for each half of the roadway, with the tests offset from tests in the adjacent half of pavement by 150 linear feet. Regardless of any other requirement, all cul-de-sacs shall have a minimum of one density test within the cul-de-sac.

C. Lime depth checks are required for all pavement subgrades at the same spacing and frequency requirement as density tests.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

D. Lime determination shall be made using a soil proctor from the site. Subgrade shall be stabilized to a minimum 6 inches thick to reduce PI to 15 as determined by lime series. If a PI of 15 or less cannot be obtained, then the lime-treated soils must obtain a pH of 12.4, must be increased to 8 inches thick; and be compacted to 95 percent standard proctor density (add 1 percent for field variation). Lime subgrade shall be mixed evenly and allowed 72 hours between mixing to cure. Remixed lime shall have 100 percent of the representative sample passing a 1 3/4-inch sieve and 85 percent of the sample passing a 3/4-inch sieve and 60 percent passing the #4 sieve.

E. Lime operations shall not occur if the ambient temperature is 40 degrees Fahrenheit and falling. Lime operations may occur if the ambient temperature is 35 degrees Fahrenheit and rising.

F. Subgrade densities shall be retaken in the event of a 1/2 inch or greater rainfall or in the event the ambient air temperature falls below 32 degrees Fahrenheit for greater than three hours.

G. Subgrade density testing shall occur after the subgrade has been cut to final lines and grade. No subgrade/earthen material may be placed on the subgrade after passing density tests have been achieved.

H. Prior to the application of lime slurry, the roadbed shall be excavated to subgrade, shaped to conform to the typical sections, lines, and grades as shown on drawings. The material, before lime is added, shall be scarified to the secondary grade (proposed bottom of the lime stabilized subgrade). A “proof roll" shall be performed prior to the application of lime slurry to identify any wet or unstable materials. Any wet or unstable materials below the secondary grade shall be corrected by scarifying, adding lime, and compacting until it is of uniform quality. The results of the proof roll and any correcting action shall be documented by the testing laboratory.

CONCRETE PAVEMENT

A. All concrete mix designs shall be approved by both the independent testing laboratory and the City prior to the placement of concrete on any project.

B. Concrete operations shall not occur if the ambient temperature is 40 degrees Fahrenheit and falling. Concrete operations may occur if the ambient temperature is 35 degrees Fahrenheit and rising.

C. Concrete shall be tested every 150 cubic yards or less of concrete that is placed each day. Test shall be conducted for the following criteria:

1. Entrained air – Not to exceed 5 percent.

2. Slump – Between 2 1/2 and 5 inches.

3. Concrete Temperature – Not to exceed 95 degrees Fahrenheit (without appropriate admixtures)

4. Cylinders – A minimum of one set of four cylinders to be tested for compressive strength.

D. Concrete cylinders, taken at the time of placement, shall be the standard for testing for compressive strength. In limited, unique circumstances, concrete cores of the finished pavement may be tested for compressive strength, with prior approval by the City.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

E. In the event concrete cores are approved for testing, the pavement shall meet the required compressive strength without consideration of an allowance for cut cores or any other reduction in strength allowance.

F. Pavement shall meet both the minimum compressive strength and the minimum thickness requirements before acceptance by the City. Pavement that fails to meet both requirements shall be removed and replaced prior to acceptance by the City.

G. In the event pavement thickness requirements are not met, the limits of the short pavement shall be identified through the use of additional cores at 10-foot spacing on each side of the deficient pavement until the minimum thickness requirement is met.

H. In the event a variance for deficient pavement thickness is considered by the City, the City shall consider the extent of the thickness deficiency in area and thickness, the concrete compressive strength, the thickness of the subgrade, the performance of the remainder of the pavement on the project, and the performance history of the contractor on the project when reviewing the variance. In addition, the impact of the deficient pavement on the City's long-term maintenance costs shall be considered.

1. Accepted pavement deficient in thickness between 0.00 and 0.1 inches shall be considered without a maintenance fund payment based upon the recommendation of the design engineer, the extent and location of the deficient pavement, verification of subgrade, and other relevant specifications being met and other relevant factors.

2. Pavement deficient in thickness between 0.11 and 0.20 inches shall require a maintenance fund payment to the City of 25 percent of the contract unit price times the area of deficient thickness pavement.

3. Pavement deficient in thickness between 0.21 and 0.25 inches shall require a maintenance fund payment to the City of 50 percent of the contract unit price times the area of deficient thickness pavement.

4. Pavement deficient in thickness greater than 0.25 inches shall not be considered for acceptance.

I. Finished pavement shall have either a burlap-drag or a tight (less than 12 inches between centerlines) belt finish. Pavements that are excessively smooth or rough shall be subject to removal and replacement.

J. Finished streets shall positively drain and be free from areas of standing water (birdbaths) within 12 hours after water has ceased to flow by gravity. Street subject to acceptance by the City for City maintenance shall be flooded with sufficient water along the gutter line to identify potential birdbaths prior to acceptance into the one-year maintenance period. Pavement scarifying or grinding is not allowed to remediate birdbaths on newly constructed pavement.

K. All concrete placed shall be uniformly sprayed with a membrane curing compound as described in Item 526 in the TxDOT standard specification for construction. Improper application will result in rejection of the concrete.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

6.16 TRAFFIC CALMING GUIDELINES

A. The City encourages the implementation of traffic calming philosophy in the design and retrofitting of subdivisions. The ITE "Guidelines on Traffic Calming" and the Texas Manual on Uniform Traffic Control Devices shall be considered in the design of new subdivisions. The City may require traffic calming implementation in new subdivision design. It is the responsibility of the land planner to document consideration of traffic calming techniques in the initial design and plat process (i.e., concept plan stage).

B. Approved traffic calming devices shall not include the installation of speed bumps in either new or existing subdivisions. Other physical modifications to the standard street cross section may be considered as a last resort. Nonstandard street geometries shall require a clearly identified, actual problem of the nature that may be resolved by the proposed physical modification. All physical modifications require prior written approval by the City.

Sidewalks

6.17 SIDEWALK DESIGN

A. Definition of Sidewalk – A sidewalk is defined as that paved area in a street right-of-way or adjacent easement that is between the curb lines or the edge of pavement of the roadway and the adjacent property or easement lines that is designed for the use of pedestrians.

B. The maximum grade of the sidewalk shall be 1/2-inch per foot. The maximum cross-fall of the sidewalk shall be 1/4-inch per foot. Sidewalks shall conform to the latest Americans with Disabilities Act (ADA) and Texas Department of Licensing and Regulation (TDLR) requirements and to the following standards.

C. Residential and Nonresidential Areas – When constructed, shall be a concrete sidewalk, 5 feet in width and located within the street right-of-way. Sidewalks and parkways (curb to right-of-way) shall be graded at 1/4-inch per foot above the top of the street curb.

D. If other materials are placed in the right-of-way between the sidewalk and curb, the material shall meet City specifications, and be of a color and texture distinctly different from the sidewalk and specified on the site plan.

E. Meandering Sidewalks – Meandering sidewalks may be located in a common area if sufficient width does not exist in the ROW.

F. Sidewalks on Bridges – All street bridges on major thoroughfares and major collectors shall have a sidewalk constructed on each side of the bridge. Pedestrian access or routing shall be provided on all bridges on all streets. The sidewalk shall be a minimum of 6 feet wide with a parapet wall or traffic rail, provided a minimum of 2 feet behind the back-of-curb of the roadway. A standard pedestrian bridge rail protecting the sidewalk shall be provided on the outside edge of the bridge.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

G. Sidewalks on Box Culvert Crossings – All box culvert crossings shall have a sidewalk constructed on each side of the culvert. The sidewalk shall be a minimum of 5 feet wide with a standard pedestrian handrail as shown in Figure 11.13, provided on the outside edge of the culvert unless the drop off is greater than 10 feet from the outside edge of the sidewalk.

H. Sidewalk wheelchair ramps shall be required at all intersections. They shall be installed in accordance with ADA and TDLR requirements The intersections of cul-de-sacs that do not have a defined straight section of cul-de-sac and a cul-de-sac bulb do not have to install wheelchair ramps at the intersection. Wheelchair ramps shall be located in front of any stop or yield signs or stop bars.

I. All wheelchair ramps shall have raised detectable warning surfaces (truncated domes) in accordance with accessibility requirements.

J. Sidewalk construction across an esplanade: When required, raised esplanades shall be cut to allow for the continuation of crosswalks at grade. At-grade sidewalks across esplanades shall be a minimum of 6 feet wide. Patterned concrete or brick may be used with specific approval of the City.

Driveways

6.18 DRIVEWAY DESIGN REQUIREMENTS

A. Design Philosophy

Large speed differentials among motor vehicles traveling the same or connecting roadways creates unsafe driving conditions. Minimizing speed differentials through the proper design of driveway approaches promotes driver and pedestrian safety.

It is the City's policy to require a driveway design that creates no more than a 20 mph (miles per hour) maximum speed differential on roadways. The goal of the City policy is to create a balance between optimal access and safety.

Generally, as the widths of streets and vehicular speeds increase, the number of driveway approaches should decrease. Driveway approaches accessing major thoroughfares should be situated in a manner that minimizes the number of potential conflict points. A single piece of property served by multiple driveways may increase speed differentials and is generally considered undesirable. For commercial development, shared commercial driveways shall be a requirement. Regulated access, removing turning vehicles from the traffic stream and channelization of traffic should be determined on a site-specific basis, taking into consideration the policies and requirements of the City and other regulating entities, and following generally-accepted traffic engineering principles.

City policy is to require turn bays and acceleration/deceleration lanes on major thoroughfares or to use equally effective traffic-controlling methods that will minimize speed differential and increase overall safety.

B. A sight distance analysis is required for all driveways located within a horizontal or vertical curve of the frontage roadway.

C. Driveways shall not be located within the functional areas of intersections.

D. Driveway grades shall be minimized. The maximum algebraic change in grade of driveways allowed on all streets is 7 percent.

E. Driveway approaches shall be built with a circular curb radius connecting the raised curb of the roadway to the driveway approach in accordance with the City Standard Construction Details. In order that the definition of the location of the edge of pavement for the roadway may be maintained, driveway approach radii shall always be designed to become tangent to the street curb line.

F. Driveway approaches, driveways and required parking spaces shall be all-weather, dustless surfaces in accordance with Appendix A – Zoning of the Code of Ordinances.

G. Driveway curb returns shall terminate within the boundaries of the lot served by the driveway. Driveway widths shall be measured between the edges of pavement or the face of curbs, as applicable, at the property or right-of-way line. Driveway approaches within the public right-of-way shall be constructed of concrete.

H. All driveways shall be designed to intersect the adjacent street at a 90-degree angle unless specifically approved by the City.

I. Driveways shall not be permitted in the transition area of any right-turn, acceleration or deceleration lane.

J. Driveways that intersect at a mid-block median shall have the driveway centerline intersect with the midpoint of a median opening (measured nose-to-nose).

6.19 SINGLE-FAMILY RESIDENTIAL DRIVEWAY REQUIREMENTS

A. No direct access to a major thoroughfare or major collector from a residential driveway approach is allowed. Access to a minor collector or local street is allowed.

B. No lot may have more than two driveways accessing the adjacent street or streets. Side lot access is not allowed within the first 120 feet of a street serving as the entrance to a subdivision.

C. Driveways shall be located a minimum of 30 feet away from the intersection of streets, measured from the curb return of the street to the curb return of the portion of the driveway closest to the street.

D. Circular driveways are allowed on residential lots with a local street frontage of 75 feet or greater. A maximum of two driveways are allowed on the street on which the 75-foot street frontage is located, provided that the driveways meet all other requirements of this chapter.

E. Residential driveways shall have a minimum curb radius of 5 feet. The driveway curb returns shall terminate within the boundaries of the lot served by the driveway.

F. Residential driveway approaches shall have a minimum width of 12 feet and a maximum width of 30 feet. On-site residential driveways shall be a minimum of 12 feet.

G. Driveway approaches within the public right-of-way shall be constructed of concrete.

H. All special, non-standard materials, such as exposed aggregate, dyed concrete, or concrete pavers, and special signage, that are installed by a developer, homebuilder, or homeowner shall be specifically approved by the City and shall be maintained by the installer, owner, or his assigns. Any maintenance of non-standard items by the City will be done using standard materials and methods.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

6.20 MULTI-FAMILY RESIDENTIAL REQUIREMENTS

A. Multi-family residential developments shall meet the same driveway standards as nonresidential developments.

6.21 NONRESIDENTIAL DRIVEWAY REQUIREMENTS

A. Adequate distance between cross street intersections and access drives shall be provided to ensure intersection or driveway conflict areas are minimized.

B. Along either side of any corner commercial or industrial property only one driveway will be allowed, and the driveway approaches shall be located so as to maintain a minimum distance from the corner of the intersecting roadways equal to 65 feet if the street is an arterial or 55 if the street is a collector or local street. Driveways on corner lots are subject to all the requirements of this chapter, including spacing and cross-access requirements.

C. Nonresidential driveways shall be shared among different property owners or users when necessary to maintain minimum spacing requirements. Joint-access drives shall include full drive width and access pavement and be built at the same time as the first development.

D. Interconnectivity of multiple properties shall be maintained in the frontage of the lot adjacent to the road.

E. Nonresidential driveways shall match existing openings in medians, whenever possible. No cuts through the left-turn reservoir of a median shall be permitted.

F. Undivided nonresidential driveway approaches shall have a minimum width of 25 feet and a maximum width of 40 feet. Divided nonresidential approaches shall have a minimum width of 32 feet and a maximum width of 58 feet. Travel lanes of divided driveways shall be a minimum of 12-foot wide and shall be divided by a raised median a minimum of 8-foot wide.

G. Nonresidential driveway approach curb radii shall be a minimum of 25 feet. Curb radii of signalized driveway approaches shall be a minimum of 35 feet. Selection of the appropriate driveway curb radii shall consider the roadway speed limit, pedestrian activity, the existence of turn lanes, roadway geometries, intersection signalization, and other appropriate criteria.

H. Nonresidential driveways which serve service fixtures such as drive-through windows, mailboxes, gasoline pumps, and other similar fixtures shall allow traffic to utilize the fixture without interfering or impeding the movement of driveway or roadway traffic.

I. Nonresidential driveway spacing shall meet the spacing requirements for driveways located along major thoroughfares and collectors, unless specifically approved by the City.

J. The spacing and location requirements for driveways shall be applied to both existing driveways and those shown on proposed development drawings and plats. Driveway locations and requirements shall be considered at the earliest possible stage of development of a tract.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

6.22 DRIVEWAYS ALONG MAJOR THOROUGHFARES AND COLLECTORS

A. The following requirements shall apply with respect to driveway approach spacing and location along major thoroughfares and collector streets. Spacing between driveways should be measured along the property line from the edge of one driveway to the closest edge of the next driveway, and not from centerline to centerline.

1. The minimum required spacing between driveway approaches and intersections for driveways along collector streets and major thoroughfares is as follows.

Table 6.2 – City of Brenham Minimum Driveway Spacing

Posted Speed (mph)	Minimum Spacing (feet)
25	150
30	230
35	300
40	350
45	400
50	450
>50	TIA required

2. Driveway approaches accessing major thoroughfares and collectors shall be aligned with opposing driveway approaches, if any, or should be offset by 200 feet or more to provide adequate left turn storage capacity in advance of each driveway approach and to avoid the overlap of left-turn lanes.

3. The spacing and location of driveways shall be related to both existing adjacent driveways and those shown on approved development drawings.

4. Driveways shall be spaced at distances sufficient to ensure that conflicting movements at adjacent driveways do not overlap.

B. Entrances to nonresidential driveway approaches shall be designed so as to provide adequate sight distance required for safe travel. A sight distance analysis, sealed by a professional engineer, shall be provided on all construction drawings. The sight distance analysis will show the available sight triangles with all proposed and existing improvements in place.

C. Turn bays shall meet the minimum requirements of the Institute of Transportation Engineers (ITE) and the American Association of State Highway and Transportation Officials' (AASHTO) "A Policy on Geometric Design of Highways and Streets."

D. Notwithstanding any other requirements set forth herein, signalized driveway entrances shall be required of driveway approaches whose TIA recommends the installation of a signal and shall conform to ITE and AASHTO traffic signal spacing guidelines.

E. Deceleration lanes for right-turns into driveways shall be required in accordance with the TIA to minimize driveway or roadway conflicts.

1. No driveway shall be permitted within the transition area of a right-turn or deceleration lane, unless otherwise approved by the City.

City of BRENHAM

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

2. The applicant shall be responsible for the design, right-of-way adjustment of utilities, and construction costs of any required auxiliary and deceleration lane.

6.23 Construction Standards

Table 6.3 – City of Brenham Driveway Construction Standards

	Residential	Commercial	Industrial
Minimum Concrete Thickness	5” in ROW	6” in ROW	8” in ROW
Rebar Spacing	#3’s @ 12” centers	#4’s @ 12” centers	#5’s @ 12” centers
* Slope in accordance with Texas Accessibility Standards			

6.24 Driveways on Existing Strip Paved, Open Ditch Section Roadways

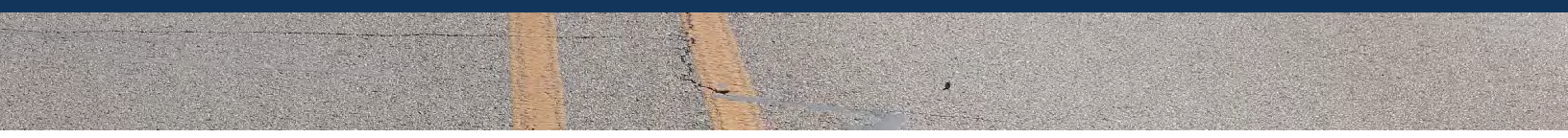
A. All driveways along existing strip paved, open ditch section roadways shall have culvert pipes installed below them in accordance with Detail STM-5, which is included in the Appendix B of this document.

END OF CHAPTER

Website: cityofbrenham.org
Phone - Main Line: 979-337-7200
Development 979-337-7220 | Utilities 979-337-7401
200 W. Vulcan, Brenham, Texas 77834

PUBLIC INFRASTRUCTURE DESIGN MANUAL

CHAPTER 7 - TRAFFIC SIGNS, MARKINGS, AND STREET LIGHTING



Version 2021-1

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

CHAPTER 7
TRAFFIC SIGNS, MARKINGS, AND STREET LIGHTING

7.01 GENERAL

A. These standards describe the general requirements for the design and construction or the modification of traffic signs and markings within the City limits.

B. All traffic signs and markings to be installed in accordance with the Texas Manual of Uniform Traffic Control Devices (MUTCD).

C. Developer shall purchase and install all traffic control signs and markings and all required street signs.

D. This guideline serves as a reference standard and does not supersede any design standards set forth by the MUTCD, Texas Accessibility Standards (TAS) of the Architectural Barriers Act, or any other federal, state, or local law or regulation. The intent is to provide a standard reference to promote the highest quality and latest engineering practices available.

E. Traffic signs, markings shall be prepared by an individual, group, firm, or corporation having demonstrated professional emphasis and experience in transportation planning, engineering, and in the preparation of similar analyses. The construction documents shall bear the seal and signature of a Texas Registered Professional Engineer.

F. Street layouts shall be designed to avoid the use of multi-way stop signs in new developments to the maximum extent practicable.

7.02 TRAFFIC SIGNS

A. Traffic and street signage locations shall be shown on the paving plan in the construction drawings. Traffic signs shall conform to the requirements of the Texas Manual of Uniform Traffic Control Devices as adopted by the City. Prior to final approval of a construction project, all signage shall be installed in accordance with the approved construction drawings.

B. Standard signage shall be flat blank aluminum, covered with high-intensity prismatic sheeting or higher-grade sheeting. Traffic control signage shall meet the requirements of the Texas Manual for Uniform Traffic Control Devices. Refer to the City Standard Construction Details.

C. All traffic signs shall be installed on approved steel posts with a Texas Universal Triangular Slipbase System per TxDOT SHT. SMD (Slip-1) - 02 or a Universal Anchor System.

D. Posts shall be installed to a depth of approximately 33” below grade in a 12” diameter x 30” deep concrete foundation.

E. Traffic Signs shall be installed so that the lowest part of the lowest sign is 7’ above grade.

F. Traffic signs shall be installed a minimum of 2’ from the back of the nearest curb.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

7.03 Street Name Signs

A. Each intersection on an arterial street shall have a minimum of four street name signs (two for each intersecting street) installed on the same post and above the proposed traffic control signs for that intersection.

B. Each intersection on local or collector streets shall have a minimum of two street name signs (one for each intersecting street) installed on the same post and above the proposed traffic control signs for that intersection on opposite corners of the intersection.

C. Street name signs shall have a green (color) hi intensity grade reflective background and shall have 4.5” white lettering and upper-case characters.

D. The block numbers and suffixes are to be 2.5” white lettering.

E. Street signs shall be 6” in height and 30” long.

7.04 Striping and Pavement Markings

A. Developer shall apply striping to arterial and collector street segments only.

B. Developer to apply appropriate pavement markings to all classes of streets.

C. Striping and pavement markings shall meet TxDOT standards.

D. Pavement markings shall be shown on the approved construction drawings for all projects.

E. Gorilla Hi-Performance Acrylic Zone Marking Paint or approved alternate shall be used on all streets.

7.05 Street Lighting

A. Developers will be required to install streetlights on galvanized metal poles, according to the following standards on public streets in subdivisions within the city limits and furnish necessary easements or rights-of-way.

B. Streetlights shall be located and spaced to ensure adequate illumination for both vehicular and pedestrian safety in accordance with City Code – Subdivision Ordinance Section 23-16(21). Streetlights shall be installed at all street intersections and intervals of not more than 300 feet along streets, except that they may be spaced at an average of 600 feet between intersections on low-density residential streets.

C. The recommended location and minimum number of streetlights shall be approved by the local electrical utility company and be marked on the final approved copy of the subdivision plat.

D. Streetlights shall be located so as to be of general benefit to the surrounding neighborhood.

E. Streetlights shall be installed a minimum of 2’ from the back of the nearest curb.

F. Streetlights shall be mast arm mounted, and the mast arm shall be mounted 30’ above grade.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

G. Streetlights shall incorporate an 8' mast arm constructed of hot-dipped galvanized metal.

H. Luminaire shall be an arm mounted, cobra head type, 120/277-volt, 110-watt, static LED luminaire with photo control receptacle on top.

I. The developer of the subdivision shall be responsible for the total expense of furnishing and installing the streetlight luminaire, complete with photoelectric controls, standard, with an underground electric supply circuit of proper size; and the developer shall be responsible for all trenching and backfill for installing the underground circuit.

J. The specification of all equipment and materials to be used shall have prior approval of the City before installation.

7.06 CONSTRUCTION DRAWING REQUIREMENTS

A. This section defines the minimum elements that are required on the construction sheets.

1. Title Sheet

   a. Include intersection(s) and street name(s), Engineer, and City Logo.

   b. Date when plans are completed.

   c. Vicinity map and key map location.

   d. Project title including project scope and proper road names.

   e. Funding for construction.

   f. Site map with north arrow.

   g. Signature block, including a block for private utility signoffs.

2. Index Sheet.

3. The City Construction Notes.

4. TxDOT specification note and barricade note, when applicable.

5. Private Utility Notes (utility notes for all known utilities).

6. Project-specific traffic signal notes.

7. Basis of Estimate or Summary of Traffic Signal Quantities Sheet

   a. This sheet includes all wires or cables, conduits, ground boxes, and span wires providing quantities.

   b. Detailed estimated quantities per location or per specific system.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

c. Provide all detailed items with TxDOT reference item and numbers.

d. Bid items will be discussed under bid documents.

e. Identify materials to be furnished by City or others (when applicable).

f. Quantities are for estimate purposes only.

8. Existing Conditions Layout

a. Show all existing signing, (including speed limits, all approaches), joints in pavement, type of pavement, condition of pavement (for loops if applicable), and overhead power lines.

b. Show scale.

c. Existing pavement markings and signing.

d. Existing geometries.

e. Existing utility locations.

f. Any existing signal equipment.

g. North arrow up or to the right.

h. Right-of-way and easements.

9. Paving Plan (when applicable)

a. Provide a proposed design showing required wheelchair ramps and landings to access pedestrian push buttons. These paving improvements must comply with the current TAS of the Architectural Barriers Act.

b. Provide applicable construction notes or paving details.

c. Provide various notes to contractor.

d. Provide ramp and landing dimensions as required.

10. Pavement Marking and Signing Layout

a. This base shall show all proposed paving improvements as existing and include all existing signing and striping.

b. Provide proposed design of all applicable pavement markings.

c. “Signal Ahead” signs are typically provided on approaches in accordance with MUTCD requirements.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

d. Show on drawings:

(1) Right-of-way and easements.

(2) Roadway geometries.

(3) Utilities.

(4) Existing Pavement Markings and Sign details (complete).

(5) Proposed Pavement Markings and Sign details (complete, including removal of existing pavement markings and signing as needed).

(6) Construction signing.

(7) Stop bars.

(8) Crosswalks, if required.

(9) Wheelchair ramps, if required.

(10) North arrow up or to the right.

(11) Legend.

(12) Scale.

(13) Special notes.

11. Pedestrian Walkway Details

a. Current pedestrian walkway details with the following plan layout details.

b. Existing intersection condition.

c. Proposed pole locations and identified.

d. Proposed pedestrian walkway design layout.

12. Notes for Plan Layout

a. Callouts for all signals and sign types.

b. Callouts for all signs and all sign types.

c. Notes to reference specific sheet(s).

d. Any note pertaining to signal design shall be included.

200 W. Vulcan Street
P.O. Box1059
Brenham, TX 77834-1059
Ph: 979.337.7200
www.cityofbrenham.org

e. Special VIVDS specification if required.

f. Special equipment descriptions.

g. Maintenance of existing traffic signals and operation parameters.

13. Standard Detail Sheets

a. Any details pertaining to the proposed signal design shall be included.

b. The details shall be the latest available from the City and TxDOT.

c. Any necessary quantities, such as pole and foundation details, shall be filled out.

d. All detail sheets to be sealed.

END OF CHAPTER

City of BRENHAM

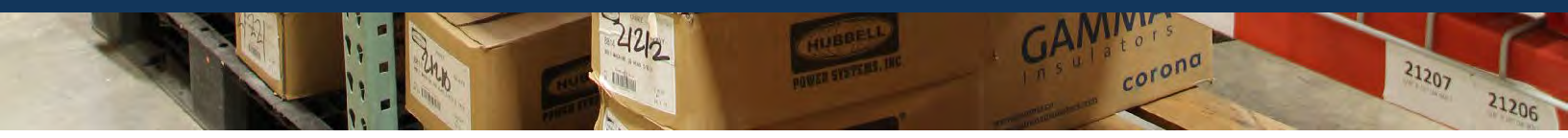
Website: cityofbrenham.org
Phone - Main Line: 979-337-7200

Development	Utilities
979-337-7220	979-337-7401

200 W. Vulcan, Brenham, Texas 77834

PUBLIC INFRASTRUCTURE DESIGN MANUAL

APPENDIX A - APPROVED PRODUCTS LIST

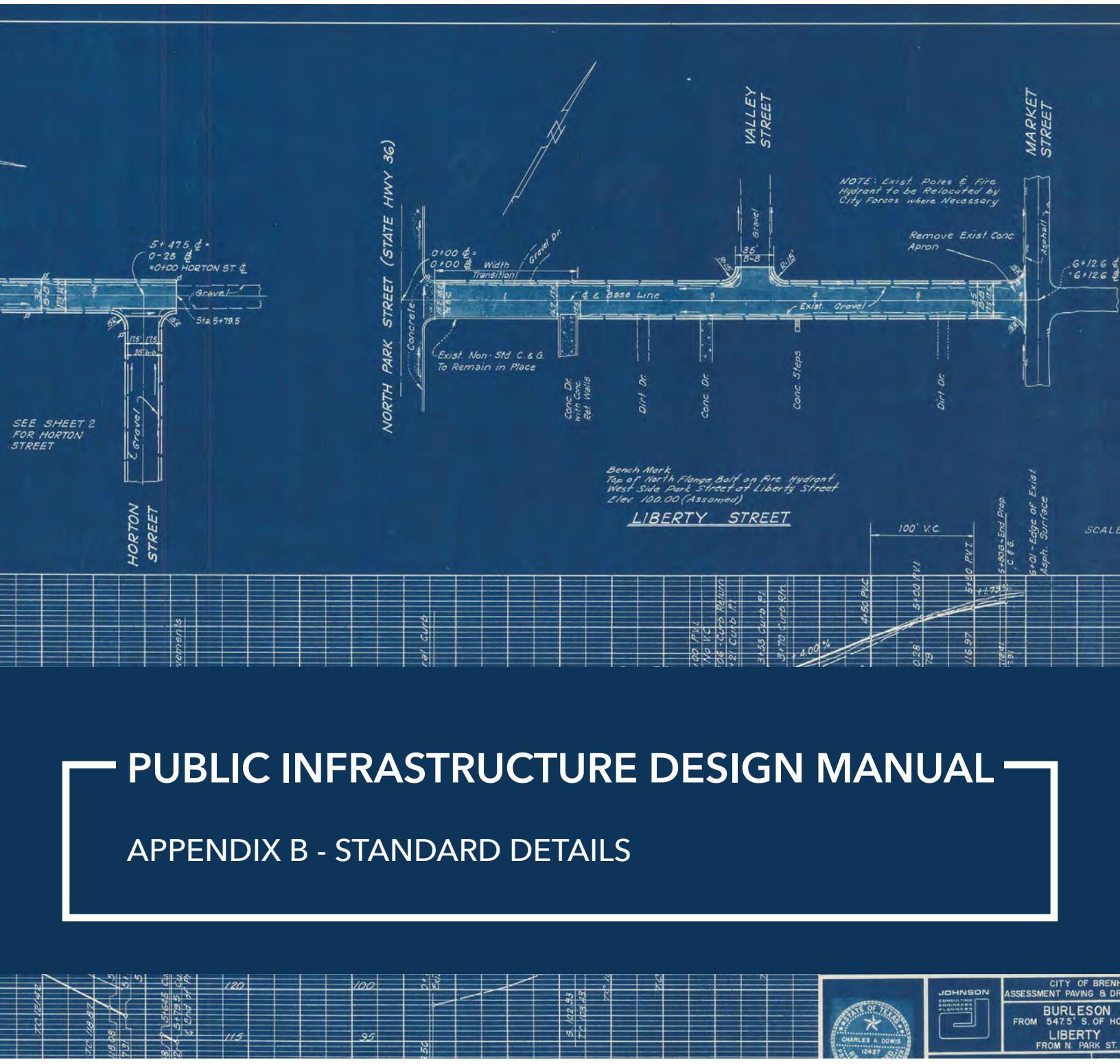


Version 2021-1

City of Brenham Approved Products List		
Component	**Type**	**Preferred Manufacturer**
PVC Fittings	Gasketed SDR 26 Heavy Wall Fitting	Plastic Trends **OR** Equivalent
Cleanout Adapter	SDR 35	Plastic Trends
Treaded Cleanout Plug	SDR 35	Plastic Trends
Sanitary Sewer Cleanout Boot		Sigma
Gravity Pipe	SDR 26	JM Eagle
Force Main Pipe	C-900 Green	
Meter Box	Christy #B09	Old Castle
Meter Box Lid for Sewer	Christy #BX09D Marked Sewer	Old Castle
Tracer Wire	#12 Solid, Insulated Tracer Wire **OR** #14 Solid, Copper Clad Insulated Tracer Wire	
Retainer	CamLock Style 120	Smith-Blair
Gate Valve	Ductile Iron	American Flow Control
Ductile Iron Fittings		Sigma **OR** Equivalent
32" Cast Iron Manhole Ring		East Jordan Iron Works
32" Manhole Sewer Lid	City of Brenham Logo	East Jordan Iron Works
Concrete Risers		MDN
Fiberglass Manhole Patch		Containment Solutions
Valve Box	19-22" 461-S	Tyler Union
Valve Box Top	19-22" 461-S	Tyler Union
Valve Box Lid	CI 5 1/4" Drop Marked Water	Tyler Union
Valve Box	22-37" 562-S	Tyler Union **OR** Sigma
Valve Box Top	22-37" 562-S	Tyler Union **OR** Sigma

City of BRENHAM

Website: cityofbrenham.org
Phone - Main Line: 979-337-7200
Development 979-337-7220 | **Utilities** 979-337-7401
200 W. Vulcan, Brenham, Texas 77834



PUBLIC INFRASTRUCTURE DESIGN MANUAL

APPENDIX B - STANDARD DETAILS

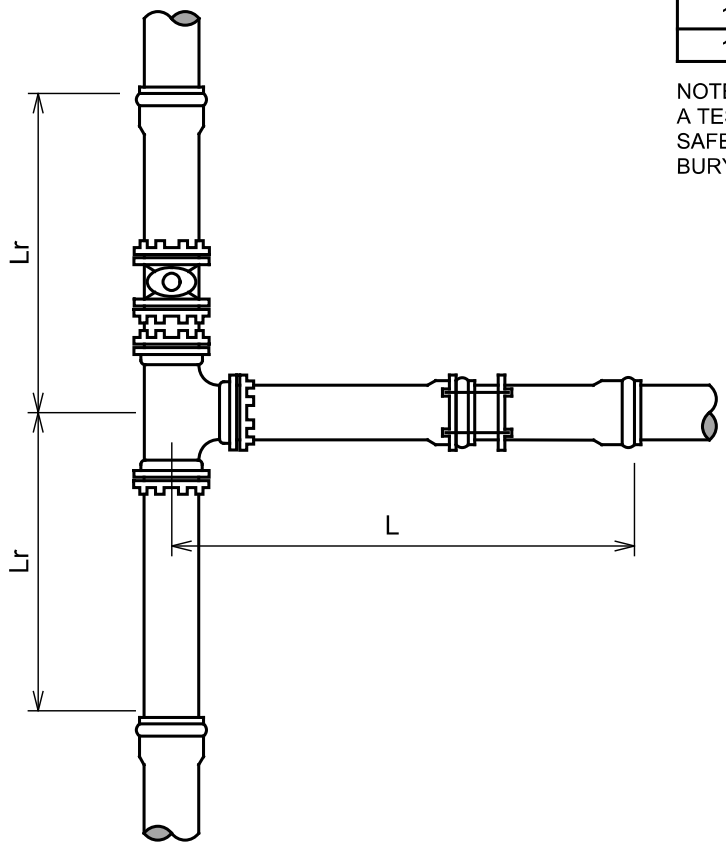
Version 2021-1

GENERAL NOTES

1. THE VALUES IN THE TABLE WERE ESTABLISHED FOR DISTANCE 'Lr' EQUAL TO 'L'. OTHER VALUES OF 'L' MAY BE CALCULATED FOR VARYING DISTANCES OF 'Lr'.
2. ALL JOINTS WITHIN DISTANCE 'L' OF A TEE SHALL BE RESTRAINED USING AN APPROVED MECHANICAL RESTRAINT SYSTEM.
3. NO JOINTS, OTHER THAN RESTRAINED VALVES LOCATED ADJACENT TO THE TEE, ARE ALLOWED WITHIN DISTANCE 'Lr' OF A TEE.

TEES		
MAIN SIZE	BRANCH SIZE	'L' AND 'Lr'
6"	4"	4'
6"	6"	7'
8"	4"	3'
8"	6"	6'
8"	8"	10'
10"	6"	5'
10"	8"	8'
10"	10"	11'
12"	6"	4'
12"	8"	7'
12"	10"	10'
12"	12"	13'
16"	6"	3'
16"	8"	5'
16"	10"	8'
16"	12"	10'
16"	16"	17'

NOTE: CALCULATIONS BASED ON A TEST PRESSURE OF 150 PSI, A SAFETY FACTOR OF 1.5 AND A BURY DEPTH OF 3.5'



City of BRENHAM

THRUST RESTRAINT (TEES)

STANDARD CONSTRUCTION DETAILS

DATE: 07/12/21

REVISED DATE: 07/12/21

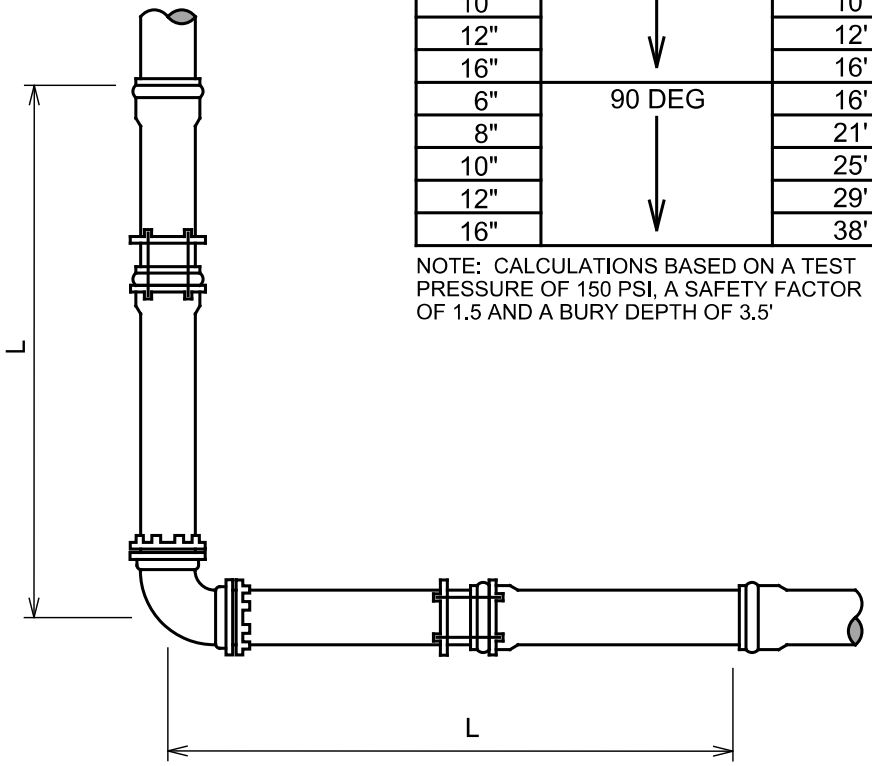
WTR - 1

GENERAL NOTES

1. ALL JOINTS WITHIN DISTANCE 'L' OF A HORIZONTAL BEND SHALL BE RESTRAINED USING AN APPROVED MECHANICAL RESTRAINT SYSTEM.

HORIZONTAL BENDS			
PIPE SIZE	BEND	'L' PVC PIPE	'L' D.I. PIPE W/ POLY
6"	11-1/4 DEG	2'	2'
8"		2'	2'
10"		3'	3'
12"		3'	3'
16"		4'	4'
6"	22-1/2 DEG	3'	3'
8"		4'	5'
10"		5'	6'
12"		6'	7'
16"		8'	9'
6"	45 DEG	6'	7'
8"		9'	10'
10"		10'	12'
12"		12'	14'
16"		16'	18'
6"	90 DEG	16'	18'
8"		21'	23'
10"		25'	28'
12"		29'	33'
16"		38'	43'

NOTE: CALCULATIONS BASED ON A TEST PRESSURE OF 150 PSI, A SAFETY FACTOR OF 1.5 AND A BURY DEPTH OF 3.5'



City of BRENHAM

THRUST RESTRAINT (HORIZONTAL BENDS)

STANDARD CONSTRUCTION DETAILS

DATE: 07/12/21

REVISED DATE: 07/12/21

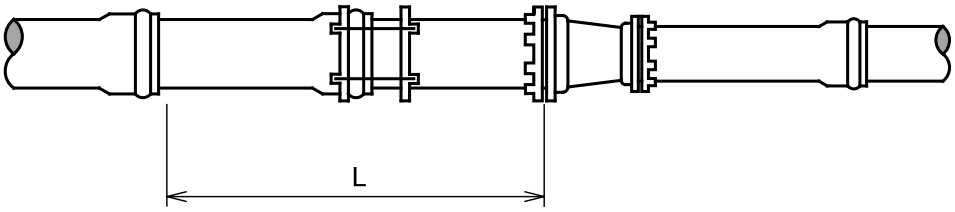
WTR - 2

GENERAL NOTES

1. ALL JOINTS WITHIN DISTANCE 'L' ON THE LARGE PIPE SIDE OF A REDUCER SHALL BE RESTRAINED USING AN APPROVED MECHANICAL RESTRAINT SYSTEM.

REDUCERS			
LARGE PIPE SIZE	SMALL PIPE SIZE	'L' PVC PIPE	'L' D.I. PIPE W/ POLY
6"	4"	26'	40'
8"	6"	27'	42'
10"	8"	26'	41'
12"	10"	46'	70'
16"	12"	51'	78'

NOTE: CALCULATIONS BASED ON A TEST PRESSURE OF 150 PSI, A SAFETY FACTOR OF 1.5 AND A BURY DEPTH OF 3.5'



City of BRENHAM

THRUST RESTRAINT (REDUCERS)

STANDARD CONSTRUCTION DETAILS

DATE: 07/12/21

REVISED DATE: 07/12/21

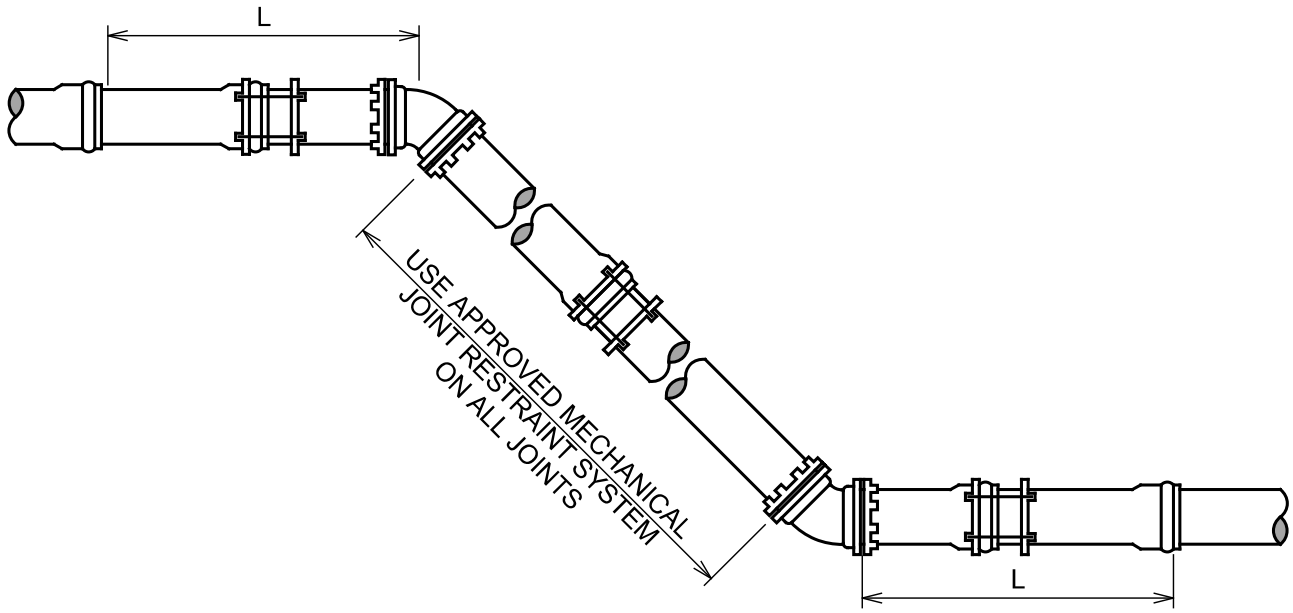
WTR - 3

GENERAL NOTES

1. ALL JOINTS WITHIN DISTANCE 'L' OF A VERTICAL BEND SHALL BE RESTRAINED USING AN APPROVED MECHANICAL RESTRAINT SYSTEM.

VERTICAL BENDS			
PIPE SIZE	BEND	'L' PVC PIPE	'L' D.I. PIPE W/ POLY
6"	45 DEG	6'	7'
8"		9'	10'
10"		10'	12'
12"		12'	14'
16"		16'	18'
6"	90 DEG	16'	18'
8"		21'	23'
10"		25'	28'
12"		29'	33'
16"		38'	43'

NOTE: CALCULATIONS BASED ON A TEST PRESSURE OF 150 PSI, A SAFETY FACTOR OF 1.5 AND A BURY DEPTH OF 3.5'



City of BRENHAM

THRUST RESTRAINT (VERTICAL OFFSETS)

STANDARD CONSTRUCTION DETAILS

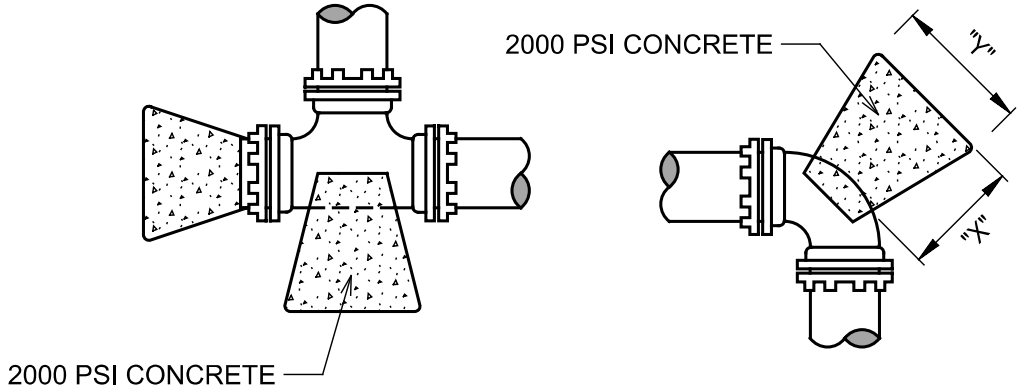
DATE: 07/12/21

REVISED DATE: 07/12/21

WTR - 4

GENERAL NOTES

1. FITTINGS SHALL BE DUCTILE-IRON COMPACT FITTINGS 4-INCH TO 12-INCH, AWWA C1 53/A21. 53.84, CONFORMING TO THE MINIMUM REQUIREMENTS OF "GRAY-IRON AND DUCTILE IRON FITTINGS, 12-INCH THROUGH 48-INCH, FOR WATER AND OTHER LIQUIDS", AWWA C153 (ANSI 21.10), CURRENT REVISION. FITTINGS SHALL BE FURNISHED WITH EPOXY OR CEMENT MORTAR LINED, AWWA C104 (ANSI A21.4).
2. POLYETHYLENE ENCASEMENT SHALL CONFORM WITH THE MINIMUM REQUIREMENTS OF "POLYETHYLENE ENCASEMENT FOR GRAY AND DUCTILE CAST-IRON PIPING FOR WATER AND OTHER LIQUIDS, "ANSI/AWWA C105, CURRENT REVISION. SOILS WITHIN THE PROJECT SHALL BE TESTED IN ACCORDANCE WITH APPENDIX A OF ANSI/AWWA C105 TO ADEQUATELY DETERMINE THE REQUIREMENTS FOR ENCASEMENT.
2. IN ADDITION TO JOINT RESTRAINTS, CONCRETE THRUST BLOCK MAY ALSO BE UTILIZED TO PROPERLY RESTRAIN JOINTS.



PIPE DIAMETER	DIMENSION "Y"				DIMENSION "X"
	PLUGS & TEES	90° BENDS	45° BENDS	22 1/2° BENDS	
4" and 6"	1' - 0"	1' - 2"	-----	-----	TO BE A MINIMUM OF 1'- 0" OR AS REQ'D.
8"	1' - 3"	1' - 6"	1' - 3"	1' - 0"	
10"	1' - 9"	2' - 0"	1' - 6"	1' - 0"	
12"	2' - 0"	2' - 3"	1' - 9"	1' - 3"	
16"	2' - 7"	3' - 0"	2' - 3"	1'- 8"	
20"	3' - 3"	3' - 3"	2' - 9"	2' - 0"	

City of BRENHAM

CONCRETE THRUST BLOCK DETAIL

STANDARD CONSTRUCTION DETAILS

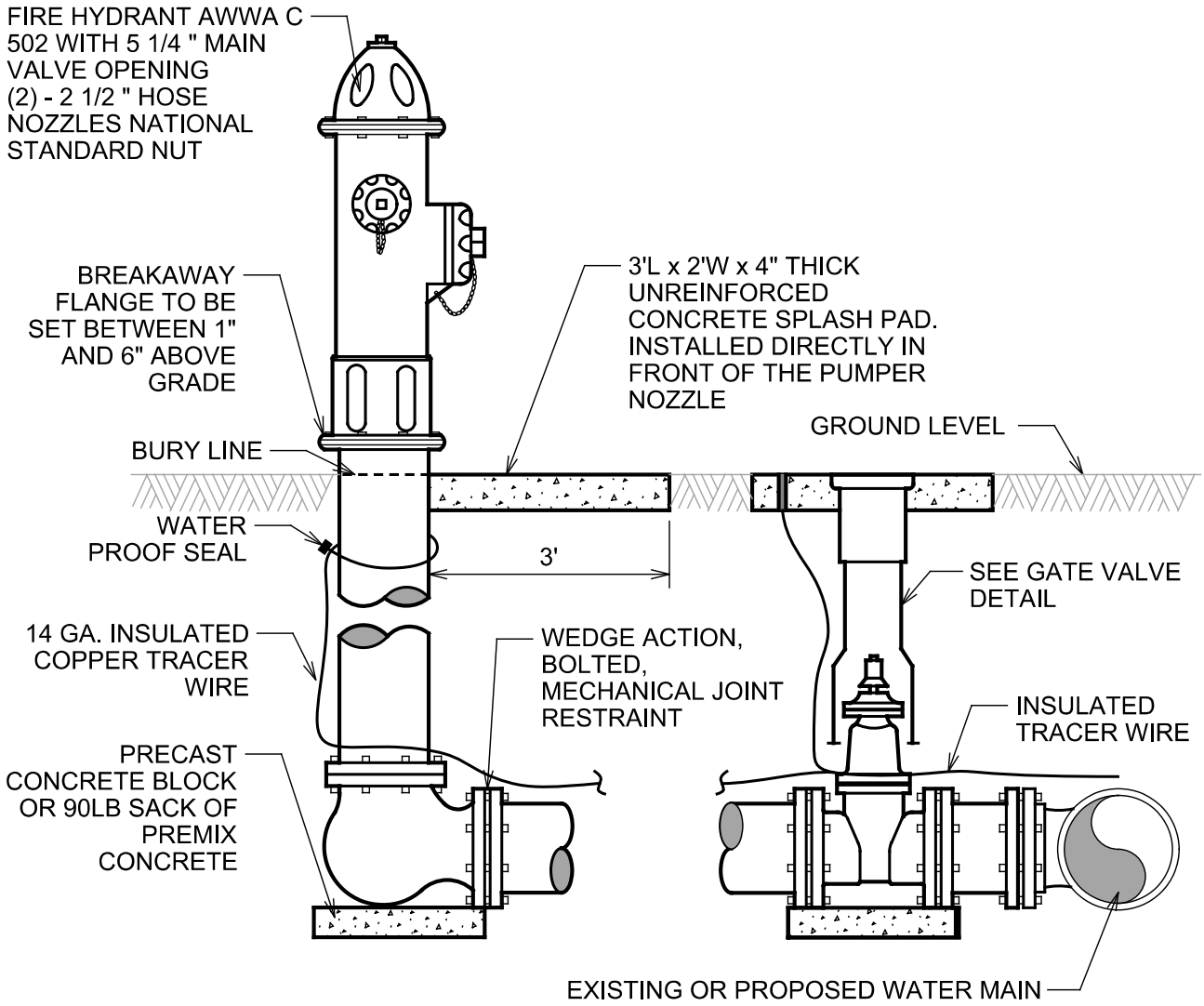
DATE: 07/20/21

REVISED DATE: 07/20/21

WTR - 5

GENERAL NOTES

1. FIRE HYDRANT SHALL BE MANUFACTURED BY MUELLER, OR AMERICAN DARLING.
2. FIRE HYDRANTS SHALL HAVE A THREE-WAY NOZZLE ARRANGEMENT, A 5-1/4 INCH COMPRESSION TYPE MAIN VALVE, A MECHANICAL JOINT (MJ) BOOT, AND CONFORM TO THE REQUIREMENTS OF AMERICAN WATER WORKS ASSOCIATION (AWWA) C502.
3. FIRE HYDRANT COLOR SHALL BE RED WITH YELLOW PUMPER CAPS AND SILVER STEAMER CAPS.
4. THE BONNET OF THE FIRE HYDRANT SHALL BE FACTORY PAINTED WHITE.
5. INSTALL WEDGE ACTION, BOLTED MECHANICAL JOINT RESTRAINT ON ALL PIPE JOINTS BETWEEN MAIN & HYDRANT.
6. CONTRACTOR SHALL INSTALL A BLUE REFLECTIVE PAVEMENT MARKER AT THE CENTERLINE OF EACH STREET IN LINE WITH THE HYDRANT.
7. HYDRANT WEEP HOLES SHALL BE WRAPPED WITH CONSTRUCTION GRADE PLASTIC.



City of BRENHAM

FIRE HYDRANT

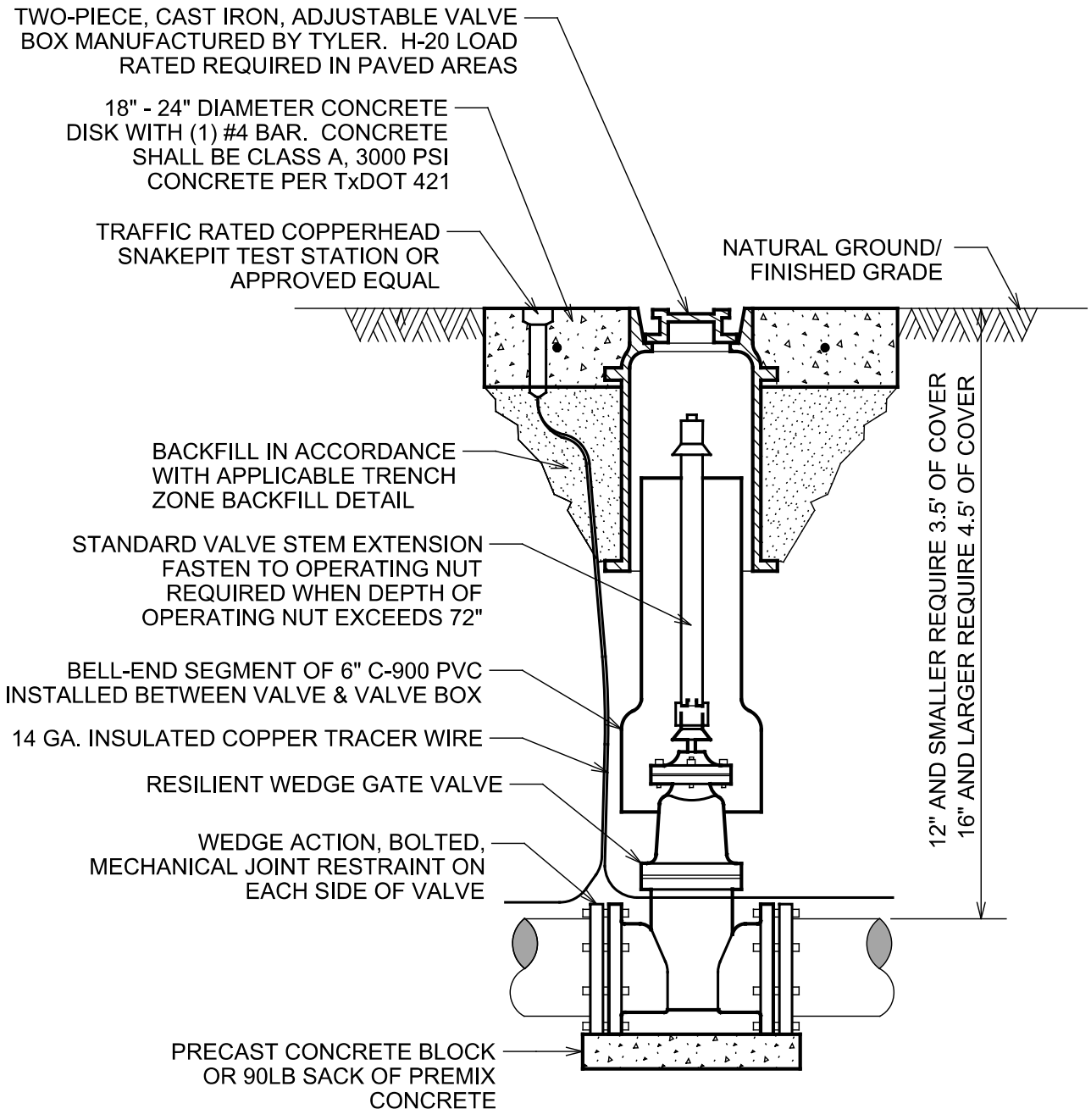
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

WTR - 6

GENERAL NOTES

1. ALL MAIN LINE VALVE 18" IN DIAMETER & SMALLER SHALL BE RESILIENT WEDGE GATE VALVES.
2. MAIN LINE VALVE WITH DIAMETERS GREATER THAN 18" MAY BE EITHER RESILIENT WEDGE GATE VALVES OR BUTTERFLY VALVES.
3. RESILIENT WEDGE GATE VALVES SHALL BE AMERICAN FLOW CONTROL.
4. TRACER WIRE SHALL BE CONNECTED TO ALL WATER METER ANGLE STOPS, FIRE HYDRANTS, AND VALVE BOX RISERS.



City of BRENHAM

GATE VALVE

STANDARD CONSTRUCTION DETAILS

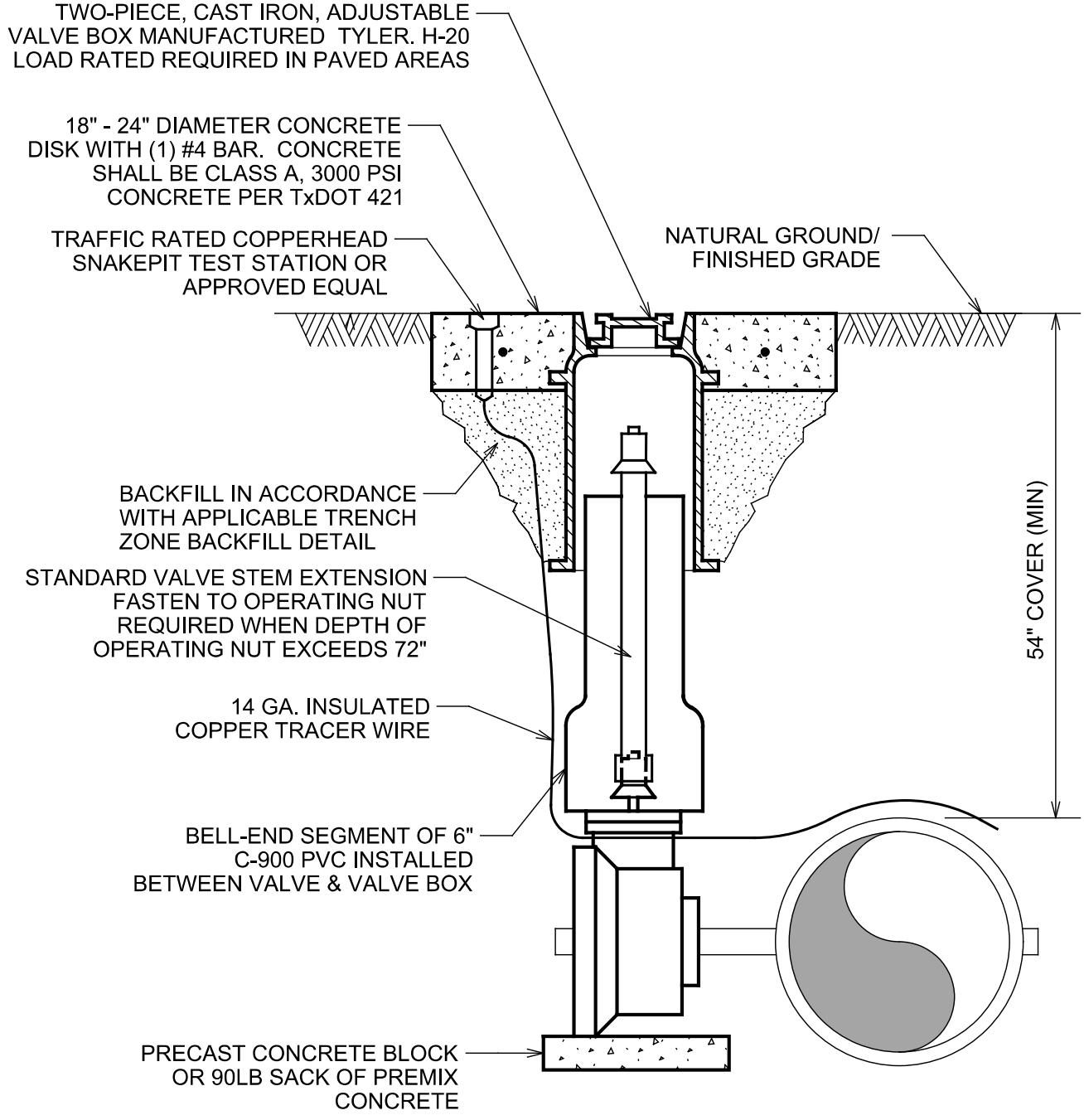
DATE: 07/12/21

REVISED DATE: 07/12/21

WTR - 7

GENERAL NOTES

1. MAIN LINE VALVES WITH DIAMETERS GREATER THAN 18" MAY BE EITHER RESILIENT WEDGE GATE VALVES OR BUTTERFLY VALVES.
2. BUTTERFLY VALVES SHALL BE PRATT OR APPROVED EQUAL.
3. TRACER WIRE SHALL BE CONNECTED TO ALL WATER METER ANGLE STOPS, FIRE HYDRANTS, AND VALVE BOX RISERS.



City of BRENHAM

BUTTERFLY VALVE

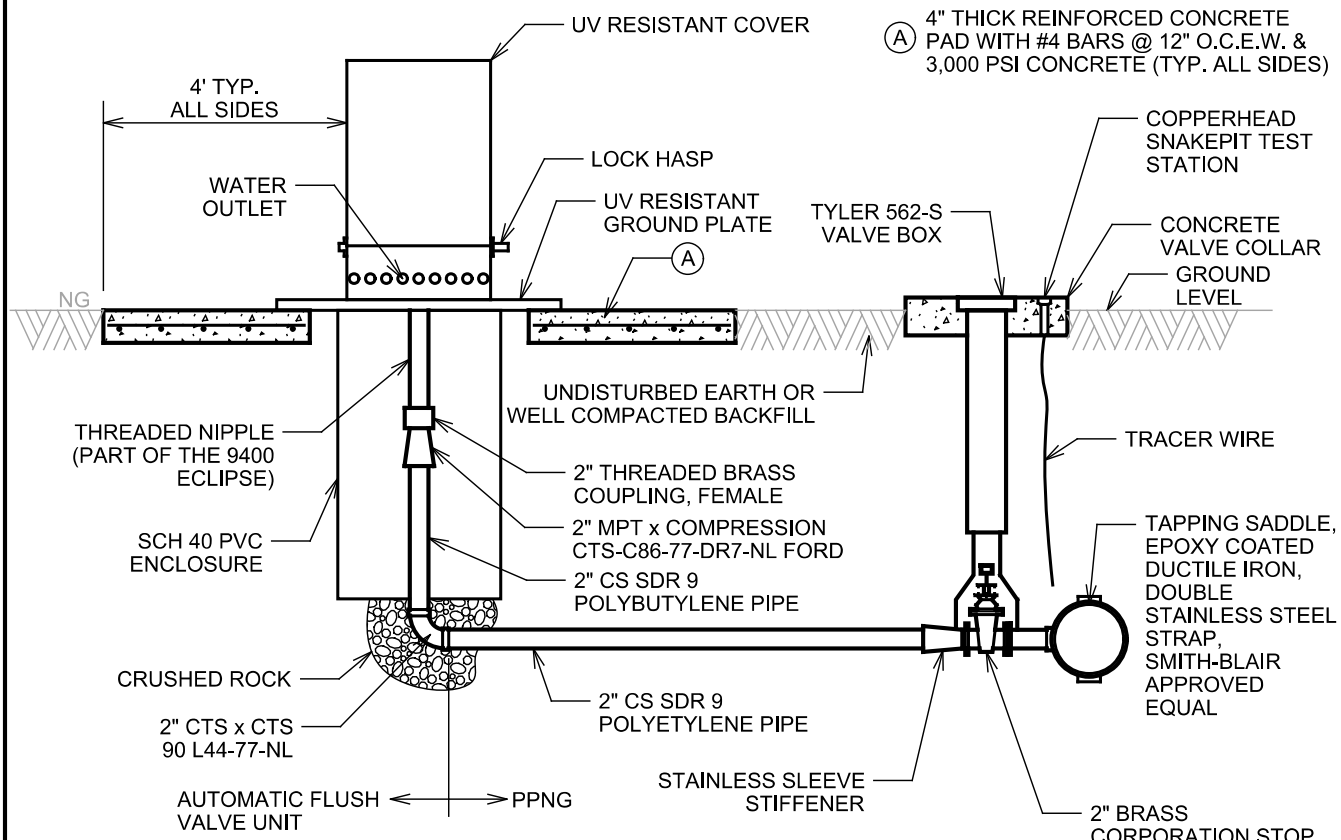
STANDARD CONSTRUCTION DETAILS

DATE: 07/12/21	REVISED DATE: 07/12/21

WTR - 8

GENERAL NOTES

1. PERMANENT DEAD-END MAIN WILL NOT BE ALLOWED IF LOOPING ALTERNATIVES ARE AVAILABLE. THIS MAY REQUIRE EXTENDING THE WATER MAINS BEYOND THE LIMITS OF THE PROJECT.
2. IN UNAVOIDABLE PERMANENT DEAD-MAIN SITUATIONS, LINES SHALL BE 6" OR LARGER AND NOT EXCEED 600 FEET IN LENGTH AND SHALL BE EQUIPPED WITH A 2" AUTOMATIC FLUSHING DEVICE.
3. THE LENGTH OF A DEAD-MAIN WATER MAIN SHALL BE MEASURED FROM THE INTERSECTION WITH A MULTIPLE FEED (LOOPED) MAIN TO THE END OF THE MAIN.
4. WHERE A WATER MAIN IS STUBBED OUT FOR FUTURE EXTENSION, PLACE A VALVE TO ISOLATE THE DEAD-MAIN AND EXTEND A 20' SECTION OF PIPE WITH A CAP ON THE END ON THE DOWNSTREAM SIDE OF THE ISOLATION VALVE. RESTRAIN THE WATER MAIN TO PREVENT LINE SEPARATION. THRUST BLOCKING WILL NO BE ALLOWED. NO CUSTOMER SERVICES SHALL BE LOCATED ON THE DEAD-END UNTIL IT IS EXTENDED. PROVIDE A 2" AUTOMATIC FLUSHING DEVICE AT THE END OF THE DEAD-END LINE IN ADVANCE OF THE ISOLATED VALVE.



NOTE: AUTOMATIC FLUSH VALVE TO BE MODEL #9400 ECLIPSE AS MANUFACTURED BY THE KUPFERLE FOUNDRY COMPANY OR MODEL #HG-1-BASIC-S-8021-2 AS MANUFACTURED BY HYDRO-GUARD.

NOTE: VALVE PRICE INCLUDES VALVE, VALVE BOX, CONCRETE COLLAR.

City of BRENHAM

DEAD-END MAIN WITH AUTOMATIC FLUSHING DEVICE

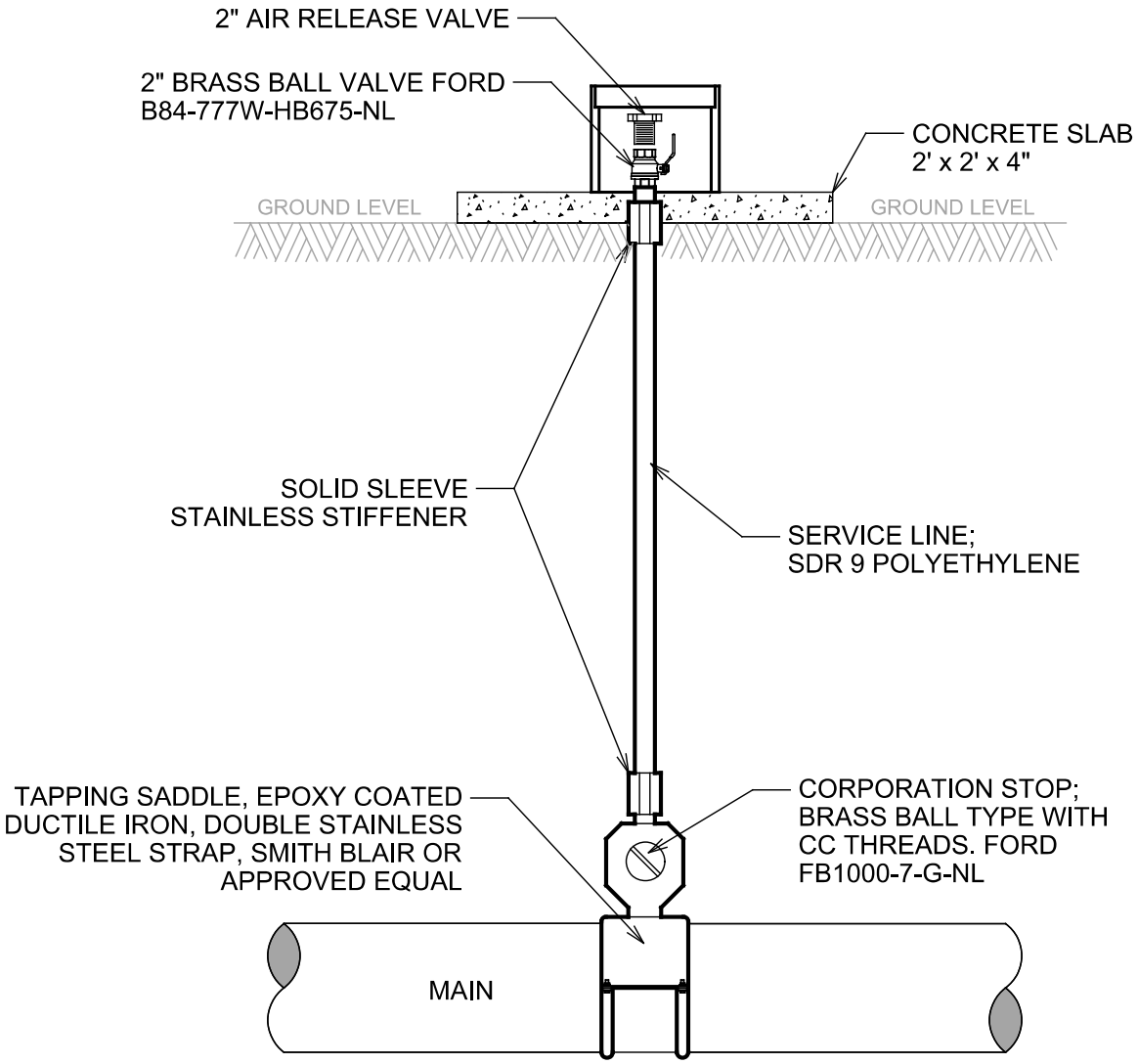
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

WTR - 9

GENERAL NOTES

1. A.R.I D040 AIR RELEASE WITH AN ENCLOSURE MADE BY PIPELINE PRODUCTS VCAS-1424-14"x24" POLYETHYLENE ENCLOSURE.
2. TAP TO COME OFF OF TOP OF MAIN TO ALLOW AIR TO ESCAPE.



City of BRENHAM

2" AIR RELEASE VALVE DETAIL

STANDARD CONSTRUCTION DETAILS

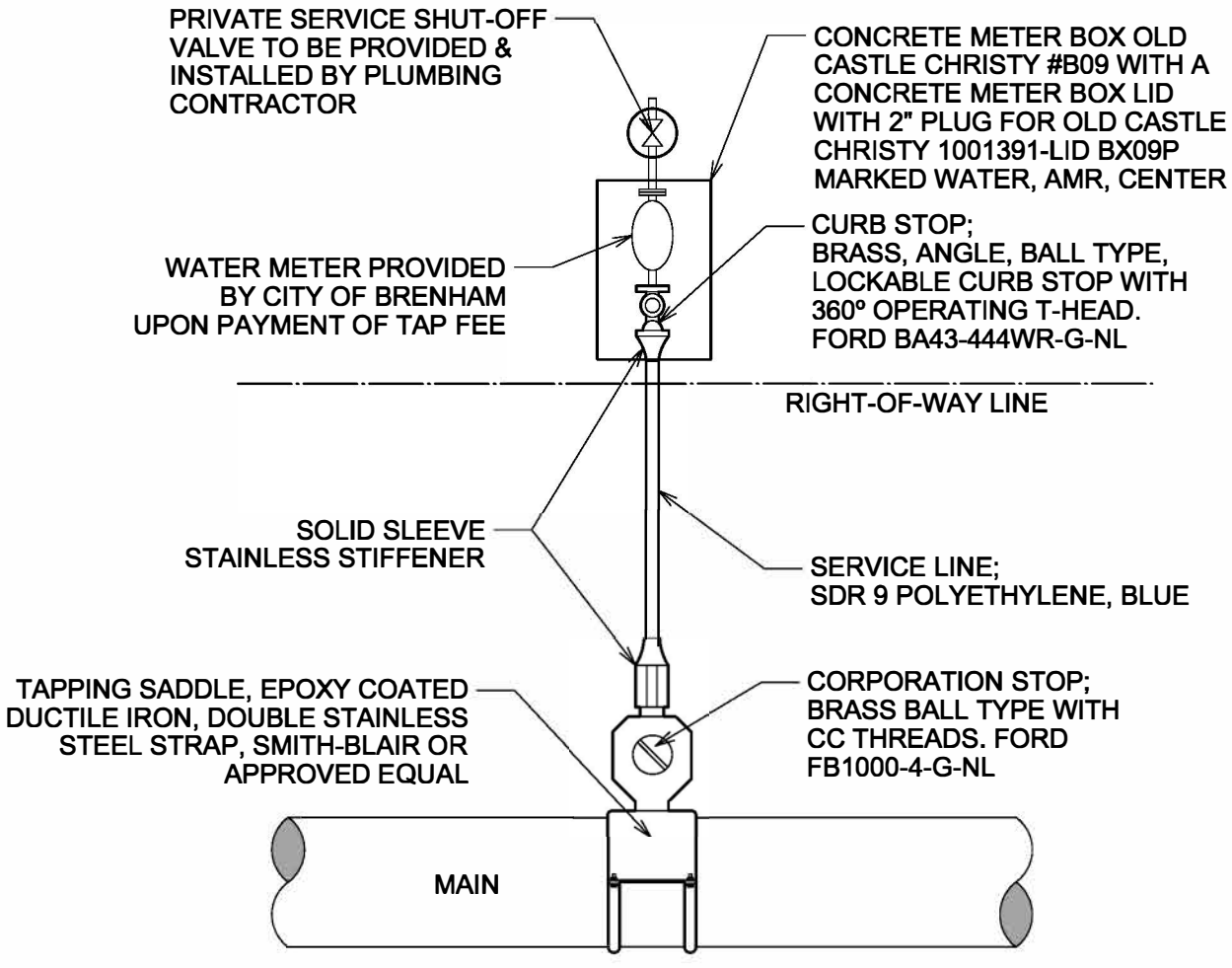
DATE: 07/20/21

REVISED DATE: 07/20/21

WTR - 10

GENERAL NOTES

1. WATER SERVICES 2" AND SMALLER MUST BE SINGLE LOT CONNECTIONS.
2. MINIMUM SIZE SERVICE FOR SINGLE LOT CONNECTION SHALL BE 1".
3. WATER SERVICE SHALL BE LOCATED WITHIN THE RIGHT-OF-WAY AS CLOSE TO THE LOT LINE AS POSSIBLE.
4. CITY OF BRENHAM TO SUPPLY WATER METER UPON PAYMENT OF TAP FEE BY DEVELOPER OR DEVELOPER'S CONTRACTOR.
5. INSTALL TRACER WIRE ALONG SERVICE LINE. CONNECT WITH WATER TIGHT UNDERGROUND CONNECTORS TO THE TRACER WIRE THAT RUNS ALONG THE MAIN WATER LINE. TERMINATE BY LEAVING A 3' SPOOL OF TRACER WIRE INSIDE OF METER BOX.



PLAN VIEW

City of BRENHAM

1" WATER SERVICE DETAIL (SINGLE SERVICE)

STANDARD CONSTRUCTION DETAILS

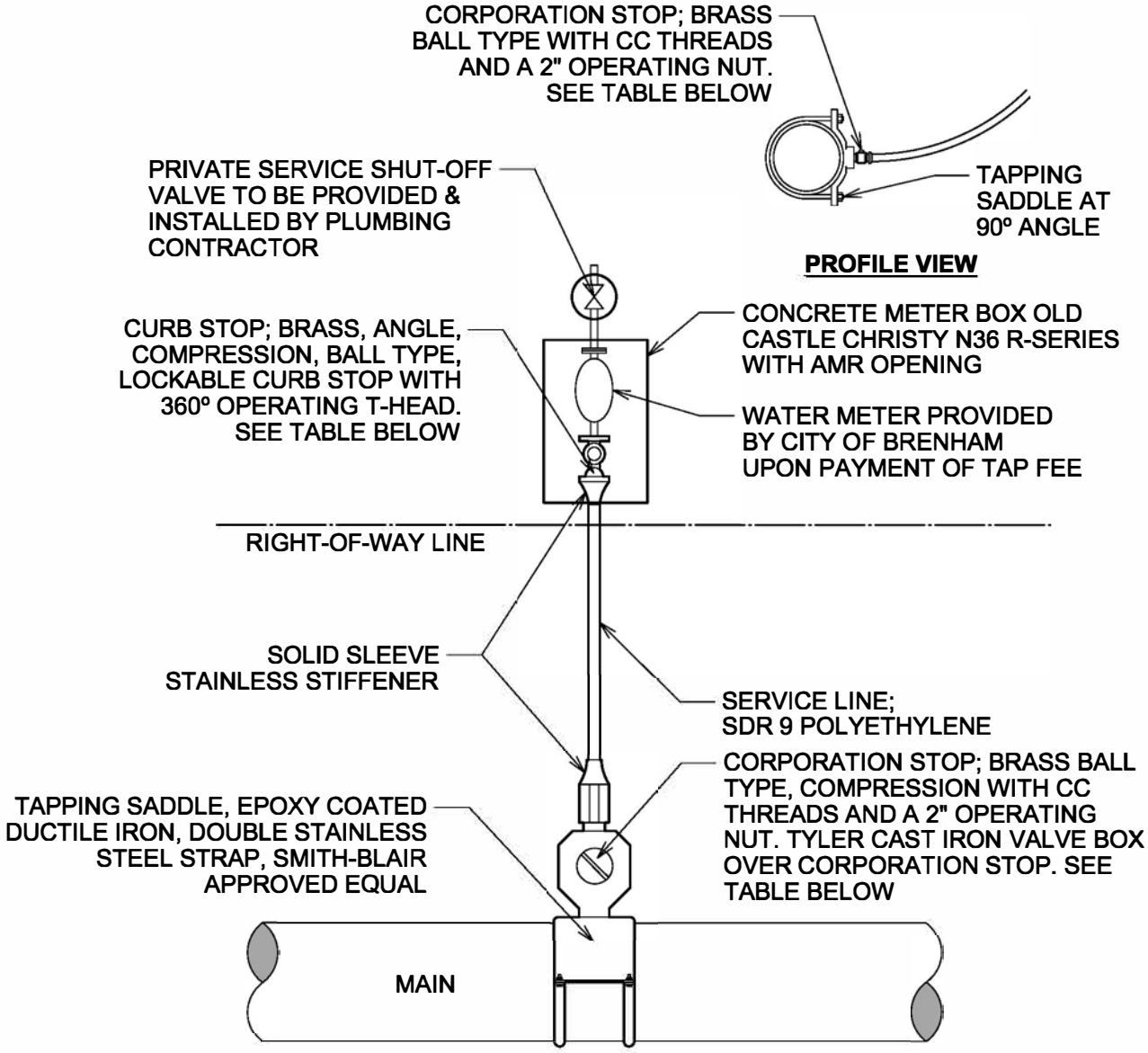
DATE: 07/20/21

REVISED DATE: 07/20/21

WTR - 11

GENERAL NOTES

1. WATER SERVICES 2" AND SMALLER MUST BE SINGLE LOT CONNECTIONS.
2. WATER SERVICE SHALL BE LOCATED WITHIN THE RIGHT-OF-WAY AS CLOSE TO THE LOT LINE AS POSSIBLE.
3. CITY OF BRENHAM TO SUPPLY WATER METER UPON PAYMENT OF TAP FEE BY DEVELOPER OR DEVELOPER'S CONTRACTOR.



METER SIZE	CORPORATION STOP	CURB STOP
1-1/2"	FORD FB1000-6-TA-QT67-NL	FORD BFA43-666-WR-G-NL
2"	FORD FB1000-7-TA-QT67-NL	FORD BFA43-777-WR-G-NL

City of BRENHAM

1 1/2" AND 2" WATER SERVICE DETAIL (SINGLE SERVICE)

STANDARD CONSTRUCTION DETAILS

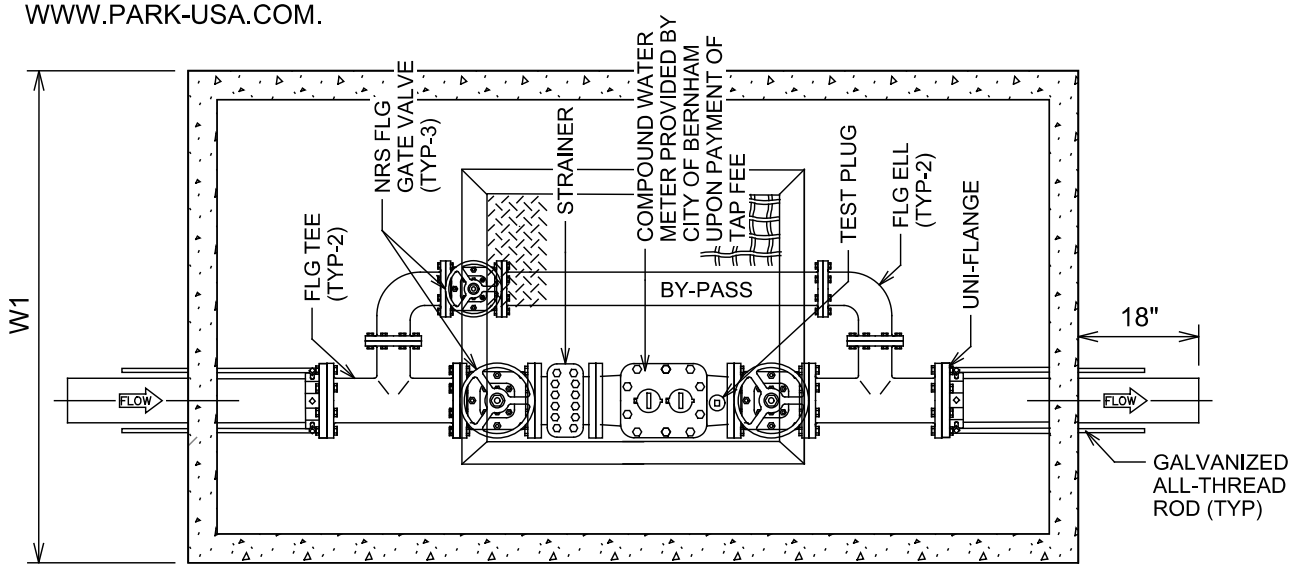
DATE: 07/20/21

REVISED DATE: 07/20/21

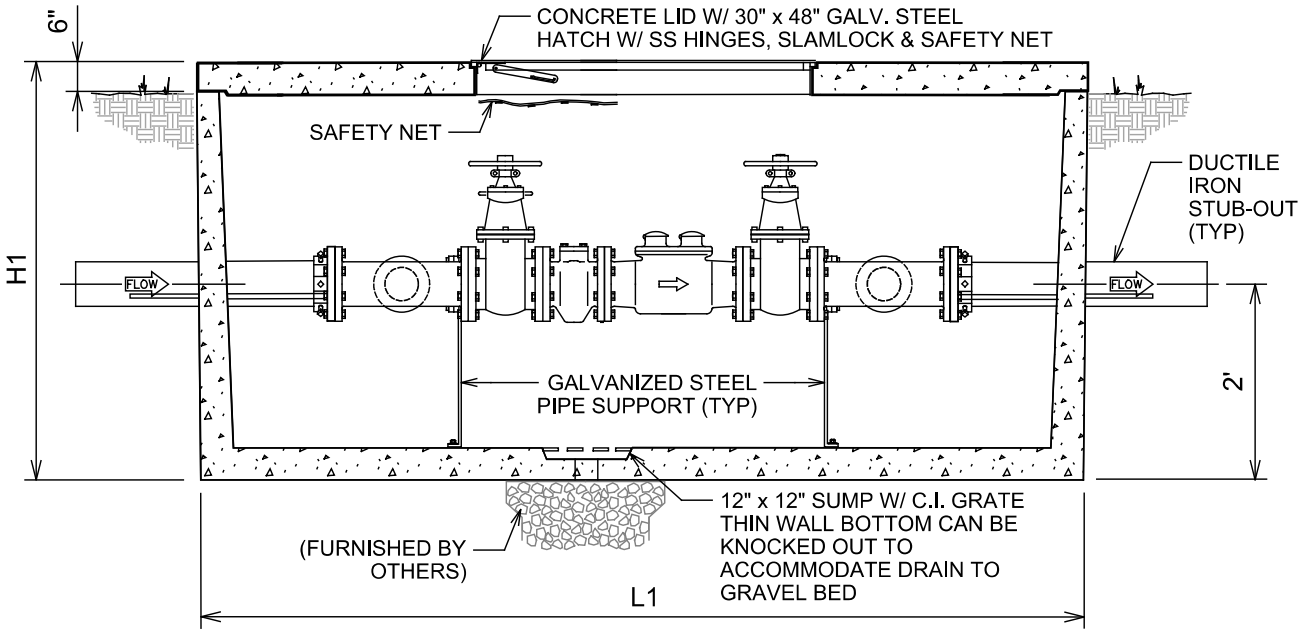
WTR - 12

GENERAL NOTES

1. DOMESTIC COMPOUND WATER METER ASSEMBLY SHALL BE PARK USA MODEL DMC-BYPASS OR APPROVED EQUAL. MANUFACTURER CONTACT INFORMATION: ParkUSA, 888-611-7275, WWW.PARK-USA.COM.



PLAN VIEW



ELEVATION VIEW

MODEL No.	METER SIZE	BY-PASS	L1	W1	H1
DMC-04	4"	2"	8' - 8"	5' - 0"	4' - 6"
DMC-06	6"	4"	8' - 8"	5' - 0"	4' - 6"

CITY OF BRENHAM USES C-2 SENSUS WATER METERS

City of BRENHAM

4" AND LARGER METER SERVICE DETAIL

STANDARD CONSTRUCTION DETAILS

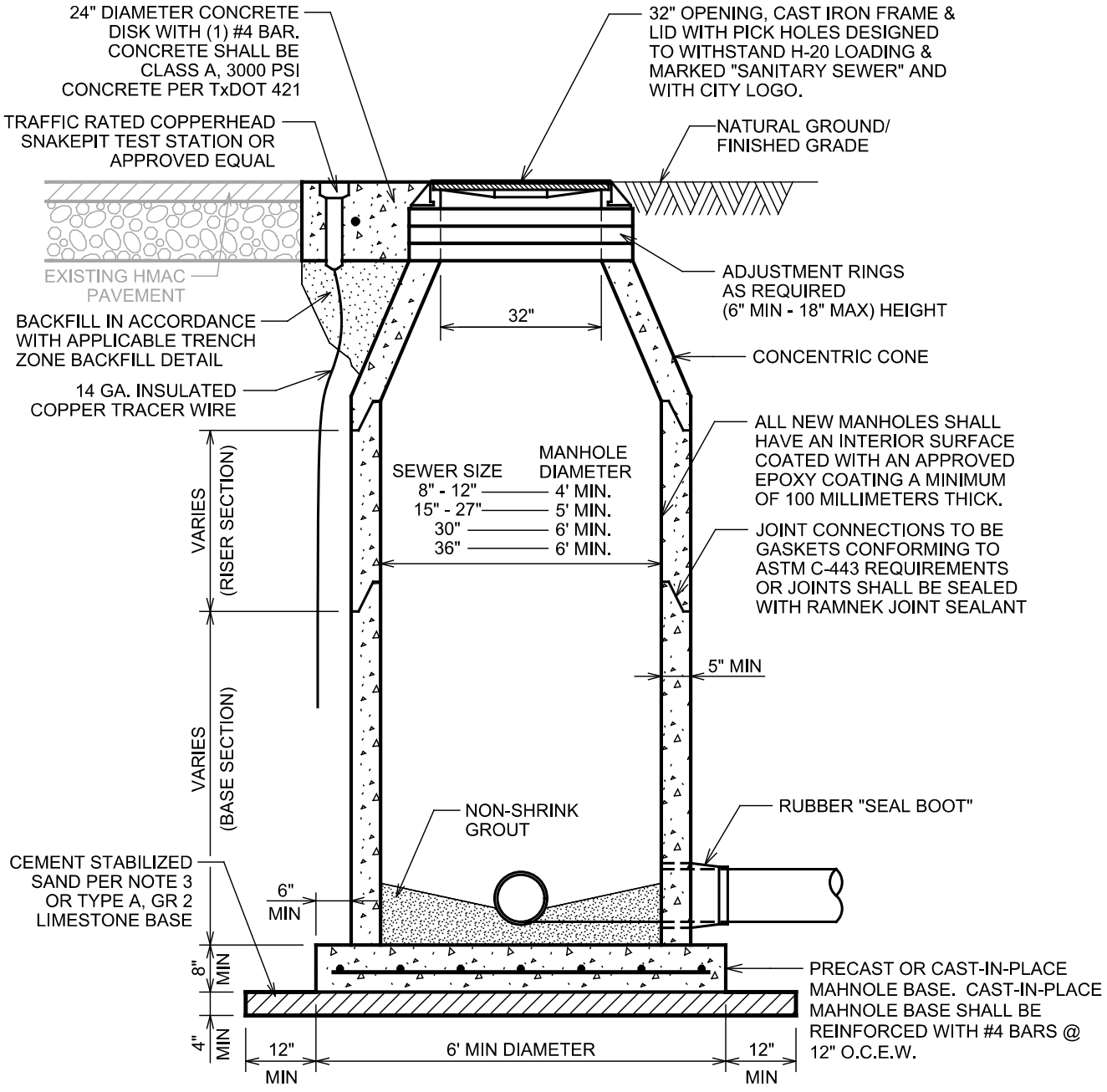
DATE: 07/20/21

REVISED DATE: 07/20/21

WTR - 13

GENERAL NOTES

1. INSTALLATION OF PRECAST STRUCTURES SHALL BE PER MANUFACTURERS INSTRUCTIONS. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF PRE-CAST STRUCTURES TO ENGINEER PRIOR TO ORDERING MATERIALS.
2. PRECAST STRUCTURE, RING, AND COVER SHALL BE DESIGNED FOR H-20 WHEEL LOADING.
3. CEMENT STABILIZED SAND SHALL CONTAIN A MINIMUM OF 1.5 SACKS OF CEMENT PER CUBIC YARD. SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487) AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PI <7; LL <25.
4. TRACER STATION TO BE INCLUDED AT ALL MANHOLES AT THE INTERSECTIONS AND AT 500' MAXIMUM SPACING.



City of BRENHAM

SANITARY SEWER MANHOLE (PRE-CAST CONCRETE MANHOLE)

STANDARD CONSTRUCTION DETAILS

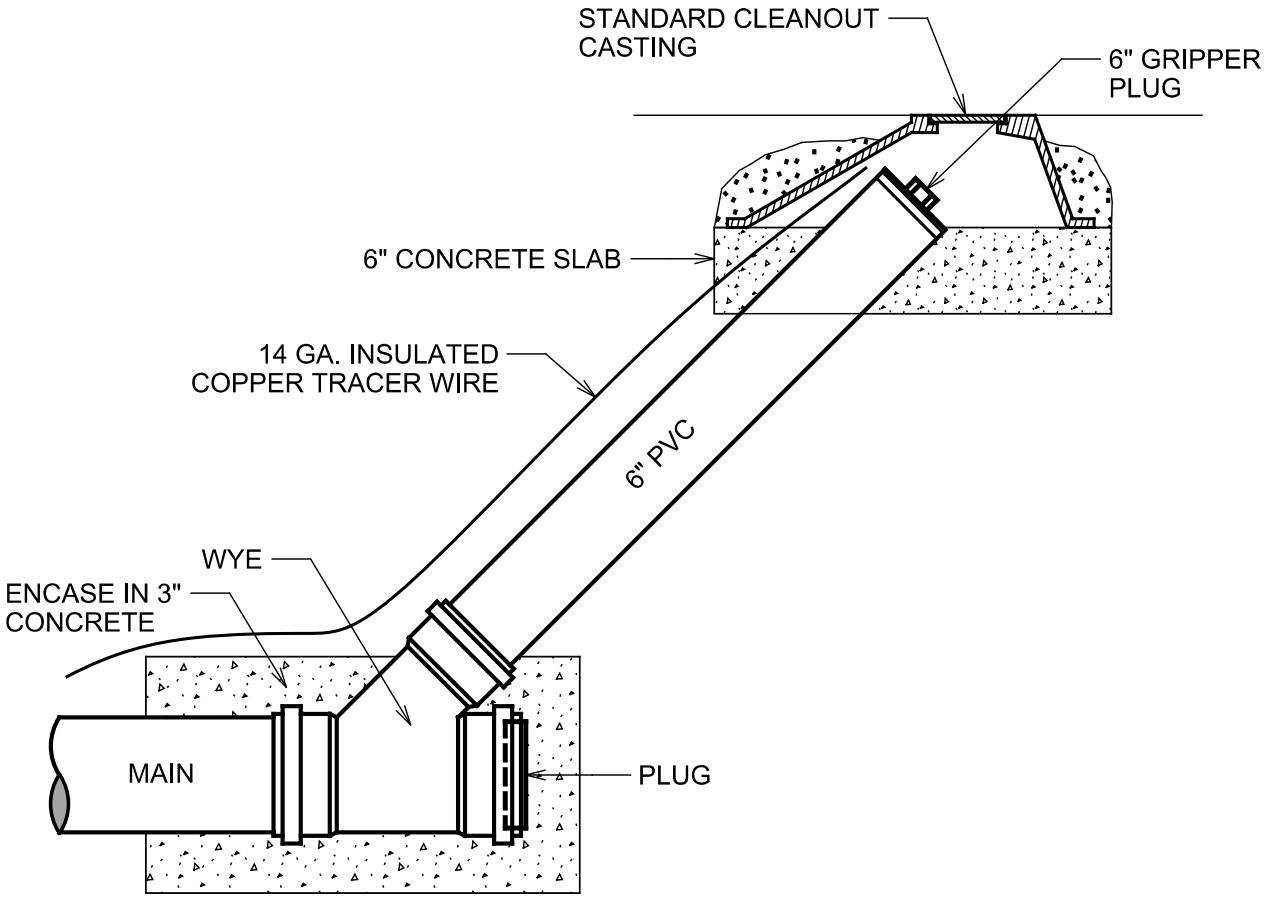
DATE: 07/16/21

REVISED DATE: 07/16/21

SAN - 1

GENERAL NOTES

1. CLEANOUT BOOTS WILL ONLY BE ALLOWED ON A DEAD END OF A SANITARY SEWER LINE THAT IS LESS THAN 150 FEET LONG WITH SPECIFIC APPROVAL FROM THE CITY.



City of BRENHAM

SANITARY SEWER CLEANOUT

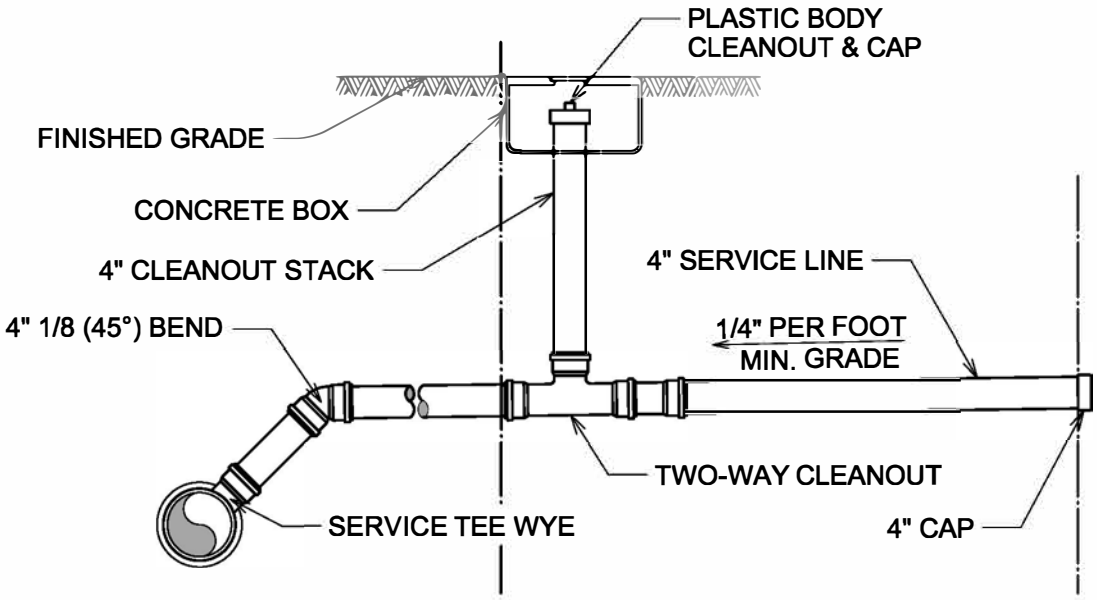
STANDARD CONSTRUCTION DETAILS

DATE: 07/16/21	REVISED DATE: 07/16/21

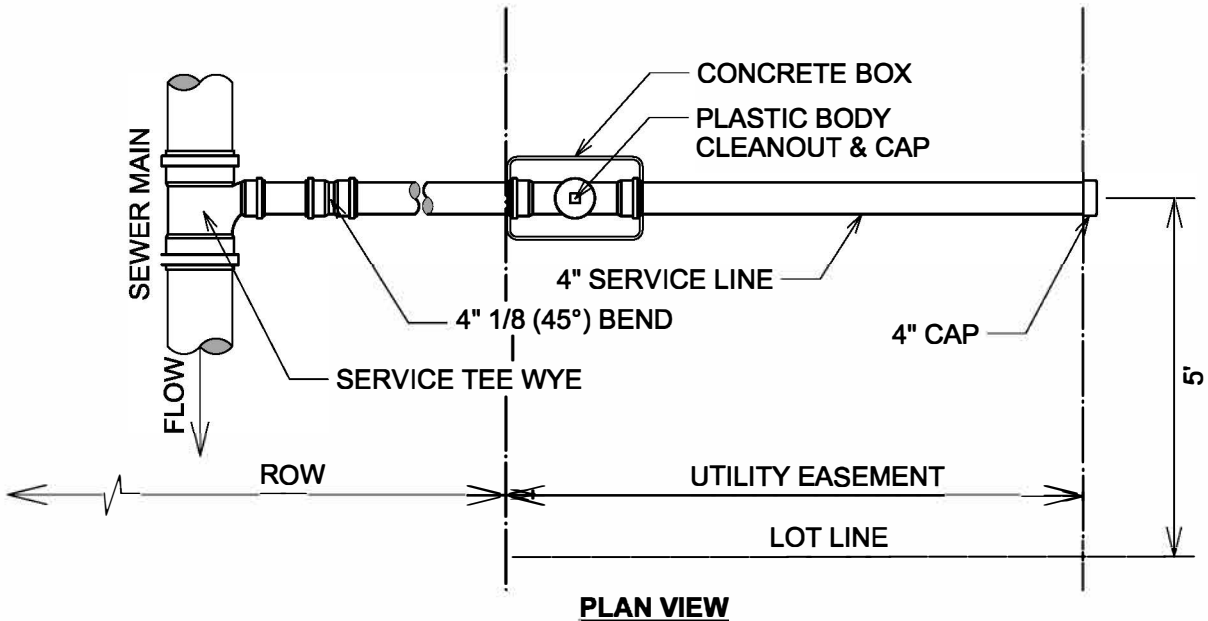
SAN - 2

GENERAL NOTES

1. SANITARY SEWER SERVICE LATERAL AND FITTINGS SHALL BE PVC - SDR 35.
2. SEWER SERVICE LEADS SHALL NOT EXCEED 125' IN LENGTH.
3. SINGLE-FAMILY RESIDENTIAL SERVICES SHOULD BE INSTALLED AT A MANHOLE WHEN POSSIBLE
4. MULTI-FAMILY RESIDENTIAL, COMMERCIAL AND OFFICE DEVELOPMENT SERVICES SHALL BE MADE AT A MANHOLE.
5. "Y" ETCHED MARK ON CURB AT SERVICE LOCATION.



ELEVATION VIEW



PLAN VIEW

City of BRENHAM

SANITARY SEWER SERVICE DETAIL (SINGLE)

STANDARD CONSTRUCTION DETAILS

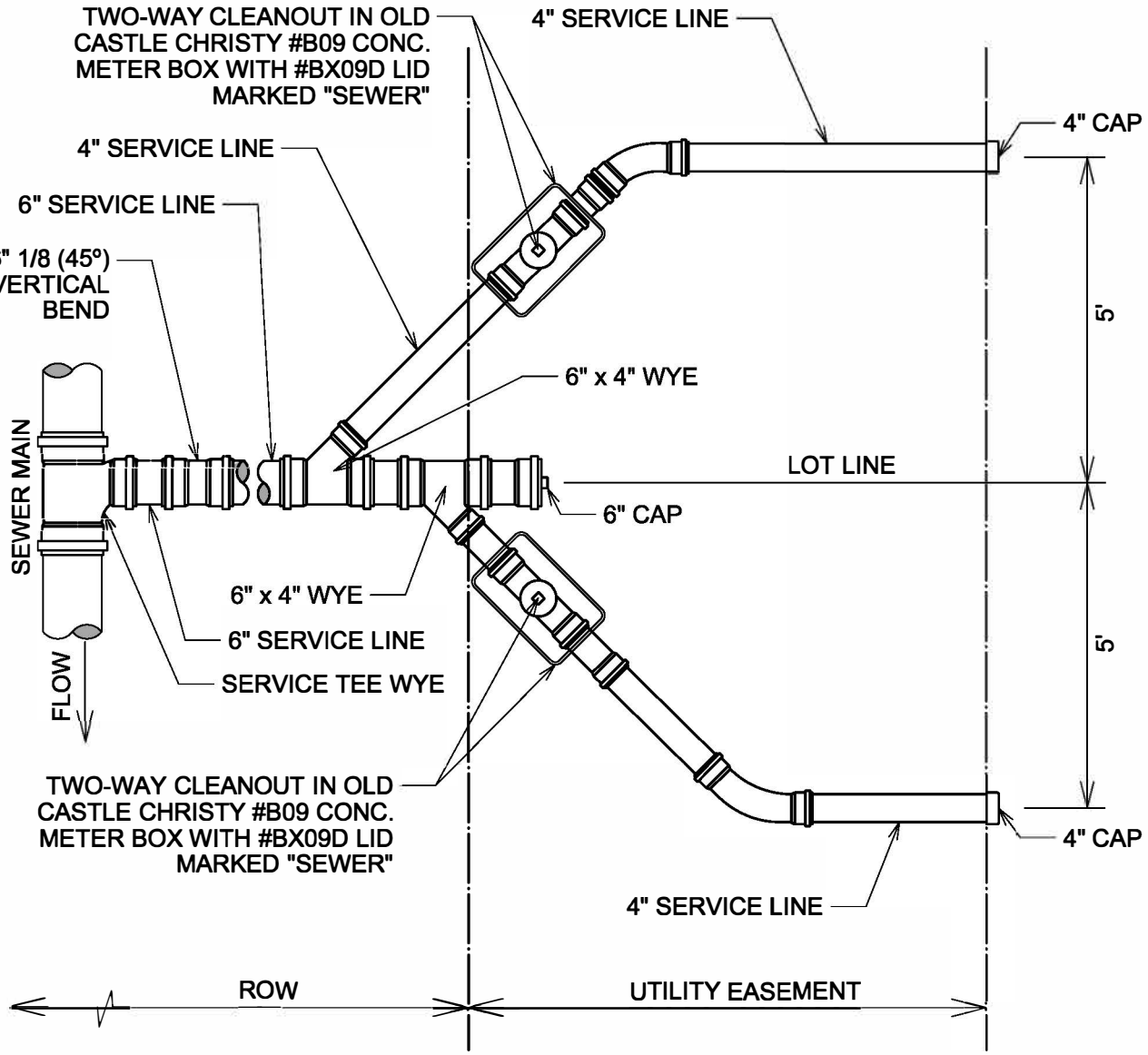
DATE: 07/20/21

REVISED DATE: 10/05/21

SAN - 3

GENERAL NOTES

1. SANITARY SEWER SERVICE LATERAL AND FITTINGS SHALL BE PVC - SDR 35.
2. SEWER SERVICE LEADS SHALL NOT EXCEED 125' IN LENGTH.
3. SINGLE-FAMILY RESIDENTIAL SERVICES SHOULD BE INSTALLED AT A MANHOLE WHEN POSSIBLE.
4. MULTI-FAMILY RESIDENTIAL, COMMERCIAL AND OFFICE DEVELOPMENT SERVICES SHALL BE MADE AT A MANHOLE.
5. "Y" ETCHED MARK ON CURB AT SERVICE LOCATION.



City of BRENHAM

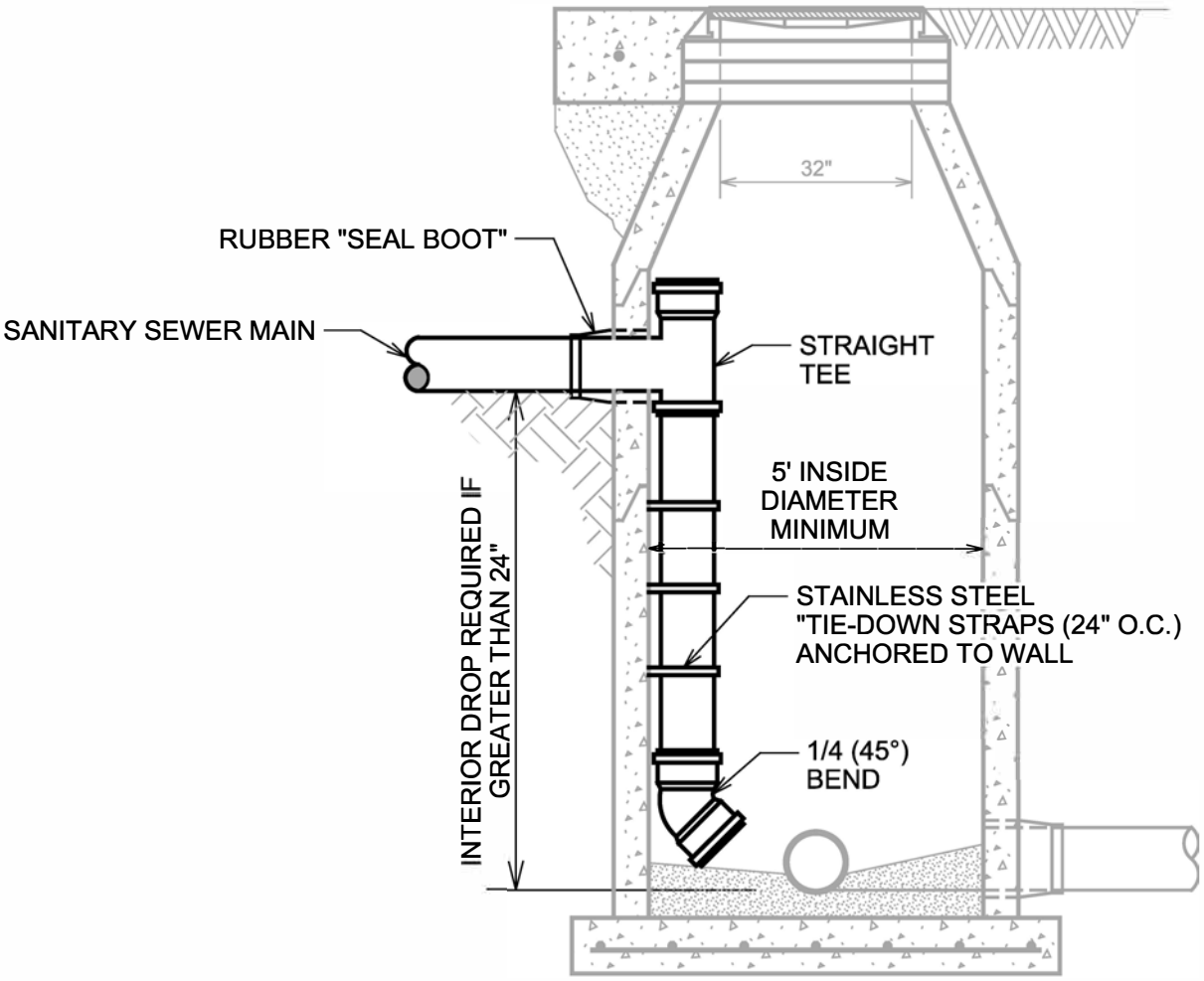
SANITARY SEWER SERVICE DETAIL (DOUBLE)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21

REVISED DATE: 10/05/21

SAN - 4



City of BRENHAM

DROP STRUCTURE FOR MANHOLE DETAIL

STANDARD CONSTRUCTION DETAILS

DATE: 11/22/19	REVISED DATE: 11/22/19

SAN -5

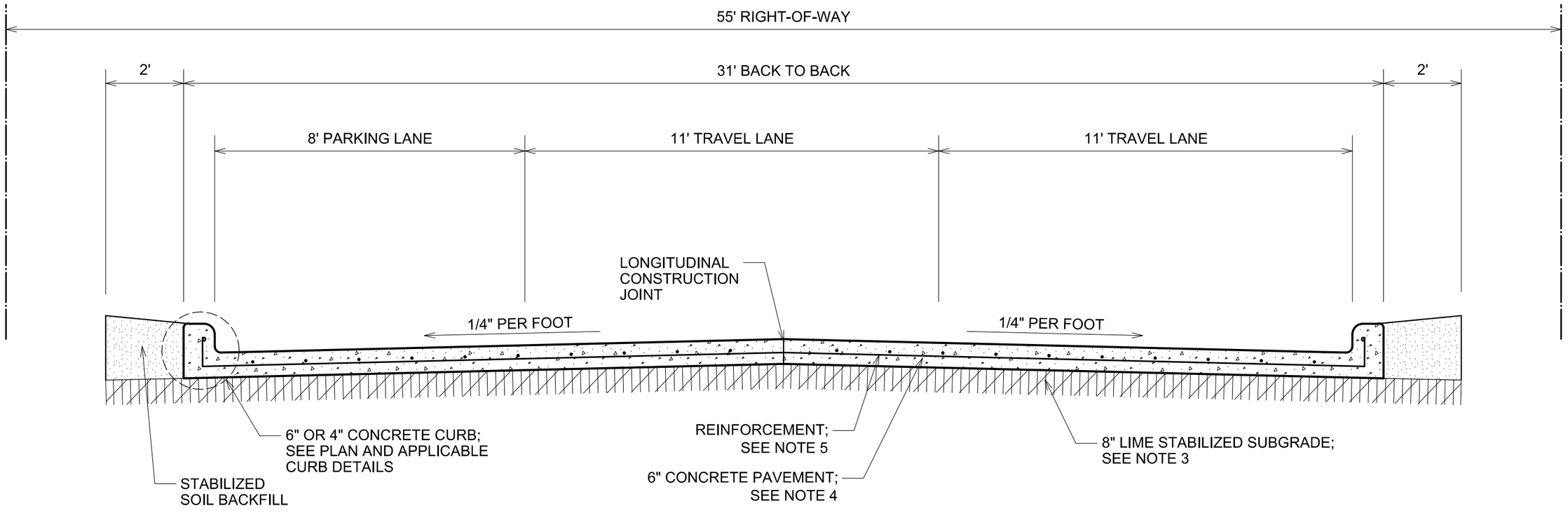
GENERAL NOTES

1. STRIP AND REMOVE ALL VEGETATION, LOOSE TOPSOIL, TREES AND ROOTS WITHIN THE CONSTRUCTION AREA.

2. SUBGRADE FILL: IMPORTED FILL MATERIALS, WHEN REQUIRED TO ACHIEVE FINAL SUBGRADE ELEVATION, SHALL BE CHOSEN THAT EXHIBIT SIMILAR CLASSIFICATION AND PHYSICAL PROPERTIES AS THE ON SITE SOILS. SAMPLES OF THE FILL MATERIAL SHALL BE MADE AVAILABLE TO THE OWNER'S TESTING LABORATORY 7 DAYS PRIOR TO PLACEMENT. SUBGRADE FILL, WHETHER IMPORTED OR EXCAVATED ON-SITE, SHALL BE PLACED IN 6" LOOSE LIFTS AND COMPACTED TO 95% STANDARD PROCTOR (ASTM D698) AT A MOISTURE CONTENT WITHIN BETWEEN -1% DRY & +3% WET OF OPTIMUM.

3. STABILIZED SUBGRADE: SUBGRADE STABILIZATION SHALL CONSIST OF A MINIMUM OF 8" LIME TREATED SUBGRADE. THE DEVELOPER IS REQUIRED TO HIRE A TESTING LABORATORY TO ESTABLISH PROPER SUBGRADE STABILIZATION SPECIFICATIONS. SPECIFICATIONS SHALL BE SUBMITTED TO THE DIRECTOR OF PUBLIC WORKS FOR APPROVAL PRIOR TO COMPLETION OF PAVEMENT DESIGN. STABILIZED SUBGRADE SHALL EXTEND A MINIMUM OF 2' BEHIND THE CURB.

4. CONCRETE SHALL MEET THE REQUIREMENTS OF TxDOT ITEM 421 - HYDRAULIC CEMENT CONCRETE, CLASS P PER TXDOT ITEM 421, TABLE 8. WITH THE FOLLOWING MODIFICATIONS: MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4,000 PSI; TXDOT ITEM 421, TABLE 9 REQUIRES FORMED CONCRETE PAVEMENT TO HAVE SLUMP FROM 4INCHES TO 5.5 INCHES AT THE POINT OF PLACEMENT.
5. REINFORCING STEEL SHALL BE #4 BARS @ 18" O.C. TRANSVERSE AND LONGITUDINALLY. GRADE OF REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 IN ACCORDANCE WITH TxDOT ITEM 440.



City of BRENHAM

TYPICAL CONCRETE PAVEMENT SECTION
(LOCAL STREET)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

PAV - 1

GENERAL NOTES

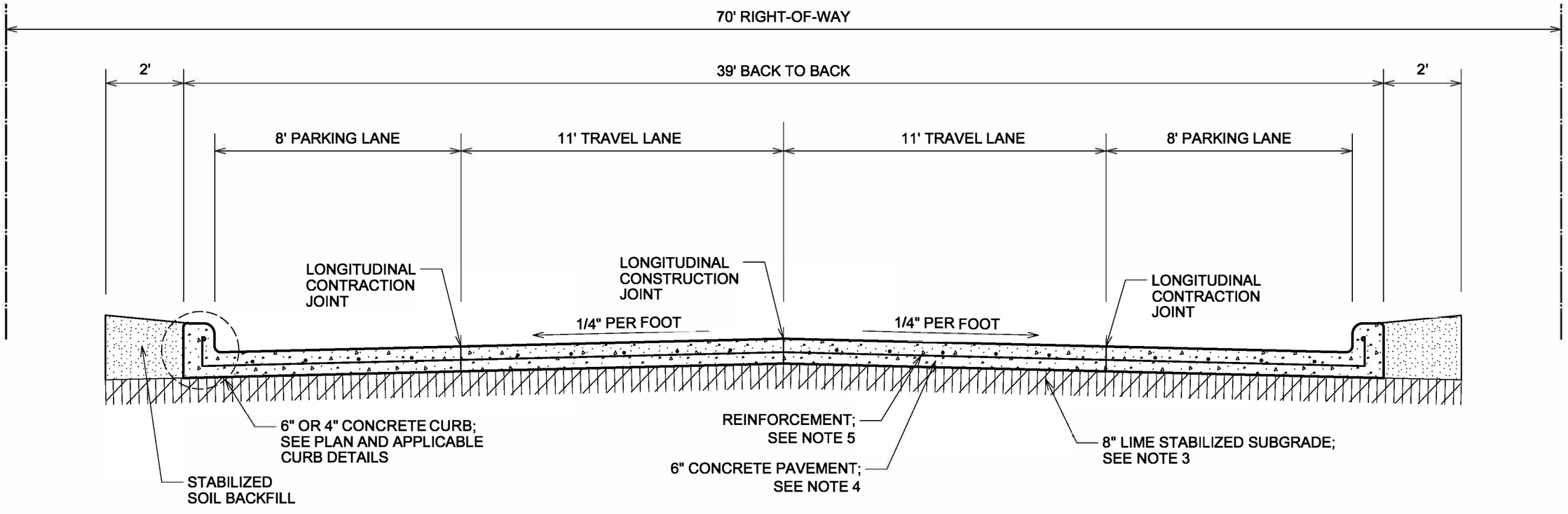
1. STRIP AND REMOVE ALL VEGETATION, LOOSE TOPSOIL, TREES AND ROOTS WITHIN THE CONSTRUCTION AREA.

2. SUBGRADE FILL: IMPORTED FILL MATERIALS, WHEN REQUIRED TO ACHIEVE FINAL SUBGRADE ELEVATION, SHALL BE CHOSEN THAT EXHIBIT SIMILAR CLASSIFICATION AND PHYSICAL PROPERTIES AS THE ON SITE SOILS. SAMPLES OF THE FILL MATERIAL SHALL BE MADE AVAILABLE TO THE OWNER'S TESTING LABORATORY 7 DAYS PRIOR TO PLACEMENT. SUBGRADE FILL, WHETHER IMPORTED OR EXCAVATED ON-SITE, SHALL BE PLACED IN 6" LOOSE LIFTS AND COMPACTED TO 95% STANDARD PROCTOR (ASTM D698) AT A MOISTURE CONTENT WITHIN BETWEEN -1% DRY & +3% WET OF OPTIMUM.

3. STABILIZED SUBGRADE: SUBGRADE STABILIZATION SHALL CONSIST OF A MINIMUM OF 8" LIME TREATED SUBGRADE. THE DEVELOPER IS REQUIRED TO HIRE A TESTING LABORATORY TO ESTABLISH PROPER SUBGRADE STABILIZATION SPECIFICATIONS. SPECIFICATIONS SHALL BE SUBMITTED TO THE DIRECTOR OF PUBLIC WORKS FOR APPROVAL PRIOR TO COMPLETION OF PAVEMENT DESIGN. STABILIZED SUBGRADE SHALL EXTEND A MINIMUM OF 2' BEHIND THE CURB.

4. CONCRETE SHALL MEET THE REQUIREMENTS OF TxDOT ITEM 421 - HYDRAULIC CEMENT CONCRETE, CLASS P PER TXDOT ITEM 421, TABLE 8. WITH THE FOLLOWING MODIFICATIONS: MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4,000 PSI; TXDOT ITEM 421, TABLE 9 REQUIRES FORMED CONCRETE PAVEMENT TO HAVE SLUMP FROM 4INCHES TO 5.5 INCHES AT THE POINT OF PLACEMENT.

5. REINFORCING STEEL SHALL BE #4 BARS @ 18" O.C. TRANSVERSE AND LONGITUDINALLY. GRADE OF REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 IN ACCORDANCE WITH TxDOT ITEM 440.



City of BRENHAM

TYPICAL CONCRETE PAVEMENT SECTION
(MINOR COLLECTOR)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

PAV - 2

GENERAL NOTES

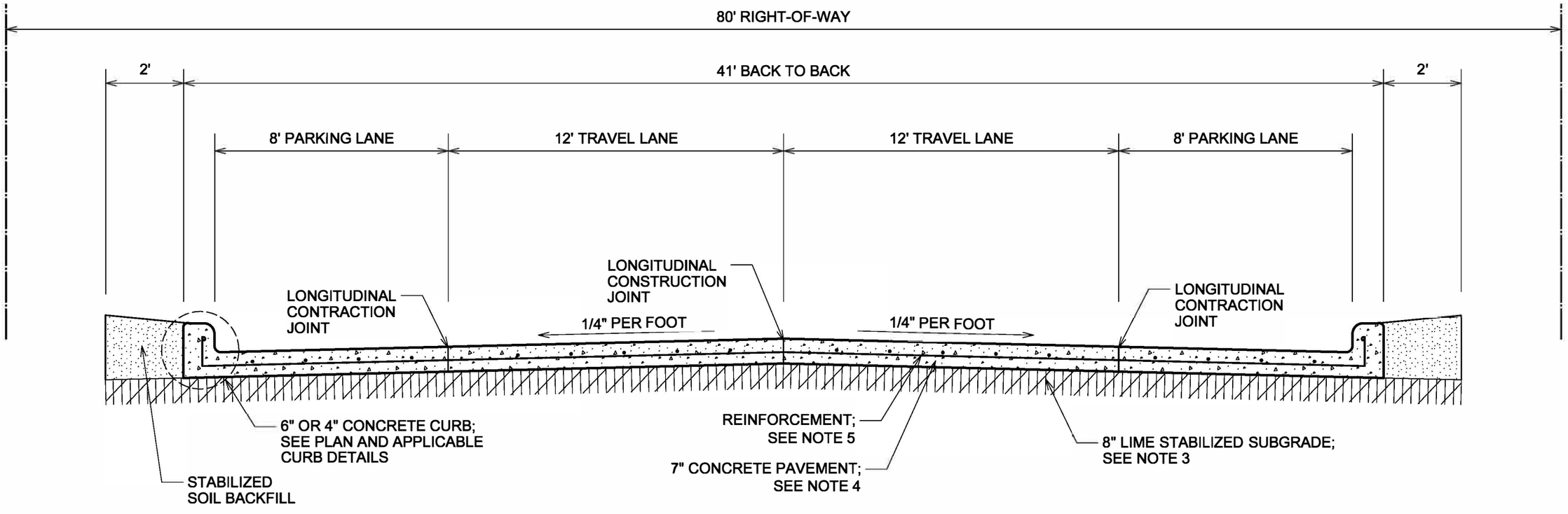
1. STRIP AND REMOVE ALL VEGETATION, LOOSE TOPSOIL, TREES AND ROOTS WITHIN THE CONSTRUCTION AREA.

2. SUBGRADE FILL: IMPORTED FILL MATERIALS, WHEN REQUIRED TO ACHIEVE FINAL SUBGRADE ELEVATION, SHALL BE CHOSEN THAT EXHIBIT SIMILAR CLASSIFICATION AND PHYSICAL PROPERTIES AS THE ON SITE SOILS. SAMPLES OF THE FILL MATERIAL SHALL BE MADE AVAILABLE TO THE OWNER'S TESTING LABORATORY 7 DAYS PRIOR TO PLACEMENT. SUBGRADE FILL, WHETHER IMPORTED OR EXCAVATED ON-SITE, SHALL BE PLACED IN 6" LOOSE LIFTS AND COMPACTED TO 95% STANDARD PROCTOR (ASTM D698) AT A MOISTURE CONTENT WITHIN BETWEEN -1% DRY & +3% WET OF OPTIMUM.

3. STABILIZED SUBGRADE: SUBGRADE STABILIZATION SHALL CONSIST OF A MINIMUM OF 8" LIME TREATED SUBGRADE. THE DEVELOPER IS REQUIRED TO HIRE A TESTING LABORATORY TO ESTABLISH PROPER SUBGRADE STABILIZATION SPECIFICATIONS. SPECIFICATIONS SHALL BE SUBMITTED TO THE DIRECTOR OF PUBLIC WORKS FOR APPROVAL PRIOR TO COMPLETION OF PAVEMENT DESIGN. STABILIZED SUBGRADE SHALL EXTEND A MINIMUM OF 2' BEHIND THE CURB.

4. CONCRETE SHALL MEET THE REQUIREMENTS OF TxDOT ITEM 421 - HYDRAULIC CEMENT CONCRETE, CLASS P PER TXDOT ITEM 421, TABLE 8. WITH THE FOLLOWING MODIFICATIONS: MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4,000 PSI; TXDOT ITEM 421, TABLE 9 REQUIRES FORMED CONCRETE PAVEMENT TO HAVE SLUMP FROM 4INCHES TO 5.5 INCHES AT THE POINT OF PLACEMENT.

5. REINFORCING STEEL SHALL BE #4 BARS @ 18" O.C. TRANSVERSE AND LONGITUDINALLY. GRADE OF REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 IN ACCORDANCE WITH TxDOT ITEM 440.



City of BRENHAM

TYPICAL CONCRETE PAVEMENT SECTION
(MAJOR COLLECTOR)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

PAV - 3

GENERAL NOTES

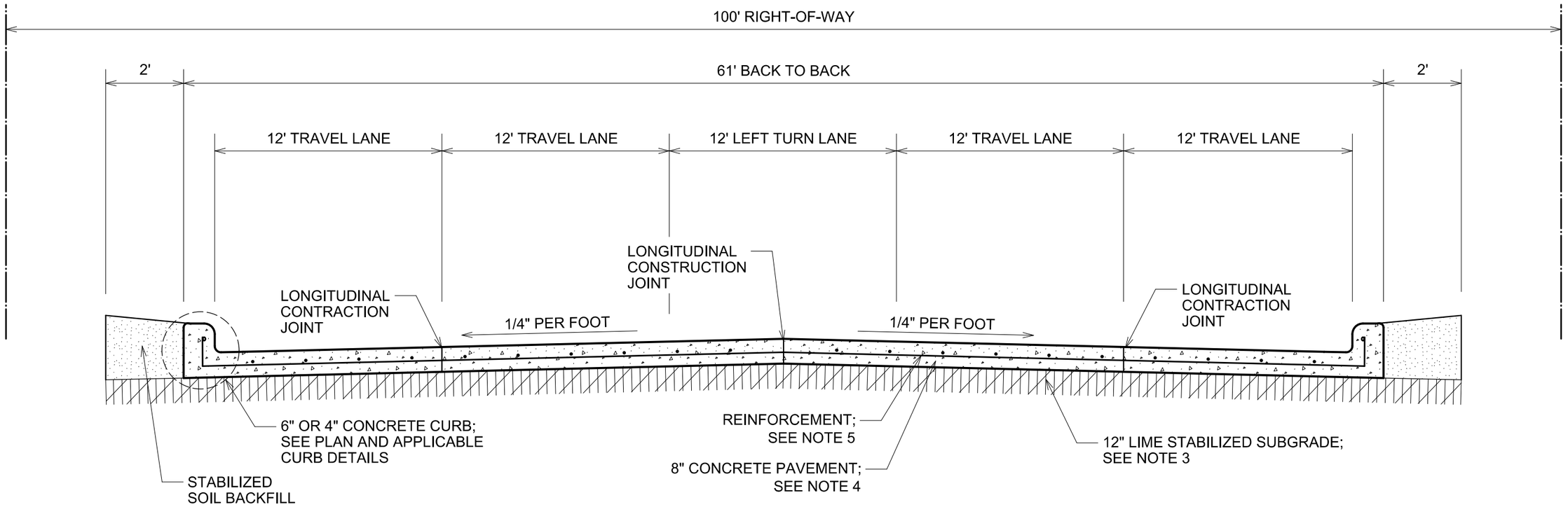
1. STRIP AND REMOVE ALL VEGETATION, LOOSE TOPSOIL, TREES AND ROOTS WITHIN THE CONSTRUCTION AREA.

2. SUBGRADE FILL: IMPORTED FILL MATERIALS, WHEN REQUIRED TO ACHIEVE FINAL SUBGRADE ELEVATION, SHALL BE CHOSEN THAT EXHIBIT SIMILAR CLASSIFICATION AND PHYSICAL PROPERTIES AS THE ON SITE SOILS. SAMPLES OF THE FILL MATERIAL SHALL BE MADE AVAILABLE TO THE OWNER'S TESTING LABORATORY 7 DAYS PRIOR TO PLACEMENT. SUBGRADE FILL, WHETHER IMPORTED OR EXCAVATED ON-SITE, SHALL BE PLACED IN 6" LOOSE LIFTS AND COMPACTED TO 95% STANDARD PROCTOR (ASTM D698) AT A MOISTURE CONTENT WITHIN BETWEEN -1% DRY & +3% WET OF OPTIMUM.

3. STABILIZED SUBGRADE: SUBGRADE STABILIZATION SHALL CONSIST OF A MINIMUM OF 8" LIME TREATED SUBGRADE. THE DEVELOPER IS REQUIRED TO HIRE A TESTING LABORATORY TO ESTABLISH PROPER SUBGRADE STABILIZATION SPECIFICATIONS. SPECIFICATIONS SHALL BE SUBMITTED TO THE DIRECTOR OF PUBLIC WORKS FOR APPROVAL PRIOR TO COMPLETION OF PAVEMENT DESIGN. STABILIZED SUBGRADE SHALL EXTEND A MINIMUM OF 2' BEHIND THE CURB.

4. CONCRETE SHALL MEET THE REQUIREMENTS OF TxDOT ITEM 421 - HYDRAULIC CEMENT CONCRETE, CLASS P PER TXDOT ITEM 421, TABLE 8. WITH THE FOLLOWING MODIFICATIONS: MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4,000 PSI; TXDOT ITEM 421, TABLE 9 REQUIRES FORMED CONCRETE PAVEMENT TO HAVE SLUMP FROM 4 TO 5-1/2 INCHES AT THE POINT OF PLACEMENT.

5. REINFORCING STEEL SHALL BE #5 BARS @ 24" O.C. TRANSVERSE AND #5 BARS @ 8" O.C. LONGITUDINAL. GRADE OF REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 IN ACCORDANCE WITH TxDOT ITEM 440.



City of BRENHAM

TYPICAL CONCRETE PAVEMENT SECTION
(ARTERIAL)

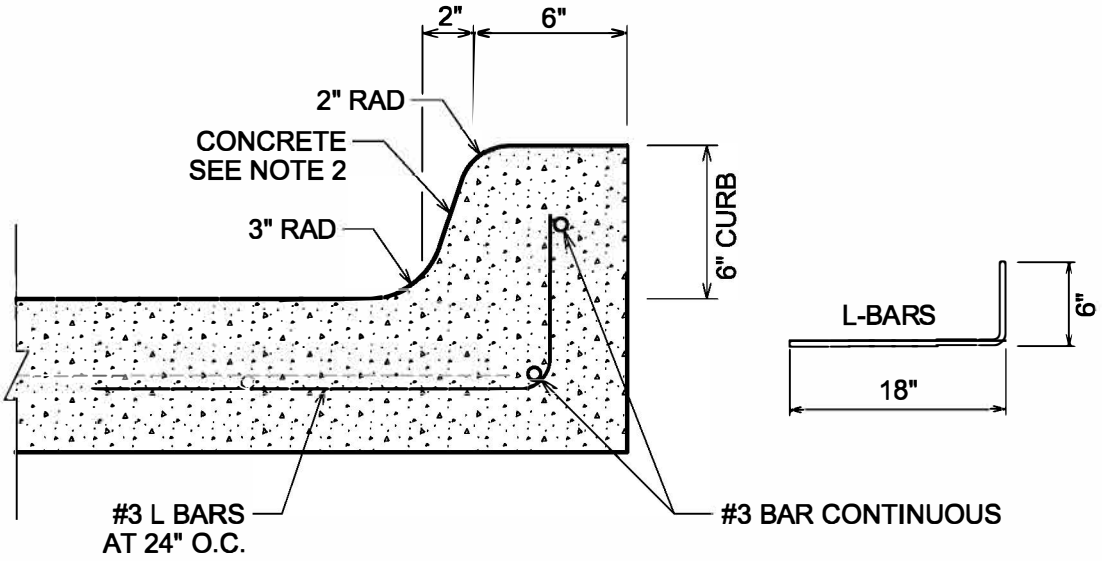
STANDARD CONSTRUCTION DETAILS

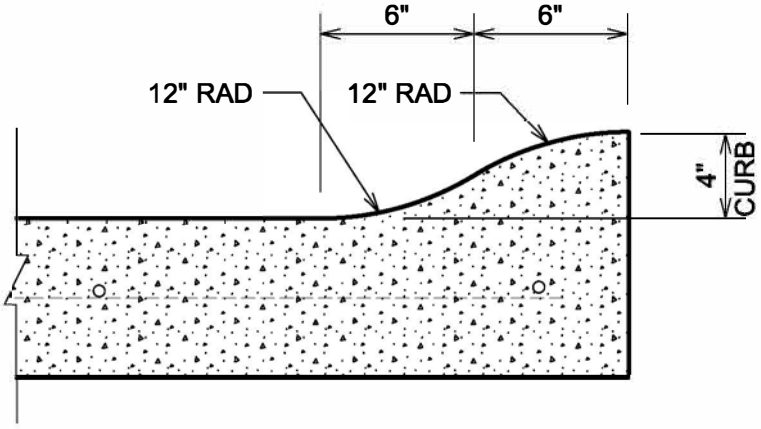
DATE: 07/20/21	REVISED DATE: 07/20/21

PAV - 4

GENERAL NOTES

1. CURB SHALL BE PLACED MONOLITHICALLY WITH THE ADJACENT CONCRETE OR CONSTRUCTED AS CURB AND GUTTER.
2. CONCRETE SPECIFICATIONS SHALL BE THE SAME AS THOSE FOR THE PAVEMENT.
3. THE COMPLETED CONCRETE CURB SHALL NOT VARY FROM THE SHAPE, DIMENSION AND CONTOUR SHOWN ON THE DETAIL BY MORE THAN 1/2“ AT ANY POINT ALONG THE CURB. NON-CONFORMING CURB SHALL BE REMOVED AND REPLACED BY A SAW CUTTING 6“ IN FRONT OF THE DEFECTIVE CURB, THEN REMOVING AND REPLACING THE ENTIRE DEPTH OF CURB AND PAVEMENT IN THE DEFECTIVE AREA.
4. EXPANSION JOINTS IN THE PAVEMENT SHALL EXTEND THROUGH ADJACENT CURB WHEN PLACED MONOLITHICALLY WITH ADJACENT CONCRETE.





City of BRENHAM

6" CONCRETE CURB
&
4" CONCRETE CURB

STANDARD CONSTRUCTION DETAILS

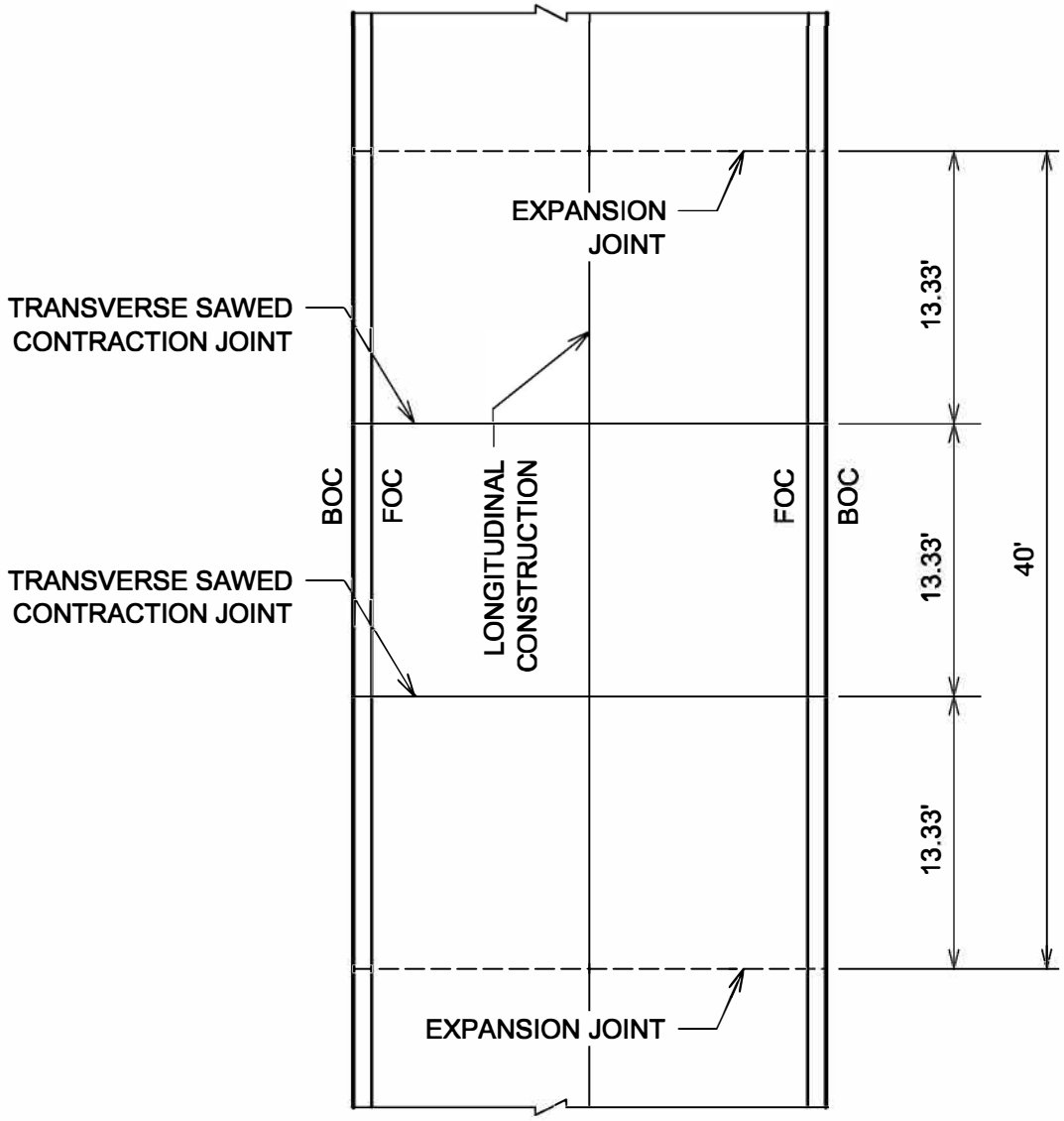
DATE: 07/20/21

REVISED
DATE: 07/20/21

PAV - 5

GENERAL NOTES

1. REINFORCING STEEL SHALL BE #4 BARS @ 18" O.C. TRANSVERSE AND LONGITUDINALLY. GRADE OF REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 IN ACCORDANCE WITH TxDOT ITEM 440.



ABBREVIATIONS:
FOC - FACE OF CURB
BOC - BACK OF CURB

City of BRENHAM

CONCRETE JOINT LAYOUT (LOCAL STREET)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21

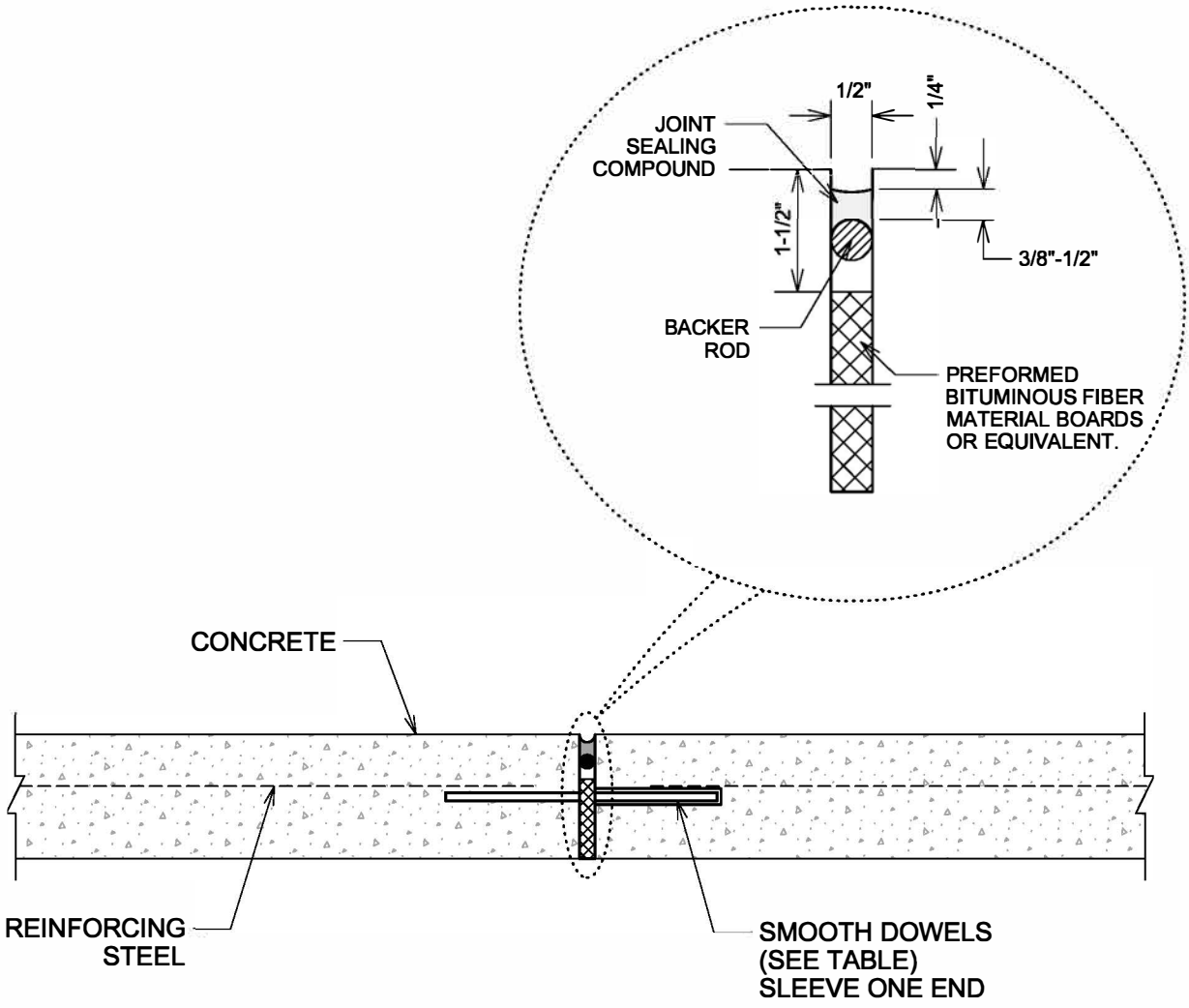
REVISED DATE: 07/20/21

PAV - 6

GENERAL NOTES

1. PAVEMENT JOINTS SHALL BE CLEANED AND SEALED IN ACCORDANCE WITH TXDOT ITEM 438, CLEANING AND SEALING JOINTS.
2. JOINT SEALANT SHALL BE CLASS 8, SILICONE OR POLYURETHANE (ASTM D5893 TYPE SL)

DOWEL BAR TABLE			
CONCRETE THICKNESS	DOWEL DIAMETER	DOWEL LENGTH	DOWEL SPACING
6"	3/4"	24"	12"
7"	7/8"	24"	12"
8"	1"	24"	12"



City of BRENHAM

EXPANSION JOINT

STANDARD CONSTRUCTION DETAILS

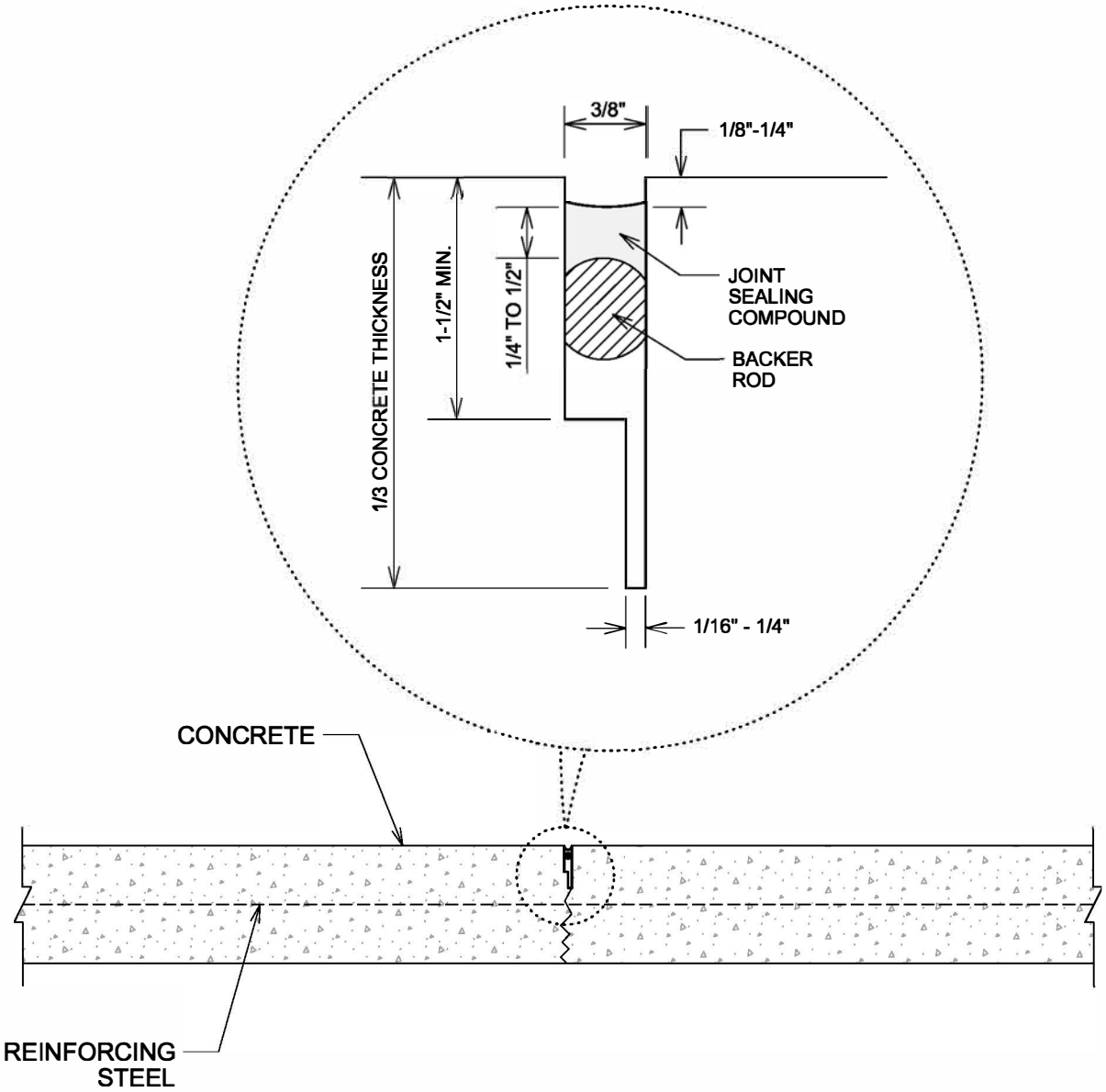
DATE: 07/20/21

REVISED DATE: 07/20/21

PAV - 7

GENERAL NOTES

1. PAVEMENT JOINTS SHALL BE CLEANED AND SEALED IN ACCORDANCE WITH TXDOT ITEM 438, CLEANING AND SEALING JOINTS.
2. JOINT SEALANT SHALL BE CLASS 8, SILICONE OR POLYURETHANE (ASTM D5893 TYPE SL)



City of BRENHAM

SAWED & SEALED CONTRACTION JOINT

STANDARD CONSTRUCTION DETAILS

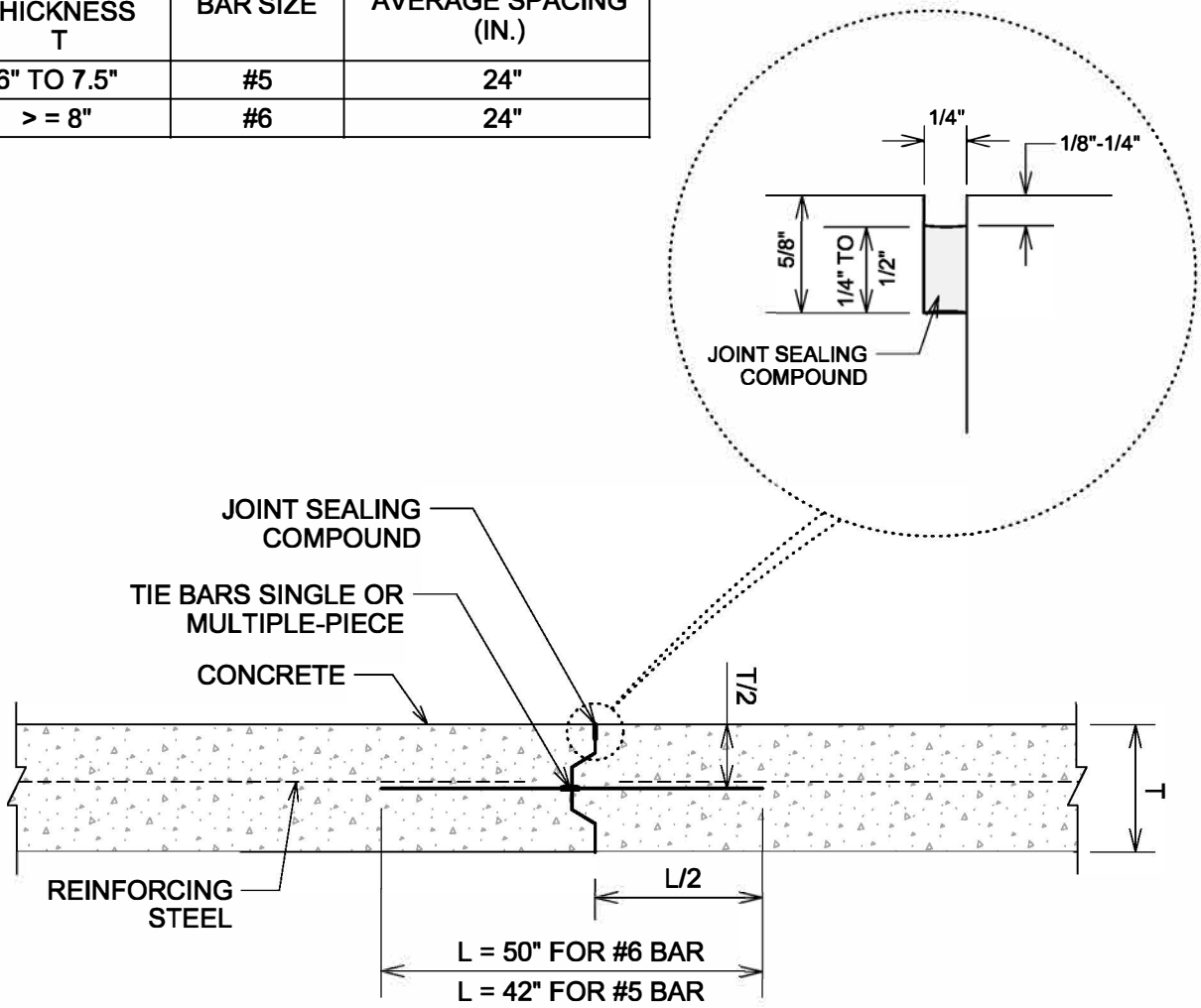
DATE: 07/20/21	REVISED DATE: 07/20/21

PAV - 8

GENERAL NOTES

1. PAVEMENT JOINTS SHALL BE CLEANED AND SEALED IN ACCORDANCE WITH TXDOT ITEM 438, CLEANING AND SEALING JOINTS.
2. JOINT SEALANT SHALL BE CLASS 8, SILICONE OR POLYURETHANE (ASTM D5893 TYPE SL)

TABLE TIE BARS (DEFORMED BARS)		
CONCRETE THICKNESS T	BAR SIZE	AVERAGE SPACING (IN.)
6" TO 7.5"	#5	24"
> = 8"	#6	24"



City of BRENHAM

METAL KEYWAY CONSTRUCTION JOINT

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21

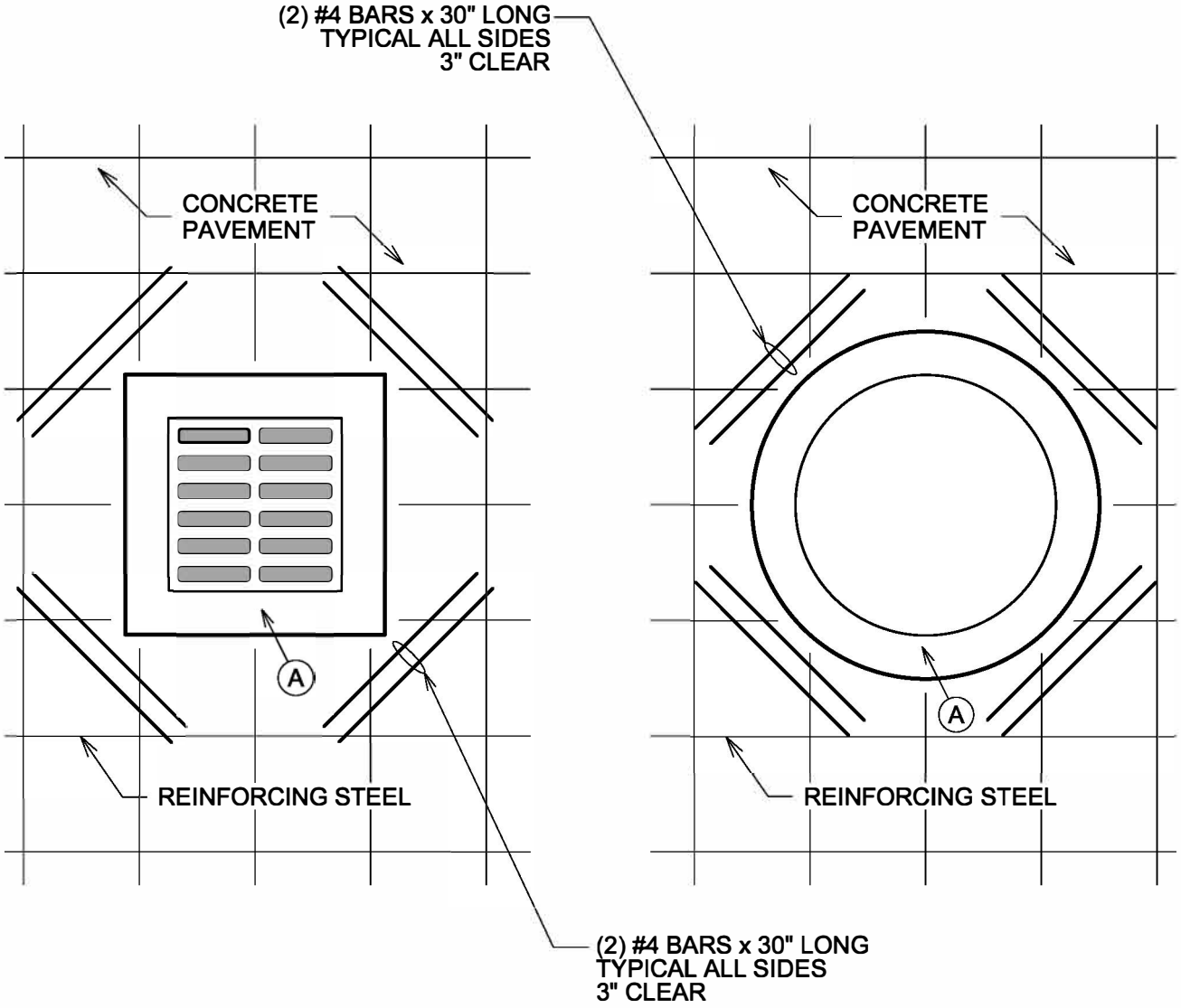
REVISED DATE: 07/20/21

PAV - 9

GENERAL NOTES

1. REFER TO THE APPROPRIATE PAVEMENT OR SIDEWALK DETAIL FOR STRUCTURAL REQUIREMENTS.

Ⓐ FIXED STRUCTURE IN CONCRETE PAVEMENT INCLUDING MANHOLES, JUNCTION BOXES, VALVE BOXES, METER BOXES, CLEANOUTS, LIGHT POLES, ETC.



City of BRENHAM

FIXED STRUCTURE REINFORCEMENT

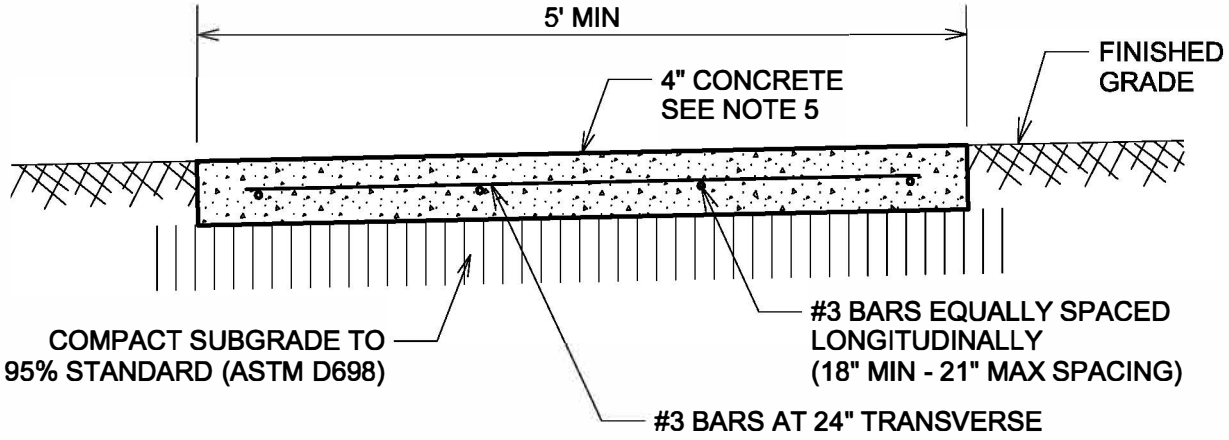
STANDARD CONSTRUCTION DETAILS

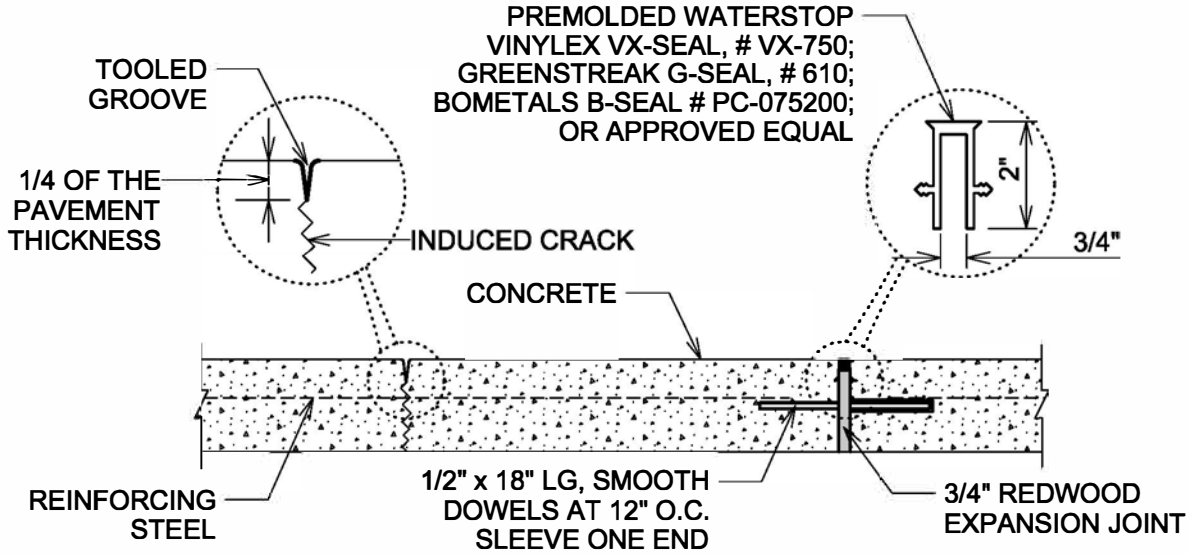
DATE: 07/20/21	REVISED DATE: 07/20/21

PAV - 10

GENERAL NOTES

1. REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 IN ACCORDANCE WITH TxDOT ITEM 440.
2. EXPANSION JOINTS SHALL BE LOCATED AT DRIVEWAYS AND OTHER FIXED OBJECTS AND AT 40' MAXIMUM INTERVALS ALONG THE SIDEWALK.
3. TOOLED CONTRACTION JOINTS SHALL BE LOCATED AT REGULAR INTERVALS EQUAL TO THE WIDTH OF THE SIDEWALK.
4. CONCRETE SHALL MEET THE REQUIREMENTS OF TxDOT ITEM 421 - HYDRAULIC CEMENT CONCRETE, CLASS A, 3,000 PSI.
5. SIDEWALKS SHALL BE SLOPED IN ACCORDANCE WITH TEXAS ACCESSIBILITY STANDARDS.
6. ALL REBAR TO BE SET ON BAR CHAIRS. PLASTIC OR METAL BAR CHAIRS ARE ACCEPTABLE; NO BRICKS, BROKEN CONCRETE, ROCKS, ETC.





City of BRENHAM

CONCRETE SIDEWALK
(DETACHED FROM CURB)

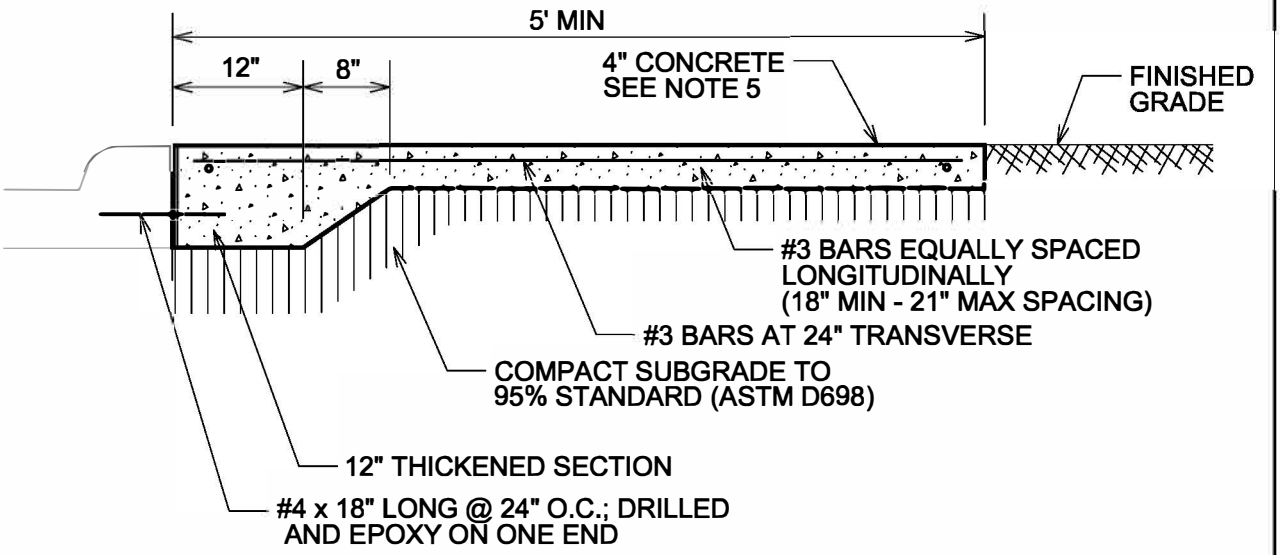
STANDARD CONSTRUCTION DETAILS

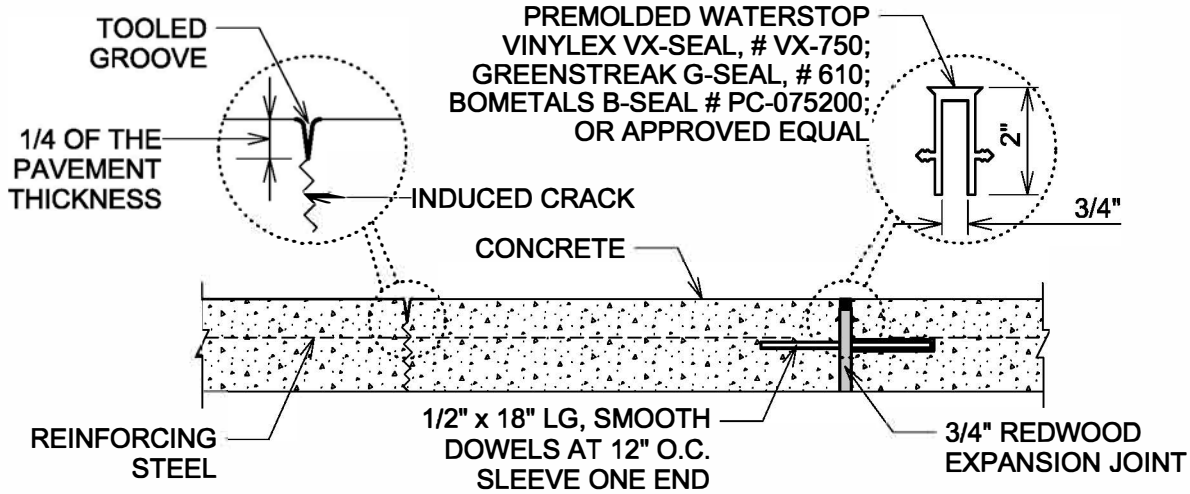
DATE: 07/20/21	REVISED DATE: 07/20/21

PAV - 11

GENERAL NOTES

1. REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 IN ACCORDANCE WITH TxDOT ITEM 440.
2. EXPANSION JOINTS SHALL BE LOCATED AT DRIVEWAYS AND OTHER FIXED OBJECTS AND AT 40' MAXIMUM INTERVALS ALONG THE SIDEWALK.
3. TOOLED CONTRACTION JOINTS SHALL BE LOCATED AT REGULAR INTERVALS EQUAL TO THE WIDTH OF THE SIDEWALK.
4. CONCRETE SHALL MEET THE REQUIREMENTS OF TxDOT ITEM 421 - HYDRAULIC CEMENT CONCRETE, CLASS A, 3,000 PSI.
5. SIDEWALKS SHALL BE SLOPED IN ACCORDANCE WITH TEXAS ACCESSIBILITY STANDARDS.
6. ALL REBAR TO BE SET ON BAR CHAIRS. PLASTIC OR METAL BAR CHAIRS ARE ACCEPTABLE; NO BRICKS, BROKEN CONCRETE, ROCKS, ETC.





City of BRENHAM

CONCRETE SIDEWALK
(ATTACHED TO CURB)

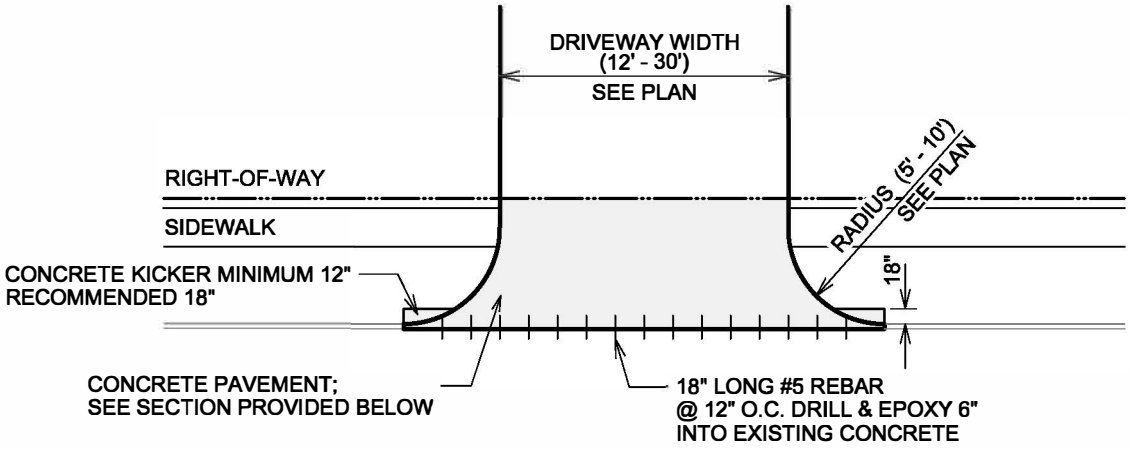
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

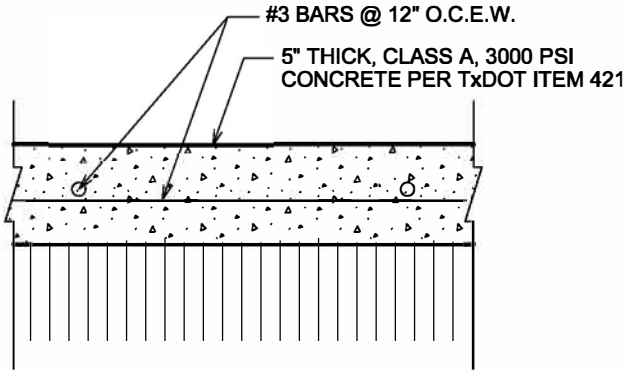
PAV - 12

GENERAL NOTES

1. USE CONSTRUCTION JOINT DETAIL IF JOINING TO EXISTING CONCRETE DRIVEWAY. USE EXPANSION JOINT DETAIL AT RIGHT-OF-WAY LINE.
2. GRADE OF REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 IN ACCORDANCE WITH TxDOT ITEM 440.
3. ALL REBAR TO BE SET ON BAR CHAIRS. PLASTIC OR METAL BAR CHAIRS ARE ACCEPTABLE; NO BRICKS, BROKEN CONCRETE, ROCKS, ETC.
4. SUBGRADE SHALL BE COMPACTED TO 95% STANDARD PROCTOR.
5. SEE PAV - 15 FOR DRIVEWAY PROFILE REQUIREMENTS.



LOCAL OR COLLECTOR STREET



CONCRETE PAVEMENT

City of BRENHAM

RESIDENTIAL DRIVEWAY (CONNECTING TO LOCAL OR COLLECTOR)

STANDARD CONSTRUCTION DETAILS

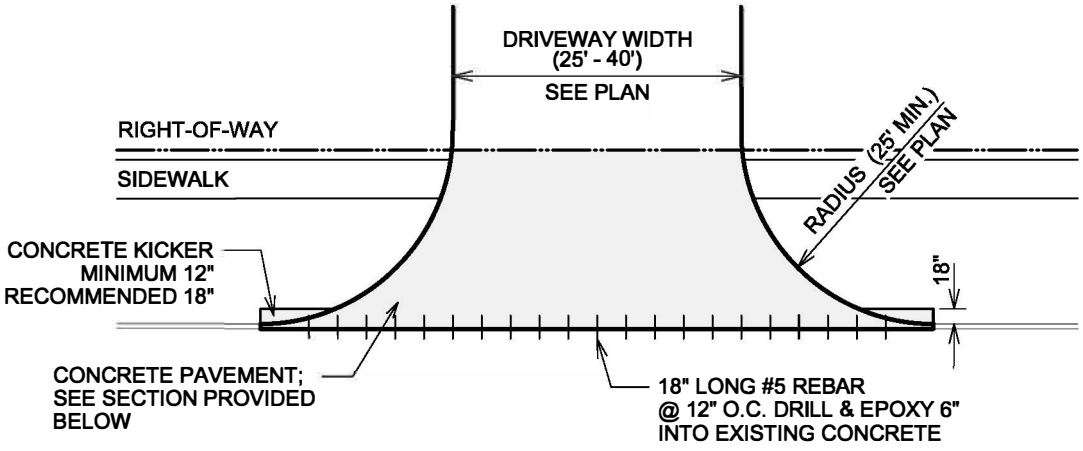
DATE: 07/20/21

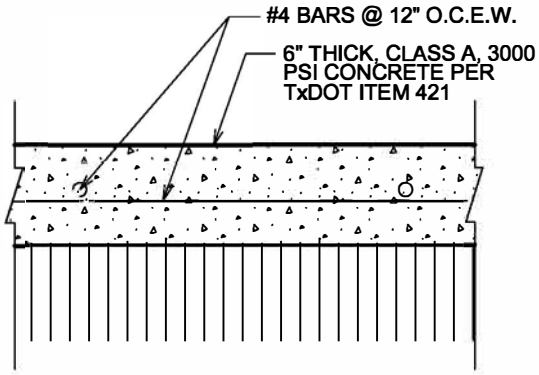
REVISED DATE: 07/20/21

PAV - 13

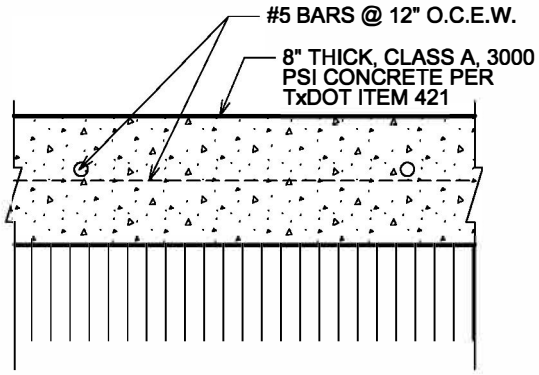
GENERAL NOTES

1. USE CONSTRUCTION JOINT DETAIL IF JOINING TO EXISTING CONCRETE DRIVEWAY. USE EXPANSION JOINT DETAIL AT RIGHT-OF-WAY LINE.
2. GRADE OF REINFORCING STEEL SHALL BE ASTM A615 GRADE 60 IN ACCORDANCE WITH TxDOT ITEM 440.
3. ALL REBAR TO BE SET ON BAR CHAIRS. PLASTIC OR METAL BAR CHAIRS ARE ACCEPTABLE; NO BRICKS, BROKEN CONCRETE, ROCKS, ETC.
4. SUBGRADE SHALL BE COMPACTED TO 90% STANDARD PROCTOR.
5. SEE PAV - 15 FOR DRIVEWAY PROFILE REQUIREMENTS.





CONCRETE PAVEMENT FOR
MULTI-FAMILY RESIDENTIAL AND
COMMERCIAL



CONCRETE PAVEMENT FOR
INDUSTRIAL

City of BRENHAM

MULTI-FAMILY RESIDENTIAL AND NON-RESIDENTIAL DRIVEWAY

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

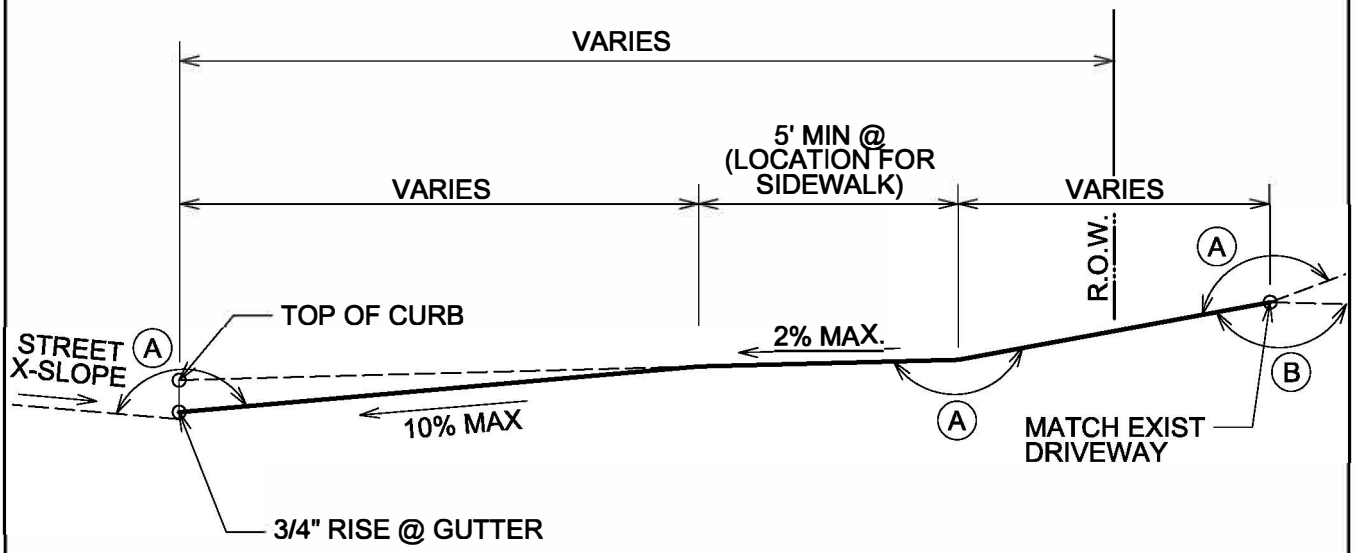
PAV - 14

GENERAL NOTES

1. DRIVEWAY GRADE MUST RISE TO TOP OF CURB ELEVATION TO CONTROL DRAINAGE IN STREET GUTTER.

(A) 8% MAX CHANGE IN GRADE (SAG PI)

(B) 12% MAX CHANGE IN GRADE (CREST PI)



City of BRENHAM

ALLOWABLE DRIVEWAY GRADE (RESIDENTIAL OR COMMERCIAL)

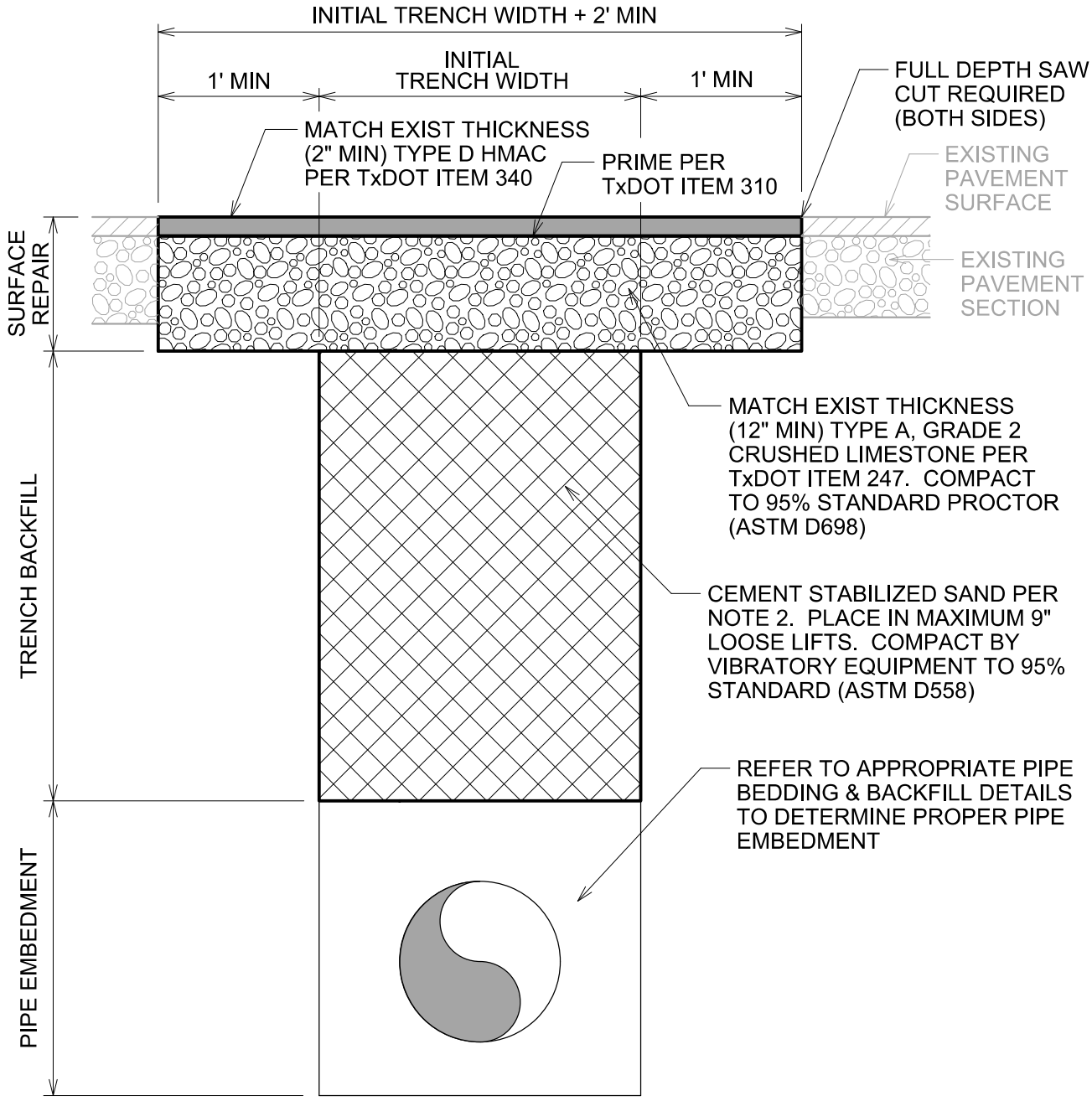
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

PAV - 15

GENERAL NOTES

1. STANDARD DETAIL IS APPLICABLE FOR WATER, SANITARY SEWER AND STORM SEWER.
2. CEMENT STABILIZED SAND SHALL CONTAIN A MINIMUM OF 1.5 SACKS OF CEMENT PER CUBIC YARD. SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487) AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PI <7; LL <25.



City of BRENHAM

PAVEMENT PATCH FOR EXISTING ASPHALT PAVED AREAS

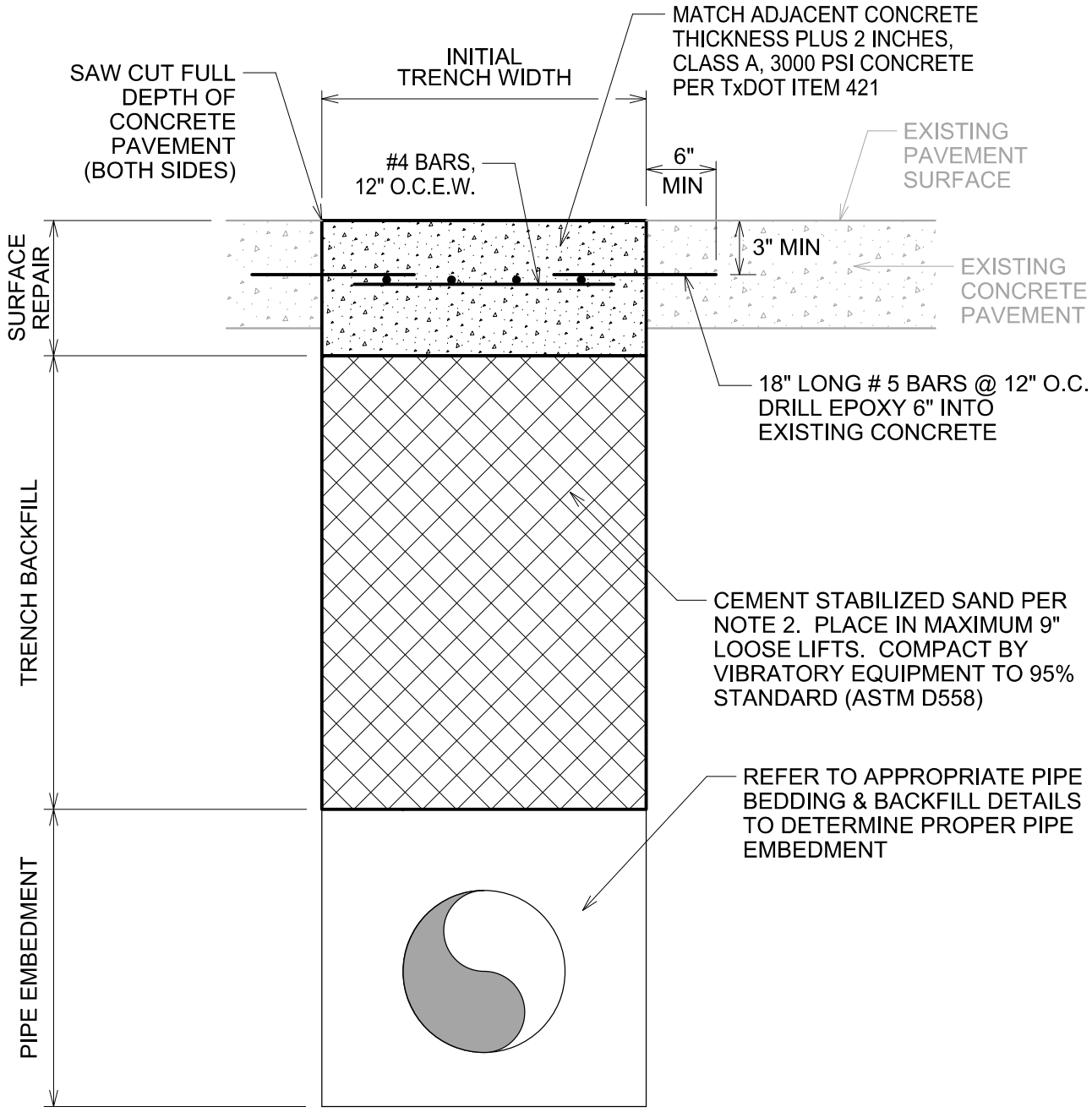
STANDARD CONSTRUCTION DETAILS

DATE: 10/08/21

REVISED DATE: 10/08/21

GENERAL NOTES

1. STANDARD DETAIL IS APPLICABLE FOR WATER, SANITARY SEWER AND STORM SEWER.
2. CEMENT STABILIZED SAND SHALL CONTAIN A MINIMUM OF 1.5 SACKS OF CEMENT PER CUBIC YARD. SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487) AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PI <7; LL <25.



City of BRENHAM

PAVEMENT PATCH FOR EXISTING CONCRETE PAVED AREAS

STANDARD CONSTRUCTION DETAILS

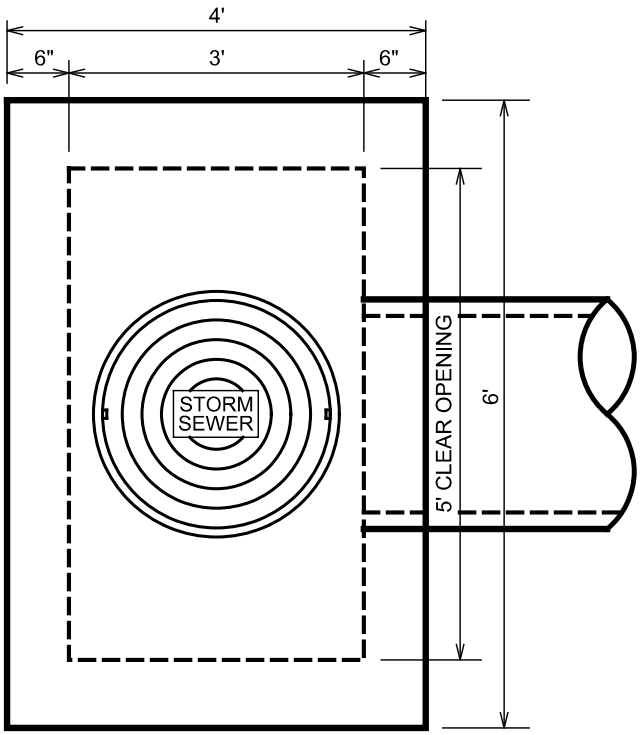
DATE: 10/08/21

REVISED DATE: 10/08/21

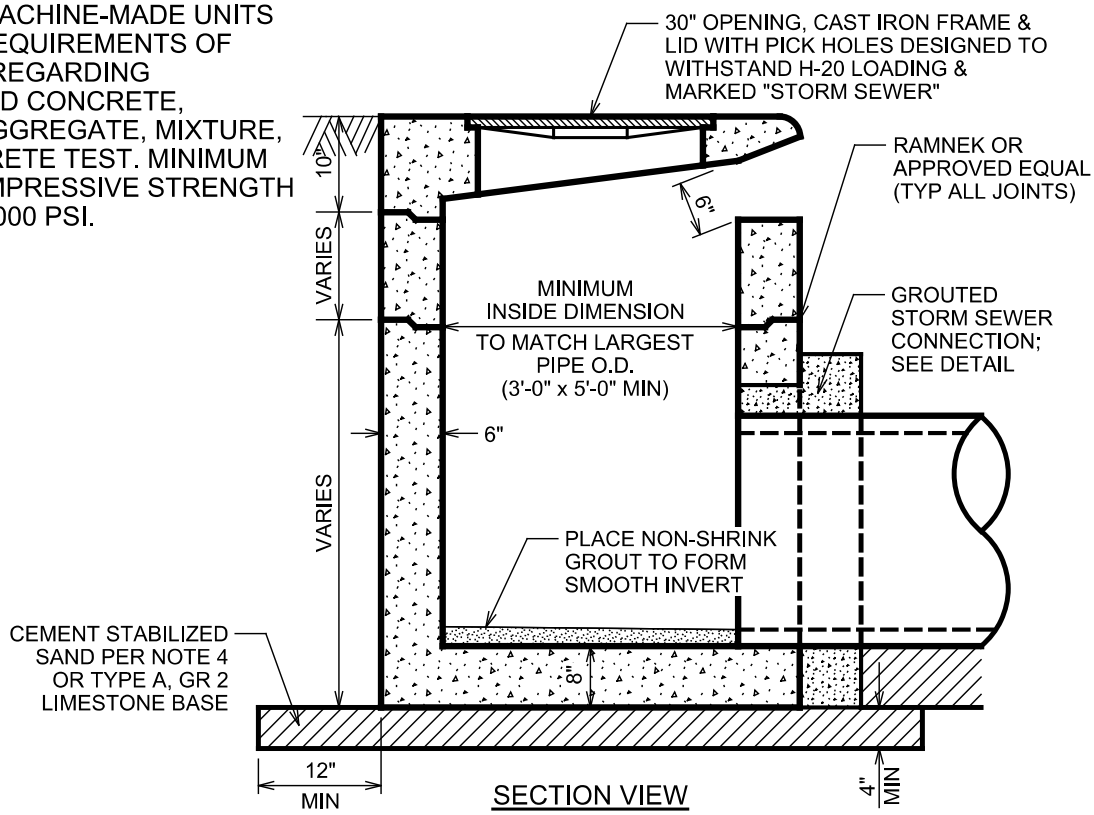
PAV - 17

GENERAL NOTES

1. INSTALLATION OF PRECAST STRUCTURES SHALL BE PER MANUFACTURERS INSTRUCTIONS. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF PRECAST STRUCTURES TO ENGINEER PRIOR TO ORDERING MATERIALS.
2. PRECAST STRUCTURE, RING, AND COVER SHALL BE DESIGNED FOR H-20 WHEEL LOADING.
3. PLACE RAMNEK OR EQUAL GASKET MATERIAL BETWEEN PRECAST STRUCTURE SECTIONS IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.
4. CEMENT STABILIZED SAND SHALL CONTAIN A MINIMUM OF 1.5 SACKS OF CEMENT PER CUBIC YARD. SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487) AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PI <7; LL <25.
5. PROVIDE CONCRETE FOR PRECAST MACHINE-MADE UNITS MEETING REQUIREMENTS OF ASTM C 76 REGARDING REINFORCED CONCRETE, CEMENT, AGGREGATE, MIXTURE, AND CONCRETE TEST. MINIMUM 28-DAY COMPRESSIVE STRENGTH SHALL BE 4000 PSI.



TOP VIEW



SECTION VIEW

City of BRENHAM

5' CURB INLET

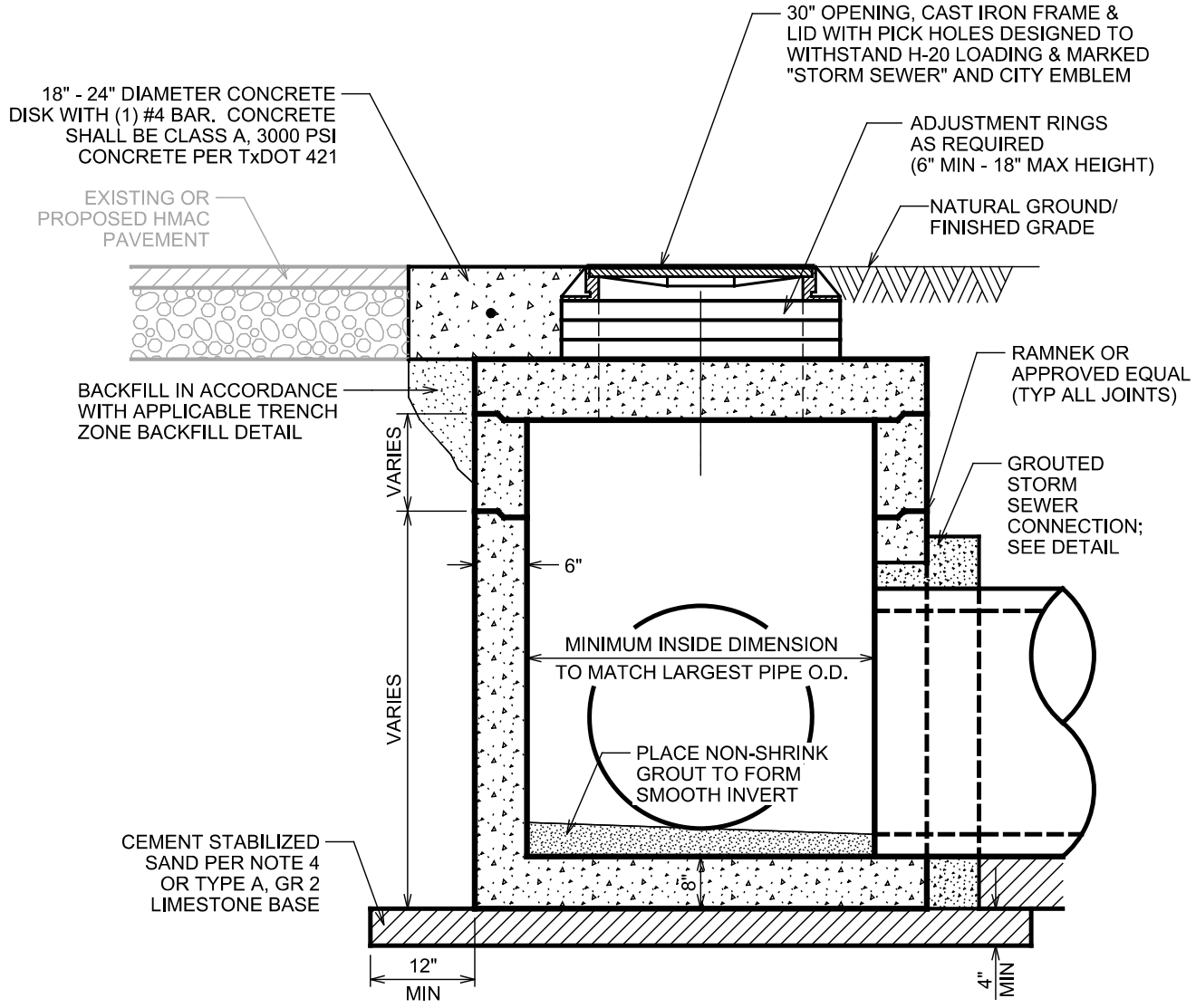
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

STM - 1

GENERAL NOTES

1. INSTALLATION OF PRECAST STRUCTURES SHALL BE PER MANUFACTURERS INSTRUCTIONS. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF PRE-CAST STRUCTURES TO ENGINEER PRIOR TO ORDERING MATERIALS.
2. PRECAST STRUCTURE, RING, AND COVER SHALL BE DESIGNED FOR H-20 WHEEL LOADING.
3. PLACE RAMNEK OR EQUAL GASKET MATERIAL BETWEEN PRECAST STRUCTURE SECTIONS IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.
4. CEMENT STABILIZED SAND SHALL CONTAIN A MINIMUM OF 1.5 SACKS OF CEMENT PER CUBIC YARD. SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487) AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PI <7; LL <25.
5. PROVIDE CONCRETE FOR PRECAST MACHINE-MADE UNITS MEETING REQUIREMENTS OF ASTM C 76 REGARDING REINFORCED CONCRETE, CEMENT, AGGREGATE, MIXTURE, AND CONCRETE TEST. MINIMUM 28-DAY COMPRESSIVE STRENGTH SHALL BE 4000 PSI.



City of BRENHAM

STORM SEWER JUNCTION BOX

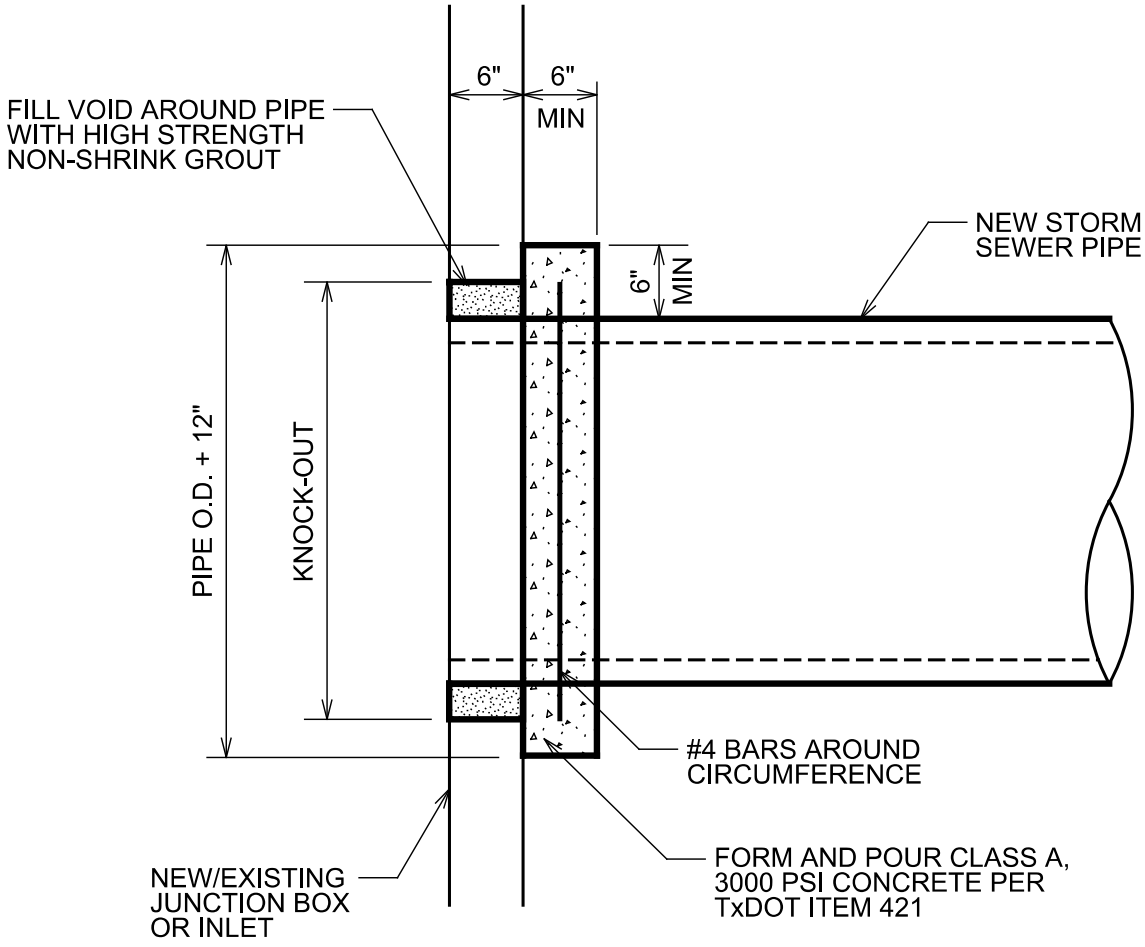
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

STM - 2

GENERAL NOTES

1. NEW PIPE TO BE SET FLUSH WITH INSIDE WALL OF STRUCTURE.



City of BRENHAM

GROUTED STORM SEWER CONNECTION DETAIL

STANDARD CONSTRUCTION DETAILS

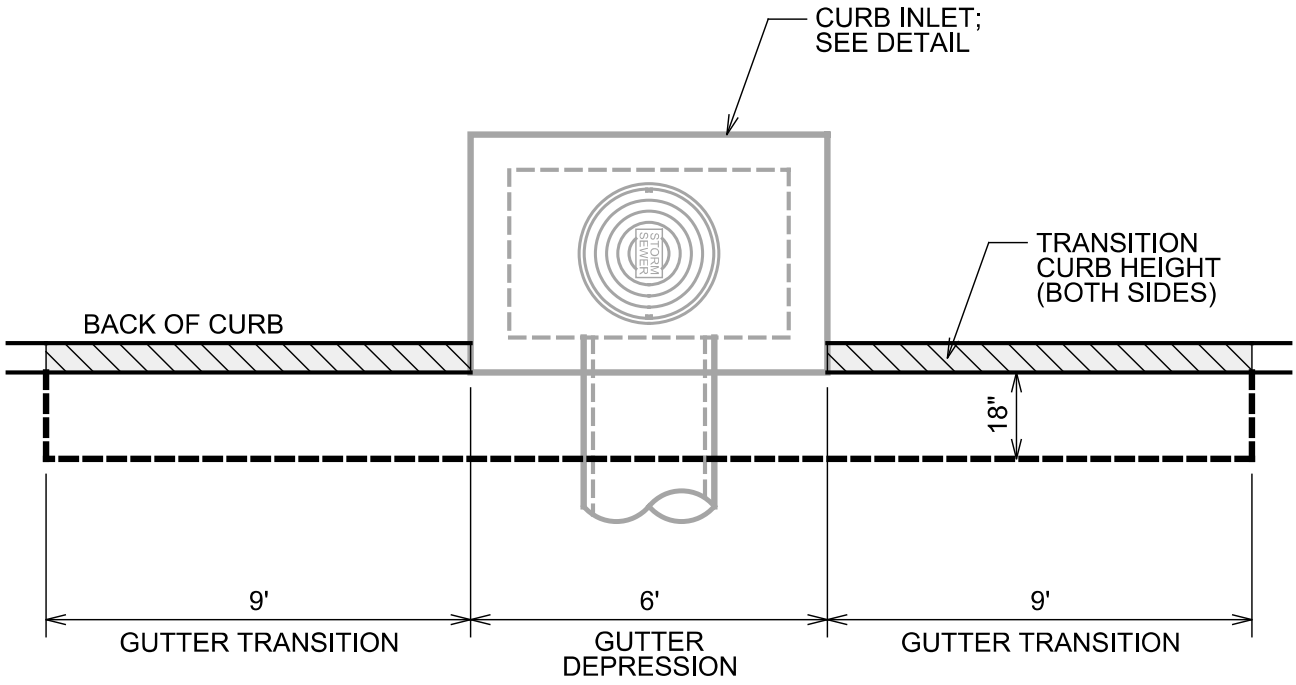
DATE: 07/20/21

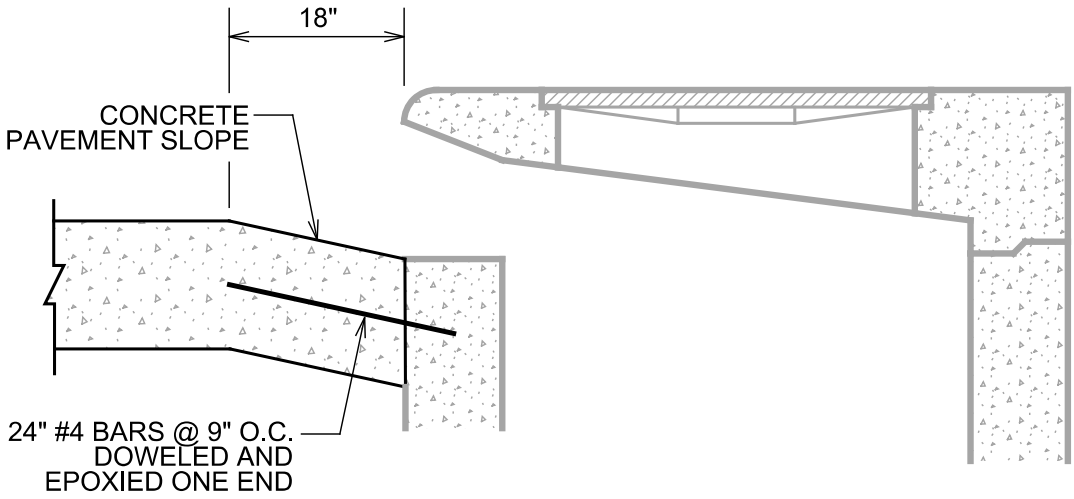
REVISED DATE: 07/20/21

STM - 3

GENERAL NOTES

1. GUTTER DEPRESSION SHALL NOT BE LOCATED WITHIN THE AREA OF A CURB RAMP/LANDING OR DRIVEWAY.





City of BRENHAM

GUTTER DEPRESSION
AT CURB INLET

STANDARD CONSTRUCTION DETAILS

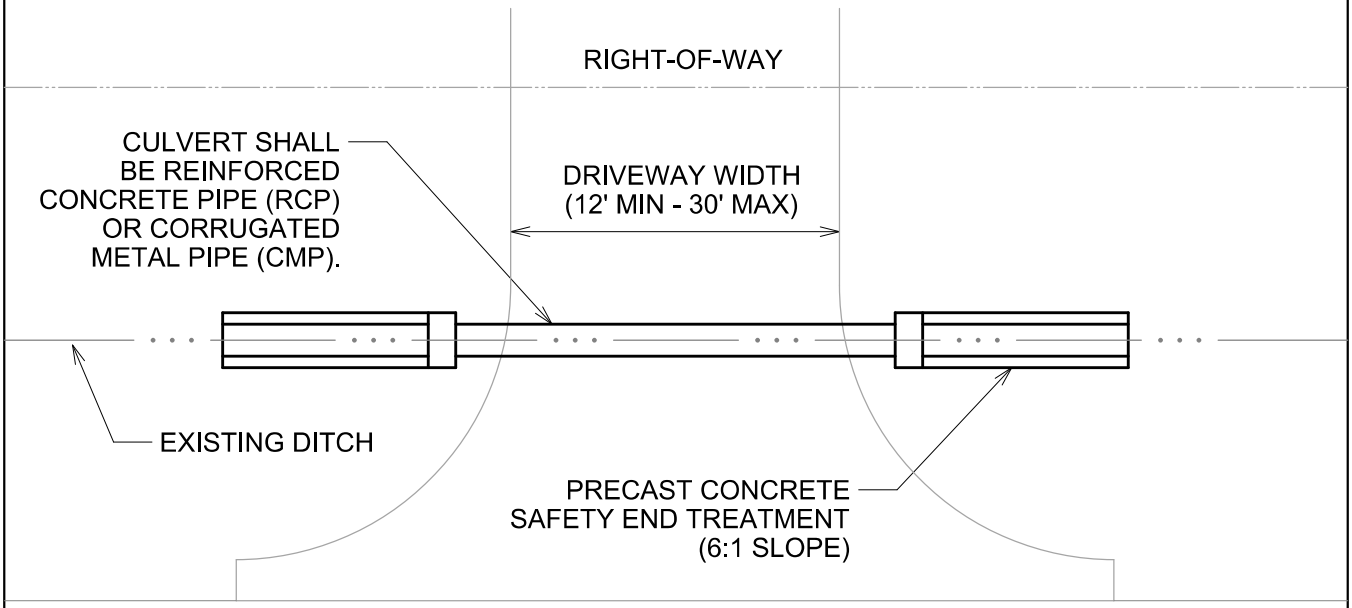
DATE: 07/20/21

REVISED
DATE: 07/20/21

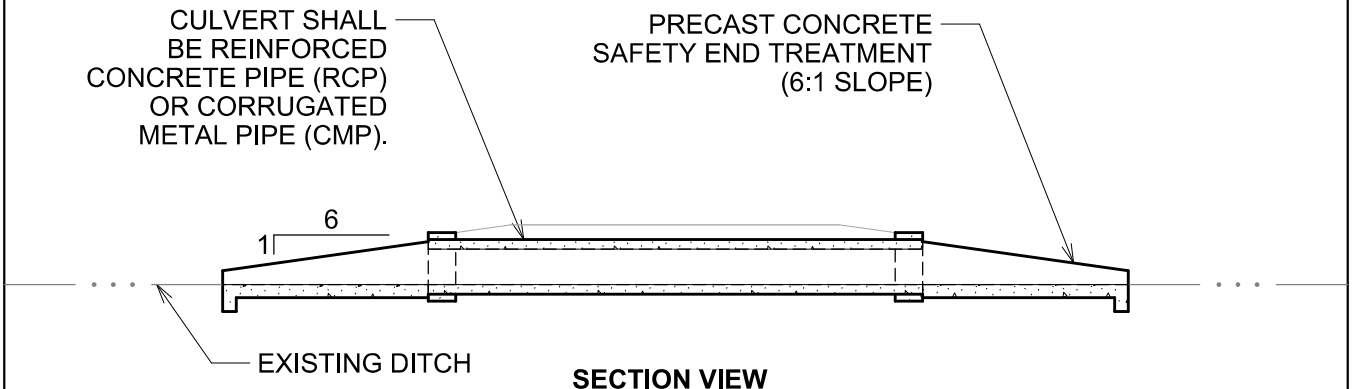
STM - 4

GENERAL NOTES

1. ADDITIONAL REQUIREMENTS APPLY FOR DRIVEWAYS ON TXDOT OWNED ROADWAYS.
2. BACKFILL WITH CEMENT STABILIZED SAND. CEMENT STABILIZED SAND SHALL CONTAIN A MINIMUM OF 1.5 SACKS OF CEMENT PER CUBIC YARD. SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487) AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PI <7; LL <25. COMPACT BY VIBRATORY EQUIPMENT TO 95% STANDARD (ASTM D558)
3. SET UPSTREAM AND DOWNSTREAM FLOW LINES TO MATCH EXISTING DITCH GRADE.
4. AFTER EXCAVATION AND PRIOR TO SETTING PIPE, CONTACT CITY TO INSPECT AND VERIFY FINAL ELEVATIONS.



PLAN VIEW



SECTION VIEW

City of BRENHAM

RESIDENTIAL DRIVEWAY CULVERT

STANDARD CONSTRUCTION DETAILS

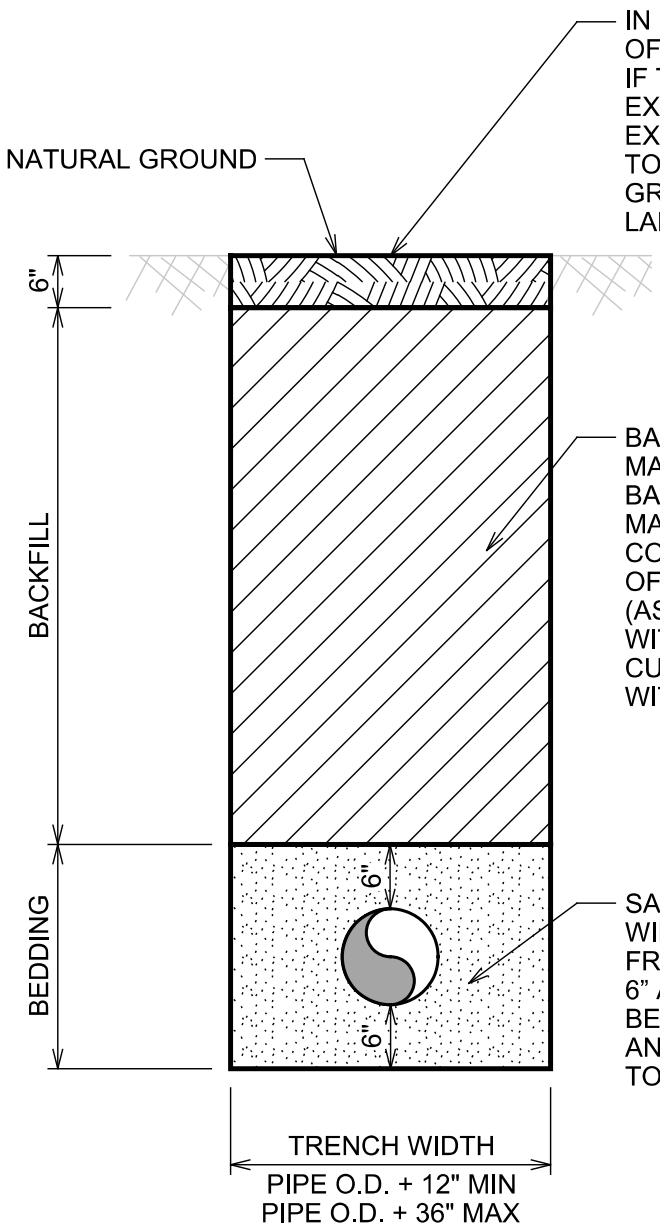
DATE: 07/20/21

REVISED DATE: 10/07/21

STM - 5

GENERAL NOTES

1. BANK SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487 AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PLASTICITY INDEX LESS THAN 7; LIQUID LIMIT LESS THAN 25.



IN NON-PAVED AREAS, THE UPPERMOST 6" OF BACKFILL SHALL CONSIST OF TOPSOIL. IF THE TRENCH EXTENDS THROUGH AN EXISTING VEGETATED LANDSCAPE, ANY EXCAVATED OR DISTURBED AREA ADJACENT TO THE TRENCH SHALL BE RE-SODDED WITH GRASS THAT IS SIMILAR TO THE EXISTING LANDSCAPING.

BACKFILL SHALL CONSIST OF SELECT MATERIAL FROM THE EXCAVATION. ALL BACKFILL SHALL BE INSTALLED IN MAXIMUM 9" LOOSE LIFTS AND BE COMPACTED TO A MINIMUM OF 95 PERCENT OF STANDARD PROCTOR DENSITY (ASTM D2922-78 AND ASTM D3017-78), WITHOUT ADDITIONAL MOISTURE CONTROL, CURED AND TESTED IN ACCORDANCE WITH ASTM C31.

SAND BEDDING SHALL FILL THE ENTIRE WIDTH OF THE TRENCH AND SHALL EXTEND FROM A DEPTH OF 6" BELOW THE PIPE TO 6" ABOVE THE PIPE. BEDDING SHALL BE INSTALLED IN MAXIMUM 9" LOOSE LIFTS AND BE COMPACTED BY VIBRATORY EQUIPMENT TO A 90% STANDARD PROCTOR (ASTM D698).

City of BRENHAM

WATER & SANITARY SEWER
BEDDING & BACKFILL
(NON-PAVED AREAS)

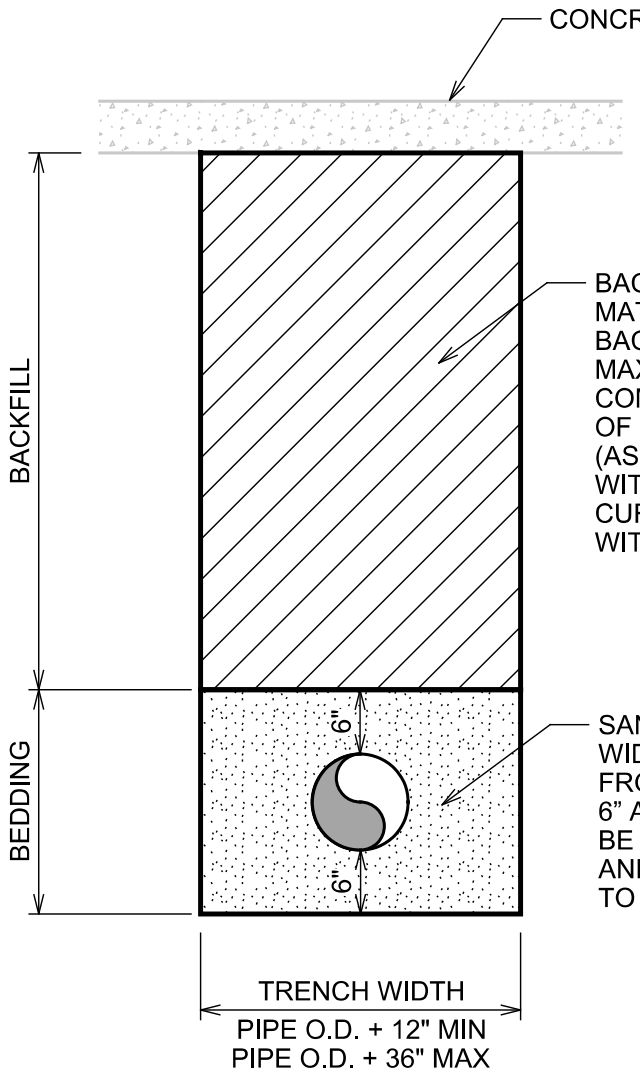
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

BBF - 1

GENERAL NOTES

1. BANK SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487 AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PLASTICITY INDEX LESS THAN 7; LIQUID LIMIT LESS THAN 25.



BACKFILL SHALL CONSIST OF SELECT MATERIAL FROM THE EXCAVATION. ALL BACKFILL SHALL BE INSTALLED IN MAXIMUM 9" LOOSE LIFTS AND BE COMPACTED TO A MINIMUM OF 95 PERCENT OF STANDARD PROCTOR DENSITY (ASTM D2922-78 AND ASTM D3017-78), WITHOUT ADDITIONAL MOISTURE CONTROL, CURED AND TESTED IN ACCORDANCE WITH ASTM C31.

SAND BEDDING SHALL FILL THE ENTIRE WIDTH OF THE TRENCH AND SHALL EXTEND FROM A DEPTH OF 6" BELOW THE PIPE TO 6" ABOVE THE PIPE. BEDDING SHALL BE INSTALLED IN MAXIMUM 9" LOOSE LIFTS AND BE COMPACTED BY VIBRATORY EQUIPMENT TO A 90% STANDARD PROCTOR (ASTM D698).

City of BRENHAM

WATER & SANITARY SEWER
BEDDING & BACKFILL
(CONCRETE PAVED AREAS)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

BBF - 2

GENERAL NOTES

1. BANK SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487 AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PLASTICITY INDEX LESS THAN 7; LIQUID LIMIT LESS THAN 25.

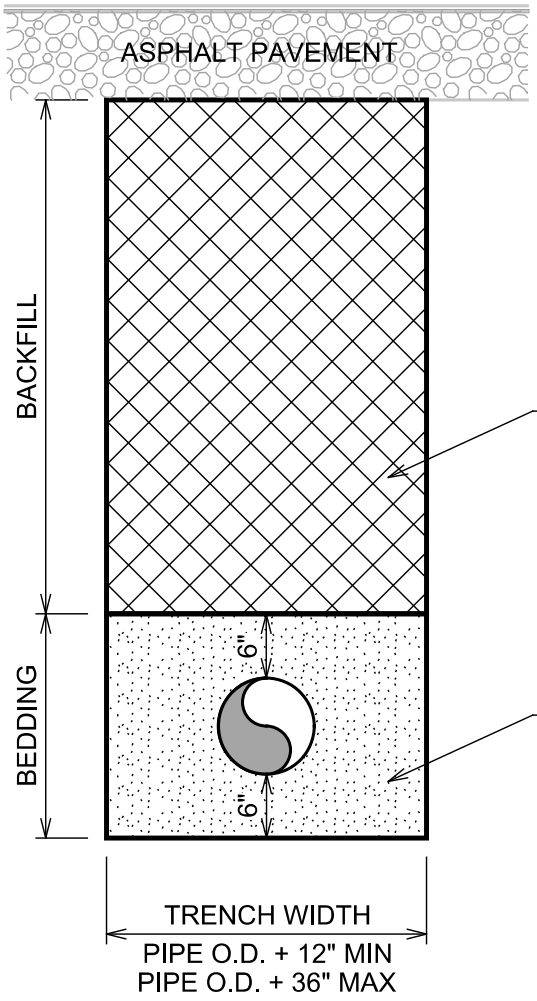
2. UNDER ASPHALT PAVING, BACKFILL SHALL BE CEMENT STABILIZED SAND AND SHALL EXTEND FROM THE TOP OF THE SAND BEDDING TO THE ELEVATION OF THE BOTTOM OF THE BASE SECTION. THE CEMENT STABILIZED SAND BACKFILL SHALL MEET THE FOLLOWING REQUIREMENTS:

A. THE CEMENT SHALL BE PORTLAND CEMENT, TYPE I, ASTM C150.

B. THE SAND SHALL BE CLEAN, DURABLE SAND; LESS THAN 0.5% CLAY CLUMPS, ASTM C142; LESS THAN 0.5% LIGHTWEIGHT PIECES, ASTM C123; ORGANIC IMPURITIES, ASTM C40; NOT SHOWING A COLOR DARKER THAN STANDARD COLOR; AND PLASTICITY INDEX OF LESS THAN 6, ASTM D423 & ASTM D424.

C. CEMENT-SAND MIXTURE SHALL CONSIST OF AT LEAST 1.5 SACKS OF CEMENT PER TON OF SAND. MINIMUM UNCONFINED COMPRESSIVE STRENGTH OF 100 PSI IN 48 HOURS, WHEN COMPACTED TO A MINIMUM OF 95% OF STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78), WITHOUT ADDITIONAL MOISTURE CONTROL, CURED & TESTED IN ACCORDANCE WITH ASTM C31.

D. CEMENT STABILIZED SAND SHALL BE PLACED & COMPACTED WITHIN 3 HOURS OF BATCHING.



CEMENT STABILIZED SAND BACKFILL SHALL BE INSTALLED IN MAXIMUM 8" LOOSE LIFTS AND BE COMPACTED TO 95 PERCENT STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78).

SAND BEDDING SHALL FILL THE ENTIRE WIDTH OF THE TRENCH AND SHALL EXTEND FROM A DEPTH OF 6" BELOW THE PIPE TO 6" ABOVE THE PIPE. BEDDING SHALL BE INSTALLED IN MAXIMUM 9" LOOSE LIFTS AND BE COMPACTED BY VIBRATORY EQUIPMENT TO A 90% STANDARD PROCTOR (ASTM D698).

City of BRENHAM

WATER & SANITARY SEWER BEDDING & BACKFILL (ASPHALT PAVED AREAS)

STANDARD CONSTRUCTION DETAILS

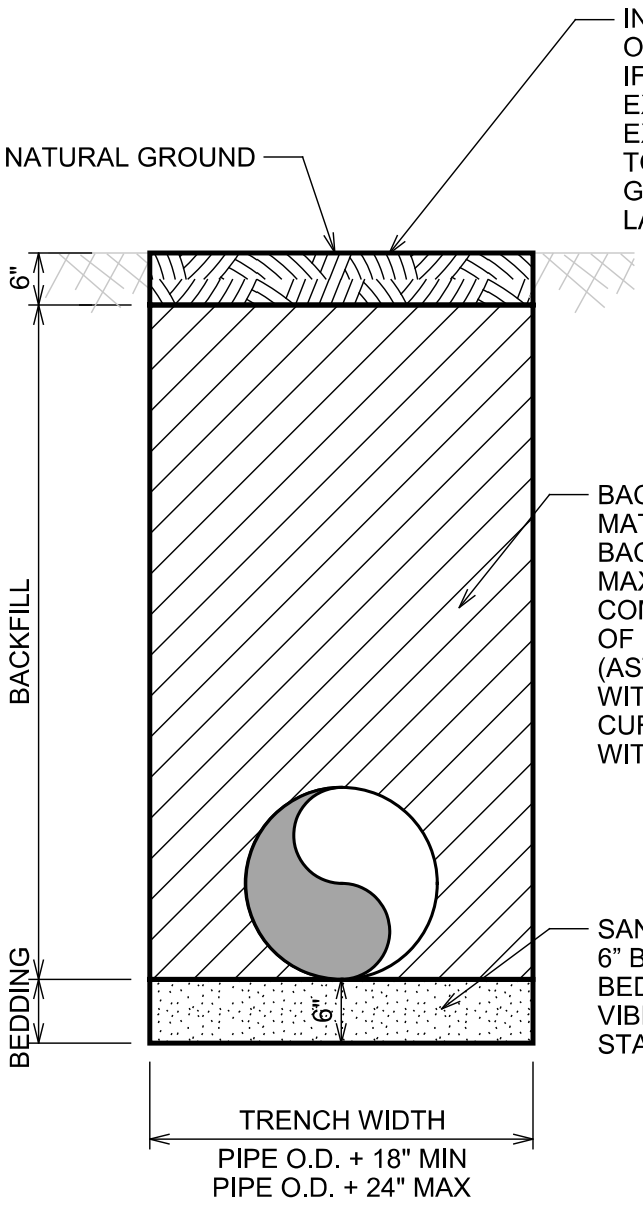
DATE: 07/20/21

REVISED DATE: 07/20/21

BBF - 3

GENERAL NOTES

1. BANK SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487 AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PLASTICITY INDEX LESS THAN 7; LIQUID LIMIT LESS THAN 25.



IN NON-PAVED AREAS, THE UPPERMOST 6" OF BACKFILL SHALL CONSIST OF TOPSOIL. IF THE TRENCH EXTENDS THROUGH AN EXISTING VEGETATED LANDSCAPE, ANY EXCAVATED OR DISTURBED AREA ADJACENT TO THE TRENCH SHALL BE RE-SODDED WITH GRASS THAT IS SIMILAR TO THE EXISTING LANDSCAPING.

BACKFILL SHALL CONSIST OF SELECT MATERIAL FROM THE EXCAVATION. ALL BACKFILL SHALL BE INSTALLED IN MAXIMUM 9" LOOSE LIFTS AND BE COMPACTED TO A MINIMUM OF 95 PERCENT OF STANDARD PROCTOR DENSITY (ASTM D2922-78 AND ASTM D3017-78), WITHOUT ADDITIONAL MOISTURE CONTROL, CURED AND TESTED IN ACCORDANCE WITH ASTM C31.

SAND BEDDING SHALL BE A DEPTH OF 6" BELOW THE BOTTOM OF THE PIPE. BEDDING SHALL BE COMPACTED BY VIBRATORY EQUIPMENT TO A 90% STANDARD PROCTOR (ASTM D698).

City of BRENHAM

STORM SEWER BEDDING & BACKFILL FOR RCP PIPE (NON-PAVED AREAS)

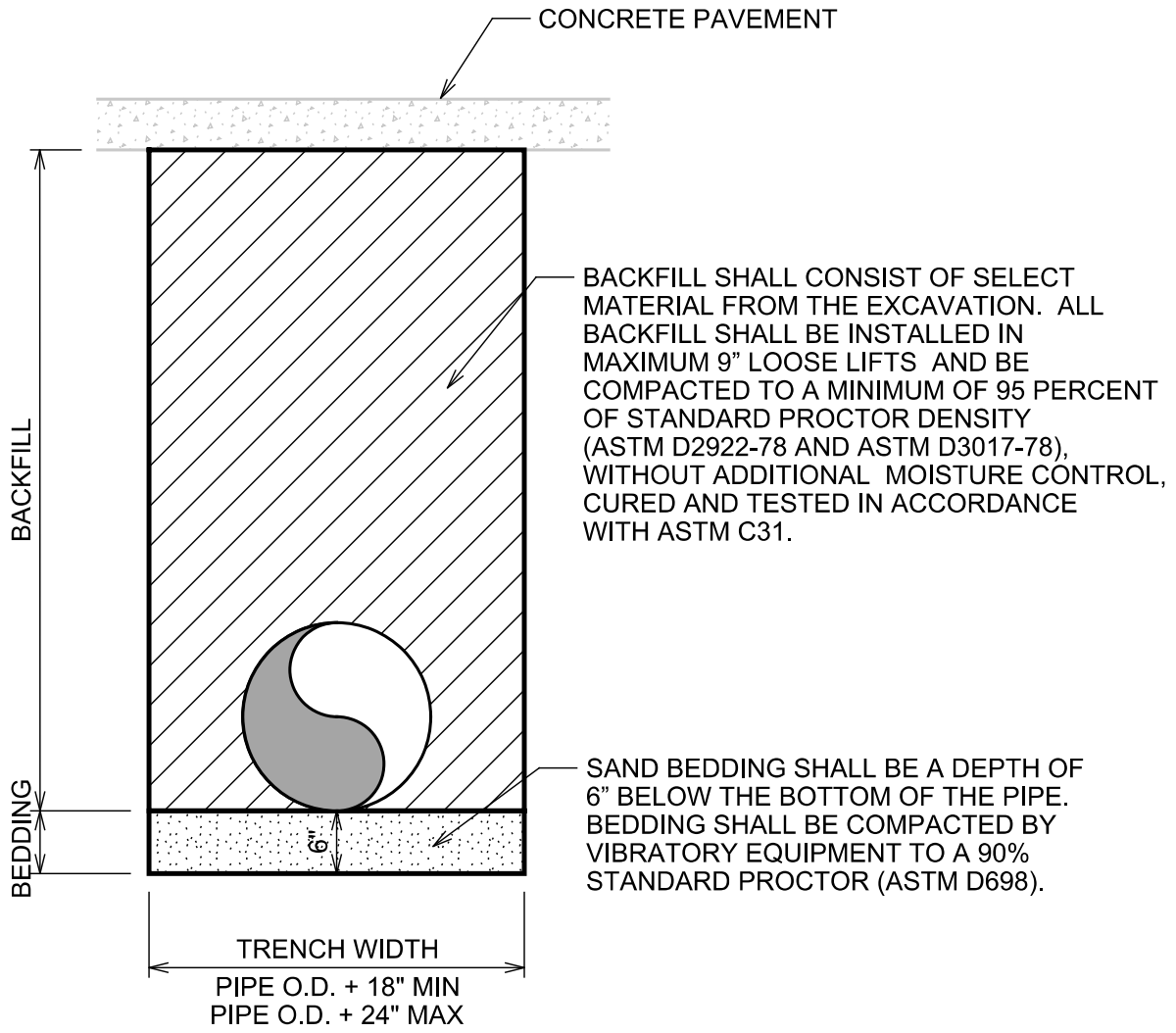
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

BBF - 4

GENERAL NOTES

1. BANK SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487 AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PLASTICITY INDEX LESS THAN 7; LIQUID LIMIT LESS THAN 25.



City of BRENHAM

STORM SEWER
BEDDING & BACKFILL
FOR RCP PIPE
(CONCRETE PAVED AREAS)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

BBF - 5

GENERAL NOTES

1. BANK SAND SHALL BE SP, SW OR SM PER USC (ASTM D2487 AND SHALL HAVE THE FOLLOWING PROPERTIES: LESS THAN 15% PASSING #200 SIEVE; LESS THAN 2% CLAY LUMPS; PLASTICITY INDEX LESS THAN 7; LIQUID LIMIT LESS THAN 25.

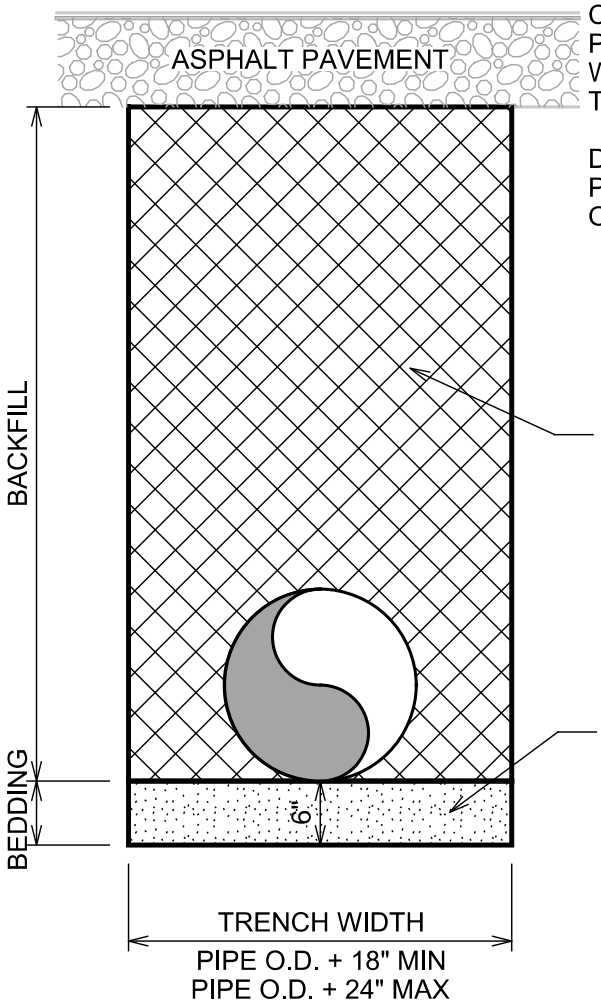
2. UNDER ASPHALT PAVING, BACKFILL SHALL BE CEMENT STABILIZED SAND AND SHALL EXTEND FROM THE TOP OF THE SAND BEDDING TO THE ELEVATION OF THE BOTTOM OF THE BASE SECTION. THE CEMENT STABILIZED SAND BACKFILL SHALL MEET THE FOLLOWING REQUIREMENTS:

A. THE CEMENT SHALL BE PORTLAND CEMENT, TYPE I, ASTM C150.

B. THE SAND SHALL BE CLEAN, DURABLE SAND; LESS THAN 0.5% CLAY CLUMPS, ASTM C142; LESS THAN 0.5% LIGHTWEIGHT PIECES, ASTM C123; ORGANIC IMPURITIES, ASTM C40; NOT SHOWING A COLOR DARKER THAN STANDARD COLOR; AND PLASTICITY INDEX OF LESS THAN 6, ASTM D423 & ASTM D424.

C. CEMENT-SAND MIXTURE SHALL CONSIST OF AT LEAST 1.5 SACKS OF CEMENT PER TON OF SAND. MINIMUM UNCONFINED COMPRESSIVE STRENGTH OF 100 PSI IN 48 HOURS, WHEN COMPACTED TO A MINIMUM OF 95% OF STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78), WITHOUT ADDITIONAL MOISTURE CONTROL, CURED & TESTED IN ACCORDANCE WITH ASTM C31.

D. CEMENT STABILIZED SAND SHALL BE PLACED & COMPACTED WITHIN 3 HOURS OF BATCHING.



CEMENT STABILIZED SAND BACKFILL SHALL BE INSTALLED IN MAXIMUM 8" LOOSE LIFTS AND BE COMPACTED TO 95 PERCENT STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78).

SAND BEDDING SHALL BE A DEPTH OF 6" BELOW THE BOTTOM OF THE PIPE. BEDDING SHALL BE COMPACTED BY VIBRATORY EQUIPMENT TO A 90% STANDARD PROCTOR (ASTM D698).

City of BRENHAM

STORM SEWER
BEDDING & BACKFILL
FOR RCP PIPE
(ASPHALT PAVED AREAS)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21

REVISED
DATE: 07/20/21

BBF - 6

GENERAL NOTES

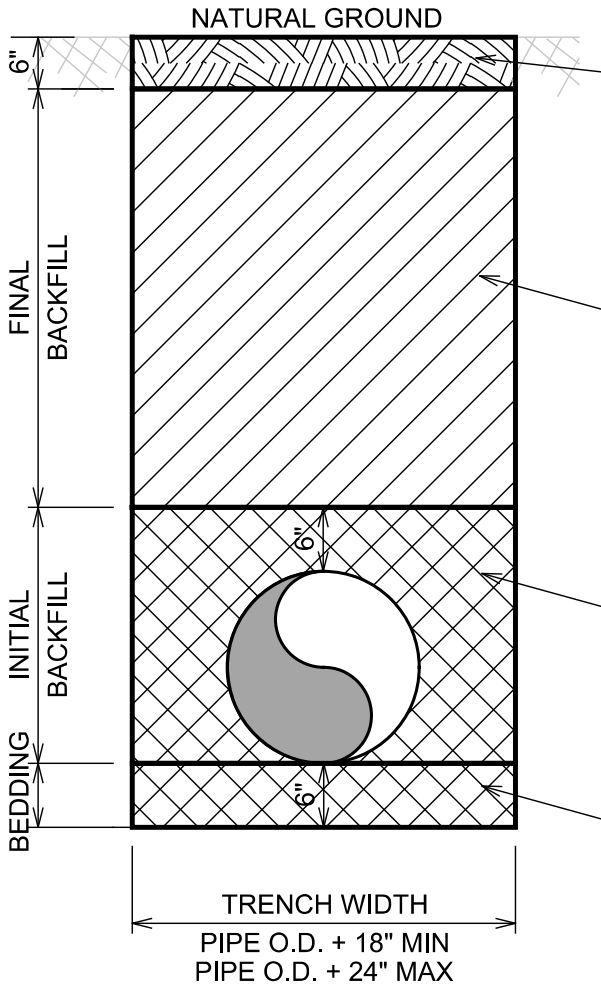
1. BEDDING AND INITIAL BACKFILL SHALL BE CEMENT STABILIZED SAND AND SHALL EXTEND FROM 6 INCHES BELOW THE PIPE TO 6 INCHES ABOVE THE PIPE. THE CEMENT STABILIZED SAND BACKFILL SHALL MEET THE FOLLOWING REQUIREMENTS:

A. THE CEMENT SHALL BE PORTLAND CEMENT, TYPE I, ASTM C150.

B. THE SAND SHALL BE CLEAN, DURABLE SAND; LESS THAN 0.5% CLAY CLUMPS, ASTM C142; LESS THAN 0.5% LIGHTWEIGHT PIECES, ASTM C123; ORGANIC IMPURITIES, ASTM C40; NOT SHOWING A COLOR DARKER THAN STANDARD COLOR; AND PLASTICITY INDEX OF LESS THAN 6, ASTM D423 & ASTM D424.

C. CEMENT-SAND MIXTURE SHALL CONSIST OF AT LEAST 1.5 SACKS OF CEMENT PER TON OF SAND. MINIMUM UNCONFINED COMPRESSIVE STRENGTH OF 100 PSI IN 48 HOURS, WHEN COMPACTED TO A MINIMUM OF 95% OF STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78),WITHOUT ADDITIONAL MOISTURE CONTROL, CURED & TESTED IN ACCORDANCE WITH ASTM C31.

D. CEMENT STABILIZED SAND SHALL BE PLACED & COMPACTED WITHIN 3 HOURS OF BATCHING.



IN NON-PAVED AREAS, THE UPPERMOST 6" OF BACKFILL SHALL CONSIST OF TOPSOIL. IF THE TRENCH EXTENDS THROUGH AN EXISTING VEGETATED LANDSCAPE, ANY EXCAVATED OR DISTURBED AREA ADJACENT TO THE TRENCH SHALL BE RE-SODDED WITH GRASS THAT IS SIMILAR TO THE EXISTING LANDSCAPING.

BACKFILL SHALL CONSIST OF SELECT MATERIAL FROM THE EXCAVATION. ALL BACKFILL SHALL BE INSTALLED IN MAXIMUM 9" LOOSE LIFTS AND BE COMPACTED TO A MINIMUM OF 95 PERCENT OF STANDARD PROCTOR DENSITY (ASTM D2922-78 AND ASTM D3017-78), WITHOUT ADDITIONAL MOISTURE CONTROL, CURED AND TESTED IN ACCORDANCE WITH ASTM C31.

CEMENT STABILIZED BACKFILL SHALL FILL THE ENTIRE WIDTH OF THE TRENCH AND SHALL EXTEND FROM THE TOP OF THE BEDDING TO 6" ABOVE THE TOP OF THE PIPE. MAXIMUM 8" LOOSE LIFTS, COMPACT TO 95 PERCENT STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78)

CEMENT STABILIZED SAND BEDDING SHALL BE A DEPTH OF 6" BELOW THE BOTTOM OF THE PIPE. COMPACT TO 95 PERCENT STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78)

City of BRENHAM

STORM SEWER BEDDING & BACKFILL FOR HDPE PIPE (NON-PAVED AREAS)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

BBF - 7

GENERAL NOTES

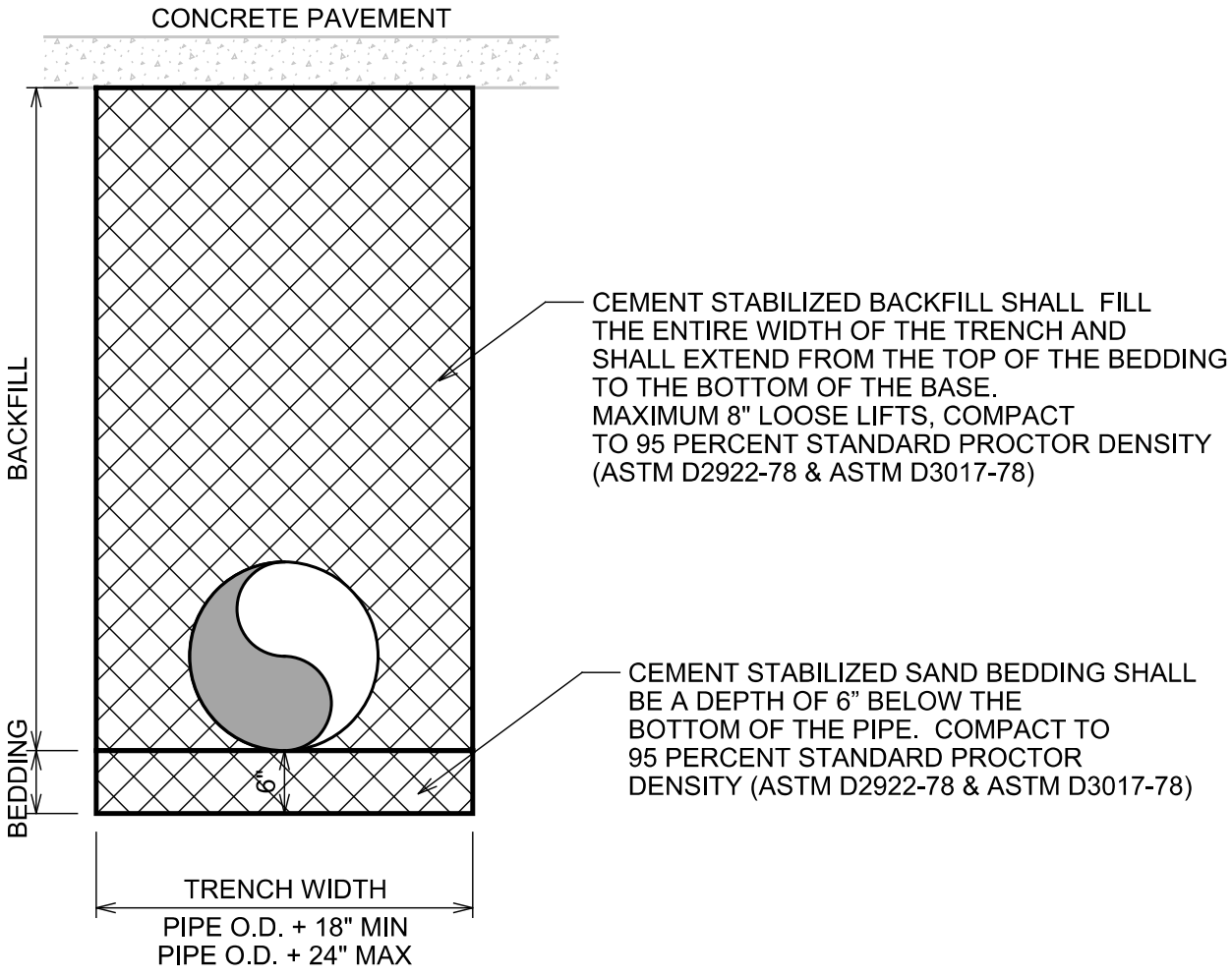
1. UNDER CONCRETE PAVING, BEDDING AND BACKFILL SHALL BE CEMENT STABILIZED SAND AND SHALL EXTEND FROM 6 INCHES BELOW THE PIPE TO THE BOTTOM OF THE BASE SECTION. THE CEMENT STABILIZED SAND BACKFILL SHALL MEET THE FOLLOWING REQUIREMENTS:

A. THE CEMENT SHALL BE PORTLAND CEMENT, TYPE I, ASTM C150.

B. THE SAND SHALL BE CLEAN, DURABLE SAND; LESS THAN 0.5% CLAY CLUMPS, ASTM C142; LESS THAN 0.5% LIGHTWEIGHT PIECES, ASTM C123; ORGANIC IMPURITIES, ASTM C40; NOT SHOWING A COLOR DARKER THAN STANDARD COLOR; AND PLASTICITY INDEX OF LESS THAN 6, ASTM D423 & ASTM D424.

C. CEMENT-SAND MIXTURE SHALL CONSIST OF AT LEAST 1.5 SACKS OF CEMENT PER TON OF SAND. MINIMUM UNCONFINED COMPRESSIVE STRENGTH OF 100 PSI IN 48 HOURS, WHEN COMPACTED TO A MINIMUM OF 95% OF STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78),WITHOUT ADDITIONAL MOISTURE CONTROL, CURED & TESTED IN ACCORDANCE WITH ASTM C31.

D. CEMENT STABILIZED SAND SHALL BE PLACED & COMPACTED WITHIN 3 HOURS OF BATCHING.



City of BRENHAM

STORM SEWER
BEDDING & BACKFILL
FOR HDPE PIPE
(CONCRETE PAVED AREAS)

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21

REVISED
DATE: 07/20/21

BBF - 8

GENERAL NOTES

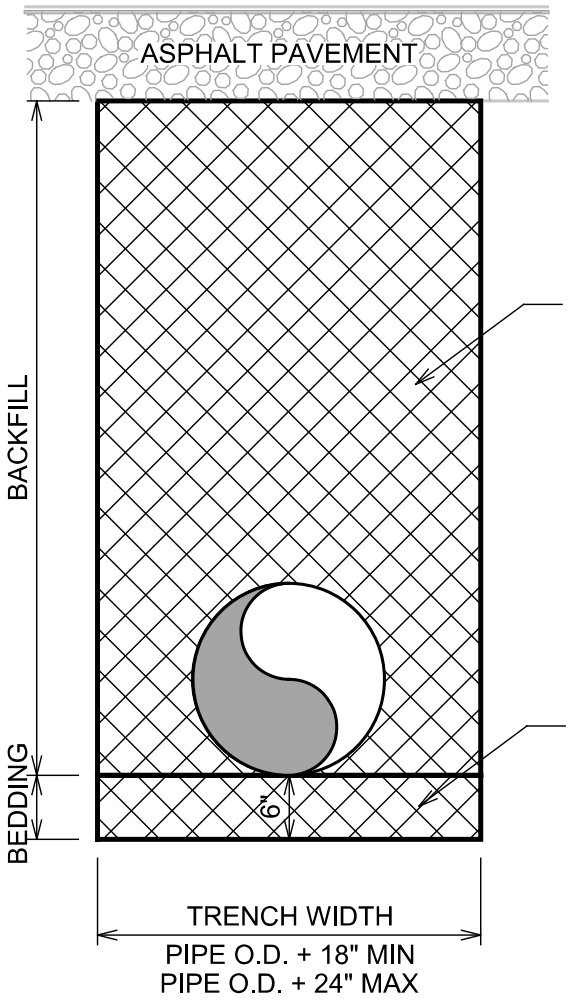
1. UNDER ASPHALT PAVING, BEDDING AND BACKFILL SHALL BE CEMENT STABILIZED SAND AND SHALL EXTEND FROM 6 INCHES BELOW THE PIPE TO THE BOTTOM OF THE BASE SECTION. THE CEMENT STABILIZED SAND BACKFILL SHALL MEET THE FOLLOWING REQUIREMENTS:

A. THE CEMENT SHALL BE PORTLAND CEMENT, TYPE I, ASTM C150.

B. THE SAND SHALL BE CLEAN, DURABLE SAND; LESS THAN 0.5% CLAY CLUMPS, ASTM C142; LESS THAN 0.5% LIGHTWEIGHT PIECES, ASTM C123; ORGANIC IMPURITIES, ASTM C40; NOT SHOWING A COLOR DARKER THAN STANDARD COLOR; AND PLASTICITY INDEX OF LESS THAN 6, ASTM D423 & ASTM D424.

C. CEMENT-SAND MIXTURE SHALL CONSIST OF AT LEAST 1.5 SACKS OF CEMENT PER TON OF SAND. MINIMUM UNCONFINED COMPRESSIVE STRENGTH OF 100 PSI IN 48 HOURS, WHEN COMPACTED TO A MINIMUM OF 95% OF STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78),WITHOUT ADDITIONAL MOISTURE CONTROL, CURED & TESTED IN ACCORDANCE WITH ASTM C31.

D. CEMENT STABILIZED SAND SHALL BE PLACED & COMPACTED WITHIN 3 HOURS OF BATCHING.



CEMENT STABILIZED BACKFILL SHALL FILL THE ENTIRE WIDTH OF THE TRENCH AND SHALL EXTEND FROM THE TOP OF THE BEDDING TO THE BOTTOM OF THE BASE. MAXIMUM 8" LOOSE LIFTS, COMPACT TO 95 PERCENT STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78)

CEMENT STABILIZED SAND BEDDING SHALL BE A DEPTH OF 6" BELOW THE BOTTOM OF THE PIPE. COMPACT TO 95 PERCENT STANDARD PROCTOR DENSITY (ASTM D2922-78 & ASTM D3017-78)

City of BRENHAM

STORM SEWER
BEDDING & BACKFILL
FOR HDPE PIPE
(ASPHALT PAVED AREAS)

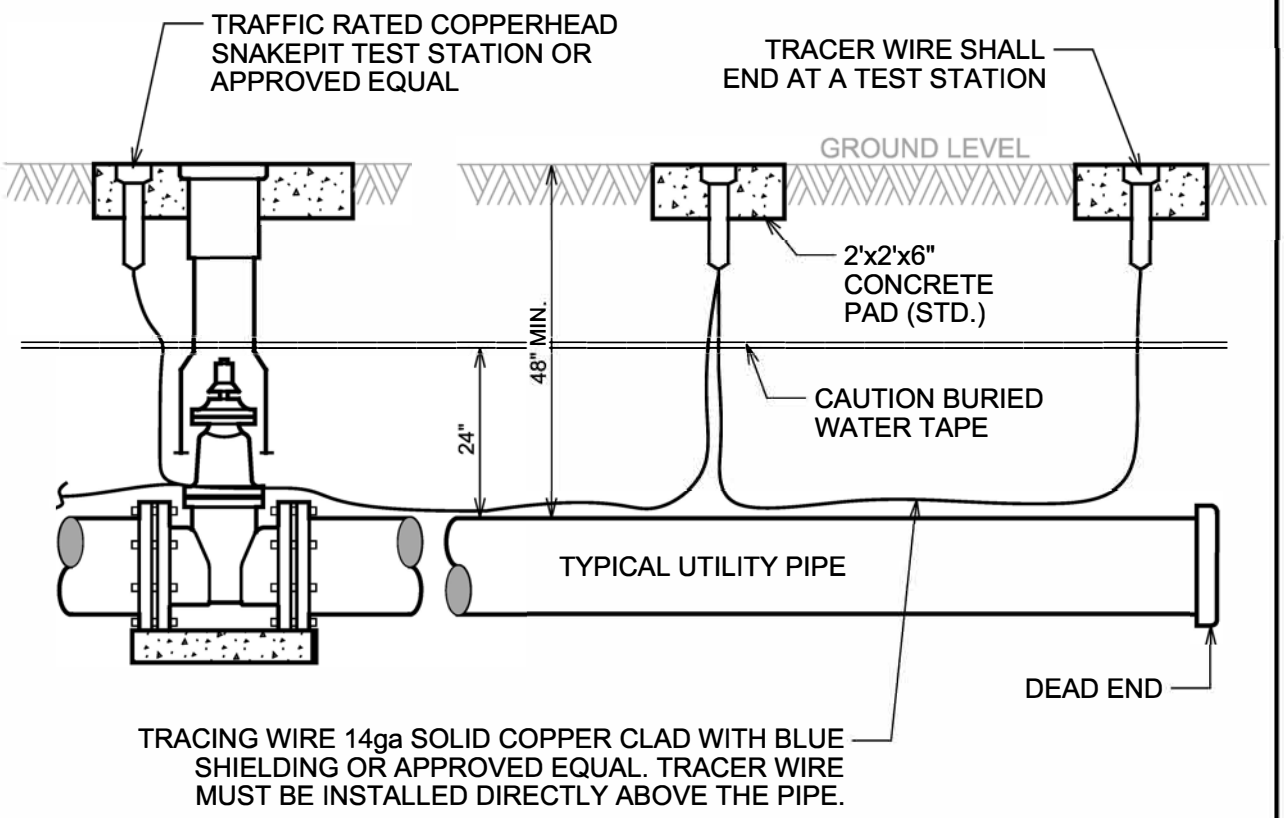
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

BBF - 9

GENERAL NOTES

1. A CONTINUOUS TRACER WIRE, SUCH AS A SOLID 14-GUAGE COPPER CLAD WIRE WITH BLUE SHIELDING OR APPROVED EQUAL, SHALL BE AFFIXED TO THE TOP OF THE NEW WASTEWATER MAIN PRIOR TO BURY AND SHALL HAVE A SNAKE PIT TRACER STATION INSTALLED AT A MAXIMUM OF 500 FEET.
2. THE TRACER STATION SHALL HAVE A 2' X 2' CONCRETE PAD AROUND IT AND SHALL BE SHOWN ON THE PLANS.
3. TRACER WIRE SHALL BE CONNECTED TO ALL WATER METER ANGLE STOPS, FIRE HYDRANTS, AND VALVE BOX RISERS. WIRE SPLICES SHALL BE COMPLETED USING APPROVED, UNDERGROUND CONNECTORS. SOLDERED CONNECTIONS ARE NOT PERMITTED. A CONTINUITY TEST SHALL BE COMPLETED PRIOR TO ACCEPTANCE.



City of BRENHAM

PIPE LOCATION MARKING (ALL UTILITIES)

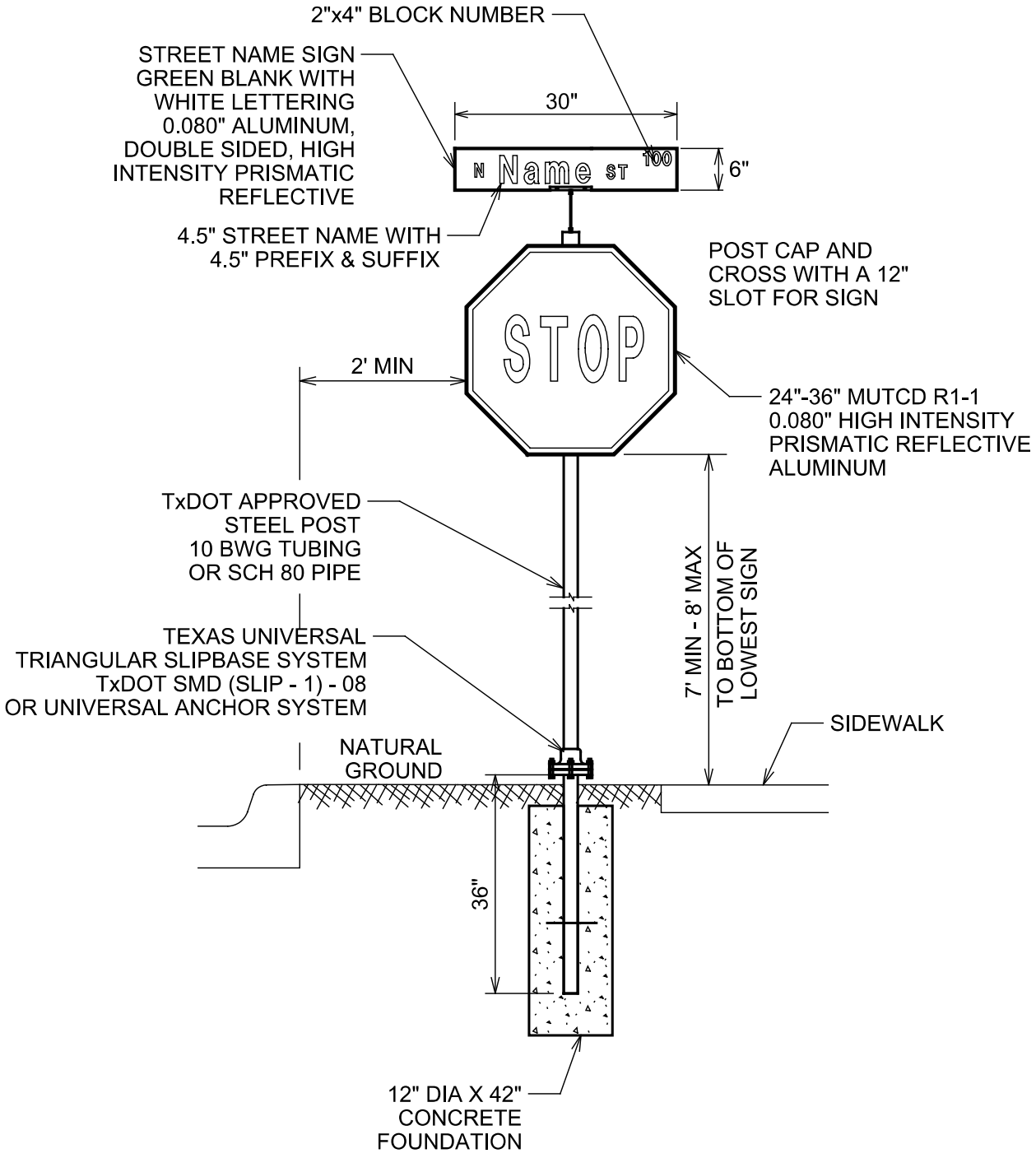
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

BBF - 10

GENERAL NOTES

1. SIGNS SHALL MEET MUTCD AND TxDOT STANDARDS.



City of BRENHAM

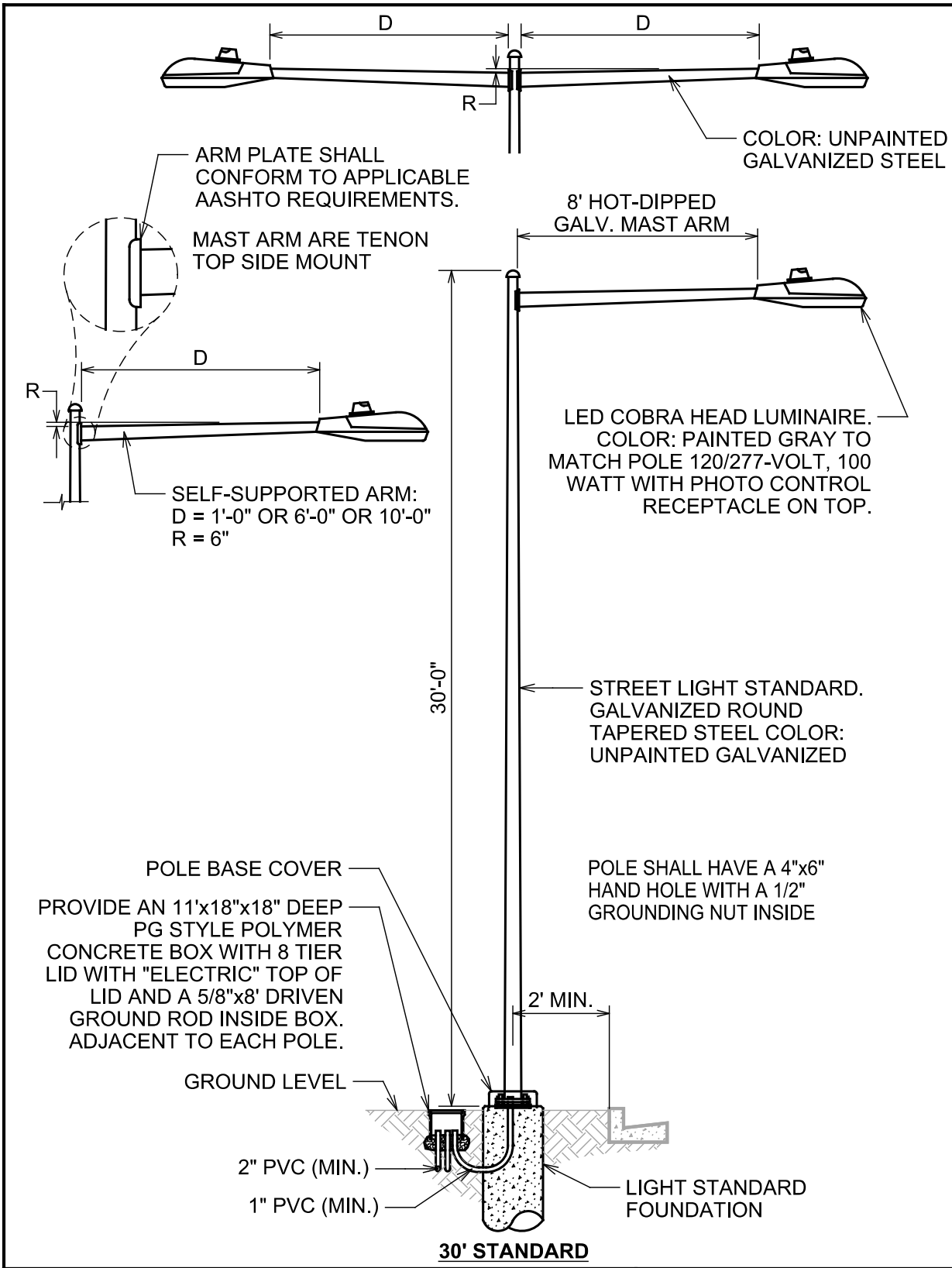
STREET NAME/STOP SIGN

STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21

REVISED DATE: 07/20/21

SGN - 1



30' STANDARD

City of BRENHAM

TYPICAL STREET LIGHT STANDARD DETAILS

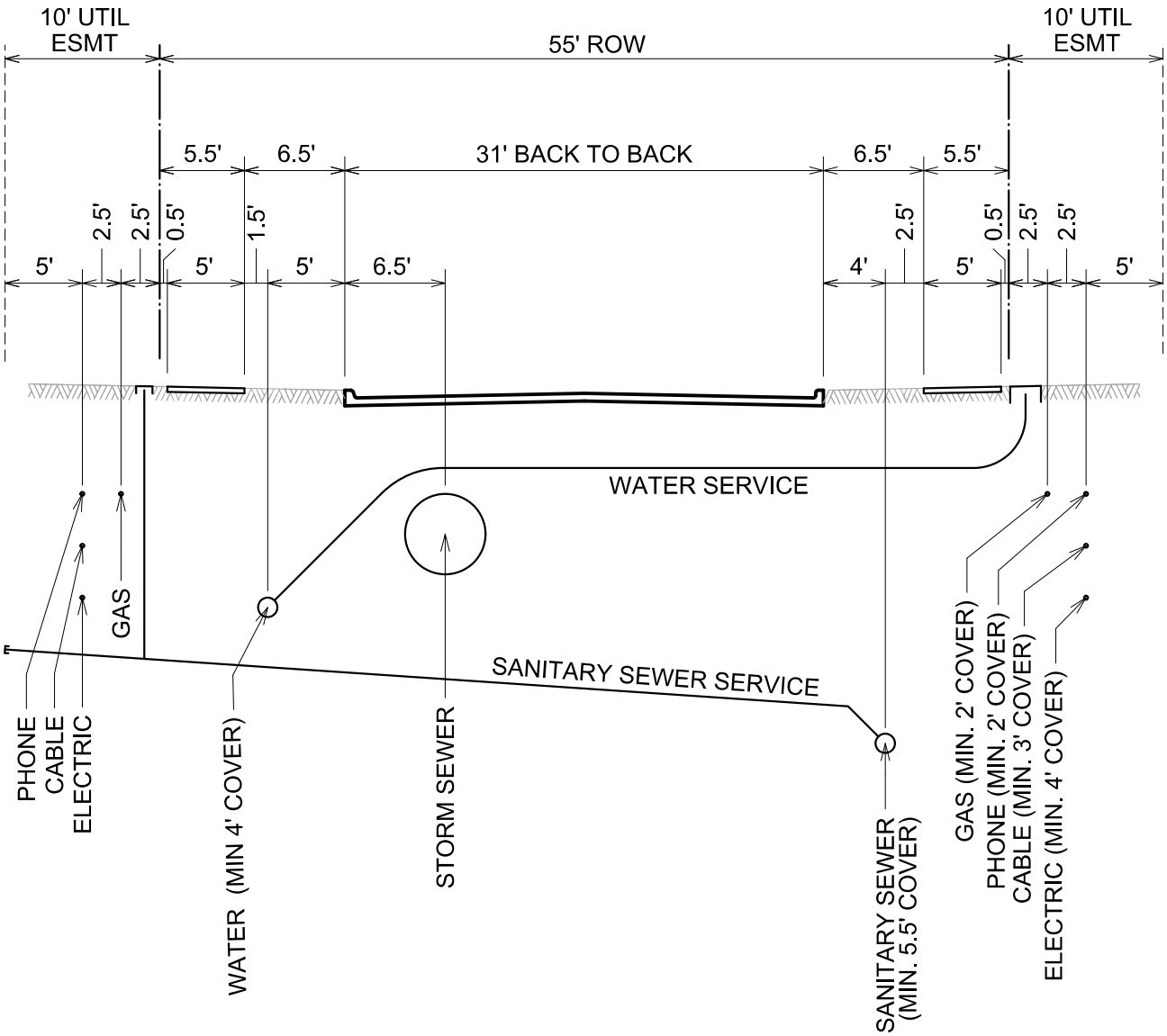
STANDARD CONSTRUCTION DETAILS

DATE: 07/20/21	REVISED DATE: 07/20/21

SGN - 2

GENERAL NOTES

1. THIS DETAIL SERVES AS A GENERAL GUIDE ONLY. CITY ENGINEER AND UTILITY PROVIDERS WILL DETERMINE FINAL LOCATION.



City of BRENHAM

TYPICAL UTILITY LAYOUT (LOCAL STREET)

STANDARD CONSTRUCTION DETAILS

DATE: 09/21/21	REVISED DATE: 09/21/21

ROW - 1