

WATER AND WASTEWATER DESIGN CRITERIA

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1.0 GENERAL

The following information is intended to assist engineers and the general public in the design and construction of water and wastewater facilities. Information herein is to provide minimum New Braunfels Utilities (NBU) requirements only. Sound engineering judgment shall be utilized to determine if these minimum requirements are suitable for each engineering design.

2.0 SERVICE EXTENSION PROCEDURE

2.1 GENERAL INFORMATION

This section is intended to provide information needed to obtain water and wastewater service extension approvals for future development and is only applicable to developments projected to have less than 250 connections. Any development projected to have 250 or more connections will require detailed analysis and coordination with NBU Engineering for approval. TCEQ approval will be required based on Chapter 217.5, 217.6, 217.7 and 290.39 (j).

The service extension is not to be interpreted as a vehicle solely for the purpose of securing a utility commitment, but rather a procurement of rights to install utility mains, associated facilities, and off-site improvements within NBU's Adopted Water and Wastewater Service Area. These water and wastewater facilities are not extended through capital improvement programs or other NBU initiated projects.

The NBU Service Area is the Impact Fee Boundary for the NBU water and wastewater utility. It is a set of geographic boundaries within which water or wastewater service may be provided. Properties must be completely within the service area before a service extension application can be submitted.

2.2 SERVICE EXTENSION APPLICATION REQUIREMENTS

The forms listed below are utilized when requesting a service extension. Other forms may apply. Examples of the forms are provided in Appendix A.

- A. Administrative Application
- B. NBU Board Application
- C. Service Extension Policy General Provisions
- D. Connection Calculation Sheet
- E. Annexation Request

2.3 SERVICE EXTENSION GUIDELINES FOR PROCESSING

- A. All properties not within city limits of New Braunfels must request annexation or give the city the future right of annexation without protest. An annexation request or consent for annexation shall be submitted with the service extension application.
- B. All extension requests not requiring NBU cost participation or reimbursement may be approved by the Chief Engineer of Water Services
- C. All service extensions requesting NBU cost participation or reimbursement must be submitted to the Chief Engineer of Water Services for consideration and approval by NBU Chief Executive Officer.
- D. Approved applications are not a reservation of capacity in the system, but are an acknowledgment of the intent to serve.

2.4 SYSTEM CAPACITY DETERMINATION PROCEDURE FOR REVIEWING SERVICE EXTENSIONS BY NBU

- A. NBU will determine what existing facilities are in place and any remaining capacity after considering all existing services connected and capacities committed to the system.
- B. NBU will determine the length of time, after all funded projects have been constructed, from present conditions until additional system improvements are needed.
- C. A service extension may or may not be approved depending on the time frame of approval, funding, and construction of additional system improvements and related agreements and conditions.

2.5 EXPIRATION OF SERVICE EXTENSION APPROVALS

- A. Expired service extensions may be refiled upon expiration date, not prior.
- B. A new application packet will be required upon refiling.
- C. A new number will be assigned and new fees required.
- D. In cases where approvals are contingent upon developer contracts and/or Capital Improvement Projects (CIP), the timing for expiration begins upon completion and NBU acceptance of those projects, not the approval date of application.

Note: See Service Extension Policy General Provision in Appendix A for complete guidelines and policy concerning service extensions.

3.0 POINT OF DELIVERY

3.1 WATER POINT OF DELIVERY

The point where water leaves the line or apparatus owned by NBU and enters the line or apparatus owned by the customer. Typical points of delivery include domestic and irrigation water meters, fire line up to the containment backflow device, and hydrant meters.

The point of delivery for an NBU owned and maintained water service lateral is the line side from the water main to the water meter. The customer is responsible for the line from the meter to the private plumbing which includes, but may not always be the case, a customer yard cut-off.

The customer is responsible for design, construction, operation, and maintenance of customer's installation beyond the point of delivery and has sole control and supervision over customer's installation, including compliance with all city plumbing codes.

3.2 WASTEWATER POINT OF DELIVERY

The point where wastewater leaves the line or apparatus owned by the customer and enters the line or apparatus owned by NBU. The point of delivery shall be determined by NBU, and is not necessarily the point of location of the wastewater cleanout. Typically, the point of delivery is at the property line or edge of easement.

The point of delivery for an NBU owned and maintained wastewater service lateral is the line side from the wastewater main to the cleanout or property line (in cases where cleanout is not installed or installed properly near the property line). The customer is responsible for the line from the cleanout/property line to the private plumbing.

The customer is responsible for design, construction, operation, and maintenance of customer's installation beyond the point of delivery and has sole control and supervision over customer's installation, including compliance with all city plumbing codes.

4.0 PRIVATE PLUMBING

4.1 PLUMBING INSPECTIONS INSIDE AND OUTSIDE THE CITY'S ZONING JURISDICTION

Within the zoning jurisdiction of the City of New Braunfels and within the boundaries of other jurisdictions as specified by contract, private plumbing installations shall be inspected by the Building Inspection Department to ensure compliance with the currently adopted requirements of the International Plumbing Code (IPC) as codified by the City of New Braunfels or other jurisdictions. New private plumbing installations on properties located outside of the zoning jurisdiction of the City for which NBU provides direct retail water or wastewater service (outside-city installations) shall be inspected in accordance with the following rules:

A. Backflow Prevention Review

1. All new residential or commercial facilities are required to comply with the requirements of this article. Compliance by a new utilities water system customer with the requirements for installation of one or more backflow prevention assemblies will be verified in conjunction with the customer's application for water service, or with the customer's building and plumbing permits. All customers owned backflow prevention assemblies shall be tested upon installation by the owner at their expense with a TCEQ certified Backflow Prevention Assembly Tester (BPAT).
2. NBU may require field inspection of the customer's premises, in addition to plan submittal and review, to determine the actual or potential hazards and backflow prevention assembly requirements.
3. All mechanical layouts or building plans submitted to the City of New Braunfels building inspections division will be reviewed to assure compliance with the requirements of this article and the plumbing code. All mechanical layouts or plans will be stamped by the City of New Braunfels building inspections to indicate that containment backflow prevention may be required, and contact must be made with NBU for a determination.
4. A new customer's application for water service must be accompanied by a mechanical layout or plan for all proposed structures to be connected to the utilities water system, showing or describing all plumbing arrangements and indicating the proposed type and size of backflow prevention assemblies to be installed. This information will be routed through NBU Water Engineering, Backflow Prevention Specialist to ensure compliance with the provisions of the article. Upon installation and testing of the approved assembly or air gap arrangement, NBU will make a record of the installation.

B. Customer Service Inspection Certificate (CSI)

Under the provision of Texas Administrative Code 290.46(j), customers are required to provide a certificate demonstrating a successful Customer Service Inspection (CSI) prior to NBU providing continuous water service to new construction customers, residential or commercial. A Customer Service Inspection is not a plumbing inspection, rather it is an examination designed to identify illegal lead materials, cross-connections, and/or contamination hazards.

1. Prior to providing continuous water service to new construction:
2. On any existing service when the water purveyor has reason to believe that cross connections or other unacceptable plumbing practices exist; and
3. After any substantial improvement, alteration, correction, or addition to a customer's system.

The CSI inspector must complete and deliver a Customer Service Inspection Certification Form to NBU's Backflow Prevention, certifying that the plumbing

installation is in compliance with the Plumbing Code before final connection to the NBU water and/or wastewater systems may be made.

Upon the request of NBU, access to plumbing installations must be provided to NBU quality control inspectors.

C. Customer Service Inspections

NBU is working with a third-party contractor to complete all CSI inspections on all residential and commercial properties to meet Texas Commission on Environmental Quality (TCEQ) regulations. The fee for the inspection will be added to the water connection fees. The fee will be listed as “New Service Fee, Customer Service Inspection”. The fee will be provided by NBU for each domestic water meter connection per the current fee schedule. This fee will not be required for irrigation meters at this time. The new connection fee will start on June 1st, 2015. No other CSI Inspection person or company will be accepted for new residential or commercial CSI Inspections. If you have any questions, please do not hesitate to contact NBU Water Systems Engineering Department, Backflow Prevention Specialist 830.608.8880 or email crossconnection@nbutexas.com.

D. Inspector Registration Requirements

According to TAC 290.46(j) (1), Individuals with the following credentials shall be recognized as capable of conducting a CSI certification.

1. 290.46(j) (1) (A) Plumbing Inspectors and Water Supply Protection Specialists licensed by the Texas State Board of Plumbing Examiners (www.tsbpe.state.tx.us).
2. 290.46(j) (1) (B) Customer Service Inspectors who have completed a commission approved course, passed an examination administered by the executive director, and hold a current professional license as a customer service inspector (www.tceq.state.tx.us).

4.2 STATE RULES AND REGULATIONS RELATING TO BACKFLOW AND CROSS CONNECTION CONTROL

Backflow prevention assemblies shall be installed in private plumbing systems, fire protection systems, process water systems, and/or other private water distribution systems that are directly or indirectly connected to NBU’s potable water distribution system per the NBU Cross Connection Backflow Prevention Policy. Contact backflow@nbutexas.com for more information.

5.0 STANDARD PRODUCT LIST PROCEDURES

5.1 INTRODUCTION

Through previous investigation, testing and usage by NBU, certain types, brands and models of some products and materials have established a satisfactory record for certain services. These products have been tabulated by manufacturer's names and identifying numbers on Standard Products Lists (SPL). Construction-related SPL has been assembled into the NBU "Standard Products List". The Standard Products List should not be interpreted as being pre-approved lists of products necessarily meeting the requirements for a given construction project and products included in the lists shall not be substituted unless they are approved by the Engineer and NBU. Contractors electing to use products from the SPL shall submit a list of products and the corresponding SPL number, together with the approvals for their use.

Products in use by NBU are subject to ongoing consideration and evaluation by staff. When changes, deletions, or additions become necessary and are approved, the product list will be revised and included in updates to the Standard Products List.

Questions concerning NBU's Standard Products List may be addressed to NBU Water Engineering.

5.2 NBU WATER AND WASTEWATER UTILITY STANDARD PRODUCT APPROVAL PROCESS

- A. Product and equipment manufacturers shall submit a written request for consideration to NBU Water Engineering. This request shall comprise a complete submittal, in a single package, and include the following:
 - 1. Product description, technical specifications, and catalog information.
 - 2. All applicable product standards (AWWA, ASTM, ANSI, NFPA and others) and related manufacturer's certifications.
 - 3. Test results showing compliance with applicable standards, including independent laboratory test results, if necessary.
 - 4. Manufacturer's installation procedures for the particular product.
 - 5. Product availability, delivery time, and manufacturer's location.
 - 6. Maintenance requirements, special equipment and procedures, and recommended maintenance schedules.
 - 7. Product references (municipal or public users) shall include users name, address and telephone number, product application and number of years in use, and name and telephone number of a contact person having knowledge of the particular usage.
 - 8. Material safety data sheet (MSDS), if applicable.

9. Recent product revisions or improvements.
 10. Explanation of how the product benefits NBU in terms of prolonged service life, reduced maintenance, reduced life-cycle cost and other relevant aspects.
- B. If the submittal is acceptable, NBU Water Engineering shall submit it to NBU staff for consideration. Products may be requested for testing or field evaluation.
 - C. Following review of the submittals NBU staff may request a presentation by the manufacturer at a regularly-scheduled staff meeting to demonstrate the product or provide additional information.
 - D. Procedures for testing or evaluation shall be as agreed upon between the supplier and NBU. Results will become a part of the product file and will be made available to the supplier upon request.
 - E. When products are evaluated in a construction or CIP project, the location and installation details shall be recorded in the inspection record and filed with NBU. In addition, the installation shall be cross-referenced on all as-built plans, profiles, quad maps, and other NBU maintained maps.
 - F. A database listing all testing locations, time of test and results shall be compiled and periodically updated. From this information, the NBU staff will recommend approval or disapproval of the products.
 - G. NBU Water Engineering will advise the applicant of NBU's decision regarding the product.
 - H. The newly accepted product will be added to the appropriate Standard Products List (SPL).
 - I. Problems regarding accepted products shall be submitted to NBU Water Engineering for review. Such review may lead to a recommendation to rescind approval. NBU shall inform the product manufacturer of the reasons for removal from the SPL.

5.3 PRODUCT AND PURCHASE SPECIFICATION REVIEW

All purchase specifications and each SPL will be reviewed at least every five (5) years. Products will be under constant evaluation as they are used in the water and wastewater systems.

6.0 CONSTRUCTION PLAN INFORMATION AND SUBMITTAL REQUIREMENTS

6.1 GENERAL

- A. One (1) complete set of Civil Construction plans, size ANSI "D" 22 inch by 34 inch, and an engineering report shall be submitted to the NBU Water Engineering for verification of conformance to the NBU Standards, Specifications, and Design Criteria.

- B. Approved easements and/or permits for highway and/or railroad crossings must be provided.
- C. A Development Permit must be obtained from the regulatory agencies.
- D. Plans that include fire lines must have approval by the City of New Braunfels Fire Department (NBFD) and other related agencies.
- E. All water and/or wastewater plans will include the following items:
 - 1. Engineer's dated signature and seal of a Professional Engineer licensed in the State of Texas on each plan sheet.
 - 2. Engineering firm name and registered number (format F-XXXXX) on each plan sheet.
 - 3. Date of plans and revisions.
 - 4. North arrow and scale must be shown. The standard horizontal scale for plan and profile sheets shall be 1" = 50', 40' or 20' for the plan view. The vertical scale shall be 1" = 5', 4' or 2'. The same scale shall be used on all plan and profile sheets. For sheets other than plan and profile, horizontal scales of 1" = 50', 40' or 20' may be used as appropriate.
 - 5. A general location map on the cover sheet drawn at scale no greater than 1" = 2000' with project limits, project address, labeled major roadways, and north arrow shown.
 - 6. NBU work order number as provided by NBU after initial plan review.
 - 7. General Notes and Standard Details
 - a. Standard NBU Water and Wastewater construction notes.
 - b. Applicable Standard NBU Water and Wastewater details
 - c. If over Edward Recharge Zone, TCEQ Notes should be included (reference www.tceq.state.tx.us).
 - d. If over Edward Recharge Zone, Standard Detail Drawings are required.
 - 8. Subdivision file number and/or service extension number and all required permit numbers such as development permit, Texas Department of Transportation permit, railroad crossing permit, etc. shall be listed on the Cover Sheet.
 - 9. Recordation number or volume and page number of all permanent and temporary easements.
 - 10. Size, pipe material and location of main with respect to easement boundaries and rights-of-way.
 - 11. Property lines and dimensions, legal description, lot and block numbers, rights-of-way dimensions, easements boundaries, easement widths, curb locations, sidewalk locations, and street names.

12. Matchline from one sheet to the next sheet, indicating stationing and sheet no.
(Example: matchline station 5+00, see sheet xx of xx).
 13. Trench Excavation and Safety Protection notes on each plan sheet.
 14. Erosion and sedimentation control plan.
 15. USGS, NBU, or TxDOT benchmarks.
 16. Location, size, length, and material of all existing water and wastewater mains, lines, and services. The direction of flow in the wastewater mains shall be indicated.
 17. Location, size, and description of other utilities where they may conflict with water or wastewater mains or other service lines.
 18. Curve data for roads, property lines, water lines, reclaimed water lines, and force mains.
 19. Curves are not permitted on wastewater mains.
 20. Final plat recording or land status report.
 21. Street address for all existing structures shall be shown on the lot(s) where the structures are located.
 22. Pressure zone designation for subject tract and zone boundaries where applicable.
- F. Final plan approval may require additional authorizations.
1. Texas Department of Transportation permit
 2. Railroad permit
 3. Gas Company permit
 4. Easement acquisition
 5. County approval
 6. City Approval
 7. Texas Department of Health approval
 8. Texas Commission on Environmental Quality approval
 9. Non-occupancy letter
 10. Service Extension approval
- G. Engineering Reports shall include the following:
1. Water system size and capacity calculations per 10.2.A for proposed and ultimate development conditions.
 2. Wastewater flow determinations per 10.3.A for proposed and ultimate development conditions.

3. Wastewater pipe size calculations per 10.3.B for proposed and ultimate development conditions.
4. Lift station and force main calculations per 10.3.H, as applicable for proposed and ultimate development conditions.
5. Full size exhibits (ANSI D paper size) depicting the overall development, utility layouts, service counts, tie-ins, pressure zones, existing topography, proposed topography, and other information as required to illustrate development parameters and boundary conditions.

6.2 WATER SYSTEM PLAN

- A. All drawings shall include all applicable items listed in the General Requirements mentioned above plus the following items:
 1. Water main standard sizes are as stated in Section 10.2.
 2. Length of all water mains from fitting to fitting and/or matchline to matchline.
 3. Cut and replacement limits of existing surface improvements (pavement, sidewalk, etc.)
- B. All plan view drawings shall include all applicable items listed in the General Requirements above plus the following items:
 1. Stations of all proposed connections to existing or proposed water mains.
 2. For proposed connections to water mains or facilities to be constructed by others: identify the project by name, the design engineer, and service extension number.
 3. Water main station numbers for beginning points, ending points, points of curvature, points of tangent, points of reverse curve, points of intersection, valves, fire hydrants, other appurtenances, and grade breaks.
 4. Station numbers shall be identified for the water mains where they cross any other utility.
 5. Details of appurtenances.
 6. The location of all existing and proposed water services, water mains, valves and fire hydrants.
 7. Current FEMA Special Flood Hazard Area limits and Floodway limits with labels identifying the hazard zone, panel number, and effective date.
 8. A reference noting the field book notes for the original survey.
 9. Design velocity at maximum day plus fire flow.
 10. Calculated design pressure at highest and lowest lot served.
 11. Thrust restraint on the plan view or a standard detail indicating the required thrust restraint lengths by pipe size and fitting type.

12. Retaining walls, including geogrid, straps, tie-backs and all other components.
 13. Culverts, bridges, and other drainage structures.
- C. A profile view shall be provided for all water mains 12 inch in diameter and larger. It shall show all applicable items listed in the General Requirements plus the following items:
1. The existing ground profile, proposed street finish grade, and proposed subgrade.
 2. Station numbers, elevations, diameter, and material of all utility crossings.
 3. Station numbers and soil geology information at stream crossings to evaluate the need for special surface restoration.
 4. Identify pipe size, percent grade, and pipe material to be used including ASTM and/or AWWA designation. If an alternate material is to be allowed, both should be listed (example "D.I. or DR14 PVC").
 5. Station numbers and elevations for starting points, ending points, point of intersection, grade breaks, valves, fire hydrants, air release valves, pressure/flow regulating valves and at intermediate points every 100 feet.
 6. Retaining walls, including geogrid, straps, tie-backs and all other components.
 7. Culverts, bridges, and other drainage structures.

(NOTE: Plan Approval shall expire one year from the date of current approval. If construction has not begun on the facility within one year of the approval date, plans must be resubmitted for approval and must include all criteria in effect at the time resubmitted.)

6.3 WASTEWATER SYSTEM PLANS

- A. All drawings shall include all applicable items listed in the General Requirements mentioned above plus the following items:
1. Drawn from left to right, low point to high point.
 2. Drop manholes and vented manholes labeled as appropriate.
 3. Indicate pipe length and flow direction from manhole to manhole.
- B. All plan view drawings shall include all applicable items listed in the General Requirements mentioned above plus the following items:
1. Station numbers at all proposed connections to existing or proposed wastewater mains.
 2. For proposed connections to wastewater mains or facilities to be constructed by others, identify the project name, the design engineer, and the service extension number.
 3. The location, alignment, and structural features of the wastewater main, including manholes and concrete retards, if applicable.

4. Station numbers for beginning points, ending points, manholes, services, clean-outs and other appurtenances.
 5. Details of all required appurtenances.
 6. Location of all existing and proposed wastewater services, mains and manholes.
 7. Current FEMA Special Flood Hazard Area limits and Floodway limits shall be shown with labels identifying the hazard zone, panel number, and effective date. Base Flood Elevations shall be shown on the plan when infrastructure is placed within or adjacent to a Special Flood Hazard Areas.
 8. A reference noting the field book notes for the original survey.
 9. Retaining walls, including geogrid, straps, tie-backs and all other components.
 10. Culverts, bridges, and other drainage structures.
- C. A profile view shall be provided for all wastewater mains and shall include all applicable items listed in the general requirements above plus the following items:
1. The existing ground profile and proposed street finish grade or subgrade or finished grade if not under pavement.
 2. Station numbers and elevations of all utility crossings.
 3. Station numbers and soil geology information at stream crossings to evaluate the need for special surface restoration.
 4. Identify the pipe size, percent grade, and pipe material to be used including ASTM and/or AWWA designation. If an alternate material is to be allowed, both should be listed (example "DI or PVC").
 5. Station numbers and elevations for starting points, ending points, manholes (rim and inverts), wastewater service lines, stacks (if applicable), clean-outs, and at intermediate points every 50 feet.
 6. Elevations shall be indicated on the profile showing the finish floor elevations of all existing structures. If the structure has an active septic tank or other disposal system, the flow line elevation of the plumbing where it exits from the structure is to be indicated. If a lot or tract is vacant, side shots may be required from the middle of each lot to ensure gravity service is possible from the lot to the main.
 7. Flow rate (gpm), velocity, and depth of flow information (QVD) shall be noted on the profile for minimum flow, peak dry weather flow, and peak wet weather flow. QVD information must be shown on each sheet by individual labels per segment or via a table with this information. A table covering all segments in the set on the overall water or wastewater layout sheets does not meet this requirement.
 8. Retaining walls, including geogrid, straps, tie-backs and all other components.
 9. Culverts, bridges, and other drainage structures.

6.4 EASEMENTS

All utilities installed outside Public Rights-of-Way (ROW) shall be installed in an exclusive utility easement dedicated to NBU. Easements shall comply with NBU Real Estate Services' Requirements for Permanent Water and Sewer Easements, as updated.

- A. The utility easement shall have minimum width per Table 1. Width shall be the greater of the two options provided for each size category.

Table 1: Easement Widths

Main Size (W or WW)	Easement Width (feet)
21-inch or smaller	20 or Twice the Depth
24-inch	25 or Twice the Depth
Greater than 24-inch	30 or Twice the Depth.

- B. Where the easement is not adjacent to ROW or an existing public utility easement, an additional 10 feet of easement width is required.
- C. If easements are not parallel and adjacent to the ROW, the main shall be set to one side of the easement to permit excavation while allowing for spoils and haul vehicles on the other side of the easement. The centerline of the main will typically be offset 10 feet from the edge of easement. Offset shall be adjusted for large diameter or deep mains as directed by NBU.
- D. When utilities are located outside a street ROW or overlapping public utility easement, they must be skewed towards the ROW side to allow for excavation or haul vehicles on the other side of the easement.
- E. Wastewater easements shall be configured such that all manholes are accessible by maintenance vehicles such as light-duty trucks and combination vector units. The surface of all offsite easements must be graded such that slopes in all directions are no greater than 12% without NBU approval. Grade breaks exceeding 8% are not permitted.
- F. Additional access easements are required if direct vehicular access to manholes or other features is blocked by creeks, drainage channels, ponds, excessive slopes, retaining walls, or other features. Access easements shall be a minimum 20 feet in width with longitudinal slopes no greater than 12% and side slopes no greater than 5%.
- G. Utility easements shall be configured such that all fire hydrants have minimum 10 feet of clearance in all directions.

- H. Utility easements provided for meter vaults, wastewater access chambers sampling stations, or air valve assemblies shall extend a minimum of five feet in all directions from the outside wall or footing of the assembly.
- I. Easements parallel to lot lines shall be wholly contained on one lot and shall not cross lot lines.
- J. All utility easements shall be accessible from public ROW via a City of New Braunfels standard Commercial-Multifamily-Industrial Driveway.
- K. No structures, private landscaping or irrigation shall be installed or placed within NBU easements.
- L. Private roadways or pavement will be allowed within NBU easements on a case-by-case basis. If pavement is permitted, the property owner shall be responsible for all pavement repairs and restoration within the easement that are damaged as a result of NBU repair or maintenance activities.
- M. Minimum vertical clearance to obstructions above NBU easements shall be 25 feet.
- N. A minimum 10 foot of clearance shall be provided between proposed NBU lines and existing or proposed structures. Clearance shall be measured from the outside edge of the line to the nearest point of the structure.
- O. Gates shall be installed where easements cross existing or proposed fence lines. Gates shall be a minimum 16-feet in width to permit vehicular access and secured with a lock provided by NBU. Gates shall comply with NBU Standards.
- P. The Developer is responsible for 100% of the cost to acquire offsite easements. Easements shall be recorded in the County Real Property Records prior to approval of the construction plans.
- Q. NBU shall not be responsible to the Developer for any delays, costs, expenses, or damages of any kind during the time that NBU is in the process of acquiring any easements through negotiation and/or condemnation.

7.0 CONSTRUCTION INSPECTION, ACCEPTANCE, AND WARRANTY

7.1 CONSTRUCTION INSPECTION PROCEDURE

The following items must be submitted to the NBU Water Engineering to release an NBU inspector for assignment to a project. The appropriate contact person will be able to answer any questions regarding the following information:

- A. Two (2) sets of signed plans are required. Also required are two (2) copies of signed contracts (lump sum contracts should include water and wastewater quantities on a developer's or consulting engineer's letterhead), two (2) sets of cut sheets with one (1) copy of field notes and two (2) copies of any permits listed on the front of the plans.

- B. One (1) copy of the bid tabulation (if the project is bid out) will be required with the above listed items for all service extensions submitted for construction. All of these required items must be submitted at the same time. For reviews occurring during the construction phase, two (2) copies of the revised plans are required.
- C. To set up a Pre-Construction Meeting, contact NBU Water Engineering.
- D. One (1) paper copy and electronic copies of the approved plans and contracts must be submitted to the NBU Water Engineering at least three (3) working days before the Pre-Construction Meeting.
- E. The contractor shall call the One Call System for information on existing buried utilities.

7.2 NBU ACCEPTANCE

To obtain final NBU acceptance of a project, the following must be completed and/or submitted and approved:

- A. Refer to NBU Specification 515, along with other applicable specifications, for all testing requirements.
- B. One (1) paper and digital copy of contractor redline drawings showing all field changes.
- C. Record drawings and CAD Deliverables. Reference Water and Wastewater Record Drawing, CAD, GIS Deliverables Submission Standards and Requirements in Appendix.
- D. NBU provided Closeout Submittal Form, signed and sealed by the Engineer of Record.
- E. Engineers cost estimate for water and wastewater improvements, signed and sealed by the Engineer of Record. The cost estimate shall include line items for the following assets: water mains (length and size), water services (number and size), water valves (number and size), fire hydrants (number), water storage tanks (dimensions and capacity), sewer mains (length and size), sewer force mains (length and size), sewer services (number and size), sewer manholes (number), and sewer structures (number).
- F. Any outstanding fees, based on final cost figures must be paid.
- G. Digital copy of the Planning Commission approved plat
- H. Developer Customer's and Contractors Payment and Receipt Affidavit (if applicable)
- I. Backflow Prevention Test & Maintenance (T&M) report (if applicable)

If landscaping and vegetation items are outstanding, a conditional acceptance letter may be issued. This allows for the release of letter of credit requirement for the majority of the water and wastewater related work that has been satisfactorily completed. When all work is completed and all necessary information is provided, a final acceptance letter will be issued. NBU will assume

ownership and maintenance of the system upon the issuance of a Final Acceptance letter for the project.

If the project includes a lift station, the lift station will be considered separately for operation and maintenance acceptance. (Refer to Section 8.3)

7.3 CONSTRUCTION WARRANTY

The correction of any damages or adjustments required to the facilities resulting from the final development of a project will remain the responsibility of the owner and/or developer. A two-year warranty on all water and/or sewer facilities shall begin upon the date of the final acceptance letter.

8.0 LIFT STATION REVIEW, APPROVAL, AND ACCEPTANCE

8.1 ENGINEERING REPORT, PLANS AND SPECIFICATIONS REVIEW AND APPROVAL

Refer to NBU's Lift Station Design Criteria for all submittal and design requirements.

(NOTE: Plan Approval shall expire one year from the date of approval. If construction has not begun on the facility within one year of the approval date, plans must be resubmitted for approval and must include all criteria in effect at the time resubmitted.)

8.2 SUBMITTAL AND SHOP DRAWING REVIEW

Once the engineering report, plans and specifications have been approved, at least two (2) complete sets of submittals and shop drawings shall be provided to the NBU Water Engineering. These submittals shall contain complete detailed information and drawings for all lift station equipment and components.

8.3 NBU OPERATION AND MAINTENANCE ACCEPTANCE

NBU may accept a lift station with a firm pumping capacity greater than 120 gpm for operation and maintenance provided the following conditions are met:

- A. The station is located within NBU's approved wastewater service area.
- B. NBU has inspected the lift station and determined that it is constructed in conformance to NBU's requirements. Any lift station not conforming to NBU's standards shall be upgraded to NBU standards before NBU will accept the lift stations for operation and maintenance.
- C. The owner or his representative has provided all information requested in Sections 8.1 and 8.2 above, five (5) complete sets of all Operations and Maintenance Manuals for all equipment installed and has received NBU's approval.

- D. The owner has granted NBU a wastewater easement for the lift station and access road. A copy of the recorded easement plat, legal description and any other legal documents granting the easement shall be delivered to NBU. The easement shall extend to at least five (5) feet outside the lift station fence and shall include access road with turn-around areas that extend back to paved public rights-of-way. This easement shall be separate and in addition to any necessary pipeline easement.

If the lift station is to become a permanent installation, transfer of ownership and title to the land may be required by NBU prior to acceptance of the station for operation and maintenance.

- E. A letter of assignment has been written to NBU from the owner transferring title of the lift station and related equipment to NBU. This letter shall be delivered to NBU before acceptance of the lift station for operation and maintenance. The original owner may regain title to a temporary lift station that was designed and constructed entirely at his expense and for which no refund was made by NBU. After written notification by NBU that the lift station has been abandoned, the original owner has one (1) month to notify NBU in writing of his intent to regain title to the temporary lift station site.
- F. One (1) complete set of Record Drawings shall be provided to NBU in paper and digital format, as specified by the NBU's CAD Deliverable requirements, prior to acceptance of the lift station for operation and maintenance.

9.0 ABANDONMENT OR REMOVAL OF FACILITIES

If a new project will abandon existing facilities, the plans shall provide for the appropriate abandonment or removal (if required by NBU or other entities) of these facilities.

9.1 MAINS

Abandonment of water and wastewater mains in ROW shall consist of cutting the main at locations identified in the plans and filling the main with a pumpable grout meeting the requirements of the current specifications. Water and wastewater mains shall be removed when required as a condition of the City or TxDOT ROW permit or when they will conflict with proposed infrastructure. ROW shall be backfilled to required compaction after removal.

Abandonment of water and wastewater mains in private easements shall consist of filling the main with a pumpable grout meeting the requirements of the current specifications. Plans should include methods of abandoning or removing all other mains.

9.2 MANHOLES

Manholes in roadway ROW to be abandoned shall be removed to a level not less than four feet below grade, inlets and outlets securely plugged, and the structure filled with flowable fill in compliance with current NBU specifications.

Manholes outside roadway ROW to be abandoned shall be removed to a level not less than four feet below grade, inlets and outlets securely plugged, flowable fill shall be installed to a level not less than 6 inches above top of pipe, and the remainder of the structure filled with material in compliance with current NBU standards and specifications.

9.3 LIFT STATIONS

Refer to NBU's Lift Station Design Criteria.

9.4 SERVICE LINES

All water service lines (including fire lines) that are being abandoned and not transferred to a new distribution line should be disconnected at the corporation stop and all other valves and appurtenances removed. Any meters to be abandoned shall be removed and delivered to a storage facility as directed by the NBU Inspector.

10.0 DESIGN REQUIREMENTS FOR WATER AND WASTEWATER SYSTEMS

10.1 INTRODUCTION

These guidelines are intended to establish the minimum basic design requirements for water and wastewater systems within NBU's service area, but do not address major facilities such as water and wastewater treatment plants. Generally, these systems will be operated and maintained by NBU.

All project manuals shall include the appropriate NBU Standard Specifications. All projects are required to be built in accordance with these NBU Standard Specifications, which may include other requirements not addressed here. All variations are subject to the approval of NBU. Additional requirements for specific projects may be established where the conditions of service to the tract and related system operation and maintenance needs warrant.

The following information is provided to assist engineers and the general public in the design and construction of water and wastewater facilities within the NBU service area. All plans for such facilities shall be prepared by or under the supervision of a Professional Engineer, licensed in the State of Texas. It will be the responsibility of the engineer to ensure that the plans are in compliance with the latest versions of all applicable federal, state, and local ordinances, rules, and regulations.

These include, but are not limited to, the following:

- A. Design Criteria for Sewage Systems - Texas Commission on Environmental Quality (TCEQ)
- B. Rules and Regulations for Public Water Systems - TCEQ.
- C. City of New Braunfels Code of Ordinances
- D. NBU Standard Specifications

- E. NBU Water and Wastewater Design Criteria
- F. NBU Lift Station Design Criteria

10.2 WATER SYSTEMS

A. Size/Capacity Determination

1. General

- a. Hazen Williams Friction Coefficient $C = 100$, higher C coefficient may be used for new mains only upon approval by NBU with sufficient documentation to show effects of long-term use.
- b. Maximum system static pressure - 150 psi
- c. If the maximum static pressure exceeds 80 psi, a PRV will be required on the property owner's side of the water meter and should be shown on the plan view.
- d. Minimum operating pressure is 50 psi at the highest elevation meter location using average day demand.

2. Residential Development

- a. Average day demand = 0.24 gal/min/connection
- b. Peak day demand = 0.48 gal/min/connection
- c. Peak hour demand = 0.83 gal/min/connection

3. Peak Hour Demand Requirements

- a. The maximum allowable velocity shall not exceed 5 feet per second (fps).
- b. The minimum pressure at any point in the affected pressure zone must not be less than 35 psi.

4. Emergency Demand (Fire Flow) Requirements

- a. The maximum allowable velocity shall not exceed 10 fps.
- b. Fire flow requirements will be determined in accordance with the City of New Braunfels Fire Code and associated rules. The City of New Braunfels Fire Department has adopted the 2018 International Fire Code. Refer to the City of New Braunfels Code of Ordinance for Fire Department amendments.
- c. The minimum residual pressure at any point in the affected pressure zone at peak day plus fire flow shall not be less than 20 psi.

5. Sizing of Water Mains

Computer modeling is preferred for sizing water mains. However, for water mains less than 12 inches in diameter other engineering calculation methods may be accepted. The largest size, as determined by comparing the service area's peak hour demand and peak day plus fire flow demand, shall be used.

6. Storage Requirements

Additional storage required for developments with 250 connections or greater will be determined by NBU Engineering based on system modeling.

B. Mains

1. Minimum main size shall be 8 inches. The minimum size for any street type, however, will be governed by various factors which include fire protection requirements, high density land usage, and the designer's consideration of general system gridding, future transmission mains, neighboring developments and area configuration. Transmission line sizes will be determined on a case by case basis.
2. Water main standard sizes are 8-inch, 12-inch, 16-inch, 24-inch and 6-inch multiples thereafter.
3. Looped systems are required for service reliability. The maximum length for an 8-inch main is 1000 feet before it must be looped. Looping requires two separate connections to existing water mains.
4. Fire lines cannot be more than 100 feet in length.
5. The maximum bend for water mains is 45 degrees.
6. Water mains must be located where maintenance can be accomplished with the least interference with traffic, structures, and other utilities.

Mains shall be located as per standard details within the street unless otherwise directed by NBU.

In major collector and arterial roadways, mains must be located outside the pavement, curbs, etc., wherever feasible. When mains are located outside of the rights-of-way, they must be within a dedicated utility easement meeting the requirements of section 6.4. Main assignments in such City streets must be approved by NBU. Assignments for lines in County roads must be approved by the County Engineer.

7. Separation Distances:
 - a. The separation between water and wastewater mains must comply with TCEQ rules or have a variance approved by TCEQ before submittal to NBU.
 - b. The separation between NBU water and wastewater infrastructure and dry utilities shall be a minimum of 3 feet (outside to outside).
 - c. Maintain a minimum 2-foot vertical clearance where the water main crosses stormwater infrastructure. Steel casing must be used when water mains cross under box culverts, large storm drain pipes (48 inches or greater in diameter), or multiple barrel storm drains of any size. Steel casing sizes shall be in accordance with NBU Specifications and must extend 5 feet beyond the outer diameter of the stormwater infrastructure.
8. Piping materials and appurtenances shall conform to NBU Standard Specifications and the NBU Standard Products List (SPL).

9. Minimum depth of cover over the uppermost projection of the pipe and all appurtenances shall be 48 inches. Concrete cap or encasement must be installed if cover is less than 48 inches. Maximum depth will be as approved by NBU for the specific materials, application, and conditions.
10. For mains of 16 inches and larger, drain valves shall be placed at low points.
11. All fire lines must have a gate valve on the line at the connection to the main line and a backflow preventer inside the property line, but accessible for inspection by NBU and City personnel. The backflow preventer must be located outside the public utility easement. All unmetered fire lines shall have an NBU approved backflow device.
12. Water mains 16 inches in diameter and larger require automatic air release valves at all high points and at the down-slope side of all valve locations. Air/vacuum and vacuum release valves shall be approved on a case-by-case basis.
13. Line Stoppers

Contractors shall install line stoppers at their cost for an outage during construction if system valves are not available or the existing valves do not function. Line stoppers will be required based on the following criteria:

 - a. If the number of residential customers affected is greater than 20 and expected to last more than 4 hours.
 - b. If any commercial customers are affected by the outage then the use of line stoppers will be determined on a case by case basis.
 - c. If any critical care customers are affected by the outage then the use of line stoppers will be determined on a case by case basis.
 - d. System conditions may require a line stopper and may not be known until construction commences.
14. No water line shall be deflected either vertically or horizontally, in excess of 50% as recommended by the manufacturer of the pipe or coupling without the appropriate use of bends or offsets. Fittings may be required where more than two pipe lengths are deflected.
15. The determination of whether restrained joints or other means of anchorage are required shall be made by a qualified professional engineer with review and approval by NBU. All thrust anchorages shall be designed for a safety factor of not less than 1.50 under maximum pressure loading. Thrust blocks will not be allowed on the system without written approval from NBU. Joints will be restrained with restraining systems approved by NBU and restraint length shall be submitted to NBU at the time of plan submittal.

C. Valves

1. All isolation valves eighteen (18) inches and smaller must be gate valves. Valves larger than eighteen (18) inches may be gate valves or butterfly valves.

2. There shall be an isolation valve in each fire hydrant lead restrained to the main.
3. Valves shall be located at the intersection of two or more mains and shall be spaced so that no more than 30 customers will be without water during a shutout. For lines smaller than 24 inches, typical spacing should be 500 feet in high-density areas and 1200 feet in residential area. Mains 24 inches and larger shall be valved at intervals not to exceed 2000 ft.
4. The minimum number of valves at an intersection of water mains is $N-1$, where N is the number of legs of the intersection.
5. At dead ends, gate valves shall be located one (1) pipe length (10-ft. minimum) from the end points of the main. The Engineer shall provide (and show on drawings) complete restraint for all such valves, pipe extensions, and end caps. Permanent blow-offs are required at the end of 25 feet or longer pipe sections.
6. Branch piping (both new and future branches) shall be separated from the main with isolation valves.
7. Valves shall be located so that isolating any intersection of water main requires closing of no more than three (3) valves.
8. Valves with valve extensions and those at pressure zone boundaries shall be equipped with a locking type debris cap.
9. Valves having "push on" joints are not permitted for fire hydrant leads and laterals.
10. Pressure Reducing Valves
 - a. Where pressures are 80 psi or above then it will be required for developers to place pressure reducing valves on service lines on property side of meter at time of construction of the development.
 - b. Pressure reducing valves shall be required on water mains at NBU's discretion.

D. Fire Hydrants

1. Hydrants shall be installed at the intersection of two (2) streets and between intersections where necessary, at distances not in excess of 300 feet between hydrants in commercial or other high-density areas (as measured along ROW) and not more than 600 feet in residential areas (as measured by hose lay). In residential areas, hydrants should be placed at lot lines when placed along a roadway/access way.
2. Hydrants shall be installed on both sides of all divided road/highways, unless otherwise approved by NBU and NBFD. Roads/highways where opposing lanes of traffic are separated by a curb, safety barrier, drainage channel, or other vehicle obstruction shall be considered a divided road/highway.
3. Fire Hydrants located (off tee fittings) at the end of dead-end mains and cul-de-sacs will be required in place of a permanent blow-off.

4. No private fire hydrants shall be allowed, unless approved by NBU. If a private hydrant is allowed, then a double check detector assembly shall be required at the hydrant tap.
 5. The entire fire hydrant assembly shall have restrained joints.
- E. Services
1. Water services shall be in accordance with NBU Standard Details. No more than two meters on a single service line (domestic and irrigation meters).
 2. Each domestic meter shall have its own individual service tap. An irrigation meter may be added to a single service other than the domestic meter for services to single-family homes only.
 3. Each non-residential meter shall have its own individual service tap. Service connections from fire lines are not permitted.
 4. Individual meter services will not be taken from transmission lines. Transmission lines are generally considered to be 18 inches in diameter or larger. Exceptions must be approved by NBU Water Engineering at time of plan submittal. The Engineer shall submit a letter with this request.
 5. 1-inch service lines shall be constructed of Type K annealed seamless copper tubing meeting the requirements of ASTM B88. AWWA C901 SDR9 Copper Tubing Size HDPE may be used for 1-inch services lines with special approval from NBU only. 2-inch services lines shall be AWWA C901 SDR9 CTS HDPE. All copper and HDPE tubing must be NSF 61 certified.
- F. Water Meters
1. Water meters 6 inches and smaller shall be provided by NBU.
 2. Water meters larger than 6 inches shall be provided by the developer at their own expense and must comply with NBU standards.
 3. Each individual residence or building shall have a separate NBU water service and water meter as determined by NBU. Offices in the same building under one piping system may have a single NBU water meter. Customer must comply with private submetering requirements established by plumbing code, TCEQ, and the Public Utility Commission of Texas.
 - a. Individual residences include the following, but does not exclude others:
 - 1) Duplex, Triplex, Fourplex
 - 2) Build-to-rent
 - 3) Mobile home
 - 4) Townhome
 - 5) Condominium

6) Others as defined by TCEQ

4. All commercial or residential building(s) of any type with gross square footage over 10,000 square feet, including all stories, shall have (i) a separate NBU meter(s) for irrigation, and (ii) another separate NBU meter(s) for all other common areas and outdoor purposes, including fountains, swimming pools, and any other outdoor use of water. Combined common areas may be combined under one water service and meter; though, each area will need to be itemized when determining the LUEs associated.
5. A separate NBU water meter and grease, oil, sand interceptor shall be provided for each restaurant establishment as determined by NBU. Shell buildings shall be designed accordingly if a restaurant establishment is a possible future tenant. Only one tenant connection to a grease trap will be allowed. Each tenant of a shell building must be provided a separate water service and water meter.
6. For commercial developments, meter size(s) shall be determined by the Engineer of Record using fixture count data, if available. Water demand by similar developments may be accepted in lieu of fixture count data, at the discretion of NBU Water Engineering. Water meters are not to be sized based on an assumed number of LUEs for a development.

G. Irrigation Meters

1. All commercial buildings, multi-family facilities, and residential dwellings are required to have separate NBU irrigation meters if an irrigation system is installed.

10.3 WASTEWATER SYSTEMS

A. Determination of Wastewater Flow

1. Residential connections shall be assumed to produce an average wastewater flow of 200 gallons/day. When designing lift stations, 300 gallons/day shall be used.
2. Non-residential wastewater flows will be evaluated on a case-by-case basis.
3. Inflow/Infiltration.

In sizing wastewater lines, external contributions are accounted for by including 750 gallons per acre per day served for inflow and infiltration. For wastewater lines in the Edwards Aquifer Zone refer to the Texas Commission on Environmental Quality requirements. Strict attention shall be given to minimizing inflow and infiltration.

4. Peak Dry Weather Flow.

The peak dry weather flow is derived from the formula:

$$Q_{pd} = \frac{18 + (0.0216 \times F)^{0.5}}{4 + (0.0216 \times F)^{0.5}}$$

Where:

$$F = \frac{200 \text{ (gal/lue/day)} \times (\# \text{ LUE})}{1440}$$

F = average dry-weather flow in gpm

5. Peak Wet Weather Flow

The peak wet weather flow is obtained by adding inflow and infiltration to the peak dry weather flow. In designing for an existing facility, flow measurement shall be used in lieu of calculations for the pre-existing developed area.

6. Minimum Flow

7. The minimum flow is derived from the following formula:

$$Q_{min} = [0.2 * (0.0144 \times F)^{0.198}] * F$$

B. Determination of Pipe Size

1. Minimum Size

The minimum diameter of all gravity wastewater mains shall be eight (8) inches. For service line sizes, refer to the NBU Standard Details. Wastewater main standard sizes are 8-inch, 12-inch, 15-inch, 18-inch, 24-inch and 6-inch multiples thereafter.

2. Design Requirements

For wastewater mains, fifteen (15) inches in diameter or smaller, use the larger size as determined below:

- a. The main shall be designed such that the Peak Dry Weather Flow shall not exceed 65% of the capacity of the pipe flowing full.
- b. The main shall be designed such that the Peak Wet Weather Flow shall not exceed 85% of the capacity of the pipe flowing full.

For wastewater mains, eighteen (18) inches in diameter or larger, the main shall be designed such that the Peak Wet Weather Flow shall not exceed 80% of the capacity of the pipe flowing full.

3. Design Velocities

The minimum design velocity calculated using the Peak Dry Weather Flow shall not be less than two (2) feet per second (fps). The maximum design velocity calculated using the Peak Wet Weather Flow should not exceed ten (10) fps. Velocities in excess of 10 fps may be considered under special conditions where no other options are available. In such cases, proper consideration shall be given to pipe material, abrasive characteristics of the wastewater flows, turbulence and displacement by erosion or shock.

4. Minimum Slope

Minimum allowable slope for mains in the New Braunfels Utilities service area shall conform with the Texas Commission on Environmental Quality standards (reference table below).

Sizes of Pipe In Inches I.D.	Minimum Slope In Percent	Maximum Slope In Percent
8	0.34	8.40
10	0.25	6.23
12	0.20	4.88
15	0.15	3.62
18	0.12	2.83
21	0.10	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	Calculate	Calculate

C. Design Considerations

1. Materials and Standards

All materials and appurtenances shall conform to the NBU Standard Products List and Standard Specifications.

2. Protecting Public Water Supply

No physical connection shall be made between a drinking water supply and a wastewater pipe or any appurtenance thereof. An air gap of a minimum of two inlet pipe diameters between the potable water supply and the overflow level connected to the wastewater pipe shall be provided.

3. Location

The location of the wastewater main shall be in conformance with the NBU Standard Details (location shall be center of street). Alternative assignments must be approved by NBU.

4. Separation Distances

- The separation between water and wastewater mains must comply with TCEQ rules or have a variance approved by TCEQ before submittal to NBU.
- The separation between NBU water and wastewater infrastructure and dry utilities shall be a minimum of 3 feet (outside to outside).

- c. Maintain a minimum 2-foot vertical clearance where the wastewater main crosses stormwater infrastructure. Steel casing must be used when wastewater mains cross under box culverts, large storm drain pipes (48 inches or greater in diameter), or multiple barrel storm drains of any size. Steel casing sizes shall be in accordance with NBU Specifications and must extend 5 feet beyond the outer diameter of the stormwater infrastructure.

5. Steep grades

Where the pipe grade exceeds 8 percent and the construction is outside of any pavement, concrete retards conforming to the NBU standards will be required at intervals of no more than 25 feet (preferably at joint locations).

6. Depth of Cover

Mains installed in undisturbed natural ground in easements of undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 48 inches of cover below finished grade.

Mains installed in existing or proposed streets, roads or other traffic areas shall be laid with at least 48 inches of cover below finished grade.

Laterals shall be laid with at least 36 inches of cover below finished grade

7. Proposed and Existing Wastewater Mains and laterals are to be protected as follows:

- a. Concrete encasement shall be used if there is less than 48 inches of cover between the top of a proposed wastewater main and 36 inches to the top of a proposed wastewater lateral to finished grade.
- b. Concrete saddle shall be used if there is less than 48 inches of cover between the top of an existing sewer main and 36 inches to the top of an existing service laterals to finished grade.
- c. Concrete encasement must be used if there is less than 2 feet between outside diameters of existing wastewater main and storm sewer.
- d. Steel encasement must be provided if the wastewater main is installed under single storm sewer pipes with diameter 48 inches or larger, box culverts of any size, or multiple-barrel storm sewers of any size. Steel encasement will extend 5 feet beyond the outer diameter of the storm sewer.

8. Turbulence

Wastewater lines shall be designed to minimize turbulence to prevent release of sulfide gases and subsequent corrosion. Polymer manholes will be required at areas of high turbulence.

9. Wastewater mains shall be laid in straight alignment with uniform grade between manholes. Curves are not permitted.

D. Manholes

All manholes shall have rings and covers with a concrete collar per Standard Detail 329.

1. Location

Manholes shall be located and spaced to facilitate inspection and maintenance of the wastewater main. Manholes shall be placed at the following locations:

- a. Intersections of mains.
- b. Horizontal alignment changes.
- c. Vertical grade changes.
- d. Change of pipe size.
- e. Change of pipe material.
- f. The point of discharge of a force main into a gravity wastewater main.
- g. Intersection of service lines to main lines 24 inches and larger.
- h. The point of connection of a building service line to the public wastewater service stub for multi-family projects exceeding fifteen (15) dwelling units
- i. The point of connection for commercial developments with use of a 2-inch domestic water meter or larger.
- j. At other locations as required by the City of New Braunfels Industrial Waste Ordinance.

2. Spacing

Manhole spacing for lines smaller than 24 inches shall not exceed 500 feet. Spacing may be increased for mains larger than 24 inches, subject to approval by NBU in writing.

3. Covers

All manholes shall have bolted, watertight covers. Manholes constructed of polymer concrete shall have composite covers per NBU specifications.

4. Corrosion Prevention

Manholes shall be constructed of Portland cement concrete with interior lining of a corrosion resistant material or polymer concrete per manufacturers approved on the NBU SPL. Polymer concrete is required for manholes on mains 18-inch diameter and larger, at force main discharge points, or at drop manholes with high corrosion potential.

5. Manhole inverts must be constructed in a way that TV equipment can access the invert and have a minimum drop of 2.5% from invert in to invert out.
6. Where new construction ties into an existing manhole, the existing manholes must be lined, coated, or replaced with a corrosion resistant material.
7. Existing wastewater invert elevations must be field verified.
8. No turns less than 90 degrees or greater than 270 degrees are allowed.

9. All lines into manholes, including drop connections, shall match crown-to-crown where feasible. Any deviation must be approved in advance by NBU in writing.
10. Drop manholes will have a maximum of 8 foot of drop and are not allowed where main size exceeds 15 inches. The minimum distance before requiring a drop pipe is 2 feet of drop.
11. Manholes shall have the following minimum sizing:
 - a. 48 inches for mains up to 18 inches in diameter
 - b. 60 inches for 24-inch mains
 - c. 72 inches for 30-inch and 36" inch mains
 - d. 84-inch diameter for mains 48 inches and larger.

E. Ventilation

Ventilation shall be provided as shown in NBU Details 333 and 344 and as required by TCEQ Rules and Regulations. Manhole covers with holes are not permitted.

F. Inverted Siphons

When justified and approved by NBU in writing, siphons shall have a minimum of two barrels. The minimum pipe size shall be eight (8) inches with a minimum flow velocity of 3.0 fps at peak dry weather flow. The minimum dry weather flow shall be used to size the smallest barrel. Three-barrel siphons shall be designed to carry the capacity of the incoming gravity wastewater mains(s) with one barrel out of service.

An additional corrosion resistant pipe shall be designed to allow for the free flow of air between the inlet and outlet siphon boxes. The diameter of this air jumper shall not be smaller than one-half the diameter of the upstream wastewater pipe. Air jumper pipe design shall provide for removal of condensate water that will collect in the pipe.

Siphon inlet and outlet structures shall be manufactured of polymer concrete and shall provide for siphon cleaning and maintenance requirements.

G. Service Lines

Wastewater service lines, between the main and property line, shall have an inside diameter not less than six (6) inches. The minimum grade allowed for service lines is two (2) percent. In all new systems, grade breaks exceeding allowable joint deflection must be made with approved fittings and shall not exceed a cumulative total of 45 degrees. No service connections shall be made to mains larger than 15 inches in diameter.

Services to lots will terminate at the property line with a cleanout or will extend four (4) feet past the underground electric conduit if electric is installed in the front easement. Services must have a minimum of thirty-six (36) inches of cover. Cleanout shall be installed at the property line. Service to lots having a five (5) foot by five (5) foot

water/wastewater easement will terminate within the easement. See NBU Standard Details for more information.

Each unit in a duplex, triplex, or fourplex shall be provided with an individual sewer service.

H. Lift Stations and Force Mains

Lift stations are discouraged and will be allowed only where conventional gravity service is not feasible. All lift stations shall comply with the requirements of NBU's Lift Station Design Criteria, as amended. This subsection details the specific design criteria for force mains. Additional requirements for individual lift stations and their associated force mains may be imposed by NBU as conditions warrant.

In addition to these criteria, all lift stations must meet the Texas Commission on Environmental Quality Chapter 217 rules and NBU Standard Specifications.

1. Force Main Design

- a. All force mains shall be ductile iron with non-corrosive lining, ASTM D2241 PVC SDR 21 or better (integrally colored green), AWWA C900 PVC DR 21 or better (integrally colored green), or an approved HDPE DR-11 or better with a minimum diameter of four (4) inches.
- b. Force main pipe within the lift station shall be flanged. Flexible fittings shall be provided at the exit wall.
- c. Force mains shall be sized so that the flow velocity is between three (3.0) and six (6.0) feet per second at ultimate development. During initial development phases, flow velocities may be as low as two and one-half (2.5) feet per second.
- d. All force mains shall be provided with a parallel secondary force main or other means of conveying the design flow to the downstream gravity sewer system while the primary force main is out of service. The capacity of the secondary force main shall be held in reserve and will not be included in the overall system capacity for normal and peak flow operations.
- e. Where secondary force mains are provided to meet the requirement above, valves or other suitable methods shall be provided to allow for reliable and rapid switchover between the primary and secondary mains.
- f. The force main profile must be designed with a smooth upward gradient unless otherwise prevented by local topography. High points in the line requiring combination air/vacuum valves are to be minimized.
- g. The maximum time required to flush the force main shall be calculated on the basis of average dry weather flow. Flush time shall be calculated for average dry weather flow using the following equations:

$$T_{flush} = (t_f + t_e) \times \frac{(Force\ Main\ Length)}{(t_c/2) \times (V_{fm}) \times (60\ sec/min)}$$

Where:

t_e = Time to empty wet well in minutes

t_f = Time to fill wet well in minutes

V_{fm} = Flow velocity in the force main in feet per second

t_c = Pump cycle time in minutes

$$*t_e = \frac{V}{q-i}$$

i = average dry weather flow in gpm

V = volume of wet well between "pump on"
and "pump off" elevations in gallons

q = Pump capacity in gpm

*See NBU's Lift Station Design Criteria for further information on "Wet Well Detention Time."

- h. Odor and corrosion control shall be provided for the force main if the force main detention time exceeds 30 minutes.
- i. Location and size of all air release valves shall be evaluated for odor or nuisance potential to adjacent property by the design engineer.
The use of air release valves shall be restricted to installations where there are not possible alternatives.
- j. Sulfide Generation Potential
Lift station/force main systems shall be evaluated for their sulfide generation potential and their ability to achieve scouring velocities during average dry weather flow periods. If the evaluation indicates that sulfide concentration of greater than 2 ppm and solids deposition are likely, the design shall:
 - 1) define a workable sulfide control technique that will minimize sulfide formation in the force main,
 - 2) include "pig" launching stations and recovery points to allow cleaning of the force main, and
 - 3) protect the gravity main and manholes downstream of the force main from corrosion. The length of pipe to be protected shall be determined on a case by case basis.
- k. Thrust restraint when required shall be shown on the plan and profile views.
- l. Force mains must terminate in a manhole constructed of polymer concrete. The flowline for the force entering the manhole must match the flowline for the gravity pipe leaving the manhole.

2. Water Hammer

- a. Calculations for water hammer showing maximum pressures, which would occur upon total power failure while pumping, shall be provided using the following equations:

$$p = \frac{a \times v}{2.31 \times g} + \text{operating pressure of pipe (psi)}$$

$$a = \frac{12}{\{(w/g) \times [(1/k) + (d/(E \times t))]\}^{0.5}}$$

Where:

p = water hammer pressure (psi)
a = pressure wave velocity (ft/s)
w = specific weight of water (62.4 lb/ft³)
g = acceleration of gravity (32.2 ft/s²)
k = bulk modulus of water (300,000 psi)
d = inside diameter of pipe (inch)
E = Young's modulus of pipe (psi)
t = pipe wall thickness (inch)
v = flow velocity in pipe (ft)
L = length of force main (ft)

- b. A cyclic fatigue life analysis must be provided in the Engineering Report for all proposed PVC force mains per the PVC Pipe Association's "Force Main Design Guide for PVC Pipe."