NAVAJO AREA STANDARDS
&
CONSTRUCTION REQUIREMENTS

Reviewed by
NAVAJO NATION and IHS STANDARDS COMMITTEE

TECHNICAL SPECIFICATIONS
FOR
MATERIALS AND WORKMANSHIP
FOR WATER AND WASTEWATER FACILITIES

MARCH 2002

TECHNICAL SPECIFICATIONS FOR MATERIALS AND WORKMANSHIP OF WATER AND WASTEWATER FACILITIES

TABLE OF CONTENTS

SECTION PAGE

Definition of Terms

Owner: The organization or its representative authorizing and administering the construction project.

Contractor: The organization or its representative performing the construction.

Operating Utility: The organization or its representative operating the water and wastewater utility affected by the construction.

Roadway Authority: The authority or agency with jurisdiction over the roadway.

Approved Equal: A substitute in materials that is considered by the **Operating Utility** to be equal to the item listed in the specifications or standards.

TECHNICAL PROVISIONS

TP 1.0 EXCAVATION, TRENCHING, AND BACKFILLING FOR WATER AND SEWER UTILITIES

1.01 Scope of Work

The work covered by this section includes the furnishing of all plant, labor, tools, equipment, and material, and performing all operations in connection with excavating, trenching and backfilling, for installations of all water/wastewater utility pipelines, related structures and accessories. This includes the necessary clearing and grubbing, pavement cutting, compaction, pavement restoration, grading, and cleanup, all in accordance with these Technical Provisions and applicable drawings. The final installation also shall meet the requirements of Section 2.0, Water and Sewer Line Separation Requirements.

If there is a conflict between these Technical Provisions and any other section of the specifications and/or drawings, then the most stringent, as determined by the Owner shall apply.

1.02 Layout and Staking

All layout and staking for site work shall be performed by a licensed engineer or land surveyor, approved by the Owner, who is to be paid by the Contractor, unless other arrangements are negotiated. Copies of survey notes shall be submitted to the Owner, with one or more copies to remain on the job site at all times.

1.03 Protection of Excavations

The Contractor shall provide suitable sheathing, shoring and bracing to protect all excavations as required, to provide safe working conditions, as directed by the Owner and in conformance with applicable OSHA, and all other safety regulations. Damages resulting from settlements, slides, cave-ins, flooding, pipeline breaks, and other causes shall be repaired by the Contractor at his expense. Suitable signs shall be so placed as to show in advance where construction, barricades, or detours exists.

The Contractor shall at all times perform his work so as to insure the least possible obstruction to traffic, inconveniences to the general public and the residents in the vicinity of the work, and to insure the protection of persons and property in a manner satisfactory to the Owner. No road or street shall be closed to the public except with the permission of the proper authority. Fire hydrants on or adjacent to the work site shall be kept accessible to fire fighting equipment at all times. Temporary provisions shall be made by the Contractor to insure the use of sidewalks, and the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches.

1.04 Protection of Existing Utilities

It shall be the Contractor's responsibility to determine the locations of all known existing underground utilities not shown on the drawings and to confirm the exact locations of those existing utilities shown on the drawings. All existing utilities shall be protected from damages during excavation and backfilling of trenches and if damaged, shall be repaired at the expense of the Contractor.

1.05 Excavation

1.05.01 General

It is expected that all excavation required for the performance of the work shall be made by open cut methods unless otherwise shown on the drawings or as required by applicable encroachment permits.

1.05.02 Grading and Stacking

All grading in the vicinity of the construction shall be controlled to prevent surface water from flowing into the excavation. Any water accumulated in the excavation shall be removed by pumping or other approved methods. During excavation, material suitable for embedment and backfilling shall be piled in an orderly manner a sufficient distance back from the edges of the bank to avoid overloading and to prevent slides or cave-ins. Material unsuitable for backfilling shall be hauled from the job site and disposed of by the Contractor at approved disposal sites.

1.05.03 Pavement Cutting

Where it is necessary to remove sections of asphalt pavement, the asphalt shall be clean-cut with approved equipment in a neat line 6-inches back from the outside edge of the excavation in order to provide a key when restored.

Where it is necessary to remove sections of concrete pavement, the concrete shall be saw-cut to a depth of not less than 1-1/2-inches with neat vertical lines in such a manner that the adjoining surfaces will not be damaged.

1.05.04 Rock Excavation

If given special consideration, rock is considered to exist when excavation cannot be accomplished using a 790E John Deere Class track hoe with a rock bucket without stressing the machine. The Owner shall be the sole party in determining the existence of rock and the appropriate means of removal. The quantity of rock shall be determined in cubic yards of material removed. All other trenching and excavations, regardless of materials encountered, equipments used, or methods required for excavation, will be unclassified.

1.05.05 Dewatering

The Contractor shall remove and dispose of all water entering the trenches and shall keep the trenches water free until the water or sewer lines and other appurtenances are in place. In no case shall water, earth, or any foreign materials be allowed to enter the water or sewer pipelines.

1.05.06 Excavation for Structures

Excavation for items such as manholes, valves, foundations, catch basins, culverts, subterranean form work, and other structures shall be to the necessary depth and sufficient width to leave at least 12-inches of space between the structure's outer surface and the embankment or shoring used to stabilize the banks.

1.05.07 Over-Excavation

Whenever solid or loose rock, rocky soil with rocks larger than 3/4-inches in their largest dimension, or otherwise unsuitable soils which are incapable of properly supporting the pipe or structure are encountered in the trench bottom, all unsuitable material, as determined by the Owner, shall be over-excavated to a minimum depth of 6-inches below the pipe or structure and removed.

Except at locations where over-excavation is required, care shall be taken not to excavate below the depths indicated. In the event of accidental over-excavation, the trench bottom grade will be restored in the same manner as areas intentionally over-excavated.

1.05.08 Trench Excavation

The sides of all trenches for the installation of utility piping systems shall be as nearly vertical as soil conditions will permit from ground level to the pipe. Except for the trenching of 1-inch water service lines, the width of the trench shall not be less than 16-inches nor more than 30-inches wider than the outside diameter of the pipe barrel. Trench excavation shall be centered on pipe alignment such that a minimum clear space of 8-inches is provided on each side of the pipe. Trench width above the level of the top of the pipe may be as wide as necessary for shoring or sheathing and for proper installation of the work.

The depth of all trenches shall be as indicated on the drawings. If not otherwise specified, the depth of all trenches shall be in accordance with the specifications for the installation of waterlines and sewerlines.

Unless otherwise required by applicable permits to be less, the maximum length of trench that may be left open at any one time shall not exceed 500 feet.

1.06 Placement and Compaction of Pipe Embedment and Backfill Material

1.06.01 Pipe Embedment

Pipe embedment is defined as that material required to bring the trench bottom up to grade and that material placed alongside and above the pipe to a level of at least 6-inches over the top of the pipe. Pipe embedment shall be selected earth or sand which contains no stones, dry or frozen lumps greater than 3/4-inch in diameter, or other unsuitable material as defined by the Owner. Embedment and the first 6-inches of backfill above the top of the pipe in rock excavation shall be done in the presence of the Owner. Any backfilling, done in violation of this provision shall be cause for removal and replacement at the expense of the Contractor even though the work is found to be in accordance with these specifications.

Bedding: Bedding is that portion of pipe embedment zone beneath the pipe. If the native soil is suitable for bedding, the bottom of the trench shall be accurately shaped to provide uniform bearing and support for the entire length of the pipe. Bell holes shall be excavated to provide minimum clearances of 2-inches below the couplings or bells. Imported bedding material shall likewise be placed to provide uniform and adequate longitudinal support under the pipe. Bedding material shall be placed and compacted in lifts not to exceed 6-inches in loose measure.

Haunching: Haunching is that portion of the pipe embedment zone from the bottom of the pipe to the springline of the pipe. Haunching material shall be placed and hand tamped to provide adequate side support to the pipe while avoiding both vertical and lateral displacement of the pipe from proper alignment.

Initial Backfill: Initial backfill is that portion of the pipe embedment zone from the springline of the pipe to a minimum level of 6-inches above the top of the pipe. Initial backfill material shall be placed and compacted in lifts not to exceed 6-inches in loose measure. Compaction shall be performed in such a manner so as to avoid damage and disturbance of the embedded pipe.

Final Backfill: Final backfill is defined as that material used in the area between the Initial Backfill and the existing ground surface. Material shall be placed and compacted in lifts not to exceed 6-inches in loose measure except as otherwise specified.

1.06.02 Compaction Requirements

Unless otherwise specified by permit issued by the roadway authority or by special arrangement between the Operating Utility and the Owner, bedding, haunching, initial backfill, final backfill, and gravel resurfacing shall be compacted to the following percentages of the maximum density as determined by ASTM D1557 (If using Standard Proctor ASTM D-698, add 5% to all

compaction requirements listed in the table below). In-place densities of materials shall be determined by the sand-cone method, ASTM D1556 or by nuclear method, ASTM D2922.

Percent of Maximum Density - D1557

Backfill Location	Bedding Backfill	Haunching Backfill	Initial Backfill	Final Backfill
Roadway Rights-of-Way Within Roadway Prism	95% *	95%	95%	95%
Roadway Rights-of-Way Outside of Roadway Prism	90% *	90%	90%	95%
All Other Conditions	90%	90%	90%	90%

* or the existing conditions within the undisturbed bottom of the trench.

1.06.03 Water Jetting

The introduction of water to the pipe embedment or final backfill material shall not be permitted as a means of compaction.

1.07 Imported Backfill

1.07.01 Imported Pipe Embedment

If the native soil is unsuitable, the Contractor shall import suitable pipe embedment material. Pipe embedment shall be select earth or sand which contains no stones, dry lumps, or frozen lumps greater than 3/4-inches in diameter and shall be defined as 100% passing 3/4-inches, 40-99% passing # 4 sieve and 30% or less passing # 200 sieve. Unsuitable material is defined as solid or loose rock, soils with rocks larger than 3/4-inches in their largest dimension, or other unsuitable soils which are, as determined by the Owner, incapable of properly supporting the pipe.

1.07.02 Imported Final Backfill

If the native soil is unsuitable for use as final backfill, the Contractor shall import suitable final backfill. Imported final backfill may be any material which is locally available and is capable of being compacted to the required density. This material shall be free of boulders and rocks larger than 6-inches in their smallest dimension, frozen clumps of dirt, organic material, or rubble which could damage the pipe.

1.08 Bedding and Backfill for Structures

1.08.01 Bedding

Bedding material for structures is defined as that material beneath the structure. This material shall be as specified in the standard detail for each structure.

1.08.02 Backfill

Backfill for structures is defined as that material from the bottom of the structure to the existing ground surface. This material and the required compaction of such shall be the same as that specified for in the final backfill on pipelines, or as specified in the drawings.

1.09 Settlement of Adjacent Structures

Throughout the warranty period of the contract, the Contractor shall be required to fill and compact any areas where settlement has taken place and shall also be responsible for the settlement of any adjacent structure or object caused by any excavation performed under his contract.

1.10 Surface Restoration and Resurfacing

1.10.01 Surface Restoration

The following requirements shall be followed unless alternative specifications are set forth by the roadway or other rights-of-way crossing permits, or as arranged between the Operating Utility and Owner.

After the piping and structures have been installed and all backfilling completed, areas which were disturbed shall be brought to true grades. All slopes shall be trimmed and dressed, and all surfaces graded to maintain existing drainage. All streets, alleys, driveways, sidewalks, curbs, or other surfaces which have been disturbed or damaged shall be resurfaced or replaced. All excess excavated materials shall be properly disposed of by the Contractor.

As required by the operating utility, the contractor shall install the utility brand carsanite markers at all road crossings, water valves, fittings, junctions, connections, points of intersection, or at a minimum, every 1500 feet. Naturally, this would apply only within the rural areas, along stretches of roadways, or as requested by the operating utility. This is also a requirement for marking sewer manholes, cleanouts, and service connections.

1.10.02 Roadway Patching

Whenever existing roadways are disturbed during the course of construction, the Contractor shall restore the roads to their original condition.

For ease of compaction, the Contractor may use well graded gravel, crushed stone, or flowable fill from a Ready Mix plant as backfill as approved by the roadway agency. The material shall be clean, vary in size from 3/8-inches to 1-1/4-inches with not more than 10 percent of the material less than 3/8-inches in size and shall be compacted in 6-inch layers or as directed by the Owner. Flowable fill is defined as one bag concrete, with gradations of 100% passing the 3/8 sieve, and less than 25% passing the #200 sieve. The slump should be between 5" and 8", and the 28 day strength should be between 50 psi and 150 psi.

Surfacing shall be replaced where the roadway has gravel, crushed stone, asphaltic, or concrete surfacing. Gravel or crushed stone shall be replaced in quantities and locations as directed by the Owner, or as required by the roadway permitting authority. Asphalt mix or concrete surfacing shall be replaced, and in the case of asphalt, appropriately compacted (e.g., tamped) in the roadway to a depth equal to existing roadway surface but not less than 2-inches in asphalt or 6-inches in concrete. A compacted stabilized gravel or crushed stone base 6-inches in depth shall be placed in the roadway at all locations where surfacing is required prior to placement of the bituminous or concrete wear course, unless other requirements are stipulated by the roadway authority.

The Contractor shall obtain any and all necessary written permissions, easements, and permits from federal, state, and county agencies prior to beginning any roadway excavation.

TECHNICAL PROVISIONS

TP 2.0 WATER AND SEWER LINE SEPARATION REQUIREMENTS

2.01 General

Water lines located near sewers present conditions for serious potential cross contamination. Protection from cross contamination can be provided by separation of the facilities and use of special piping materials. For measuring separation between pipes, all measurements shall be the clearance between pipes (pipe O.D. to pipe O.D.).

2.02 Horizontal Separation of Water and Sewer Lines

When water and sewer mains or service lines are laid parallel to each other, the horizontal distance between the water and sewer lines shall not be less than 10 feet. Each line shall be laid in a separate trench or the space in between filled with compacted fill. The requirements for this separation shall apply to all other buried utilities except the distance may be reduced to five feet for secondary electric, and gas distribution lines less than 60 psig; however, all stipulations of the electric, gas, or other subsurface utilities must be met.

When physical conditions such as an existing obstruction will not allow the required 10 foot horizontal separation, the water and sewer mains may be laid closer than 10 feet if the bottom of the water main is at least 12 inches above the top of the sewer main and if prior written approval is given by the Owner.

2.03 Vertical Separation of Water and Sewer Lines

2.03.01 Water Above Sewer

When water lines cross sewer lines, the water line shall cross above the sewer line with a minimum vertical separation of 12 inches. If necessary, the depth of bury for the water line may be reduced to 36 inches (normally 42 inches) at the crossing to maintain the 12 inch vertical separation. When the minimum 12 inch vertical separation is not possible, the water line must cross below the sewer line. No joints in new water lines shall be permitted within 10 feet of crossing a sewer line.

2.03.02 Sewer Above Water

When a water line must cross below a sewer line, the minimum vertical separation between the lines is 12 inches. Backfill of the trenches shall be compacted to provide adequate support to prevent settling of the sewer line and damaging the water line.

For new water construction, the water lines shall be normal PVC or PE water distribution pipe with a 20-foot (minimum) pipe section centered on the sewer crossing. No joints of new water line construction shall be permitted within 9 feet of crossing a sewer line. While it is desirable to have all crossings perpendicular, new water line (centered on the crossing) may cross under a sewer line at a maximum of 25^{o} from perpendicular.

For new sewer construction, the sewer line shall be ductile iron pipe with gasketed joints, or approved equal, with an 18-foot section centered on the crossing. No joints in new sewer line construction shall be permitted within 9 feet of crossing a water line.

For water and sewer crossings electric, gas, or other buried facility; the standards established by that other specific utility must be met.

2.04 Water Line Separation from Sewer Manholes

No water pipe shall pass through, under, or come into contact with any part of a sewer manhole.

2.05 Water and Sewer Service Line Separation Within 5 feet of the House

This section shall apply to that portion of water and sewer service lines located within five feet of the house. All lines within five feet of the house will be considered as part of the house plumbing. For new construction, all service lines shall have a 10 foot minimum horizontal separation. This can best be accomplished by having the water and sewer service lines exit the house 10 feet apart or from different sides. If the 10 foot separation cannot be maintained and prior written approval is obtained from the Owner, the service lines can be laid closer than 10 feet, if the bottom of the water service line is at least 12-inches above the top of the sewer service line and the water service line is continuous with no joints until the separation requirement is met.

2.06 Separations Between Water Lines and Components of the Sewage Disposal System

Waterlines shall not be installed within 10 feet of a septic tank, within 25 feet of a drain field, or 50 feet from an outhouse. Also, waterlines shall not be installed within 100 feet of the perimeter fence of an **individual** lagoon, or within 500 feet of the perimeter fence of a **community** lagoon.

2.07 Separation Between Residences and Sewer Lagoons

No permanent residence shall be within 1000 feet from the perimeter fence line of a **community** sewer lagoon, or within 300 feet from the perimeter fence line of an **individual** sewer lagoon without written consideration of the Operating Utility.

TECHNICAL PROVISIONS

TP 3.0 WATER MAINS, WATER SERVICE LINES, AND APPURTENANCES

3.01 Scope of Work

The work covered by this section includes the furnishing of all plant, labor, tools, equipment, and material; performing all operations in connection with the construction of water mains, including the placing of all necessary valves, hydrants, fittings, and appurtenances, and the construction of water service lines, including saddles, corporation stops, curb stops, water meters, domestic stops, fittings, and appurtenances, in accordance with these technical provisions and applicable drawings.

3.02 Water Mains

3.02.01 Polyvinyl Chloride (PVC) Pipe and Fittings

Fittings for PVC pipe 4-inch and larger shall be class 350 SSB mechanical joint ductile iron conforming to AWWA C153 and shall be cement-mortar lined conforming to AWWA C104 or if shown on the plans, may be Class 200 PVC Bell and Gasket conforming to ASTMs D3139 and D1784, Type 1, Grade 1, and ASTM D2241.

PVC material shall conform to ASTM Dl784, Type 1, and Grade 1. PVC pipe shall conform to ASTM D2241 and the pipe shall be PVC 1120, SDR 21 and 200 psi pressure rating or SDR 26 and 160 psi as specified on the plans. All PVC pipe joints shall be rubber compression ring type gaskets conforming to ASTM D3139 - Rieber type or equal. Special piping provisions are required when higher pressures are encountered.

Plastic pipe with scratches, gouges, or grooves deeper than one-tenth (0.10) the wall thickness shall be rejected. Localized pipe damage may be cut out and the undamaged portion of the pipe may be used with the approval of the Owner. The damaged sections of pipe shall be completely destroyed or immediately removed from the job site.

Ductile iron pipe of specific class and type as shown on the plans may be required under certain circumstances. The pipe may require polyethylene encasement. In cases where the soil environment is corrosive - the soil resistivity is less then 1000 ohm-cm, the PH is less than 4 or greater than 8.5, or sulfides or high moisture content exist in the soil, etc. - the Contractor shall be required to wrap all M.J. fittings and all Ductile Iron pipe with 9 mill polyethylene film per AWWA C105/A21.5.

3.02.02 Water Main Installation

Pipe and fittings shall be installed generally in accordance with the manufacturer's printed specifications and instructions, to the standards of the AWWA for installing the type of pipe used, and in accordance with Technical Provision 1.0, Excavation, Trenching, and Backfilling for Water and Sewer Utilities, and Technical Provision 2.0, Water and Sewer Line Separation Requirements. Minimum bury depth shall be 42-inches, unless otherwise specified, with a maximum depth of 72-inches unless specifically exempted by the engineer.

Pipe and fittings shall be carefully handled to avoid damage. Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material shall be removed, cleaned, and relaid. At times when pipe laying is not in progress, the open ends of the pipe shall be closed with a water tight plug.

Long radius curves, either horizontal or vertical, may be laid with standard pipe by deflecting at the joints. The amount of deflection at each pipe joint shall not exceed the manufacturer's printed recommended deflections. When rubber gasket pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wider on curves for this purpose.

3.02.03 Connections to Existing Mains

A tapping permit shall be obtained from the local or district Operating Utility by the Contractor and all work shall be in conformance with said tapping permit.

Connections to existing mains shall be dry connections (unless otherwise permitted by the Operating Utility) made in a neat and workmanlike manner. Each connection with an existing water line shall be made at a time and under conditions which will least interfere with water service to customers affected thereby as authorized by the Operating Utility and as evidenced by an approved tapping permit. Such connections shall be made to the satisfaction of the Operating Utility. Proper tools and fittings to suit actual conditions encountered in each case shall be utilized. The cutting of pipe for inserting fittings or closure pieces shall be done in strict accordance with recommendations of the pipe manufacturer, without damage to the pipe, or coating, and so as to leave a smooth end at right angles to the axis of the pipe.

Great care shall be taken to prevent pipeline contamination when cutting into and making connections with existing pipelines used for the conveyance or

distribution of water for domestic or public use. The Contractor shall cooperate with the Operating Utility in locating services and shall conduct his operations in such a manner that no trench water, mud, or other contaminating substances are allowed to enter the connected line or lines at any time during the progress of the work. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then swabbed with or dipped in strong chlorine solution having a chlorine content of 200 parts per million.

3.03 Valves For Water Mains

3.03.01 Gate Valves

All gate valves shall conform to AWWA Specification C509, iron body, epoxy coated, bronze mounted, resilient wedge, counter clockwise opening, inside screw, non-rising stem with O-ring seals, and 2-inch square wrench nut. Valve working pressure rating shall be 200 psi minimum. The valves shall be Mueller, Kennedy, Watrous, Dresser M&H, or approved equal with mechanical joint or push on joints as specified on the plans with appropriate transition gaskets. For operating pressures greater than 200 psi, special considerations shall be followed.

3.03.02 Valve Boxes

Valve boxes shall be installed on all buried valves and shall be 5-1/4-inch nominal diameter shaft, two-piece adjustable screw type equal to Tyler No. 6850 Series. The length of the box shall be sufficient to permit access to the valve at the specified depth of bury. Tyler Series extensions will be utilized to extend the valve box when required. The word "Water" shall be cast onto the lid.

3.03.03 Valve Installation

Before installing the valve, care shall be taken to see that all foreign material and objects are removed from the interior of the valve. The valve shall be opened and closed to see that all moving parts are in working order.

All valves shall be set and jointed to the pipe in the manner as set forth in the AWWA Standards for the type of connecting ends furnished. All valves shall be set in and tied to poured in-place concrete support blocks as per the standard detail. Valves and valve boxes shall be set plumb and valves boxes shall be placed over the valve in such a manner that the valve box does not transmit shock or stress to the valve. The cast iron valve box cover shall be set flush with, or slightly above, the finished grade. A 2-foot by 2-foot by 4-inch reinforced concrete pad shall be poured around each valve box. Before the concrete has hardened, the Contractor shall neatly scribe in the concrete pad the

valve size and a line representing the direction of flow of water through the valve.

3.04 Fire Hydrant Assembly

3.04.01 Fire Hydrant

Fire hydrants shall be of standard manufacture with the name of the manufacturer and direction of opening cast on the hydrant top. Fire hydrants shall conform to AWWA C502. The end connections shall be mechanical joint. The hydrants shall be equipped with a breakaway safety flange and safety stem coupling at or near the bury line such that a heavy impact would minimize breakage of hydrant parts. The hydrants shall open counter clockwise, have a 5 1/4-inch or larger main valve opening, 6-inch inlet, 1 1/2-inch tapered pentagonal operating nut, 2 hose nozzles 2 ½-inches in diameter, and a 4 ½-inch pumper nozzle, all with National Standard hose threads. The hydrant shall be Mueller A423 or Kennedy K81A.

3.04.02 Hydrant Connections and Auxiliary Gate Valves

An auxiliary gate valve and valve box shall be installed adjacent to each fire hydrant per the standard detail or as specified on the plans. The pipe between the fire hydrant and the auxiliary gate valve and between the auxiliary gate valve and the main shall be 6-inch minimum.

3.04.03 Fire Hydrant and Guard Installation

Before installing any hydrant, care shall be taken to see that all foreign materials and objects are removed from the interior of the barrel. The hydrant shall be opened and closed to see that all moving parts are in working order.

Hydrants shall be installed plumb with the pumper nozzle toward the street. The hydrant shall be set per the standard detail for the hydrant and guard.

3.05 Thrust Blocking

Thrust blocking as detailed in the standard drawings shall be placed at bends, caps, tees, crosses, and fire hydrants. Blocking shall be concrete mix poured in place. Concrete blocking shall bear against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to block weep holes or obstruct access to the joints of the pipe or fittings. The concrete shall not cover nuts and bolts of joints or fittings. Ductile Iron Joint Restraints used in conjunction with Mechanical Joint fittings may be used as a substitute for concrete blocking.

3.06 Water Main Crossings

3.06.01 Wash Crossings

Water mains shall be installed as shown on the plans. The Contractor shall divert surface flows, conduct dewatering, and perform all steps necessary to maintain proper bedding conditions and alignment. Typically a 6-foot minimum depth of bury is required at the centerline of the wash.

3.06.02 Road Crossings

In lieu of boring, roads may be open cut for water line and casing installation. The original surface pavement on all open cut roadways shall be either cut square or sawed straight. As with open cut, if boring is required the steel conduit shall be extended from right-of-way to right-of-way. The Contractor shall obtain written permission from the appropriate agency prior to beginning any roadway excavation. Backfill within the limits of a roadway prism may require special compaction in accordance with the requirements of the roadway crossing permits.

Surfacing shall be replaced where the roadway has gravel, concrete, or asphaltic paving in the same thickness as were removed, or as specified by the Owner, and completed as soon as possible following backfilling.

PVC water line road crossings shall be installed within steel casing on approved casing chocks or redwood skids secured to the pipe with stainless steel straps. Ductile Iron pipe resting on the bells also may be used as the carrier pipes. The casing ends shall be sealed with an approved rubber boot or 9 mil plastic sheeting with stainless steel clamps. Casing pipe shall be straight welded SCH 10 steel pipe ¼" wall unless otherwise specified. An alternative method for roadway crossing is to install ductile iron pipe, Class 52, bell and spigot, direct bury by open cut excavation from right of way to right of way. This would be considered when crossing minor roads or trails, or for congested area within an urban setting.

If the water line crossing is a looped system, mainline gate valves shall be installed on each side of the roadway. If not a looped system, then only one mainline gate valve is required on the up stream side of the roadway.

3.07 Water Service Connections Materials

3.07.01 Polyethylene (PE) Pipe

Polyethylene (PE) pipe shall be 1-inch IPS, 200 psi, SIDR 7 in conformance with ASTM D2239. The pipe shall be produced from a high density ultra-high molecular weight PE pipe compound, PE 3406 or PE 3408 which conforms to the latest revision of ASTM D1248. The pipe shall be equal to Driscopipe 5100 Ultral-line or Yardley Ultra-high Molecular Weight PE. The designation PE 3406 or PE 3408 shall be stamped on the pipe.

3.07.02 Service Line Fittings and Connections

Fittings and connections for PE pipe shall be made with non-flare compression connections and shall be Mueller Insta-Tite H-15426, or approved equal. All threaded connections from the water main to and including the inlet of the domestic stop shall be standard iron pipe (I.P.) threads.

3.07.03 Saddles

Saddles shall be specific for the type, size, and pressure rating of the mainline as recommended by the saddle manufacturer. Saddles shall be double strapped, double banded, or of the contoured band type. Saddles and saddle components shall be brass, bronze, or stainless steel. Tap threads shall be FIP. Acceptable saddles include Ford S71 and Mueller H-13478 for IPS PVC O.D. pipe, or Ford 202B or approved equal for DI and AC O.D. pipe.

3.07.04 Corporation Stops

Corporation stops shall be bronze alloy with MIP threads inlet by FIP threads outlet. They shall be equal to Mueller H-10046 corporation stops or Ford Type FB1700.

3.07.05 Curb Stops

Curb stops shall be 1-inch bronze alloy, quarter turn check, FIPT x FIPT end connections, with tee head and 30-inch (approx.) stationary operating rod. Curb stops shall be Minneapolis pattern top threads with resilient O-rings seals and equal to the Mueller B-20287, or Ford B11-444M or AY McDonald 6105.

3.07.06 Curb Stop Boxes

Curb stop boxes shall be the extension type, cast iron with 1 1/2-inch upper section. Curb box lid shall be cast iron and have a countersunk brass pentagon head plug. The curb stop boxes shall be Minneapolis pattern 2-inch base bushed to 1 1/2-inch and equal to Mueller H-10302 or Ford Type PXL. The finished elevation of the plug shall be such that it extends just slightly above the ground surface. The stationary rod shall be sized so that the top extends 2 to 4-inches below the top of the curb box. An 18-inch by 18-inch by 4-inch depth reinforced concrete collar shall be poured around each curb box.

3.07.07 Water Meters

Water meters shall be of cast bronze construction with magnetic drive and a hermetically sealed register which reads in gallons. The meter shall accurately record flows from 1/4 to 20 gpm and shall be a 5/8-inch by 3/4-inch Sensus SR model with frost plate. The Sensus SR II model is not acceptable.

3.07.08 Meter Yokes/Coppersetters

Yokes or coppersetters for water meters shall have 3/4-inch ID x 12-inch riser, with a ball valve with padlock wing angle on the inlet, with a meter nut on the outlet side, and in the base, a 1-inch double purpose union swivel inlet and outlet connection. Yokes shall have an eye for the insertion of a cross brace and equal to Ford VB 72-12W-11-44 or AY McDonald 20-212WX-DD-44. The cross brace shall be a 1/2-inch OD PVC pipe or # 4 rebar 18-inches in length. The tandem coppersetter shall have an "S" tube with two bronze adapters, iron thread by meter nut, for the pressure regulators. The PRV shall be Watts Series 25AUB or approved equal.

3.07.09 Meter Boxes

Meter boxes shall be 20-inches diameter, 30-inches high nonmetallic by DFW or approved equal and shall be extended a minimum of 1-inch below the service line. The meter box lid shall be a cast iron, double lid cover with 11-1/2-inches lid opening, plastic or aluminum inner lid, and locking outer lid with pentagon head worm type lock. The meter box cover shall be equal to Castings model M-70.

3.07.10 Domestic Stops (Not part of the NTUA's facilities)

Domestic stops shall be a 1-inch bronze alloy, quarter turn check, FIPT x FIPT end connections, with tee head and 39-inch stationary operating rod. They shall have resilient O-rings seals and equal to the Ford B11-444 or AY McDonald 610.

3.07.11 Domestic Stop Valve Boxes (Not part of the NTUA's facilities)

The domestic stop valve box shall consist of 3-inch diameter PVC-DWV pipe with a 3-inch hub by FIP threaded adapter with a 3-inch MIP threaded plug for the lid. The finished elevation of the plug shall be such that the stationary rod is located immediately below or within the plug so that the rod can be operated with an adjustable wrench from ground surface with the plug removed. The 3-

inch diameter PVC-DWV pipe shall be cut so that the top of the adapter extends 3 to 6-inches above ground surface.

3.08 Water Service Line Installation

Water service lines and appurtenances shall be installed in accordance with TP 1.0, Excavation, Trenching, and Backfilling for Water and Sewer Utilities, and TP 2.0, Water and Sewer Line Separation Requirements. A minimum of 3 feet of cover is required for water service lines.

Service lines shall be cut using tools specifically designed to leave a smooth, even, and square end on the pipe. The cut ends shall be reamed to the full inside diameter of the pipe. Pipe ends are to be connected using fittings which seal to the outside surface of the pipe which shall be cleaned to a sound smooth finish before installation. Splices shall be kept to a minimum and no splices shall be made within 10 feet of any sewer line.

All 1-inch service connections to water mains 4-inches or larger shall be made using saddles (tap tees are permitted for new construction). Service connections to 2-inch pipe shall be made using tees. Particular care shall be exercised to assure that the main is not damaged by the installation of the saddle. The saddle shall be aligned on the water main so that it is at a 45 degree angle above the springline of the pipe. The hole drilled into the pipe through the saddle shall be no smaller than 1/8-inch less than the size of the saddle.

Where required, the Contractor shall reconnect existing water service connections to the new water mains using materials specified herein. Individual pressure reducing valves, where required, shall be installed on a tandem meter yoke as shown on the standard detail. Prior to installation of the meter and connection to the building or house, the entire water service line and appurtenances shall be flushed.

3.09 Pressure Tests

Where any section of a waterline is provided with concrete thrust blocking for fittings or hydrants, the pressure tests shall not be made until at least 48 hours after installation of the concrete thrust blocking unless otherwise approved by the Owner.

3.09.01 Pressure Test

All test equipment, labor, water for testing, appurtenances and material, and performance of all operations in accordance with the specifications are the responsibility of the Contractor.

All pipelines shall be tested for water tightness up to the individual service meter or domestic stop. The test equipment will not be provided, but is subject

to inspection by the Owner. Arrangements for water used in pipeline testing and payment for the water shall be coordinated with the Operating Utility. Pressure gauges used in testing shall be graduated at a maximum in 5 psi increments. Two gauges will be used simultaneously for verification of the gauges' functionality. Prior to the test, the pipeline will be pressured to 10 psi above the test pressure. The pressure will then be decreased to the test pressure so that gauge responsiveness can be observed.

The test pressure shall be at least 160 psi measured at the lowest point of elevation in the test section. No section shall be tested that is greater than one mile in length or that has greater than 25 psi pressure change due to elevation. The test shall be conducted in such a manner that existing mains, services lines, and service user's plumbing are not damaged. Damage caused by testing shall be corrected at the expense of the Contractor. All connections, blow-offs, hydrants, house services up to the meter yoke or domestic stop, and valves shall be tested with the main as far as is practicable. When testing piping systems designed to operate above 160 psi, special considerations shall be arranged with the Operating Utility.

No air testing shall be allowed.

The test section shall be filled slowly with potable water and all air shall be vented from the line. The test shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption. The test shall have a minimum duration of two hours with the two hour period beginning when the test pressure is attained and the pump ceases operation.

No pipe installed shall be accepted if the leakage is greater than that determined by the following formula:

$$Q = \frac{N*D*(P)^{1/2}}{7400}$$

in which,

Q = allowable leakage in gallons per hour

N = number of joints in the pipeline being tested, this "N" being the standard length of pipe furnished divided into the length being tested with no allowance for double gasket joint caused by use of couplings instead of integral bell pipe or for joints at branches, blow-offs, fittings, etc.

D = nominal diameter of pipe in inches

P = the test pressure in psi gauge as discussed in the third paragraph of this procedure

During the test, the test pressure should not lose more than 5 psig without being pumped back up to the test pressure. The totals of the gallons of water required to hold the test pressure during the two hours plus the amount of water required to return the line to the test pressure at the end of the test period is the total leakage. If the total leakage is less than the allowable, the line can be accepted. All visible leaks will be repaired regardless of the amount of leakage. Should the test on any section of the pipeline show leakage greater than the allowable leakage, the Contractor shall locate and repair the defective pipe, fitting, or joint until the leakage is within the allowable leakage for the two hour test duration.

3.09.02 Observation of Tests

The Owner is to witness the pressure testing of waterlines. Prior to the test, the Contractor shall have all equipment set up completely, ready for operation and shall have previously successfully performed the test to verify that the test section will pass. The Contractor shall notify both the Owner and the Operating Utility a minimum of three working days in advance of the date that the Contractor plans to perform the pressure tests.

The Owner shall observe the testing to verify that the testing was performed according to the specifications and that the test data were properly and accurately recorded. The Owner will complete the required certification forms and submit them to the Operating Utility for approval. A letter of approval or disapproval of the test results will be sent from the Operating Utility to the Contractor.

3.10 Disinfection

A liquid chlorine solution shall be introduced continuously into one end of the system and allowed to flow along and through all lines and appurtenances to be disinfected until a minimum of 50 ppm of chlorine is detected at representative points throughout the line. A contact period of 24 hours shall be maintained before the system is flushed out with clean water until a maximum of 0.4 ppm chlorine residual is detected. All valves shall be operated several times during the 24 hour contact period.

After disinfection, the Contractor shall collect bacteriological samples for testing at his expense. The analysis shall be performed by a laboratory certified by the State Health Department or the U.S. Environmental Protection Agency. If a positive result (unsatisfactory bacteriological test) is obtained, the system shall be disinfected and retested by the Contractor. This shall be repeated until a negative result (satisfactory bacteriological test) is obtained. Disinfection by introducing granular or tablet chlorine compounds in each pipe length is not an acceptable method of disinfection.

EXHIBIT A OF TP-3
WATER LINE PRESSURE TEST CERTIFICATION

Location of Line Tested:
A) _____ (Vicinity/State)
B) _____ (Project's Drawing Name)
C) _____ (Project's Sheet No.)
D) _____ (Project's Drawing No.)

Date of Test: _____

Gauges Manufacturer & Model: 1) _____

2) _____

Standard Length of Pipe in Test Section: _____ Feet.

Test Section _____
(Parcel, Line No., etc.)

Length (Sta.-Sta.)	Line Size (Inch)	Pipe Pressure Rating (Psi)	Test Pressure (Psig)	Observed Pressure Range (Psig)	Total Leakage (gal./ 2hrs.)	Total Leakage (gal./ 2hrs.)

The above test information is certified by:

Signature : _____

Name, Organization : _____

Address, Telephone No. : _____

: _____

Date of this Report : _____

Certification Received by : _____ On _____
Operating Utility Engineering Date

Test Results Checked by : _____
Passed ( ) Failed ( ) _____

Copy of Approval of the test sent to: _____
On _____ By _____
Date Operating Utility Engineering

EXHIBIT A OF TP-3

Allowable Leakage:

$$Q = \frac{ND(P)^{1/2}}{7400}$$

Q = Gallon per Hour

N = $\frac{\text{Total Length of Line Being Tested (ft)}}{\text{Standard Length of Pipe (ft)}}$ = _____ = _____

D = Nominal Diameter of Pipe (inches) = _____

P = Test Pressure (psig) = _____

Allowable Leakage (2 Hour Test) = 2Q = $\frac{ND(P)^{1/2}}{7400}$ X 2 = _____ (Gal.)

Are the pressure gauges graduated at a maximum of 5 psi increments? _____

Was the line pressured to 10 psi above the test pressure so that the gauge responsiveness could be observed? _____

Is the length of the test section less than one mile? _____

Is the elevation difference between the highest and lowest points in the test section less than 57 feet? _____

Are the pipes in the test section the same pressure rating? _____

Time - Description of Activity	Gauge Reading	Amount of Water Added
Total Time: hrs.		Total: gals.

Verified By: _____

Operating Utility's Representative/Date

_____

Title

EXHIBIT A OF TP-3

Test Section: _____

(Parcel, Line No., Etc.)

Length (sta.-sta.)	Line Size (inch)	Pipe Pressure Rating (psi)	Test Pressure (psig)	Observed Pressure Range (psig)	Total Leakage (gal./ 2hrs.)	Total Leakage (gal./ 2hrs.)

TECHNICAL PROVISIONS

TP 4.0 SEWER MAINS, SERVICE LINES, INDIVIDUAL SUBSURFACE SYSTEMS, AND APPURTENANCES

4.01 Scope of Work

The work covered by this section includes the furnishing of all plant, labor, equipment, and material; performing all operations in connection with the construction of gravity sewer mains and service lines, including manholes and other appurtenances, in accordance with these technical provisions and applicable drawings.

4.02 General

The sewer line shall be constructed in the location and to the grade and size shown on the drawings or as directed in writing by the Owner. Excavation, trenching, and backfilling shall be in accordance with TP 1.0 of these specifications. Inspection of service lines and manhole connections shall be accomplished before backfilling, but work covered by this section will not be accepted until backfilling has been completed satisfactorily. Any section of sewer that is found defective in material, alignment, or grade shall be corrected to the satisfaction of the Owner.

4.03 Materials

4.03.01 Polyvinyl Chloride (PVC) Sewer Pipe

Except for extensions to dead ends of 400 feet or less where 6-inch is permitted, minimum sewer main pipe size shall be 8-inch nominal diameter at 0.4% slope, and minimum sewer service pipe size shall be 4-inch nominal diameter at 2.0% slope. All PVC sewer pipe shall be made of materials conforming to the requirements of ASTM D1784, Type I, Grade I for Rigid Polyvinyl Chloride compounds. The PVC sewer pipe shall be SDR 35, Type PSM, with elastomeric gasket joints and shall meet the requirements ASTM D 3034. The pipe shall have an integral bell with a solid cross section rubber ring which has been factory assembled and securely locked in place to prevent displacement. Standard lengths shall be 20 feet.

4.03.02 Polyvinyl Chloride (PVC) Sewer Pipe Fittings

All PVC sewer pipe fittings shall be SDR 35, Type PSM, with elastomeric gasket joints and shall meet the requirements of ASTM D 3034. Service connections to new sewer mains shall be wye fittings. Connections to existing sewer mains may be wye saddles.

4.03.03 Ductile Iron Sewer Pipe

Pipe shall meet the requirements of AWWA C151, with either mechanical or push-on joints, with an interior lining of 40 mil of polyurethane or ceramic epoxy and exterior of standard bituminous coating. Thickness shall be Class 52 in all sizes.

4.03.04 Ductile Iron Pipe Fittings

Service connections to ductile iron pipe shall be via saddle-type fittings equal to the "Seal-Tite" saddle manufactured by General Engineering Co., Frederick, MD or the Fowler "Quik-Way" sewer tap. Connections between PVC sewer pipe and ductile iron pipe shall be via the appropriate size Calder coupling; however, the ductile iron pipe should be extended from manhole to manhole to minimize the use of adapters.

4.03.05 Precast Concrete Manhole Sections

Manhole sections shall conform to ASTM C 478. A polyisoprene rubber connector meeting the material and performance requirements of ASTM C923 and equal to the A-Lok Connector as manufactured by A-Lok Products Inc., Trenton, N.J., shall be used to seal between the precast manhole and the sewer pipe. Ram-Nek flexible gasket or approved equal shall be used to seal between manhole sections, grade rings, and cover ring. Bottom manhole sections shall have integral precast base or reinforced concrete floor slabs.

4.03.06 Manhole Covers and Frames

The frames and covers shall be cast iron, equivalent to a Deeter 1257, 330 pounds, with a Type C surface and pick slot. The cover minimum opening shall be 22-inches in diameter with a 6-inch high ring. The lid shall not have any holes including pick holes which penetrate the entire thickness of the lid. A 3/4-inch by 2-inch by 2-inch recessed slot with a ½-inch diameter pin, crossing the small dimension and centered along the long dimension, shall be provided in the lid in lieu of a pick hole.

4.03.07 Manhole Steps

Manhole steps shall be made of ½-inch steel rod encapsulated with copolymer polypropylene as manufactured by M. A. Industries, Inc., Kelley and Dividend Drive, Peachtree City, GA., or approved equal and shall conform to ASTM C478. The ALCO 12653A aluminum step is also acceptable. Steps shall have minimum projections of 4-inches, spaced no more than 16-inches apart, minimum overall widths of 14-inches, and thoroughly anchored into the walls.

4.03.08 Concrete

All concrete in addition to the concrete used in precast sections shall have a compressive strength of not less than 3,000 pounds per square inch at 28 days of age. The aggregates, Portland cement, and concrete shall comply with the provisions of ASTM C144 and C33, ASTM C150, Type II. The concrete mix shall be approved by the Owner and shall include no less than 5-1/2 bags of Portland cement per cubic yard. When directed by the Owner, the Contractor shall have compressive strength tests made of the concrete in accordance with ASTM Standard Specifications.

4.03.09 Sewer Cleanout and Frame

Where required on the plans, a Neenah R1791A or approved equal cast iron cleanout cover and frame shall be used on all 8-inch sewer cleanouts.

4.04 Installation of Sewer Pipe

4.04.01 Pipe Laying

All trenching, excavation, and backfilling shall be performed in accordance with TP 1.0 of these specifications. The bottom of the trench shall be shaped to give substantial uniform bearing and support for each section for the entire length of the pipe. Bell holes shall be excavated to provide a minimum clearance of 2-inches below the coupling or bell. Pipe laying shall proceed upgrade, with the spigot end pointing in the direction of the flow. Each pipe shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe. As the work progresses, the interior of the sewer shall be cleared of all dirt and superfluous materials of every description. If the maximum width of the trench at the top of the pipe specified in TP 1.0 of these specifications is exceeded for any reason other than by direction, the Contractor shall install such concrete cradling, encasement, gravel base or other bedding as may be required to satisfactorily support the added load of the backfill.

Trenches shall be kept free from water and the pipe shall not be laid when conditions of the trench or the weather are unsuitable for such work. At all times when work is not in progress, all open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substances will enter the pipe.

4.04.02 Depth of Bury

All sewage collection lines shall be ductile iron if less than 3 feet of cover is provided within streets and less than 2 feet of cover is provided in all other areas.

4.04.03 Installation of Service Connections

Wye fittings shall be provided and installed for sewer service connections to new sewer mains. Service saddles are not appropriate for service connections to newly constructed sewer mains but may be used for connections to existing sewer mains. The wye shall be installed such that it is at about a 45 degree angle with the vertical.

When water mains and sewers cross over each other, the provisions of TP 2.0, Water and Sewer Line Separation Requirements, shall apply.

4.05 Manhole Installation

4.05.01 General

Manholes shall be installed in the locations shown on the plans and shall be constructed in accordance with the standard details. Manholes shall be spaced no more than 400 feet apart, and shall be installed at every change in grade, pipe size, or direction.

The invert channel shall be smooth and U-shaped. The lower portion shall conform to the inside of the adjacent sewer section and the upper portion shall be greater in height than the diameter of the largest pipe. A minimum invert elevation drop of 1/10 of a foot from the entrance to the outlet shall be provided in all manholes where there is a change in direction or grade. Changes in size and grade of the channel shall be made gradually and evenly. The invert channel may be formed directly in the concrete, or where there is no change in grade or direction between incoming and outgoing sewers, may be constructed by laying a full section of sewer pipe through the manhole and cutting out the top half after the surrounding concrete has hardened.

The floor of the manhole outside the channel shall be smooth and shall slope toward the channel not less than one inch per foot and not more than 2-inches per foot. Drop inside the manhole shall not exceed 2 feet, measured from the invert of the inlet pipe to the invert of its corresponding channel. If the drop exceeds 2-feet, then a drop manhole shall be installed. A channel must be formed in the concrete of an ogee shape so there is no free drop. Joints between manhole sections, adjustment rings, and cover rings shall be sealed with Ram-Nek flexible gasket or approved equal, and a concrete collar shall be installed in accordance with the standard details.

All sewers extending from manholes shall be supported with compacted gravel from where the sewer pipe leaves the manhole to where the pipe is supported by undisturbed soil.

4.05.02 Connection to Existing Manhole

The Contractor shall obtain a tapping permit from the Operating Utility prior to making connections to existing manholes. The connection to the existing manhole shall be made in accordance with the approved plans. Care should be exercised when connecting to the existing manhole so that limited fracture and cracking will occur on the existing manhole. Also, placement of the new sewer main should be correctly aligned to the invert elevation so as to allow for proper flow of sewage through the manhole. Excessive damage to the existing manhole or improper installation of the new sewer main, as determined by the Operating Utility, shall be cause for replacement of the existing facilities within the construction area by the Contractor. This replacement shall be done to the satisfaction of the Operating Utility.

4.06 Sewer Main Crossings

4.06.01 Wash Crossings

Sewer mains shall be installed as shown on the plans. The Contractor shall divert surface flows, conduct dewatering, and perform all steps necessary to maintain proper bedding conditions and alignment.

4.06.02 Road Crossings

In lieu of boring, the roadway may be open cut for sewer line within casing installation. The original surface pavement on all open cut roadways shall be either cut square or sawed straight. As with open cut, if boring is required, the steel conduit shall be extended from right of way to right of way. The Contractor shall obtain written permission from the appropriate agency prior to beginning any roadway excavation. Backfill within the limits of a roadway prism may require special compaction in accordance with the roadway crossing permits.

Surfacing shall be replaced where the roadway has gravel, concrete, or asphaltic paving in the same thicknesses as were removed, or as specified by the Owner, and completed as soon as possible following backfilling.

PVC sewer line road crossings shall be installed within steel casing on acceptable casing chocks or redwood skids secured to the pipe with stainless steel straps. Ductile Iron pipe resting on the bells also may be used as the carrier pipes. The casing ends shall be sealed with an approved rubber boot or 9 mil plastic sheeting with stainless steel clamps. Casing pipe shall be straight welded SCH 10 steel pipe ¼" wall unless otherwise specified. An alternative method for roadway crossing is to install ductile iron pipe, Class 52, bell and spigot, direct bury by open cut excavation from right of way to right of way. This would be considered when crossing minor roads or trails, or for congested area within an urban setting.

A manhole shall be installed on each side of the roadway right of way, unless specifically exempted by the Owner. The minimum grade of all road crossings should be 1.0% unless exempted by the Operation Utility.

4.07 Sewer Service Line Installations (Not part of the Utility company's facilities)

4.07.01 General

All trenching, excavating, and backfilling should be performed in accordance with TP 1.0 and TP 2.0 of these specifications. All new construction shall provide a minimum slope of 1/4-inch per foot (2%) and maintain at least 2 feet of cover over the line. Clean outs should be placed at the house, at any in-line bend greater than 45 degree, and at 100-feet intervals. Bends greater than 45 degrees are discouraged. Services should not enter a manhole but should enter the main line at least 10 feet either side of the manhole.

4.07.02 Connection to Wyes or Main

Sewer service lines should be connected to the sewer wyes provided with the new sewer main. If connecting to an existing main without existing wyes, the connections shall be made with wye saddles. The Contractor shall obtain from the Operating Utility tapping permits before making sewer service connections to existing sewer mains. The saddle shall be aligned on the sewer main such that it is at about a 45 degree angle with vertical and in no case shall deviate, by more than 15 degrees from either side of 45 degrees without prior approval. During the installation of the sewer saddle, the Contractor shall not allow the pipe cutout or other foreign objects to enter the sewage collection system.

4.08 Sewer Line Testing

4.08.01 Alignment Test

The Contractor shall notify the Operating Utility two working days in advance of the date that the Contractor is ready for inspection of sewer alignment. The sewer shall be checked by the Owner to determine whether any displacement of the pipe has occurred after the trench has been backfilled to 2 feet above the pipe and tamped as specified. The test shall be made as follows: A light shall be flashed between ends of line by means of a flash light or reflected light. Any deviation from true line or grade, causing less than a full lamped circle, may be cause for rejection. Any ponding of water in the sewerline may be cause for rejection. A full lamp circle is when a full circle of light is seen from any position around the pipe perimeter.

4.08.02 Deflection Test

The maximum allowable deflection (reduction in vertical inside diameter) for

PVC pipe shall be five percent. Deflection testing may not be required in all cases; however, the Owner reserves the right to require the Contractor to perform random deflection tests. If three successive tests are determined to be unsatisfactory, the Contractor shall perform deflection tests on the entire project. All locations with excessive deflection shall be excavated and repaired by re-bedding or replacement of pipe. Acceptable methods of deflection testing include use of properly sized go-no-go mandrels or other proposals suitable to the operating utility.

4.08.03 Exfiltration Test

The Contractor shall conduct an exfiltration test on each section of sewer between manholes. The Contractor shall provide at his own expense all necessary equipment and materials required for the tests. One of the following testing methods shall be used.

Air Testing: Testing equipment shall be equal to the "Air-Loc" low pressure air testing system manufactured by Cherne Industrial, Inc. of Edina Minnesota. The gauge used for the air test shall have a minimum division of 0.10 psi.

Testing shall be conducted in accordance with ASTM C924 (Testing Sewer Lines by the Low-Pressure Air Test Method), except as modified herein. Air testing shall be done between consecutive manholes throughout the entire length of the installed line. Air shall be added to the plugged test section until the internal air pressure reaches 4.0 psig. At least two minutes shall be allowed for the air pressure to stabilize. The air supply shall then be disconnected and the time required for the pressure to drop from 3.5 to 3.0 psig shall be measured with a stopwatch. No one shall enter a manhole when a line into it is pressurized. If the groundwater level is above any portion of the test section, the test pressures shall be increased by an amount equal to the average hydrostatic pressure of the groundwater.

The test section will be accepted if the time required for the pressure to decrease from 3.5 to 3.0 psig is equal to or greater than the time in the following table. The pipe diameter shall be based on the nominal size of the sewer main. If the time measured is less than the time specified in the table, the Contractor shall locate and repair any leaks and retest the sewer until it is acceptable.

Minimum Duration for Pressure Drop (400 feet Max.)	
Pipe Diameter (Inches)	Time (Minutes)
4	2.5
6	4.0
8	5.0
10	6.5
12	7.5

The following formula should be utilized to determine the minimum duration for pressure drop for test sections greater than 400 feet or pipe sizes greater than 12-inchs.

$T = 0.000371 \cdot D^2 \cdot L \div 2$

Where: T = Time in Minutes
D = Nominal Diameter in Inches
L = Pipe Length in Feet

Water Testing: One gallon of water may be lost in 2 hours, per each section between manholes, when testing any size main up to 12-inches. The line shall not be tested with the manhole. At least 4 feet of head shall be used for the test. Service lines need not be tested, but they must be plugged to conduct the test of the main. If any leakage in excess of the allowable occurs in any section of the sewerline, that section(s) shall be repaired and retested after the leaks are located.

4.08.04 Groundwater Infiltration

Infiltration of groundwater in excess of 200 gallons per day per inch diameter per mile of sewer line indicates that the sewer is not watertight. Infiltration less than this amount does not relieve the Contractor of the requirement to perform exfiltration testing. If excess infiltration is noted after exfiltration tests have been completed, it shall be considered as evidence that the original test was in error or that subsequent failure of the pipeline has occurred.

4.09 Manhole Testing

Manholes shall be tested for water tightness. Each manhole shall be tested by itself. All lift holes shall be plugged with an approved non-shrink grout. All mains into and out of the manhole shall be stoppered with a suitable device. If the manhole fails the

initial test, necessary repairs shall be made and the manhole shall be retested. One of the following methods shall be used.

Vacuum Testing: Vacuum testing should be conducted, in accordance with ASTM C1244 (Vacuum Test for Concrete Manholes), except as modified below. The vacuum test head shall be placed inside the top section and the seal inflated in accordance with the manufacturers' recommendations. A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-inches. The manhole shall pass if the time is greater than 60 seconds for 48-inches diameter, 75 seconds for 60-inches, and 90 seconds for 72-inches diameter manholes.

Hydrostatic Testing: Hydrostatic testing shall be conducted in accordance with ASTM C969, except as modified below. The manhole shall be filled with water to the ring. The maximum loss shall be 5 gallons in a 2-hour test regardless of the manhole depth. The amount of loss shall be determined by measuring the volume of water required to maintain the water level in the manhole within 2-inches of the top of the cone or flat top throughout the entire duration of the 2-hour test.

4.10 Observation of Pressure Tests

The Owner is to witness the pressure testing of sewer lines and manholes. Prior to the test, the Contractor shall have all equipment set up completely ready for operation and shall have previously successfully performed the test to verify that the test section or manhole will pass. The Contractor shall notify both the Owner and Operating Utility a minimum of two working days in advance of the date that the Contractor plans to perform the pressure tests. The Owner will complete the required certification forms and submit them to the Operating Utility for approval. A letter of approval or disapproval of the test results will be sent from the Operating Utility to the Contractor (see "Exhibit A of TP-4).

EXHIBIT A FOR TP-4

WATER TEST

SEWER MAIN/MANHOLE TESTING FORM

Project No. _____ Inspector _____

Project Title _____ Inspector _____

Allowable Leakage: 1 gal/section/2 hr for 8" PVC to 12" PVC, regardless of length, using 4-feet of head test pressure.

SEWER MAIN

Sewer Main (MH# to MH#)	Size (in)	Length (ft.)	Actual Leakage (gal.)	Pass/Fail (P or F)	Remarks

Observed By: _____ Date: _____

Title: _____

Allowable Exfiltration: 5 gal./MH/2 hrs. regardless of height.

SEWER MANHOLE

Manhole No.	Station	Actual Leakage (gal.)	Pass/Fail (P or F)	Remarks

Observed By: _____ Date: _____

Title: _____

* Lamp test shall be conducted after completion of street construction and final grading,

EXHIBIT A OF TP 4

SEWER LINE TEST CERTIFICATION

LOCATION OF LINE TESTED: _____
Include Project's Name & Number

DATE(S) TEST WAS CONDUCTED: _____

STANDARD LENGTH OF PIPE USED ON THIS PROJECT IS _____FEET.

THE ATTACHED TEST INFORMATION IS CERTIFIED BY:

Signature: _____

Names, Organization: _____

Address, Telephone Number: _____

Date of Report: _____

ALLOWABLE LEAKAGE VERSUS TOTAL LEAKAGE CHECKED BY: _____

PASSED(x) _____

FAILED (x) _____

LETTER OF APPROVAL OF THE TEST SENT TO: _____
Project Agency Involved

ON_____ BY_____
Date Operating Utility Representative

COPIES OF TEST CERTIFICATION SENT TO OPERATING UTILITY ENGINEERING ON

_____ BY _____
Date Operating Utility Representative

EXHIBIT B for TP 4

AIR TEST

SEWER MAIN/MANHOLE TESTING FORM

Project No. _____ Inspector _____

Project Title _____ Inspector _____

Air testing shall be conducted between consecutive manhole. The test section shall be acceptable if the time required for the pressure drop from 3.5 to 3.0 psig is greater than or equal to the time in the "Minimum Duration" for Pressure Drop table of TP 4.08.03.

SEWER MAIN AIR TEST

Sewer Main MH# to MH#	Size (in.)	Length (ft.)	Start Test Pressure (Psig)	Stop Test Pressure (Psig)	Elapsed Time (min.,sec.)	Pass/Fail (P or F)	Remarks

Observed By: _____ Date: _____

Title: _____

Manhole shall pass if time is greater than 60 seconds for 48" Dia. MH, 75 seconds for 60" Dia. MH, and 90 seconds for 72" Dia. MH.

MANHOLE VACUUM TEST

Manhole No.	Station	Start Vacuum of 10" of Mercury (inches)	Stop Vacuum (inches)	Elapsed Time (min.,sec.)	Pass/Fail (P or F)	Remarks

Observed By: _____ Date: _____

Title: _____

* Lamp test shall be conducted after completion of street construction and final grading.

EXHIBIT B OF TP 4

SEWERLINE AIR TEST AND MANHOLE VACUUM TEST CERTIFICATION

LOCATION OF LINE TESTED: _____
Include Project's Name & Number

DATE(S) TEST WAS CONDUCTED: _____

THE GAUGE USED FOR TESTING SHALL HAVE MIN. DIVISION OF 0.10 PSI

STANDARD LENGTH OF PIPE USED ON THIS PROJECT IS _____ FEET.

THE ATTACHED TEST INFORMATION IS CERTIFIED BY:

Signature: _____

Names, Organization: _____

Address, Telephone Number: _____

Date of Report: _____

ALLOWABLE PRESSURE DROP AND VACUUM DROP CHECKED BY: _____

PASSED(x) _____

FAILED (x) _____

LETTER OF APPROVAL OF THE TEST SENT TO _____ON
Project Agency Involved

_____ BY _____
Date Operating Utility Representative

COPIES OF TEST CERTIFICATION SENT TO OPERATING UTILITY ENGINEERING ON

_____ BY _____
Date Operating Utility Representative

TP 4.11 Individual Subsurface Disposal Systems (Not part of the Utility Company's Facilities)

4.11.01 General

The Contractor shall install individual subsurface disposal systems at the locations shown on the plans. The work shall consist of furnishing and installing a double compartment 1,000-gallon or larger septic tank, 4-inch sewer pipe, and leachfield system in accordance with these technical provisions and applicable drawings. All construction will be done in a workmanlike manner. All sites will be left with a neat appearance.

4.11.02 Septic Tanks

4.11.02.01 General

All septic tanks shall have a minimum liquid capacity of 1,000 gallons and double compartment. Liquid capacity shall be split with two-thirds in the first compartment and one-third in the second compartment. The liquid depth of the septic tanks shall be at least 4 feet but not more than 5 feet.

The inlet and outlet on all tanks shall be provided with vertical tee fittings of cast iron or PVC plastic. In concrete tanks, oval box shaped or slab type baffles of pre-cast reinforced concrete with a minimum thickness of 2-inches may be used. The inlet baffle or tee must penetrate at least 5-inches below the liquid level but in no case shall it be greater than the penetration of the outlet baffle or tee. Both inlet and outlet baffles or tees shall extend 6-inches or more above the liquid level and end 1-inch from the underside of the tank top to allow gases to escape. The outlet baffle or tee shall extend below liquid level 40 percent of the liquid depth for rectangular tanks and 35 percent for circular tanks. The common wall passage shall also be located at the 40 percent liquid level depth. The inlet invert should be at least 2-inches above the liquid level in the septic tank. Four copies of drawings indicating pertinent dimensions, type, and location of steel reinforcing in concrete tanks, and important details shall be submitted by the Contractor for approval by the Owner prior to the installation of any septic tank.

4.11.02.02 Concrete Tanks

Concrete septic tanks shall be of pre-cast, mechanically vibrated, 4,000 psi minimum strength, watertight concrete containing adequate steel reinforcement to facilitate handling. Minimum wall thickness shall be 3-inches. The top and bottom shall have a minimum thickness of 4-inches. Minimum steel reinforcement will be No. 3 reinforcing bars spaced 2 feet on centers in both directions in the top, bottom, and sides. The equivalent shall be used around

manhole inspection ports and construction joints. Minimum steel reinforcement of the access cover or lid shall be No. 4 rebars spaced 6-inches on center in both direction or equivalent. The manhole and inspection opening covers shall be provided with steel lifting handles of No. 3 or No. 4 rebar.

Tanks shall be free of cracks from casting or handling (including placement). No wire mesh or rebar shall be exposed at any point on the tank interior or exterior.

Adequate access shall be provided into the septic tank either through a removable section or manhole with a minimum of 20-inches in the least dimension. The access manhole may be placed partially over the inlet to serve as an inspection hole; otherwise, inspection openings with a minimum of 7-inches in the least dimension shall be provided above the inlet, outlet, and the inter-compartment piping. The access manhole shall be provided with a 6-inch PVC coupling that extends through the center. A 6-inch diameter inspection pipe shall be installed so that it is connected to the access manhole coupling and extends to a point 12-inches above the ground surface. The pipe shall be 160 psi, SDR 26, PVC, shall terminate above ground surface with a 6-inch slip joint PVC cap, and shall be painted red on those portions above the ground surface.

4.11.03 Septic Tank Installation

Excavation shall be approximately 1 foot wider and longer than the tank. All tanks shall be set on a smooth level surface. The septic tank shall be placed plumb and true so that the inlet and outlet are at the highest possible elevations and so that the outlet pipe is not less than 2-inches nor more than 5-inches below the inlet pipe. The minimum bury for the septic tank inlet pipe shall be 18-inches. The maximum dirt cover for the septic tank shall be 36-inches. Where over excavation occurs, the bottom shall be raised to final elevation in 6-inch compacted lifts. Any water in the excavation must be removed and elevations checked before setting the tank. After setting the tank, it shall be filled with water to prevent floating. Both the septic tank inlet and outlet lines shall be grouted to the septic tank. Backfill around the tank shall be compacted and shall be sufficient to allow for no settlement.

4.11.04 Sewer Pipe and Fittings

All 4-inch pipe and fittings, except clean out tees, risers, hub adapters, and plugs, shall be PVC, SDR 35, solvent-weld joints and shall comply with ASTM Specifications D-3033 and D-3034. All PVC shall be Type 1, Grade 1, PVC 1140 conforming to ASTM Specification D-1784.

Cleanout tees, risers, hub adapters, and plugs shall be PVC/DWV and comply with ASTM Specification D-2665.

4.11.05 Sewer Pipe Installation

All trenching, excavating, and backfilling shall be performed in accordance with TP 1.0 of these specifications. All construction shall provide a slope of 1/4" per foot (2%) and maintain at least 18-inches of cover over the line between the house and the septic tank. A minimum cover of 12-inches is required between the septic tank and drainfield system. Cleanout tees shall be two-way, 4" x 4" x 4", all solvent-weld hubs, PVC/DWV fittings. Cleanout risers for DWV cleanout shall be 4-inch PVC/DWV and shall terminate 3 to 6-inches above the ground surface with a PVC/DWV 4-inch hub adapter (solvent-weld hub by FIPT) and MIPT plug. Cleanout shall be placed at the house and at any in-line bends greater than 45 degree (bends greater than 45 degrees are discouraged) and at 100 feet intervals.

4.11.06 Drainfield Materials

4.11.06.01 Gravel

Drainfield gravel shall comply with the requirements for coarse aggregate under Federal Specification SS-A-281b, "Aggregate; (for) Portland-Cement-Concrete", and shall be Size 3 (2" to 1" nominal size). The amount of deleterious substances in the coarse aggregate shall not exceed the limits given in Section 3.2.3 of Federal Specification SS-A-281b.

4.11.06.02 Pipe and Fittings

All PVC shall be Type 1, Grade 1, PVC 1140 conforming to ASTM Specification D-1784. All 4-inch solid PVC pipe and fittings shall be PVC, SDR 35, solvent-weld joints and shall comply with ASTM Specifications D-3033 and D-3034. All 4-inch perforated PVC pipe shall be solvent-weld joints and shall comply with ASTM Specification D-2729 or D-3033 and D-3034. Perforations shall be ½ to 5/8 inch diameter holes on 5-inch centers in two rows spaced 90 to 120 degrees apart.

4.11.06.03 Drainage Fabric

The drainfield fabric shall be non-woven and composed of polypropylene filaments and shall be inert to biological degradation and naturally encountered chemicals, alkalies, and acids. The fabric shall have a minimum average grab tensile strength of 120 pounds, a minimum average burst strength of 285 psi, a minimum average coefficient of permeability of 0.3 cm/sec, and a minimum thickness of 60 mils. The drainage fabric shall be equal to the Mirafi 140N non-woven fabric as manufactured by Mirafi, Inc., P.O. Box 240967, Charlotte, North Carolina.

4.11.07 Drainfield Installation

The trench width in the drainfield shall normally be 24-inches and shall not exceed 36-inches nor be less than 12-inches without the consent of the Owner. Trench bottoms shall be smooth and level from beginning of trench to end. All smeared or compacted surfaces of the trenches or bed shall be raked to expose the natural texture of the soil. All loose material shall be removed from the trench before the gravel is placed. The drainfield trench shall be kept as shallow as possible but with a minimum depth of 24-inches and a maximum depth of 60-inches. Drainfields shall be built so that all lines are looped. Where rock, clay, or ground water are encountered, the Contractor shall immediately notify the Owner and shall cease work on the drainfield installation. The bottom of the trench shall be covered with a 6-inch minimum depth lift of gravel. The lift shall be leveled (but not compacted) by hand to within $\pm$ 1-inch throughout the entire length of the trench. The 4-inch perforated plastic pipe shall then be laid level $\pm$ 1- inch by hand and centered in the trench. After the pipe has been laid, a second 6-inch lift of gravel shall be placed by hand and not compacted. The gravel shall be placed so that it extends 2-inches above the pipe. A layer of synthetic drainage fabric then shall be placed over the gravel and folded up the sides of the trench to prevent backfill soil from coming in contact with the gravel.

The trench shall then be backfilled and not compacted. The top shall then be mounded with a 8 to 12-inch crown and shall not be compacted. No mechanical or vehicular traffic shall be used to compact the trench. Backhoes shall not be allowed on trenches during or after the backfilling operation.

Four, red T-type, steel posts shall be placed at the outside corners of the drainfield. The post shall be driven a minimum of 14-inches into the ground and shall extend a minimum of 36-inches above the ground. The Contractor shall leave the premises in a neat and orderly condition. Excess dirt shall be spread evenly over the ground in the immediate area or disposed of in a manner approved by the Owner.

4.11.08 Gravel-less Drainfield Materials

The gravel-less drainfield shall consists of interlocking leaching chamber units, opened end plates, and closed end plates constructed from molded high density polyethylene. Gravel- less drainfield components shall be equal to the Infiltrator as manufactured by Infiltrator Systems Inc., P.O. Box 768, Old Saybrook, CT 06475, or an approved equal.

4.11.09 Gravel-less Drainfield Installation

In place of perforated pipe and gravel for distribution and storage of waste water, leaching chambers or gravel-less drainfield systems can be employed.

The trench width for a gravel-less drainfield shall normally be 36-inches or as specified by the supplier of system. Trench bottoms shall be smooth and level from beginning of trench to end. All smeared or compacted surfaces of the trenches or bed shall be raked to expose the natural texture of the soil. All loose material shall be removed from the trench before the chamber units are installed. The trench shall be kept as shallow as possible but with a minimum depth of 24-inches and a maximum depth of 36-inches.

The installation of the gravel-less system shall be per the manufacturer's recommendations. Where rock, clay, or ground water are encountered, the Contractor shall immediately notify the Owner and shall cease work on the drainfield installation. The area between the leach chamber and trench wall shall be backfilled and compacted. The minimum cover for the gravel- less drainfield is 12-inches. The top shall then be mounded with an 8 to 12-inch crown and shall not be compacted. No mechanical or vehicular traffic shall be used to compact the trench. Backhoes shall not be allowed on trenches during or after the backfilling operation.

A 4-inch solid sewer PVC-DWV inspection port with adapter hub and plug shall be installed at the end of each line. The Contractor shall leave the premises in a neat and orderly condition. Excess dirt shall be spread evenly over the ground in the immediate area or disposed of in a manner approved by the Owner.

TECHNICAL PROVISIONS

TP 5.0 FINAL SITE UTILITY INSPECTION REQUIREMENTS

5.01 Final Inspection Package

The Contractor shall submit a complete site utility inspection package which is to include the following items; all copies of which shall be legible.

5.01.01 As-Built Drawings

Four (4) blueline sets and one (1) set of size D Mylar "as-built" drawings which contain:

A. Cover Sheet
B. Rights of Way Plat Sheets
C. Utility Plan View Sheets
D. Water/Sewer Plan and Profile Sheets
E. Details Sheets - standard and specific drawings

5.01.02 As-Built Notebook

Four (4) three ring, loose leaf binders containing the following information:

A. Water Pressure Test Certification and Test Results Approved by the Operating Utility. See “Exhibit A” of TP 3.
B. Sewer Main and Manhole Test Certification and Test Results Approved by the Operating Utility. See “Exhibit A” or “Exhibit B” of TP 4
C. Executed Transfer Agreement with Cost of Plant. See “Exhibit A and B” of TP 5.
D. Water Meter Serial Number Listing and Current Meter Readings.
E. Approved Tapping Permits.
F. Approved Water/Sewer Material Submittals.
G. A set of 1.44 MB diskettes or CD in AutoCAD version specified in Drawing Standards.

5.02 Scheduling Final Inspection

The scheduling for the final inspection shall be coordinated with the Operating Utility by the Contractor. A complete as-built package is to be provided to the Operating Utility for review a minimum of 21 calendar days prior to the scheduled inspection.

5.03 As-Built Drawing Requirements

Each project site that contains utilities to be transferred to the Operating Utility must be submitted with the following requirements and sheets.

5.03.01 General Requirements for All Sheets

5.03.01.01 Each sheet must be stamped by an A/E* and prominently labeled, signed, and dated by the Contractor (excepting cover and rights of way sheets):

AS BUILT _____
(Name) (Date)

I certify that I have constructed this project following the standards set forth in TPs 1 - 4, and I have complied with all vertical and horizontal pipeline separation requirements.

5.03.01.02 All facilities shall be shown as constructed and references to "proposed" or "future" deleted.

5.03.01.03 Where appropriate, each sheet must have a north arrow. Whenever possible, the arrow shall be up or to the right of the sheet.

5.03.01.04 Where appropriate, each sheet must have a standard legend and bar scale. All existing mains must be solid lines and sewer manholes must be solid circles.

5.03.01.05 All sheets must be numbered sequentially beginning with "Sheet 1 of (Total) Sheets."

5.03.02 Cover Sheet

5.03.02.01 Since drawings occasionally cover several project sites, the location for each as-built site must be prominently identified by project number and project site location.

5.03.02.02 A map of the total Navajo Nation that shows the project location, a vicinity map with a scale of 1" = 2 miles, and north arrow is to be provided. These maps may be on a separate sheet or on the topographic boundary sheet.

5.03.02.03 The project site location, with the project number(s), should be shown on both Navajo Nation and vicinity maps.

5.03.03 Plat Sheet

5.03.03.01 Show site boundaries with bearings and distances, complete with ties to permanent state plane markers (Section Corners, established monuments, etc.) and bearing references. All bearings shall be in the appropriate State Plane System in NAD 83 if possible; all distances shall be ground distances. Indicate basis of bearing.

5.03.03.02 Show and describe location of elevation and vertical datum references. A broken line may be utilized if the benchmark is not within the drawing scope or scale.

5.03.03.03 Show each lot and street boundary defined with bearings and distances, if appropriate. Show street centerline bearing, distance, and curve data.

5.03.03.04 Provide statements "Street Rights of Way are Dedicated to the Common Use of Utilities" if appropriate, and "the operating utility is not responsible for the repair or replacements of improvements in utility easements disturbed during operation and maintenance activities."

5.03.03.05 Show minimum 20 foot wide easements for each utility (electric, natural gas, water, sewers, telephones, cable) not located within the street right of way. Add an additional 10-foot width for each additional parallel utility. The Owner will provide to the Contractor as-built drawings of utilities not constructed by the Contractor.

5.03.03.06 Utility or street rights of way may require expansion in localized areas to include all utility appurtenances (e.g., fire hydrant guards) which are not within the normal easement.

5.03.03.07 Provide a narrative legal description of the site boundary.

5.03.04 Utility Plan View Sheet(s)

5.03.04.01 On a sheet with a scale between 1"=20' and 1"=50', provide a plan view of the site that shows all utilities (e.g., propane, water, sewers, electric, natural gas, telephones, cable).

5.03.04.02 Show all lot, street, and easement boundary lines without bearing and distances.

5.03.04.03 Label all houses with final house numbers. Numbers must be consistent with a swing tie table.

5.03.04.04 Provide a legend, north arrow, and bar scale.

5.03.04.05 Show as-built routing of all water and sewer mains and service lines. Emphasize water and sewer mains by using bolder lines. Use a smaller but bold line for service lines. Reference the standard Operating Utility legend.

5.03.04.06 Label water mains with size, type of material, pressure rating, and length of pipe from P.I. to P.I. Example: 6" PVC, SDR 21, 232.00'.

5.03.04.07 Label sewer mains with size, type of material, and distance between manholes. Example: 8" PVC, SDR 35, 389.00'.

5.03.04.08 Label water and sewer main taps point to previous projects with previous project number and as-built sheet number. Contractor shall contact the Operating Utility to determine this information.

Examples:	White Cone Composite	Red Water Housing
	IHS NA 88-114	NHA AZ 12-106
	Sheet 15 of 43	Sheet C-8

5.03.04.09 Show and label depth of bury at all locations where water main varies from the standard depth of bury of 42 inches.

5.03.04.10 For fire hydrants, gate valves, tees, bends, water meters, curb stops, and saddles state the manufacturer model number and type of joint for the actual item used. As an option this information can be shown on the standard detail sheet next to the appropriate detail, or include submittals.

5.03.04.11 Show and label all water main fittings actually used. Examples: 6" G.V., 6" DI TEE, 6" DI 45^{o} BEND.

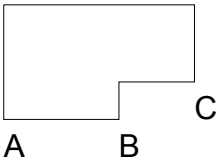
5.03.04.12 Provide swing ties in table format for all gate valves, water meters, domestic stops, curb stops, water main taps, manholes, main line clean out, yard clean outs, and sewer wyes. Swing ties shall be measured from building corners or other permanent structures.

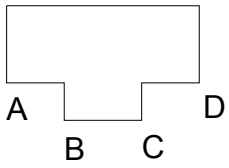
SWING TIES (Examples)

House No.	Domestic Stop		Water Meter		Curb Stop		Water Main Tap		Yard Clean out		Sewer Wye	
	A	B	A	B	A	B	A	C	A	B	A	C
1	31.6	3.8	34.8	32.9	36.7	35.8	42.0	65.0	22.4	11.6	57.0	73.0

Item	House No.	Distance	
		A	B
MH 11A-3	3	56.2	68.4
		A	B
GV-1	5	43.4	63.6
		A	B
GV-2	5	43.6	61.6
		B	C
MH 11A-1-2	15	93.4	73.0
		B	C
CO-2	14	64.8	61.5

5.03.04.13 Label corners of each building or structure, as necessary, to provide references for swing tie tables.





5.03.04.14 Provide pipe information for each size and type of pipe in a table with the following format:

PIPE DIMENSIONAL DATA

Use	Size (in)	Type of Material	Joint Type	SDR	Pressure Rating PSI	Dimensions (in)			ASTM No.
						O.D.	I.D.	Wall Thick	
Water	6	PVC	Slip	21	200	6.625	5.993	0.316	D2241
Water	1	PE	Stab	7	200	1.349	1.049	0.150	D2239
Sewer	8	PVC	Slip	35	N/A	8.400	7.920	0.240	D3034
Sewer	4	PVC	Slip	35	N/A	4.215	3.975	0.120	D3034

5.03.05 Water/Sewer Plan and Profile Sheet(s)

5.03.05.01 Plan View

Provide all items from the utility plan view sheet requirements on the Utility Plan View Sheets portion; TP 5.03.04.

5.03.05.02 Profile View

5.03.05.02.01 Label all manholes and sewer main clean outs with manholes and clean out numbers. Provide rim elevations with inlet and outlet invert elevations. The manhole numbers must conform to the existing manhole numbering system. Station all manholes and connections

5.03.05.02.02 Label all sewer mains with size, type of material, slope, and distance. Distance shall be the actual distance of the pipeline (O.D. of manholes to O.D. of manholes).

5.03.05.02.03 Show all water mains that cross the sewer main and dimension O.D. to O.D. the vertical separation. Station all water mains and appurtenances.

EXHIBIT "A" OF TP5

Note: (This is an Example only. The actual cost of Plant shall be attached to the Transfer Agreement.)

COST OF PLANT

Kayenta, Arizona

NHA Project AZ 12-51

ITEM	QUANTITY	UNIT	LABOR	MATERIAL	TRANS.	TOTAL
8" PVC Sewer Main	1745	LF	$7,187.22	$5,750.00	$1,437.44	$14,374.66
Precast Manhole	7	EA.	$2,101.10	$1,681.68	$ 420.00	$ 4,209.78
8" Sewer Clean out	1	EA.	$ 123.50	$ 68.75	$ 24.75	$ 216.50
Sewer Service Connection	30	EA.	$2,415.00	$1,932.00	$ 483.00	$ 4,830.00
					Subtotal:	$23,630.94
6" PVC Water Main	1707	LF	$16,438.41	$13,150.73	$3,287.68	$32,876.82
Fire Hydrant	3	EA.	$ 750.00	$ 600.00	$ 150.00	$ 1,500.00
6" Gate Valves	9	EA.	$ 948.47	$ 758.00	$ 189.00	$ 1,895.47
1" Water Service Line w/Meters	30	EA.	$ 6,420.00	$ 5,136.00	$1,284.00	$12,840.00
					Subtotal:	$ 49,112.29
TOTAL COST OF UTILITY PLANT:						**$72,743.23**
Less: Sewer Service Connection not transferred to Operating Utility:						$ 4,830.00
TOTAL OF PLANT TRANSFERRED:						**$67,913.23**

EXHIBIT "B" OF TP5

UTILITY TRANSFER AGREEMENT
for
WATER AND WASTEWATER FACILITIES

This agreement is made between _____, hereinafter called the Grantor and the **NAVAJO TRIBAL UTILITY AUTHORITY,** hereinafter call the Grantee.

WHEREAS, the Grantor has constructed or caused to have constructed water and wastewater facilities located at or near_____ _____ as shown on the plans titled_____ _____, designed by _____, and dated _____ and said facilities and related final as-built plans already have been inspected, accepted and approved by the Grantee, and;

WHEREAS, the Grantor wishes to convey to the Grantee all his interest in these facilities and appurtenances constructed at the above-mentioned location on or about the above-mentioned time, along with all rights, rights of way, and privileges so that the Grantee may own, operate, and maintain all such facilities and appurtenances.

NOW THEREFORE IT IS AGREED:

For consideration of $1.00 the receipt of which already has been acknowledged, the Grantor transfers, assigns, grants, and conveys to the Grantee all rights, titles, interests, easements, and rights of way in the aforementioned facilities, and;

The Grantee agrees to accept such aforementioned facilities, and further agrees to own, operate, and maintain such facilities in a reasonable and prudent manner until such facilities are determined to be no longer of any value. Further, the Grantor hereby warranties all such facilities against defects in workmanship and materials, and for design deficiencies, errors, and omissions for the period of one year beginning on _____and ending on _____.

A listing of the total inventory and Cost of Plant determined by the Grantor to be transferred to the Grantee is attached as EXHIBIT ____ and make a part of this Utility Transfer Agreement. The total Cost of Plant as appears on this document is $_____.

IN WITNESS THEREOF, both parties have signed and dated this agreement.

Grantor: by _____ Date:_____
Signature

_____
Print Name

Navajo Tribal Utility Authority: by _____ Date:_____
Signature

_____
Print Name