City of Moscow Mills, Missouri
Sanitary Sewer and Appurtenances
Construction Standards

TABLE OF CONTENTS

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I. Construction Standards for Gravity Sewers

A. Unless otherwise required by the City Engineer, all gravity sewer install within the corporate limits of the City of Moscow Mills shall meet the following requirements:

1. Four (4) inch through fifteen (15) inch polyvinyl chloride pipe shall be solid walled pipe meeting ASTM D-3034, SDR 35.

2. Eighteen (18) inch through twenty-seven (27) inch polyvinyl chloride pipe shall be solid walled pipe meeting ASTM F-679, SDR 35.

3. Twenty-one (21) inch through fifty-four (54) inch polyvinyl chloride pipe shall closed profile pipe meeting ASTM F-794, closed profile pipe.

4. When required by City Engineer, ductile iron pipe (D.I.P.) Will be used conforming to ANSI/AWWA C151/A21.51-02 with cement lining in accordance with ANSI/AWWA C104/A21. 4-95. All ductile iron pipe shall be class 50.

B. Joints for PVC pipe shall be gasketed, bell and spigot, push-on type conforming to ASTM D-3212. Joints for ductile Iron pipe shall be push on type with rubber gaskets conforming to ANSI/AWWA C111/A21.11-00.

C. All PVC sewer pipe shall have a minimum pipe stiffness of 46 psi.

D. Pipe shal be furnished in standard 13 ft. or 20 ft. lengths.

E. All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

F. Curves will be allowed in the sewer to match curve in road. Curves in sewer pipe shall be as recommended by the pipe manufacturer with a minimum radius of 200 ft.

G. Delivery, Storage and Handling

1. PVC pipe shall be stored in suppliers' yards and on the job site in accordance with AWWA M23 and the manufacturer's recommendations. PVC pipe that has been subjected to excessive ultraviolet radiation from the sun shall not be used. The determination as to the acceptability of PVC pipe faded by the sun;s radiation shall rest solely with the City Engineer.

2. Store PVC pipe in the field by supporting the pipe uniformly per AWWA M23. Do not stack pipe higher than 4 ft. or stack the pipe with weight on

the bell ends. Cover stored PVC pipe to protect it from the sun's ultraviolet radiation. Any pipe that has been contaminated with any petroleum products (inside or outside) shall not be installed.

3. Pipe and fittings shall be handled according to manufacturer's recommendations. Proper care shall be used to prevent damage in handling, moving and placing the pipe. All pipe, fittings, and other pipeline materials shall be lowered into the trench in a manner that prevents damage. The pipe shall not be dropped, dragged or handled in a manner that wil cause bruises, cracks, or other damage. PVC pipe or fittings that have been gouged or scratched shallb e subject to rejection as determined by the City Engineer.

H. Quality Assurance

1. The manufacturer of each shipment of pipe shall be required to supply a statement certifying that each lot or load of pipe has been subjected to the tests specified for PVC gravity sewer pipe. Tests shall show that the pipe has been found to meet all the requirements of ASTM D3034, F679, and/or F794 as applicable.

2. PVC pipe shall carry a current certification of the National Sanitation Foundation (NSF) as acceptable to use in the transport of potable water.

3. PVC pipe and couplings shall bear indelible identification markings as required by ASTM D3034, F679, and/or F794 and as follows:

   a. All pipe, fittings, and couplings shall be clearly marked at an interval not to exceed 5 ft. as follows:

      - Nominal pipe diameter.

      - PVC cell classification.

      - Company, plant, date of manufacture, ASTM and SDR designation.
        Fittings and couplings do not require the SDR designation.

      - Service designation or legend.

I. Boring and Jacking

1. All construction under hard surfaced roads, railroads or where required by the City of Moscow Mills shall be done by boring and jacking of steel culling pipe.

2. The outer steel shall be of sufficient strength to meet the loading conditions of H-20 loading for pavements, Cooper D-72 loading for railroad crossings, and shall meet the following minimum required wall thickness:

Table A: Casing Pipes for All Roads

Pipe	Recommended Minimums Casing Diameter (I.D.)	Minum Wall Thickness
8"	14"	0.438"
10"	16"	0.500"
12"	18"	0.562"
15"	20"	0.594"
18"	24"	0.688"
21" - 54"	approved by City Engineer	

3. Casing spacers shall be high density polyethylene type, spaced as manufacturer recommends.

4. The end of casing shall be sealed with 1/8" thick commercial grade Neopurene Wrap around clamped with stainless bands.

5. Al work performed beneath existing structures, across railroad right-of-ways, and under pavements shall be performed in accordance with the requirements of the parties or agencies having jurisdiction over these locations. The Contractor shall contact representatives of all affected agencies prior to starting work and shall meet all requirements of the agencies in regard to methods of construction and the safety precautions to be taken in performing the work. All costs involved in meeting these requirements shall be paid for by the Contractor and no additional compensation will be allowed.

6. A suitable approach trench shall be opened, adjacent to the toe of the slope of the embankment. The approach trench shall be long enough to accommodate the length of the casing to be placed, and wide enough to provide sufficient working room. Guide timbers or rails shall be installed in the bottom of the trench to keep the casing online. Heavy timber backstop supports shall be installed at the rear of the trench “pushing frame” and furnished to fit or match the end of the pipe to be jacked, so that the pressure of the jacks will be evenly distributed over the end of the pipe. Two hydraulic jacks of sufficient power shall be used to apply pushing or jacking pressure. Excavating at the top and sides may be approximately 1" greater than the outside periphery or the pipe. Excavation shall be accurately cut to line and grade. Adjoining sections of steel pipe shall be welded with a continuous weld. Pipe shall be jacked upgrade where possible.

7. After casing pipe has been augured the grade shall be checked for slope by pouring water through the casing. This test shall be performed in the presence of the City Construction Observer. Casing pipe with black fall or not bored at the appropriate depth shall be rejected.

J. Pre- Cast Concrete Manholes

1. Pre-cast manholes shall conform to ASTM C478-03 with modified joint and premium rubber joint conforming to ASTM C443-02. The manhole sections shall be set on an 8" pre-cast slab sections are required.

2. Manhole steps shall be copolymer polypropylene plastic, and shall be installed in sanitary manhole. Copolymer polypropylene steps shall be M.A. Industries PS-1-PF or American Step Co. ML-10 with ½" grade 60 steel reinforcement or GCDC-WWS approved alternate. Steps shall be embedded in the rider and conical top section wall a minimum distance of 3". The minimum clear distance of 4" from the wall measured from the point of embedment. Steps from adjoining manhole barrel sections shall be spaced 16" apart.

3. All manholes located within the boundaries of the 100 yr. Floodplain shall have water-tight, bolt-down frame and covers, Neenah Model R-1916-T.

4. All manholes not located within the 100 yr. Floodplain shall have Neenah Model R-1775 frames and covers.

5. All covers shall have stamped“Sanitary Sewer” with 2" raised letters.

6. Pre-cast concrete grade rings shall be used to bring the cover to grade. Final adjustment shall be as directed by the City Engineer. The maximum adjustment allowed shall be 9". The use of block or brick for adjustment shall not be permitted. Permissible grade ring sizes for manhole adjustment shall be 3" or 4, or 6" as required to finish grade. A maximum of two grade rings will be allowed.

7. Within roadways, an exterior seal of Wrapid Seal or approved alternate shall be installed to seal the manhole. In addition, the Contractor shall use mortar between grade rings, manhole frame, and manhole sections. Outside of the roadways the Contractor shall use an approved 1 1/4" pre-formed butyl rubber sealant between grade rings, manhole frame, and manhole sections.

8. All drop connections shall be external drop connections, constructed of PVC or ductile iron and are required when the invert of the incoming sanitary sewer is greater than 24" above the invert of the outgoing sanitary sewer.

9. Anchors shall be 5/8" re-rod epoxied in place and spaced vertically every 12". They shall be offset 4" from each side of the pipe. The rods shall be embedded 3 1/4" into manhole additional anchoring will be required if pipe is greater than 8" in diameter.

10. Future connections when called for on the construction drawings shall consist of a pre-cast hole in manhole bottom section at the designated location. One length of pipe shall be laid and capped through this hole.

11. All manholes shall be vacuumed tested after installation according to ASTM C-1244 “Standard Test Method for concrete sewer manholes by negative air pressure (vacuum) test”. The test must be witnessed by City Engineer or qualified City Inspector or else manholes will not be accepted by City.

K. Trench Excavation and Backfill

1. The pipe shall be bedded true to line and grade with uniform and continuous support from a firm base in accordance with ASTM Specification D2321. Blocking shall not be used to bring the pipe to grade. Backfill material properly placed and compacted will provide lateral restraint against deflection exceeding 5% of the base inside pipe diameter as per ASTM Specification D3034 and F679.

2. The type and gradation of the material used in bedding, haunching, and initial backfilling, as well as the manner and care with which it is installed, are important factors in achieving satisfactory installation of flexible conduit. The amount of diametric deflection that can be anticipated during installation is related to the type and gradation of the embedment material and pipe stiffness as well as the care with which it is placed under, around, and over the pipe. Thus carful consideration should be given in choosing these materials and in the method of placement and compaction in accordance with ASTM Specification D2487 and ASTM Specification D2488.

3. Trench widths shall be excavated to provide as narrow a trench as practical at a point level with the top of the pipe. Allowable trench widths for various size pipe are the following:

Table B - Allowable Trench Widths

Inside Diameter of Pipe (inches)	**Allowable Trench Widths (inches)**
4 through 12	30
15 through 18	36
21	39
24	42
27	45
30	49
33	53
36	56
42	63

48	70
54	77

In no case shall trench width exceed the pipe manufacturers recommendation.

4. Where unstable or running trench soil condition is encountered such as may be found by excavating below ground water, the trench condition must be stabilized before laying the pipe. When excessive ground eater conditions exist, the City Engineer may elect to use well point or under drains. Care should be taken to prevent displacement of bedding or foundation soil material as a result of lateral or upward movement of the running soil or removal of sand or silt during the dewatering. The City Engineer may also elect to use shoring with sheeting, stay bracing or a trench box to stabilize the trench walls during construction. It is recommended that these trench supports be left in place after construction. If the shoring is to be removed, the slot left in the tamped fill should be filled and tamped.

5. When a trench box is used, the bottom of the box shall ride above the top of the pipe where possible. When a movable box is used in place of sheeting or shoring, the Contractor shall secure the installed pipe to prevent pipe movement when the box is moved.

6. Sheeting, shoring and bracing shall be incidental to project.

7. Where an unstable (i.e. water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This can be accomplished by undercutting the trench depth and replacing to grade with a foundation fo Class processed crushed stone, or gravel. The use of processed gravel and stone will act as a mat into which the unstable soil will not penetrate. The depth of the foundation and bedding is dependent on the severity of the trench bottom, however, a six(6) inch layer is sufficient in most cases. If the foundation contains large particle size material that might damage the pipe, provide a cushion of acceptable bedding material between the foundation and the pipe. Care should be taken to prevent migration of the bedding material into the foundation material. When the pipe is laid in a rock cut, a layer of bedding six (6) inches deep.

8. Prior to pipe installation, carefully bring the <u>bedding material</u> to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following <u>bedding procedures</u> are recommended:

    a. <u>Class I Material</u>. When Class I material is used for bedding, little or no compaction is necessary due to the nature of the angular

particles. A depth of six (6) inches of Class I material is generally sufficient to provide uniform bedding. If Class I material is used for bedding, it must also be utilized for haunching up to or higher than the spring line of the pipe to avoid loss of side support through migration of Class II or Class III haunching material into the bedding.

b. Class II Material. Take care with Class II material to provide a uniformly compacted bedding. Excavate the bedding material or place to a point above the pipe bottom, determining such point by the depth of loose material resulting in preparation of the bedding and the amount of compaction that will be required to bring the material to grade. Use hand or mechanical tamping to compact the bedding material to a minimum 85 percent Standard Proctor Density. Slightly damp material will generally result in maximum compaction with a minimum of effort. If water is added to improve compaction or if water exists in the trench, take care to avoid saturation of Class II material which could result in additional stability problems of the bedding. Carefully bring the surface of the bedding to grade after compacting it.

c. Class III Material. Provide uniform pipe bedding for Class III material in the same manner as outlined for Class II materials except use hand or mechanical tamping to compact the bedding material to a minimum of 90 percent Standard Proctor Density. Take care to avoid excessive moisture in Class III material when used for bedding.

9. Initial Backfill - The placement of initial backfill material in the area around th pipe must be installed with care. The pipe's ability to withstand loading in a trench depends in a large part on the methods employed in its' installation. The follow procedures for placing initial backfill are recommended.

a. Class I Material: Use under wet conditions. In any area where the pipe will be installed below existing or future ground water levels or where the trench could be subject to inundation, Class I material shall be used for bedding, haunching, and initial backfill. However, in the initial state of placing this type of material, care should be taken to endure that sufficient Class I material has been owrked under the haunch of the pipe to proide adequate side support. Precautions should be taken to prevent movement of the pipe during placing of the material under the pipe haunch. Except for the protection of the pipe from large particles of backfill material, little care need be taken and no compaction is necessary in placing backfill material in the balance of the initial backfill area above the pipe. Where unstable trench walls exist because of migratory materials such as waterbearing silts or fine sand, care should be taken to prevent the loss of side support through the migratory action.

b. Class I Material. Use under dry conditions. In any areas where ground water will not be experienced at any time above the level of the foundation material or where the trench will not be subject to inundation, Class I material shall be placed to or higher than the spring line of the pipe and with a minimum of effort to compact the material. However, in the initial stage of placing this type of material, take care to ensure that sufficient Class I material has been worked under the haunch of the pipe to provide adequate side support. Take precautions to prevent movement of the pipe during placing of the material under the pipe haunch. Except for the protection of the pipe fro large particles of backfill materials, little care needs to be taken and no compaction is necessary in placing the initial backfill material if Class I material is used. If Class II or Class III material is used above the spring line, achieve a compaction ratio of 85 percent Standard proctor Density.

c. Class II Material. Place Class II material to the spring line of the pipe and compact by hand or mechanical tamping. Take precautions to prevent movement of the pipe during placing of the material through the pipe haunch. Place initial backfill material in two stages: one to the top of the pipe and the other to a point at least six(6) inches over the top of the pipe. Compact each stage of haunching and initial backfill by hand or mechanical tamping to a minimum of 85 percent Standard Proctor Density. If the remaining backfill material contains large particles which could damage the pipe from impact during placement, increase the second stage of initial backfill to a point at least twelve (12) inches over the top of the pipe. If the trench width is less than twice the diameter of the pipe where the moisture content at the pipeline grade is negligible and not a subject to seasonal or local variations. Class II material can be installed for pipe haunching in a dry state by hand placement with no compaction.

d. Class III Material. Place Class III material with care under the lower haunch area of the pipe, compact, and then place additional material to the spring line of the pipe. If care has been taken to shape the bedding material to the curvature of the pipe, only one stage of placement will be required to bring the haunching material to the spring line of the pipe. In either event, thoroughly compact the haunching material to a minimum of 90 percent Standard Proctor Density. Take precautions to prevent movement of the pipe during placing of material under the pipe haunch. Perform initial backfilling in the same manner as outlined for Class II materials using hand or mechanical tamping, but achieve a minimum of 90 percent Standard Proctor Density.

10. Backfill - The material that completes the backfilling operation need not be as carefully selected as the initial backfill. It is usually placed in the trench by machine. Care should be taken however, to avoid large

stones, frozen clumps of dirt, etc. which could damage the pipe by impact or by being forced through the soil cushion and against the pipe.

L. Gravity Sewer Pipe Installation

1. All pipes shall be examined for defects prior to being lowered into place. All damage, defective or unsound material will be rejected and shall be removed immediately from the site. The pipe shall be cleaned of all foreign material prior to laying and no debris, tools, clothing or other materials shall be allowed in the pipe during the laying operation. Pipe shall be laid in a dry trench with bell ends facing in the direction of laying, and shall have a minimum of 5' of cover and have sufficient insulation installed to endure freezing does not occur.

2. The full length of each section of pipe shall rest solidly upon the bedding material with recesses only to accommodate pipe bells and joints. Any pipe that is found to have its alignment, grade or joints disturbed after installation shall be removed and re-installed.

3. When the work is not in progress, open ends of pipe shall be securely closed so that no water, earth, rodents of other foreign substances can enter the line. Any section of pipe found to be defective, either before or after laying, shall be replaced with new pipe at no additional expense to the City.

4. Where sanitary sewers in the collections system are routed along streets or highways, the alignment of the sanitary sewers shall be parallel to the centerline of the road and at a distance there from as indicted on the construction drawings. Where sanitary sewers are shown crossing private property, the alignment of the mains shall be located as indicated on the construction drawings, and the work shall be done within the construction easements provided to the City.

5. The pipe shall be secured inplace with approved backfill material tamped under the haunches. Pipe which does not allow a sufficient and uniform apace for joints shall be removed and replaced with pipe of proper dimensions to insure such uniform space. Precautions shall be taken to prevent dirt from entering the joint space.

6. The minimum horizontal separation between mainlines that carry potable water and sanitary sewer or storm sewer mainlines shall be 10'. The minimum vertical separation between mainlines that carry potable water and sanitary sewer or storm sewer mainlines shall be 18". Wherever pipe lines designated to carry potable water supplies cross or are laid less than 10' feet horizontally or 18" vertically from existing or proposed drain or sewer lines, special precautions shall be taken as follows:

   a. Horizontal Separation

Should conditions prevail which prevents a lateral separation of 10', the sanitary sewer may be laid closer than 10' to a watermain, provided the main is laid in a separate trench and at such an elevation that the bottom of the pipeline is at lest 18" below the bottom of the watermain.

b. Vertical Separation

Where sanitary sewer must cross under a watermain, the vertical over the sewer to be
crossed so that the pipe joints will be equidistant from the centerline of the watermain. This minimum vertical separation shall be maintained for a distance of 8' each way of the sewer or drain being crossed. If a crossing cannot meet the 18" requirement a concrete cradle must be utilized. The watermain shall be supported to prevent its settling as directed by the City Engineer.

c. The Sanitary Sewer shall be Ductile Iron pipe (DIP) and supported to prevent settlement.

M. Connection for Service Laterals.

1. Service risers for house sewers shall be provided in the main sewers as shown on the plan sheet or as designated in the specifications. The exact location shall be as directed by the City Engineer or his designated representative during construction.

2. All existing buildings and properties shall be provided with a sanitary service riser. This includes boring a road to serve buildings and properties on the opposite side of the road where the sanitary sewer is being installed.

3. All sewer risers for single family homes shall be four (4) inches"Y" branch.

4. All other risers shall be six (6) inch "Y" branch.

5. All risers shall extend from the main line to the property line, easement line or as designated on the plan sheet. In all cases a minimum of one pipe length of sewer connection is required to be extended from the main line opening or from the riser pipe.

6. Where it is possible, the service connections shall be separated by the length of main line rather than butting two tees together.

7. It shall be the Contractor's responsibility to install the service risers at a sufficient depth to service house basements if the main line sewer is sufficiently deep. Where feasible the service riser shall be installed at a minimum depth of 8' to 10' at the property line or deeper, if necessary to sere basements.

N. Post-Installation Pipe Testing

1. Leakage: All sewers shall be tested for excessive leakage. This may include appropriate water or low pressure air testing. The leakage outward or inward (exfiltration or infiltration) shall not exceed 25 gallons per inch of pipe diameter per mile per day for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of 2 feet. The air test, if used, shall be conducted in accordance with one of the following Standards:

    a. ASTM F1417, "Standard Test Method for Installation Acceptance of plastic Gravity Sewer Lines Using Low Pressure Air."

    b. UNI-B-6, "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe." Published by the Uni-Bell PVC Pipe Association.

2. The testing method selected shall properly consider the existing groundwater elevations during the test. If the test section fails the test for excessive leakage, the contractor shall repair or replace all defective materials and/or workmanship at no additions cost to the governing authority.

3. Procedure for leakage test

    a. Plug all openings in the test section.

    b. Add air until the internal pressure of the line is raised to approximately 4.0 psi. After this pressure is reached, allow the pressure to stabilize. The pressure will normally drop as the air temperature stabilizes. This usually takes 2 to 5 minutes, depending on the pipe size.

    c. When the pressure has stabilized and is at or above the starting test pressure of 4.0 psi, start the test. If the pressure drops more than 1.0 psi drop does not occur within the test time, the line has passed the test.

    d. Table C shows the required test time, T, in minutes/100 feet of pipe for each nominal pipe size for each nominal pipe size. Test times are for a 1.0-psi pressure drop from 4.0 to 3.0 psi.

    e. If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.

    TABLE C: MINIMUM TEST TIME FOR VARIOUS PIPE SIZES

Nominal Pipe Size	T(Time Minutes/100 Feet
4"	0.5
6"	0.7
8"	1.2
10"	1.5
12"	1.8
15"	2.1
18"	2.4
21"	3.0
24"	3.6
27"	4.2
30"	4.8
33"	5.4
36"	6.0
39"	6.6
42"	7.3

f. For 48" and 54" each joint will have to be individually tested.

4. Deflection Test.

a. All PVC sewer pipe shall be deflected tested after completion of backfill. If the test section fails the deflection test, the Contractor shall repair or replace all defective pipe,. Materials and/or workmanship at no additional cost to the City.

b. Deflection tests should be conducted using a go/no-go mandrel. The mandrel's outside dimension shall be sized to permit no more than 5 per cent deflection. The percent deflection shall be established from the base inside diameter of PVC pipe. The mandrel shall be approved by City Engineer prior to it's use.

O. Restoration of Disturbed Areas.

1. When the work is completed on construction of sanitary sewers and appurtenances, all surplus material, earth, rubbish, etc. shall be removed from the site of the work. Rubbish shall be removed on a daily basis.

2. All disturbed areas shall be restored to pre-construction condition to the satisfaction of the City of Moscow Mills.

3. All costs for the cleanup, restoration work, and other intermediate operations such as, but not limited to, construction signage, street sweeping, and maintaining existing utilities, shall be considered inclusive and at no additional cost to the City.

P. Final Inspection.

1. After construction of sewer line is complete and all manholes raised to grade, a final visual inspection shall be made by the City Engineer or a designated, qualified field inspector.

2. At lest two (2) days notice shall be given the City before the final inspection.

II. Construction Standards for Lift Stations

A. General

1. Lift stations shall consist of a wet well, submersible pumps, dry valve vault, control panel and other related accessories. The lift stations shall conform to MDNR Design Guide per 10CSR 20.8.130. Design calculations of maximum flow shall be submitted with detailed specifications and flows shall be determined in accordance with the requirements of MDNR Design Guide per 10 CSR 10.8.120.

2. All lift stations with less than 500,000 gpd average daily flows shall contain two (2) submersible pumps, each pump shall be capable of pumping the design maximum (Peak) flowrate.

3. All lift stations with 500,000 gpd or more Average daily flow shall contain three (3) submersible pumps, two (2) pumps operating together shall be capable of pumping the design maximum (Peak) flowrate.

4. Grinder pumps will not be acceptable.

B. Wet Well Design Criteria for All Lift Station Wet Wells.

1. "Design of Wastewater and Storm water Pumping Stations" Water pollution control Federation, Manual of Practice No. FD-4, 1981, p. 18, indicates that the wet well shall e sized so that the cycle time for each pump will not be less than five minutes or that the average cycle time will not be more than 30 minutes. The shortest operating cycle occurs when the inflow equals to one-half the pump discharge rate. Therefore, if

V= drawndown volume, gal
q = Pump discharge rte, gpm
Q = Inflow rate into the wet well, gpm
t = Minimum time of one pumping cycle in minutes, start to start
t = (time to fill) + (run time)

$$\text{then } t = \frac{V}{Q} + \frac{V}{q - Q}$$

When $Q = q/2$

Then $t = \frac{V}{} + \frac{V}{}$

q/2 q-(q/2)

which is reduced to the operating volume where

$$V = \frac{Aq}{4}$$

2. With the operating volume, the vertical distance between the lead pump on and all pumps off floats can be determined for various wet well sizes. Between the operating volume and emergency storage requirement, the wet will size can be determined. Emergency storage volume will be dependent on the required response time and the average inflow.

3. After the size of the wet well has been determined, then the distance between the floats for lead pump on and all pumps off floats can be determined. This would be a function of wet well size and the operating volume requirement. The vertical distance between the common stop elevation and the bottom of the set well is a function of the pump selected. The common stop elevation shall not be less than the top of the pump housing or as the manufacturer specifies, whichever is greater.

4. The distance between the lead, lag, and high water levels are generally a function of the local requirement. If mercury floats are utilized, then these should not e spaced less than six inches apart, with the high water alarm level being at or lower than the lowest incoming sewer line.

5. These settings will determine the depth of the wet well which will allow the buoyancy calculations to be completed. The buoyancy analysis on the wet well will determine whether additional methods of restraint will be necessary.

6. The buoyancy force equals the displaced volume of the wet well and bottom slab multiplied by the unit weight of water.

7. The opposing force is equal to the weight of the wet well, bottom slab, top slab, and the soil over the bottom slab extension, if applicable. The safety factor is equal to the opposing force divided by the buoyancy force. The safety factor should be $\exists$ 1.5.

C. Wet Wells and Valve Vault for Lift Stations with <u>less than</u> 500,000 gpd. <u>average</u> daily flow.

1. Wet Well.

   a. The wet well shall consist of a circular basin, minimum 6 feet in diameter and minimum 10 feet in depth. The wet well shall be constructed of reinforced concrete and have walls designed to withstand the external earth loadings when the wet well is empty. The wet well shall have a reinforced concrete bottom and top, with access hatch. The base of the wet well shall be grouted at the joints

on the inside at a 1:1 slope to prevent the accumulation of solids. All pipe openings for flow into and out of the wet well shall have the pipes grouted in place, inside and outside with non-shrink grout.

b. The wet well shall contain stainless steel guide rails for the pumps, securely fastened t the top opening of the wet well to allow the pumps to accurately mate with the pump bases, which shall be secured to the bottom with stainless steel bolts.

c. All joints in the wet well shall be sealed with sealant material in compliance with Federal Specification SS-S-00210. The entire wet well shall be sealed on the outside with a two part urethane asphalt applied to provide a dry film thickness of 20 mils.

d. The wet well shall have a 6" minimum diameter ductile iron or stainless steel air vent extending through the top slab with a 180 degree turn sealed by an approved insect screen. There shall be a stainless steel or aluminum trash basket located at the inlet pipe with a stainless steel lifting chain to provide for periodic removal and cleaning.

e. Access to the wet well shall be through an aluminum hatch, rated for a 300 pound load, Halliday R2R or approved equal. The top elevation of the wet well shall be 12" higher than the surrounding ground and the grades around the wet well shall be such that all runoff will be diverted away fro the top. The hatch frame and cover shall be flush with the top of the concrete complete with hinges and flush locking mechanism, upper guide holder and level sensor cable holder. Doors shall open and automatically lock with stainless steel “hold open” arm with aluminum release handles.

f. Wet well shall be cast-in-place concrete or pre-cast concrete. Minimum concrete strength shall be 3000 psi, 28-day compressive strength.

2. Valve Vault.

a. The valve vault shall be cast-in-place concrete or pre-cast concrete, with a minimum diameter of 4' - 0" and a minimum depth of 4' - 6'.

b. The valve vault shall contain two (2), four (4) inch (minimum) diameter discharge lines, one (1) from each pump. Each line shall have Apco Rubber Flap swinging check valve and Mueller resilient Wedge gate vale with hand wheel operator. All piping and all fittings shall be flange ductile iron pipe and shall be properly supported. Immediately beyond the valve vault, there shall be two (2), 90 degree bends to bring the piping to a tee and then to force main with an ARI combination air valve (Model D-025) and a pre-cast concrete Valve Box (36"dia.). Combination air valve shall have 2" thread inlet. There shall be provided a minimum three (3) inch schedule 40

PVC drain from valve vault to the wet well and the floor of valve vault shall be grouted to provide a slope to the drain line.

D. Wet well and valve vault for Lift Stations with 500,000 gpd or more average daily flow.

1. Wet Well (Triplex Station)

a. The wet well shall be cast-in-place concrete (pre-cast concrete will not be acceptable) with a minimum size of 8'-0" wide x 10'-0" long x 10'-0" deep. The wet well shall be constructed of reinforced concrete and have walls designed to withstand the expected earthen loadings when wet well is empty. The wet well shall also have reinforced concrete bottom and top slabs. Top slab shall be designed for 100 psf live load and have a minimum thickness of nine (9) inches. The bottom slab of the wet well shall be grouted at a 1:1 slope to prevent the accumulation of solids. All pipe openings for flow into and out of wet well shall have pipes grouted in place, inside and out with non-shrink grout. All walls shall have PVC waterstop installed to prevent groundwater infiltration.

b. A double aluminum hatch, rated for 300 pound load, shall be installed and sized t allow for easy removal of two (2) pumps. A second single aluminum hatch, rated for 300 pound load, shall be installed and sized to allow for easy removal of third pump. Minimum distance between hatches shall be 12 inches. The hatch frames and covers shall be flush with the top of the concrete complete with hinges and flush locking mechanism, upper guide holder and level sensor cable holder. Doors shall open and automatically lock with stainless steel “hold open” arm with aluminum release handle.

c. The top elevation of the wet well and value vault shall be 12 inches higher than the surrounding ground and the grades around the wet well shall be such that all runoff will be directed away from lift station.

d. The wet well shall contain stainless steel guide rails for the pumps, securely fastened at the top opening of the wet well to allow the pumps to accurately mate with the pump bases, which shall be secured to the bottom with stainless steel bolts.

e. All joints in the wet well shall be sealed with a sealant material in compliance with Federal Specification SS-S-00210. The entire wet well shall be sealed on the outside with a two part urethane asphalt applied to provide a dry film thickness of 20 mils.

f. The pump bases shall be as specified by the pump manufacturer and have minimum 4" ductile iron (Class 200) discharge pipes, which run through the valve vault. There shall be provided stainless

steel lifting chains and floats for control of the pumps as called for hereinafter and as recommended by the pump manufacturer. Floats shall be provided for the control of the pumps and alarms, and floats shall be located such that they are not affected by incoming flow.

g. The wet well shall have a 10" minimum diameter ductile iron or stainless steel air vent extending through the top slab with a 180 degree turn sealed by an approved insect screen. There shall be a stainless steel or aluminum trash basket located at the inlet pipe with a stainless steel lifting chain to provide for periodic removal and cleaning.

2. Valve Vault.

a. The valve vault shall be constructed of reinforced cast-in-place concrete and shall be monolithically poured with wet well, so that the wet well and valve vault share a common wall and common top slab.

b. The bottom slab of valve vault shall have a minimum of four (4) concrete T-beams underneath it to support it and allow the valve vault to cantilever without soil support. The design calculations for concrete T-beams shall be submitted to City Engineer for review.

c. The valve vault shall have a minimum size of 5'-0" wide x 10'-0" long x 5'-0" deep.

d. The valve vault shall have three (3), four (4) inch (minimum) diameter discharge lines, one (1) from each pump. Each line shall have Apco Rubber flap swing check valve and Mueller resilient wedge gate valve with hand wheel operation. All piping and all fittings shall be flanged ductile iron pipe and shall be properly supported.

e. Two (2), 90 degree elbows shall bring piping to a tee (one pump connected directly to tee) inside valve vault. A single ductile iron pipe shall leave valve vault and immediately outside valve vault wall an ARI combination air valve (Model 0-025) with a 36" precast box shall be installed to allow air to be released from forcemain. Combination air valve shall have 2" threaded inlet.

f. Three (3) aluminum access covers, each with 300 pound load capacities shall be installed in the top slab of valve vault. Each shall have a minimum size of 30" x 30" and shall be installed to allow easy access to each set of check and gate valves. The hatch frames and covers shall be flush with the top of valve vault, and complete with hinges and flush locking mechanism, upper guide holder and shall automatically lock with stainless steel “hold open” arm with aluminum release handle.

g. There shall be provided a minimum of four (4) inch schedule 40 PVC drain from valve vault to the wet well and floor of valve vault shall be grouted to provide a slope to drain.

E. Submersible Pumps and Motors.

1. The pump and motor unit shall be a submersible type with a minimum for (4) inch discharge. The pumps shall be capable of passing a three (3) inch sphere, without clogging. The motors shall be driven by either 230 volt or 460 volt, 3 phase, 60 hertz electrical power source.

2. The submersible pumps shall be manufactured by ABS or Flygt or approved equal.

3. Grinder pumpers will not be allowed.

4. The submersible pumps shall have the following minimum size and capacity:

   a. 5 horsepower
   b. 100 gallons per minute

5. The discharge connection elbows shall be permanently installed in the wet well and the pumps shall be automatically connected to the discharge connection when lowered into place and shall be easily removed for inspection or service by means of stainless steel lifting chains. There shall be no need for personnel to enter the wet well.

6. Major pump components shall be gray cast iron, Class 30, with smooth surfaces devoid of blowholes or other irregularities. Thermal sensors shall be used to monitor stator temperatures and specialized relays/sensors shall be supplied to the control panel manufacturer prior to panel constructions. Impellors shall be of gray cast iron. Class 30, dynamically balanced, single or double shrouded non clogging design, with stainless steels shafts, and be capable of handling solids, fibrous materials, heavy sludge and be capable of passing a sold 3" diameter sphere.

F. Controls Panels and Electrical Components.

1. General Requirements

   a. The Contractor shall provide and install all hardware, software, labor materials, and equipment required to provide a complete control panel, in strict accordance with the requirements of these standards. The control panel shall be located from 3 feet to 8 feet from the set well, unless located in building.

   b. It is the intent of these Standards that all motor control and control components be supplied by a single supplier. Controls shall not be

assembled on site. System supplier shall be a UL 508 certified facility and shall be regularly engaged in the manufacture of controls for the municipal water industry. The system specified herein shall be the product of a manufacturer having at lest ten years experience in the construction of such control equipment.

c. A master wiring diagram for the control panel(s) shall be submitted for City Engineer's review and approval before beginning construction. This diagram shall be drawn in standard ladder logic format. All ladder rungs shall be numbered in the left hand margin, and all relay contacts referenced to these numbers in the right hand margin. Each electrical node in the control schematic shall have a different wire number. A bill of materials and a layout drawing of the enclosure door/inner bracket components shall appear on this drawing with a listing of nameplates pertaining to the components. Submittal drawings may be on 11" x 17" paper.

d. Final As-Built drawings shall be on full-size 24" x 36" paper. Two (2) sets shall be provided. An additional full-size-as-built drawing shall be placed in the control panel. A waterproof reduced copy of the master "as built" wiring diagram shall be laminated in clear plastic and permanently fastened to the inside of the panel door.

e. Included in the submittal package shall be data sheets of all equipment used in the control panel, as listed in the bill of materials.

f. Provide on-site start-up of supplied equipment and provide an on-site training program shall be provided to employees as selected by the Owner. The objective of the training is to provide a common working knowledge concerning the operation of the system. Training shall include one (1) two-hour training session provided at the completion of start-up.

g. System warranty shall be for a period of 3 years commencing upon successful completion of startup. Warranty includes parts and labor for all equipment/software/services provided. Warranty excludes surge/transient damage.

2. Operation.

a. Basic operation of the pumps shall be as a pump-down, lead/lag, common off system with high level alarm. Panel shall accommodate connection of floats, with the following functionality:

High Level	Lag Demand
Lead Demand	Stop

b. Each pump shall be controlled through a "Hand-Off-Auto" selector switch.

Hand: Pump shall be demanded and shall run continuously until the selector switch is turned to Off or Auto.

Off: Pump shall not be demanded.

Auto: Pump shall be controlled by the floats in the wetwell. A demand for each pump shall be delayed through adjustable time delay relays with a range pump shall be delayed through adjustable time delay relays with a range of 01 - 10 seconds. Initially, the time delay for the first pump demand shall be set at 8 seconds apart. Operation of the lag pump(s) shall not be dependant on the lead demand float.

c. The alarm system shall operate individual pilot lights as described under General Control Panel Equipment, and a common general alarm for the external horn/light (as indicated by asterisk*) upon the following faults:

1. <u>High Wetwell Level*</u>
   A contact closure from the high level float shall indicate a high level alarm condition. This alarm shall automatically reset.

2. <u>Pump Fail (No Pressure)*</u>
   A time delay shall begin when the pump is demanded. If the pump pressure switch does not indicate pressure prior to the time expiring, a “NO Flow” alarm shall exist. This alarm shall latch and prevent the pump from turning. Alarm annunciation shall remain on until manually reset.

3. <u>Pump Seal Fail</u>

   A pump seal failure shall be annunciated only by the individual pilot light. This alarm shall not stop the pump from running. Alarm annunciation shall remain on until manually reset.

3. Pump Control Panel Components.

a. Control Panels located inside shall be NEMA 12 painted steel enclosures.

b. Control Panels located outside shall be NEMA 4x stainless steel enclosures.

c. All enclosures on exterior of NEMA 4x Panel shall be stainless steel. Exterior door shall be held shut with padlockable, 3-point door latch, shall be Austin #48-5655SSX, or equal. The padlock is to be provided by the owner. Inner door shall be held shut with latch, Emka wingknob #1000-U78 and cam #1000-50, or equal. All doors shall be mounted to the enclosure with continuous hinges. Exterior door shall be gasketed to provide a watertight seal to the enclosure. Subpanel and inner door shall be 12 gauge mild steel

primed and painted white. All control switches, pushbuttons, elapsed time meters, and indicator lights shall be mounted on or through the inner door. All panel wiring and equipment layout shall be performed per N.E.M.A. and J.I.C. specifications. N.E.C. gutter spacing shall be observed. A minimum of 6" additional D.I.N. rail shall be provided for future mounting expansion.

d. Pump Control Panels shall include the following:

1. Provide a main power distribution block sized for incoming power to the panel. Each pole of the block shall be supplied with a clear cover for operator protection. Power distribution block shall be Gould 63000, 67000, or 69,000 series or approved equal, as required.

2. Provide a silicon oxide varistor surge/lightning suppressor connected to the power distribution block and sized for incoming voltage. Minimum ratings shall be 60,000 amps, 1500 Joules. Suppressor shall be Delta LA series, or approved equal.

3. Where three-phase motors are controlled, provide a plug-in style phase monitor designed to monitor phase loss, under voltage, and phase sequence with a SPDT contact to interrupt all control power in the event of phase loss. Phase monitor shall be supplied with fused protection of the three phase sensing circuit. Phase monitor shall be Diversified Electronics SLA series, Symcom model #250A, or approved equal. Fuseholder shall be three-pole Gould USM-I series, or approved equal. Fuses shall be fast-acting Gould ATM series, or approved equal.

4. Provide individual, properly sized, thermal-magnetic circuit breaker for each load served. Combination circuit breaker and overload mechanism shall not be allowed. Circuit breakers for motors and other loads shall have a minimum rating of 10,000 AIC (230vac breakers) or 14,000 AIC (480 vac breakers).

5. Provide individual, properly sized, thermal-magnetic circuit breaker for each of the following;
-Transformer
-Each motor load

6. Provide 1-pole, 15-amp circuit breakers for the following loads:
-Control circuit
-Panel receptacle/condensation heater/service light.

7. A magnetic across the line horsepower/current rated motor contractor with ambient temperature compensated overload relay shall be provided for each motor load served. Contractor

shall be Cutler-Hammer CE 15 series, ABB Series A, or approved equal. Overload relay shall be Cutler-Hammer #C316, ABB Series TA, or approved equal.

8. Pumps 40 HP and larger shall be provided with a reduced voltage solid state starter with overload protection and across-the-line bypass contractor for each motor load served. Solid state starter shall be Cutler-hammer IT series with line side surge protector, ABB PSS series, or approved equal.

9. If 120 volt, single phase is not available, a minimum 2KVA dry-type transformer shall be supplied with primary and secondary short circuit protection. Control power shall be 120 volt. Control circuit shall be connected so that a power outage of any duration does not require manual re-start of system.

10. Provide a fuseholder and fuse for the control circuit, minimum rating 5 amps (ampacity not to exceed relay contact rating). Fuseholders for control fuses shall be fingersafe with neon light indication for a blown fuse. Control fuse fuseholders shall be Gould USM-I series, Entrelec, or approved equal.

11. Numbered terminal blocks shall be supplied for all field terminations. Current capacity of terminal strips shall be equal to the load served. Terminal blocks shall be suitable for minimum 12 AWG wire at not less than 300 volts. Terminal blocks for control interface shall be Entrelec model 115116.07, or approved equal.

12. Provide an interior fluorescent service light w/safety lens fastened to the top of the enclosure with two-position “Off-On” selector knob to control. Incandescent light fixtures shall not be acceptable. Light shall be mounted without penetrating the panel outer skin with screws or fasteners.

13. An entry switch shall be mounted in the panel, which shall close a contact wired to the telemetry unit when the exterior door of the enclosure is not closed. Switch shall be Microswitch #1AC2, or equal.

14. Provide a 15-amp G.F.1 duplex receptacle connected to a separate circuit breaker, as described elsewhere, and mounted on the control panel inner door.

15. Provide a 100 watt, 120 vac silicone rubber self-adhesive condensation heater mounted on a flange with integral 40 degree thermostat. Heater shall be Watlow #020200C1-EV11B, or approved equal.

16. Provide an automatic electronic alternator for alternating pump operation on successive automatic cycles. Relay shall incorporate LED position indicators and a toggle switch to select pump #1 or pump #2 as the lead pump, or to allow automatic
alternation. Alternator shall be Diversified Electronics ARB series or approved.

17. Relays shall be general purpose plug-in relays with standard mounting configurations. The relays shall have the number of poles as shown on the drawings with neon indicating l amp and test button integral to each relay. Relay contact ratings shall be minimum 5 amps.

18. Time delay relays shall be dia or D.I.P. switch selectable, and shall have contact ratings of not less than 10 amps. Switch settings shall be labeled o n the relay. Time delay relays shall be Diversified Electronics TB series, or approved equal.

19. Selector switches shall be 30 mm oil tight type with lever operators and 10 amp contacts. Knob operators shall not be accepted. Contact blocks shall be provided as required and shall be rated for a nominal voltage of 500 vac and 10 amps. Control switches shall be Cutler-Hammer Series E34 or equal. Contact blocks shall be Cutler-Hammer type 10250T. Provide selector switches for the following functions (per pump where applicable):

    -Pump “Hand-Off-Auto” Three-position

20. Pilot lights shall be push-to-test, oil-tight industrial units utilizing 120 volt bulbs (unless otherwise specified). Lenses shall be colored as shown on the drawings. Control panel lights shall be modular construction as manufactured by Cutler Hammer E34RPB or approved equal. Contact blocks shall be Cutler Hammer type 10250T or approved equal. LED type lights shall not be acceptable. Provide pilot lights for the following functions (per pump where applicable):

(A) High Level	Red
(C) Pump Run	Green
(D) Pump Fail	Red
(E) Pump Seal Fail	Amber

21. Pushbuttons shall be oil-tight industrial units. Contact blocks shall be provided as required and shall be red for a nominal voltage of 500 vac and 10 amps. Control panel pushbuttons shall be modular construction as manufactured by Cutler-Hammer Series E34 or approved equal. Provide push-buttoned for the following functions:

(A) Alarm horn silence
(B) Pump Fail Reset

22. Provide an elapsed time meter for each pump controlled. Meter shall be six digit, non-resettable, reading in hours and tenths of hours. Elapsed time meter shall be Fourth Dimensions, of approved equal.

23. Provide a conductance actuated moisture sensing relay for each submersible pump controlled with field adjustable sensitivity. Specialized relays/sensors, if required by the pump manufacturer, shall be supplied to the panel manufacturer by the pump manufacturer prior to panel construction. Seal Fall Relay shall be Diversified Electronics, Syretec, or approved equal.

24. Provide a red strobe light mounted to the top, exterior of the enclosure. Minimum ratings shall be 1.5 Joules at 70 flashes per minute. The strobe light shall be fully sealed to prevent water from entering the enclosure and be attached by mounting screws from inside the enclosure to prevent tampering.

25. Provide automatic alarm Dialer mounted in the control panel. Dialer shall be Mission Model 110 RTU. Dialer shall be mounted inside control panel in a 15" x 15" space. The dialer shall be configured by City of Moscow Mills personnel.
The following alarms shall be wired to terminal blocks in the control panel, then connected to the dialer:

    (A) Wetwell High Level
    (B) Pump #1 Fail
    (C) Pump #2 Fail
    (D) Power Failure

26. Provide a ground lug sized for incoming power ground hear the power distribution block. Provide a ground lug sized for pump ground near pump power wire terminations. Provide a ground buss for control equipment grounding, minimum 6 termination points.

27. Provide a corrosion inhibitor mounted inside the control panel. Corrosion inhibitor shall be Hoffman #A-HCI-5E, or approved equal.

28. Power distribution wiring on the line side of panel fuses or circuit breakers shall be sized for the load served, minimum 12 AWG. Control wiring shall be minimum #16 gauge SIS type stranded wire for internal control panel circuits. Al control wires shall be numbered at each termination corresponding to

the master wiring diagram with clip-sleeve or heat-shrink type wire markers. Wrap-on or adhesive wire markers shall not be allowed. 120 vac wiring (except for neutrals) shall have red insulation. 120 vac neutral wiring shall have white insulation. 50 vac or less shall have yellow insulation. 12/24 vdc wiring shall have blue insulation.

29. Provide adhesive backed printed nameplates for all internal devices such as contactors, circuit breakers, and relays. Provide engraved phonetic nameplates, black letters, on white background, for door-mounted devices such as selector switches, push-buttons, circuit breaker toggles, and pilot lights. Nameplates shall be secured firmly to the panel.

30. A lightning/surge arrestor shall be provided at the incoming power terminals to the control panel. The unit shall be of the solid state type and be able to clamp in five (5) nanoseconds and absorb up to 25KA peak surge current during an occurrence. The unit shall have a surge life expectancy of 10,000 occurrences at 2300 amps.

31. An electrical equipment rack shall be supplied by the manufacturer of the control panel for installation by the manufacturer of the control panel for installation by the electrical contractor. The equipment rack shall be constructed of double-back Unistrut™, hot dipped galvanized material with required conduit connecting meterbase, fused disconnect switch, control panel, seal fittings, and FRP (fiberglass reinforced plastic) junction box.

G. Standby Power and Emergency Storage Capacity

1. For lift stations with <u>less than</u> 500,000 gpd design <u>average</u> flow:

a. Install a Cooper Grouse-Hinds WSR Interlocked Arktite Receptacle (Cat. No. APR204113) with enclosed manual disconnect switch. Shall be rated at 460/250 volt, 200 amp, and be 4-wire, 4-pole, style 1, with NEMA 4 enclosure.

b. To give Cit Personnel time to plug-in portable generator into Arktite receptacle a minimum of <u>one (1) hour</u> emergency storage capacity shall be provided base on <u>peak hour design flow.</u> The emergency storage must be available above the high water alarm elevation in the wet well and must be continuously available without the need for an operator to switch valves or diversions. If a dedicated emergency overflow tank is required, it shall be constructed of reinforced concrete and shall have equal pipes in place to allow flow to travel to and from wet well and emergency storage tank. The return pipe <u>from</u> the emergency storage tank to the wet well shall include a plug valve that is normally in the closed position and

shall be located at the bottom of emergency storage tank to allow for complete drainage. The emergency storage tank shall have smooth floor sloped to drain with a minimum 1% slope. The emergency storage tank shall have a minimum of two (2) - 36 inch diameter manholes for access.

2. For Lift Stations with 500,000 gpd or more design average flow:

   a. An, installed on site, diesel engine emergency standby generator shall be provided by Contractor. The unit shall be sized to allow delayed starts, (one pump at a time), and operation of all pumps, once started, in addition to auxiliary loads. An above ground double-walled fuel tank shall be provided with at least 24- hour fuel storage at generators full load capacity. The generator shall include battery charger and thermostatically controlled engine block heater.

   b. An automatic transfer switch shall be provided to switch from primary power to emergency power on a power failure or a drop in any phase voltage to 70 percent of line voltage. When primary power is restored the automatic transfer switch will transfer load back to primary power and cool down engine and the shut-off generator.

   c. Standby generator and automatic transfer switch shall be manufactured by ONAN, Catapillar or approved equal.

   d. Since and standby generator and automatic transfer switch will be installed at 1st station etc, additional emergency storage capacity will not be required.

H. Piping and Valves.

1. All piping in the wet well ad the valve vault shall be ductile iron pipe, class 250 in accordance with A W W A C-151. The connection to the PVC force main outside the valve vault shall be made with a ductile iron mechanical joint solid sleeve. Allowance shall be designed into force mains between wet well and valve vault for potential differential settlement.

I. Fencing Around Lift Station.

1. Fencing around the lift station, including the wet well, valve vault and control panel, shall consist of a 6' high chain ind fence with a barbed wire security top and a 12' wide entrance gate. Wire fabric for the fence shall be a aluminized chain link fence fabric and wire shall be No.11 gauge woven into a 2" mesh. The barbed wire top shall consist of thee strands of Nol.12-1/2 gauge line wires with No. 14 gauge barbs spaced at approximately 5"centers. Posts shall be vinyl clad schedule 40 pipe

and post shall be equipped with suitable tops. All fencing must conform to local ordinances.

Posts shall be sized and set as follows:

TYPE	SIZE	PULL
Top Rails and Brace	1-1/4" Min.	2.27 lbs.
Line Posts and Gate Frame	1-1/2" Min.	2.72 lbs.
End Corner or Pull Post	2" Min.	5.79 lbs.

CONCRETE BASES

TYPE	DIAMETER	PULL
Line Post	12"	3'-6"
End Corner Gate	16"	4'
Pull Post	16"	4'

2. Poles shall be in 30" deep concrete bases so that the pole bottom rests 6" higher than the concrete base bottom. Horizontal support bars shall be installed half way between the top rail and the ground. A #7 tension wire shall be installed at the bottom of the fencing fabric to be lifted away from the fencing poles and/or the ground.

J. Lift Station Access Road.

1. The roadway to the lift station and all areas within the fencing shall be constructed with a sub-base of 6" of compacted 3/4" minus crushed limestone and screenings and the finished pavement shall be constructed with 4" of asphaltic concrete. The paved area shall be large enough to accommodate City trucks and a paved turn around area shall be provided.

2. There shall be provided two 36" high barmier post, vinyl clad schedule 40 steel pipe at the entrance road to the lift station. There shall also be provided a 5/16" diameter galvanized chain locked on one end and attached to the other, run between the posts. For safety purposes, a 4" x 12" reflective plate shall be attached to the chain at the center of the span.

K. Testing.

1. Testing shall consist of introducing water into the wet well to ensure that the pumps operate as proposed and that all controls and alarms shall be operated in the presence of a City representative to demonstrate that they operate as intended. All alarm conditions shall be simulated and the dialer shall be programmed and shown to operate as intended.

L. Site Cleanup and Restoration.

1. After work is completed, the site of the lift station installation shall be cleared of all construction material and other debris. Grading shall

consist of providing proper drainage and all sites shall be left in a neat, clean and acceptable condition. For all property the site shall be restored to a condition equal to, or better than, it's condition before the work was started. In any existing or proposed lawn areas, the final restoration shall include sodding.

M. Guarantee.

1. The Contract shall guarantee all material and workmanship for a period of a minimum of three (3) years following acceptance of the work by the City.

III. Design and Construction Standards for Force Mains

All force mains Constructed within the Corporate limits of the City of Moscow Mills shall meet the following Standards:

A. General Requirements

1. All force mains shall be profiled on the construction plans. All force mains of any size that are not under a designed street shall also be profiled on the construction plans. All force mains 24" and larger shall be ductile iron.

2. All contractors must notify the City Engineer at least 48 hours prior to start of construction.

3. No work shall be backfilled until the construction has been inspected and approved by a qualified inspector employed by the City of Moscow Mills.

4. Force mains shall not be located in tree lawn areas (areas between back of curb and sidewalk).

5. Depth of cover shall be 3 feet minimum below finished grade.

6. All force mains shall have a 10-foot separation from any parallel water main.

7. A minimum clearance of 18 inches between force mains and water mains.

8. At high points in force mains where air can accumulate, provisions shall be made to remove the air by means of air relief valves.

9. All PVC force main shall have tracer wire installed.

B. Location of Lines and Appurtenances

1. Force mains in street right-of-way.
   a. No force main shall be constructed longitudinally under street pavement or under sidewalk.

   b. No force main shall be constructed in tree lawn area (area between back of curb and edge of sidewalk). Trees will be planned in this area.

2. Force Mains in Easement

   a. All easements for water mains shall be a minimum of fifteen (15) feet.

C. Force Main Pipe

1. General

   a. All public force mains will be a minimum of 4" in diameter. Sizing shall be determined by the City Engineer.

2. Ductile Iron Pipe (D.I.P.)

   a. All ductile iron pipe furnished under this specification shall be manufactured in strict accordance with AWWA standard specification C-151/A21.51-81 or latest revision thereof with the following additional requirements:
      - Joint Type - All ductile iron pipe joints shall be “push on joint single gasket” or “Mechanical joint ingle gasket.” The rubber gasket shall conform to the requirements of AWWA C-121.11-80, or latest revision thereof.

      - Thickness class - Pipe furnished shall be class 50 for sizes through 18 inch in diameter and class 51 for all other diameters.

      - Laying Length - Pipe furnished shall have a normal laying length of 18' or 20'.

      - Grade of Iron - Iron used in the manufacture of pipe shall have 60/42/10 physicals.

      - Cement Mortar Lining - All pipe furnished shall have standard thickness cement mortar lining in accordance with AWWA C-104/A21.4-80 or latest revision thereof.

3. Polyvinyl Chloride Pressure Pipe (PVC)

a. All polyvinyl pipe (PVC) shall be manufactured in street accordance with ASTM D 2241 and shall conform to the following additional requirements:

- Size of pipe - for pipe sizes of 4" through 24" diameter.

- Joint Type - Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gasket and machined pipe ends to form a push-on type joint.

Solvent cement joints are strictly prohibited.

- Class and Type - Al PVC pipe shall be Class 200, side dimension ration (SDR) 21.

D. Force Main Appurtenances

1. Fittings

a. All fittings shall be ductile iron, cement mortar lined, and shall conform to AWWA C-110/A21.10-82 for mechanical joints and AWWA C-111-71 or ANSI A21.11 for push on joint gasket or latest revisions thereof.

b. Combination air relief valves - shall be installed at each high point on all force mains and at all other locations as directed by City Engineer. Shall have 2" male NPT connection, body of valve shall be made of reinforced Nylon, shall have 2" ball valve installed between the pipe and valve. Shall have working pressure range of 3-150 psi and shall be self cleaning. Valve shall be manufactured by A.R.I., model D-025 combination air valve. Valve shall be enclosed in pre-cast concrete vault with a min. den. of 3'-0" and cast iron cover and frame, bottom of vault can be crushed stone, to allow for drainage.

E. Casings for Street Bores.

1. Pipe Casing - shall be minimum schedule 40 steel and have a diameter six (6) inches larger than force main.

2. Force main through casing - shall be restrained joint PVC pipe meeting ASTM D 1784 and ASTM D 2837, class 200 (DR14), for sizes 4" through 16", for sizes 18" through 24" shall meet ASTM D 2241, SDR21.

3. Force Main shall be supported in casing by high density, RACI Polethylene spacers. Spacing distance as recommended by manufacturer.

F. Excavation

1. General - Excavation for pipelines, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the same as shown on the approved drawings or as otherwise approved by the City Engineer. Any water that may be encountered or may accumulate in the excavation shall be pumped out or otherwise removed as necessary to keep the bottom of the excavation free and clear of water during the progress of work.

2. Limit of Excavation - Except by expressed written permission of the City Engineer, the maximum length of open trench shall be 600', or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller. The distance is the collective length at any location, including open excavation, pipe laying and appurtenances, construction and backfill that has not been temporarily resurfaced. No trench shall be left open at any time that the Contractor is not on the job site engaged in construction operations.

3. Trench Width - The overall trench width shall not be more than 24" nor less than 12" wider than the largest outside diameter of the pipe to be laid therein, measured at the top of the pipe, exclusive of branches. Excavating and trenching shall be true to line so that a clear space of not more than 12" or less than 6" in width is provided on each side of the largest outside diameter of the pipe for proper placement and densification of the bedding or backfill. For the purpose of this section, the largest outside diameter shall be the outside diameter of the bell, on bell and spigot pipe.

4. Excavation Below Grade - the trench shall be excavated to a minimum depth of6" below the bottom of the pipe. Before the pipe is laid, the subgrade shall be made by backfilling with an approved material in 3" uncompacted layers. The layers shall be thoroughly tamped as directed by the City Engineer so as to provide a continuous bearing and support for the pipe at every point between coupling or bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18" near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately by means of hand tools.

5. Trenching By Hand or Machine - Hand methods for excavation hall be employed in locations directed by the City Engineer. In other locations, the Contractor may use trench digging machinery or employ hand methods.

6. Bracing Excavations - All excavations shall be properly supported in the manner as required by Occupational Safety and Health Administration Federal Register Vol. 37, No. 243, sub-part P, Section 1926.652 or as required by State laws and Municipal ordinances and as may be necessary to protect life, property, the work, or as ordered by the City

Engineer. Excavations shall be braced, sheeted and supported such that they will be safe, and the ground alongside the excavation will not slide or settle. Excavation shall be so braced or sheeted so as to provide conditions under which workmen may work safely and efficiently at all times. The sheeting, shoring and bracing shall be so arranged as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

Care shall be exercised in the drawing or removing of sheeting, shoring bracing and timbering to prevent the caving or collapsing of the excavation faces that are being supported.

7. Grading and Stockpiling - the Contractor shall control grading in a manner to prevent water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm and wastewater can be uninterrupted in existing gutters, other surface drains or temporary drains.

G. Dewatering

1. The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of al water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods that will insure a dry excavation and preservation of the bottoms of excavations. Said methods may include well points, sump pumps, suitable rock or gravel placed below the required bedding for drainage and pumping purposes, temporary pipelines and other means, all subject to the approval of the City Engineer. Dewatering for the water lines shall commence when groundwater is first encountered, and shall be continuous until such time as water can be allowed to rise in accordance with the provisions of this section.

2. The Contractor shall dispose of the water from the work in accordance with State and Federal laws and with respect for adjacent properties and new construction.

H. Bedding

1. Foundation in Poor Soil - If excessively wet, soft, spongy, unstable or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the City Engineer.

2. Foundations in Rock - Where rock is encountered, it shall be removed below grade and the trench backfilled with rock uniformly graded between 3/4-inch and 1 ½-inches to provide a compacted foundation cushion with minimum allowable thicknesses of 3" under the outside

diameter of the pipe bell and 6" under the pipe barrel. Material, other than what has been stated, can be used if accepted by the City Engineer and necessary agencies. Whether or not the foundation material will be considered as rock and require bedding as described above will be determined by the City Engineer.

3. Pipe Clearance in Rocks - Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6" below and on the side of the pipe and fittings.

4. The Contractor shall be responsible for accurately shaping the pipe subgrade to fit the bottom of the pipe.

I. Installation of Force Main and Appurtenances

1. General - All pipe shall be laid without break from fitting to fitting. Pipe shall be laid to the line and, where required, grade, as shown on the approved plans and in such a manner as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the line. Where possible, vertical deflections shall be made at pipe joints and vertical bends shall be eliminated. The interior of the water pipe shall be cleaned of all dirt and superfluous material of all description as the work progresses.

2. Alignment and Grade - The force main shall be laid and maintained to the required lines and grades as shown on the plans. Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the approved plans is required, the City Engineer shall have the authority to change the plans and order a deviation from the line and grade.

3. Lowering of Force Main Pipe Into the Trench - proper implements, tools and equipment satisfactory to the City Engineer shall be provided and used by the Contractor for the safe and convenient performance of the work. All pipe, fittings, valves shall be carefully lowered into the trench piece by piece in such a manner as to prevent damage to the force main pipe and protective coatings and linings. Under no circumstances shall force main pipe be dropped or dumped into the trench.

   If damage occurs to any pipe, fittings, valves, hydrants or force main accessories in handling, the damage shall be immediately brought to the City Engineer’s attention.

4. Inspection Before Installation - All pipe and fittings shall be carefully examined for cracks and other defects while suspended and before installation. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the City Engineer, who will prescribe corrective repairs or rejection.

5. Cleaning of Pipe and Fittings - All lumps, blisters and excessive coating shall be removed from the bell or coupling and spigot ends of each pipe, and the outside of the spigot and the inside of the bell or coupling shall be wire brushed and wiped clean and dry and free of oil and grease before the pipe is laid.

6. Laying of Pipe - Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipelaying crew cannot put the pipe into the trench and place it without getting earth into it, the City Engineer may require that before lowering the pipe into the trench, a heavy tightly woven canvas bag of suitable size, or plastic caps, shall be placed over each end and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

   As each length of pipe is placed in the trench, the spigot end shall be centered in the bell or coupling and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells or couplings. Precautions shall be taken to prevent dirt from entering the joint space.

7. Cutting of Pipe - The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.

8. Bell or Coupling Ends to Face Direction of Laying - Pipe shall be laid with the bell or coupling ends facing in the direction of laying, useless otherwise specified by the City Engineer. Where the pipe is laid on a grade of 10% or greater, the laying shall proceed upward with the bell or coupling ends of the pipe upgrade, if the progression of work allows.

9. Permissible Deflection at Joints - Wherever it is necessary to deflect the pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or plumb stems or where long radius curves are permitted, the amount of deflection allowed shall not exceed 4 degrees per joint (or 2 degrees on each side of the coupling) for polyvinyl chloride pipe.

10. Jointing of Mechanical Joint Pipe

    a. Cleaning and Assembly of Joint - The last 8" of the outside spigot and inside bell of mechanical joint pipe shall be thoroughly cleaned to remove oil, grease, grit, excess coating and other foreign matter from the joint and then painted with a soap solution made by dissolving 2 cup of liquid soap in 1 gallon of water. The cast iron gland shall be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell end. The rubber

gasket shall be painted with the soap solution and placed on the spigot end with the thick edge towards the gland.

b. Bolting of Joint - The entire section of pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell. Care should be taken to locate the gasket evenly around the entire joint. The cast iron gland shall be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed finger tight. All nuts shall be tightened with a torque limiting wrench. The torque for various sizes of bolts shall be as follows:

Pipe Size (Inches)	**Bolt Size (Inches)**	**Range of Torque Min. (ft-#) Max.**
3	5/8	45-60
4-24	3/4	75-90
30-36	1	100-120
42-48	1-1/4	120-150

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

c. Permissible Defection in Mechanical Joint Pipe - Whenever it is desirable to deflect mechanical joint pipe in order to form a long radius curve; the amount of Defection shall not exceed the maximum limits shown in Table 1 at the end of this section.

11. Jointing Push-on Joint Pipe

a. Cleaning and Assembly of Joint - the inside of the bell coupling and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket, or the coupling end of polyvinyl chloride pipe.

b. A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the outside of the spigot end of the pipe or both. Gasket lubricant shall e supplied by the pipe manufacturer and approved by the City Engineer.

c. The spigot end of the pipe shall be placed into the bell or coupling end, without touching the ground with the spigot end after cleaning. The joint shall then be completed by forcing the plain end to the bottom of the socket. Pipe shall be marked with a depth mark to insure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be marked by painting or file mark. The spigot end shall be ground or filed to resemble manufacture pipe end. Complete assembly instructions shall be provided by the pipe manufacturer.

d. Permissible deflection in Push-On Joint Pipe - whenever it is desirable to deflect push-on joint pipe, in order to form a long-radius curve, the amount of deflection shall not exceed the maximum limits shown in Table 2 at the end of this section for cast iron or ductile iron pipe, or 4 degrees coupling for polyvinyl chloride pipe.

12. Anchorage

a. Anchorage - All plugs, valves, bends, reducers, tees, shall be anchored by thrust blocks and rods and clamps.

13. Backfilling

a. General - All trenches shall be backfilled after pipe, fittings and appurtenances have been installed, inspected and approved by the City Engineer.

b. Density Requirements in Trench - the Contractor shall obtain a Standard Proctor Density of 90% for the total depth of all trenches in open fields and 95% in dedicated rights-of-way. Backfilling shall be done with good sound earth, sand or gravel, and no oil cake, bituminous pavement, concrete, rock or other lumpy material shall be used in the backfill unless these materials are scattered and do not exceed 6" in any dimension and are not placed within one foot of the 2-½' limit. Material of perishable, spongy or otherwise improper nature shall not be used in backfilling and no material greater than 4" in any dimension shall be placed within 1' of any pipe, manhole or structure. Backfilling shall be accomplished in the zone in layers not to exceed 3'. All backfill material shall be subject to the approval of the City Engineer.

c. Compacted Fill - Compaction shall be done by use of vibratory equipment, tamping rollers, pneumatic tire rollers or other mechanical tampers, of the type and size approved by the Engineer. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened and compacted to the specified density. Any damage to the pipe as a result of Contractor’s operation shall be repaired and/or replaced.

d. Consolidated Fill - Consolidated fill shall be performed by flooding, pooling or jetting so as to obtain a relative density of the fill material at least equal to that specified. When flooding, pooling or jetting are used, material for use as backfill shall be placed and compacted in layers not exceeding 3' in thickness. Flooding, pooling or jetting methods shall be supplemented by the use of vibratory or other compaction equipment when necessary to obtain the required density. Care shall be taken in all consolidating operations to prevent the movement or floating of the pipe. In the event there is

movement or floating, the Contractor shall re-excavate, relay and backfill all pipe so affected. Consolidation methods shall not be used when the backfill material is not sufficiently granular in nature to be self-draining during and after consolidation and foundation materials may be softened or otherwise damaged by applied water.

e. Procedure at Street Zone - The top 2-1/2' from finish street grade or ground surface, as the case may be, shall be compacted in horizontal layers not exceeding 6" in thickness, using approved hand pneumatic or mechanical type tampers to obtain a Standard Proctor Density of 95%. Flooding and jetting will t be permitted in this upper 2-1/2' . From existing street grade to 2-1/2" in diameter, in quantity not exceeding 20% of the volume where said coarse materials are well distributed throughout the finer material and the specified compaction can be obtained.

14. Compaction Tests

a. When required by the City Engineer, compaction tests will be taken by an approved testing laboratory at locations designated by the City Engineer. All expenses involved in these tests will e borne by the Developer/Owner. Results of the tests will be made available to the City Engineer immediately and copies of test results will be supplied the City Engineer immediately and copies of test results will be supplied to the City Engineer once per week. In all cases where the tests indicate compaction less than that required in these specifications, additional compaction and tests will be required until these specifications are met. Probationary acceptance of the lines by the City will be contingent upon satisfactory compaction results. No hydrostatic testing of the water main will be allowed until satisfactory compaction is obtained. Frequency of testing will be as follows:

- 1 test at every above ground appurtenance (i.e. air combination valve and vault)

-1 test for every 1 foot of backfill for every 250 LF of mainline trench

15. Final Clean Up

a. After backfill and compaction has been completed, the right-of-way shall be dressed smooth and left in a neat and presentable condition as close to final grade or subgrade as possible and to the satisfaction of the City Engineer.

16. Safety Precaution

a. All excavations shall be performed, protected and supported as required for safety and in the manner set forth in the operation rules, orders and regulations prescribed by the occupational Safety and

Health Administration Federal Register. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled.

17. Mechanical Joint Restrain

a. General - All mechanical joint restraints shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron conforming to ASTM A 536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-heard bolts conforming to AWWAC111 and C153.

b. Description - The restraint mechanism shall consist of numerous individually activated gripping surfaces to maximize restraint capability. The gripping surfaces shall be wedges designed to spread the bearing surfaces on the pipe. Twist-off nuts, sized same as tee-head bolts, shall be used to ensure proper actuating of restraining devices. When the nut is sheared off, as standard hex nut shall remain.

c. Pressure - The mechanical joint restraint device for ductile iron pipe shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

The mechanical joint restraint device for PVC shall have a working pressure of at least 150 psi with a minimum safety factor of 2:1.

d. Acceptable manufacturers for mechanical joint restraint devices are the following:

For Ductile Iron Pipe:

EBAA Iron, Inc.	Metgalug 1100 series	(4" - 36")
Uni-Flange	Series 1400	(4" - 12")

For PVC Pipe

EBAA Iron, Inc.	Metgalug 2000 PV Series	(4" - 16")
Uni-Flange	Series 1500	(4" - 16")

J. Protection of Water Lines near Force Mains.

a. Water mains shall be located a minimum of 10 feet horizontally from existing or proposed sanitary sewer lines (centerline distance). Where water mains cross house sewers or sanitary sewers, they shall be above sewers and laid to provide a vertical clear distance of at least 18" between the bottom of the water main and the top of the sewer. When a new water main crosses an existing sewer at a

point less than 18" above the sewer, the City Engineer shall be notified and adjustments shall be made. Stability of the water and sewer lines at a point of crossing is critical and care must be taken to ensure proper welding and compaction of both water and sewer lines.

b. Where it is not feasible to install a water main above an existing or proposed sewer, e.g., to maintain minimum cover, the water main shall be laid to provide a vertical clear distance of at l east 18" between the bottom of the sewer and the top of the water main. When the clear distance is less than 18" the City Engineer shall be notified.

c. No water pipe or main shall pass through or, come within 10" horizontally of, any part of a sewer or sewer manhole.

K. Inspection and Test

1. Pipe Testing Prior to Construction

a. Before being used in any work under these specifications, and when directed by the City Engineer, pipe shall be subjected to and shall beat the requirements for testing pipe as established by the American Water Works Association in Specifications, depending on the type of pipe. These tests shall be made by the Contractor and shall be witnessed by reputable testing laboratory. The Contractor shall deliver the pipe selected for testing to the place and at the time designated by the testing laboratory. Written test reports will be furnished to the City Engineer upon request.

b. The testing laboratory shall select at random for testing as herein specified up to 2% of the number of pipe in each size of pipe furnished, except that in no case shall less than five (5) specimens be tested.

c. The specimens selected for testing purposes shall be sound pipe having dimensions consistent with the referenced specifications. The lot or lots from which the test samples are taken shall be sufficient to fill the entire order for that size of pipe used in the work under the contract if they pass the tests, shall be so designated and marked.

d. All pipe shall be subject to inspection at the factory, trench or other point of delivery by the City Engineer. The purpose of the inspection shall be to cull and reject any pipe that, independent of the physical tests herein specified, fails to conform to the referenced specifications, or that may have been damaged during transportation and/or in subsequent handling.

e. The City of Moscow Mills reserves the right to reject any and all pipe sections that may contain visual imperfections or imperfections of any type that may be considered by the City Engineer to be detrimental to the operation and life of the pipe.

2. Hydrostatic Pressure test after Installation

a. The hydrostatic test pressure for any type of pipe shall be 150 pounds per square inch based o n the elevation of the lowest point in the line of section under test and carried to the elevation of the test gage. All sections of newly laid pipe, subsequent to backfilling, shall be subjected to the hydrostatic pressure test.

b. The duration of the hydrostatic pressure test be at least one (1) hour.

c. Air Removal Before Test - Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points as the air can be expelled as the line is filling with water. After all the air has been expelled, the corporation cocks shall be closed and test pressure applied. Any cracked or defective pipe, fittings, valves discovered in sequence of this pressure test shall be removed and replaced by the Contractor with sound materials in the manner provided under this specification, and the test shall be repeated until results satisfactory to the City Engineer are obtained.

d. Procedure - Each valved section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City Engineer. The pump, pipe connection, gauges and all other necessary equipment and personnel to complete the test, shall be furnished by the Contractor and shall be approved by the City Engineer. All corporation cocks and taps to the main line and all connection piping and valves that may be required to make the test, whether or not specified or shown on the construction drawings, shall be installed by the Contractor.

e. While the test pressure is maintained, the new pipe will be inspected and any leaks will e repaired. After all leakage has stopped, the pressure of 150 psi shall be maintained for one (1) hour. Allowable leakage for each section between line valves shall not exceed the following values:

Allowable leakage per 1000 Ft./Pipe Gallons/Hr.		
Inside Diameter	**D.I.**	**PVC**
4	0.37	0.33

6	0.55	0.50
8	0.74	0.66
12	1.10	1.00
16	1.47	------
20	1.84	------

f. Should the leakage rate be greater than the above set rates, the pipeline shall not be accepted. The pipeline shall be repaired and retested.

g. The Contractor shall ensure that a satisfactory test is completed and shall employ all methods necessary to pass the test, including use of a temporary plug, if necessary.

L. Contractors Responsibilities

a. The Contractor shall be responsible for notifying the City Engineer at least 48 hours prior to start of any construction. If work is suspended for any construction. If work is suspended for any period of time after initial start-up, the Contractor must notify the City Engineer. 48 hours prior to re-start.

b. The Contractor is responsible for maintaining “As-Built” drawings complete showing all changes and important notes,, These “As-Builts” shall be submitted to the City in both a paper copy (2' x 3' Drawings) and AutoCAD format on CD-Rom Format.

TABLE 1

MAXIMUM PERMISSIBLE DEFLECTION IN LAYING MECHANICAL-JOINT PIPE

Size of * Pipe In.	Maximum Permissible Deflection Per Length - Inches				Approx. Radius of Curve Produced by Succession of Joints - Feet			
	12-Ft. Length	16-ft. Length	18-ft. Length	20-ft. Length	12-ft. Length	16- ft. Length	18-ft. Length	20-ft Length
3	16	22	25		110	145	160	
4	16	22	25		110	145	160	
6	14	19	21		125	170	190	
8	11	14	16		165	220	250	
10	11	14	16		165	220	250	275
12	11	14	16	18	165	220	250	275
14	7	10	11	12	240	320	360	400
16	7	10	11	12	240	320	360	400
18	6	8	9	10	290	380	430	480
20	6	8	9	10	290	380	430	480
24	5	6	7	8	360	480	540	600
30	5	6	7	8	360	480	540	600
36	4	5.5	6	7	430	575	650	720
42	4	5	5.5	6	460	610	690	765
48	4	5	5.5	6	460	610	690	765

TABLE 2

MAXIMUM PERMISSIBLE DEFLECTION IN LAYING PUSH-ON JOINT PIPE DUCTILE IRON OR CAST IRON

Size of* Pipe In.	Maximum Permissible Deflection Per Length – Inches				Approx. Radius of Curve Produced by Succession of Joints - Feet			
	12-ft. Length	16-ft. Length	18-ft. Length	20ft. Length	12-ft. Length	16-ft. Length	18 -ft. Length	20-ft. Length
3	10	13.5	15	17	175	230	260	290
4	10	13.5	15	17	175	230	260	290
6	10	13.5	15	17	175	230	260	290
8	10	13.5	15	17	175	230	260	290
10	10	13.5	15	17	175	230	260	290
12	10	13.5	15	17	175	230	260	290
14	6	8	9	10	290	380	430	480
16	6	8	9	10	290	380	430	480
18	6	8	9	10	290	380	430	480
20	6	8	9	10	290	380	430	480
24	6	8	9	10	290	380	430	480
30	4	5	6	7	430	575	650	700
36	4	5	6	7	430	575	650	700
42	4	5	6	7	430	575	650	700
48	4	5	6	7	430	575	650	700

IV. Construction Standards for Septic Tank Effluent Pump (S.T.E.P.) Sewage Collection System

A. In 1983, the City of Moscow Mills constructed a S.T.E.P. wastewater Collection System for the “old” or original part of the City. Any new development in the “old” part of Moscow Mills will be required to connect to this system.

B. General Description of System.

1. STEP stands for Septic Tank Effluent Pump. Most customer’s household waste goes directly into our sewer collection pipes; waste from customers on STEP systems doesn’t. Instead, household wastewater spends time in a STEP sewer system before heading out to the main sewer collection lines. There is a “STEP in between” flushing your toilet and wastewater being transported to the treatment plant.

2. How does my STEP System work? STEP means Septic Tank Effluent Pump. Your STEP system includes a holding tank for sewage, a screen chamber, and a small, high-pressure pump within the tank. The liquid waste is pumped through a small pressure line into sewer lines leading to the Moscow Mills Wastewater Treatment Plant.

3. The STEP system pump is controlled by a system of floats within your tank. The electrical box mounted on the side of your house controls the floats and pumps. The floats activate an alarm in the electrical (alarm) box when the fluid level in the tank gets too high or too low.

4. Why must my tank riser lid be visible? This helps us locate your system quickly in an emergency situation. A hidden or inaccessible lid means that your STEP system cannot be serviced.

C. S.T.E.P. System Requirements for Residential Connection.

1. Gould, 230 volt, single phase, 1 horsepower effluent pumps, control panel, floats, check valves, shut-off valves, disconnect switch and 3'-0" dia. Concrete wet well with alum. Access cover. (Simplex station)

2. 1200 gallon, one (1) chamber, pre-cast septic tank with baffles, 20" dia. Manhole located at the center and two(2) - 12 inch risers, one (1) located at each end over inlet and outlet pipes. Manhole and risers shall be at grade.

3. The pumps and effluent pumps shall be maintained by the City of Moscow Mills.

4. Minimum inlet and outlet pipe size for septic tank shall be four (4) inches.

5. Minimum forcemain size from effluent pump shall be two (2) inches (PVC).

D. S.T.E.P. System Requirements for non-residential connections:

1. Duplex Station with two (2) Gould, 230 volt, single phase, 2 horsepower effluent pumps, control panel, floats, check values, shut-off valves, disconnect switch and 4'-0" dia. Concrete wet well with alum. Access cover.

2. Minimum 2000 gallon, one (1) chamber, pre-cast concrete septic tank with baffles, 20" dia. Manhole located at the center and two (2) 12 inch risers one (1) located at each end over inlet and outlet pipes. Manhole and risers shall be at grade.

3. The pumps and effluent pumps shall be maintained by the City of Moscow Mills.

4. Minimum inlet and outlet pipe size for septic tank shall be six (6) inches.

5. Minimum forcemain size from effluent pumps shall be two (2) inches.

V. Sewer Lateral Policy and Construction Standards for City of Moscow Mills

A. Purpose:

1. The purpose of the sewer lateral policy is to:

- Provide guidelines for the design, construction, permit requirements, and maintenance of sewer laterals.
- Protect public health, safety, and the environment by reducing number and severity of sewer backups and overflows.
- minimize inconveniences to residents and businesses.
- Reduce cost of services to customers.
- Improve sewer system performance.
- Comply with the Federal Clean Water Act

B. Definition:

1. Building Sewer: It is the connection between a building's plumbing and drain system and the property line and it is considered an extension of the structure facilities, thus, is installed under the City's plumbing and building codes and inspected and approved by building inspectors.

2. Sewer Lateral: it is the sewer connection between the property line and the sewer main in the street or easement, including the sewer main connection and it is considered a private line, thus is installed under this policy and inspected and approved by the City of Moscow Mills.

C. Design and construction Criteria

1. Size and Number of Sewer Laterals: Minimum size of the sewer lateral shall be 4 inches for single family and duplexes and 6 inches for multi-family, commercial, and industrial properties. Every building with plumbing fixtures shall be separately and independently connected to the public sewer, except where one building stands in the rear of another building on an interior lot, the sewer line from the front building may be extended to the rear building, or where two or more buildings on the same property under one ownership and not subdividable may be served by a single adequately sized connection to the pubic sewer. The address of each property must be indicated on the plans.

2. Sewer lateral Pipe Type: The pipe shall be PVC, SDR 35.

3. Sewer Lateral Connection: If a property has not het been served with a sewer lateral, the sewer main must be extended past the prolongation of the property sideline by at least 10 feet. The sewer main must end with a clean out or a manhole at the direction of the City Engineer. Sewer laterals must run perpendicular to the main. Four-inch laterals should not be connected to a clean out or manhole at the main line.

4. Wet Tap Connection: Connection to the main shall be with rigid PVC saddle, stainless steel clamps, and concrete cradle up to spring line. Vertical angle from the axial flow direction shall not exceed 45 degrees. the main line must be inspected before and after coring. After coring the main and locking installation of the saddle, the connection point must be inspected by the Public Works Inspector prior to connecting to the lateral.

5. Sewer Lateral Cleanout: A PVC “Wye” type sewer cleanout (toward the sewer main) shall be installed at the final vertical bend, preferably 2 feet offset into the property line. It is recommended that two “Wye” type cleanouts be installed in order to facilitate cleaning the building and sewer main sides of the lateral.

6. Minimum Depth: A sewer lateral in the street that is less than 4 feet deep (from flow line) must be capped with concrete.

7. Minimum Slope: Slope of the sewer lateral shall be a minimum of 2%.

8. Curb Marks: A sewer lateral curb mark “S” should be installed or reinstalled whenever curbs with sewer lateral curb marks are reconstructed, or new curbs are installed, or whenever a sewer lateral is replaced.

9. Root Control (Optional): Root barrier may be wrapped around pipe joints, 2 feet in length, and strapped to the pipe to prevent root intrusion into the lateral.

10. Trench Backfill and Compaction: Pipe bedding zone shall be 3/4 inch crushed rock in accordance with the Regional Standard Drawing S-4 type C. Trench backfill shall be Class II. Trench backfill compaction shall be 90%, except the top 30 inches shall be 95%. Concrete encasement is required for a sewer lateral with a cover less than 4 feet deep from invert elevation.

11. Pavement Restoration: Pavement shall be saw cut and repaired in accordance with Chapter 90 and 93 of The City Code.

12. Existing Improvements: Prior to removal, existing improvements shall be saw cut. Sidewalk shall be replaced from joint to joint and curb and gutter removal shall be a minimum of 7½ feet and joined to existing curb and gutter through dowels. Cross-gutter shall be replaced from joint to joint and doweled to existing improvements.

13. Grease, Oil, Flammable Waste, Sand, Plaster, Lint, Hair, and Ground Glass Interceptors: Grease, oil, flammable waste, sand, plaster, lint, hair, and ground glass interceptors shall be provided when, in the opinion of the City Engineer, they are necessary for proper handling of liquid wastes containing grease in excessive amounts, or any flammable wastes, sand, plaster, lint, hair, ground glass, and other harmful ingredients.

    Interceptors are required in commercial buildings, primarily to accumulate and recover objectionable substances from liquid waste. Each interceptor must be located to provide ready accessibility for maintenance and for removing the accumulated intercepted matter. Grease traps and interceptors must be maintained in efficient operating condition by periodic removal of the accumulated grease. Detailed drawings must be submitted to the City for approval. When interceptors are required, waste not requiring separation must not be discharged through an interceptor.

    Grease Interceptor: commercial buildings such as restaurants, hotel kitchens and bars, factory cafeterias and restaurants, clubs, processing plants and the like must have a grease interceptor or trap to accumulate grease that might otherwise clog the sewer main. Existing food establishment facilities may use, with the approval of the City Engineer, grease traps.

    Gasoline, Oil, and Sand Interceptor: Interceptors must be provided to prevent the introduction of gasoline, grease, oil or sand into the sewer system in the following places:

    - Any place where motor vehicles are repaired and floor drainage is provided.
    - Any place where motor vehicles are washed.

- Any place where garages where floor drainage is provided.
- Any place where oil, gasoline or other volatile liquids can be discharged into the sewer system.
- Plants where parts are washed to remove oil or greasy substances.

Meat processing Interceptors: Where an establishment slaughters, prepares or processes meat, the waste from the floors must pass through a specially designed floor drain before entering the grease interceptor.

Laundry Interceptors: Lint interceptors must be installed on the sewer pipes from commercial laundries or multi-family laundries. The lint interceptor should have a removable ½ inch mesh screen metal basket or a similar device to collect solids such as lint, string, and buttons.

Other Trap Requirements: Bottling plants are required to discharge their process wastes through an interceptor that is designed to separate broken glass and other solids from liquid waste. Establishments that generate hair in large quantities are required to use interceptors similar to those used in commercial laundries or swimming pools. Animal hospitals and dog grooming establishments are required to install hair strainers (interceptors) on sewer lines from bathtubs or other receptacles where animals are bathed. Dental and Orthopedic sinks where plaster, was or other objectionable substances will be discharged into the sewer system, require the installation of an interceptor trap in the sewer line.

Dilution or Neutralizing Tanks: Corrosive liquids such as, chemicals, acids, or strong alkalis, must pass through an approved dilution or neutralizing tank before discharging into the regular sanitary system.

14. Where a house lateral crosses a property line it MUST be immediately and directly connected to a public sewer in the City easement or public right-of-way. House laterals are NOT to utilize City easements or public right-of-way for long distances or to cross the same as long diagonals. Horizontal bends of 60 degrees and 90 degrees will not be acceptable in lateral lines.

D. Maintenance Responsibility:

1. The property owner is responsible for maintaining, cleaning and servicing private sewer laterals, leading from the house or building to the connection at the public sewer in the street or easement. This includes the portion of the lateral on private property (building sewer) and the portion in the right-of-way or easement (sewer lateral).

2. The property owner is responsible for the maintenance, repairs, and/or renewals of sewer lateral to easement sewer mains.

3. Whenever failure or stoppage of a sewer lateral occurs, City crews sill respond only to check the City's sewer main to verify that it is open and flowing. If the sewer main is found to be clear, it is the responsibility of the property owner to call a licensed plumbing contractor to correct the problem.

4. Root Damages: Root intrusion into a private sewer lateral is a symptom of defects in the sewer lateral. If the roots entered at the joint of connection, or in an area that has deteriorated with age, or due to earth movement and subsidence, the property owner is responsible. This is because the joints and connections are generally sealed with a soft material that can wear out and cause leaking to occur, allowing the hair rot access to water and nutrients. The joints can also leak because of normal expansion and contraction of the soil. Earthquakes and other earth movement can cause the joint to move and leak. Because the property owner is responsible for the sewer lateral from the building to the main line connection, the property owner is responsible for maintenance.

5. Root Intrusion from Lateral into Main Line: Public Works sanitation crews are responsible to notify property owners in writing when they find roots from a sewer lateral protruding into the sewer main line.

6. Sewer Lateral Overflow: Where sewage from a property cleanout overflows into the street, the property owner is responsible for cleaning the gutter in the street. In instances where the sewage could reach or enter a storm drain structure, the City's maintenance crew will intervene to prevent storm water pollution and protect public health. The City will call on private contractors to secure, mitigate, clear the blockage, and clean and sanitize the area. The cost of abatement and administration will be billed to the property owner.

Passed by Ordinance #489, 7/13/09; Amended by Resolution #586, 4/18/11.